Ontario Municipal Energy Profile

Final Report

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Executive Summary

The IESO commissioned ICF to undertake this study in collaboration with the Ontario Ministry of Energy (MOE) and a group of municipal stakeholders in order to gain more insight into the current state of municipal energy use in Ontario, with a particular focus on future trends and sustainable energy improvements. This report builds on the findings of a 2008 report prepared for IESO by the Power Application Group as well as a 2010 survey of Organizational Best Practices conducted by LAS. In addition to tracking progress since these studies were completed, important new insights were gained from the wealth of additional data now available, including self-reported energy consumption data from the MOE and Save On Energy program participation data from the IESO.

Between 2006 and 2014, municipalities in Ontario have decreased their electricity and natural gas consumption and achieved energy and cost savings as a result of actively pursuing energy savings opportunities and participating in electricity and gas energy efficiency incentive programs.

Between 2010 and 2017, municipalities also improved their performance in the implementation of organizational best practices at the corporate energy management level. They have pursued higher engagement opportunities with facility staff and their local distribution companies (LDCs) through various programs such as the Town of Caledon's Corporate Energy Awards program and embedded energy manager programs from their local LDCs, which have enabled municipalities to gain a better understanding of their internal competencies and streamline their processes at the corporate level.

Municipalities are now at the forefront of adopting innovative, next-generation technologies such as net-zero buildings and net-zero or energy-plus wastewater treatment plants. They have taken the initiative to develop new and creative ways of funding their sustainable energy projects, a notable example of which is the green revolving fund.

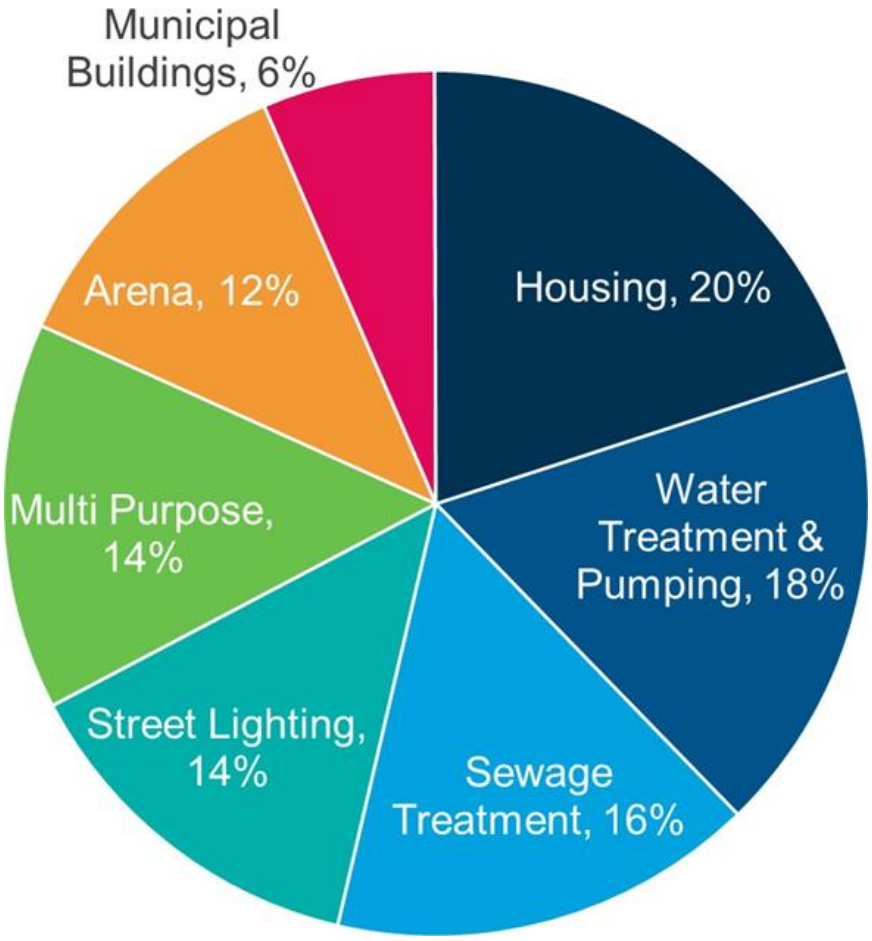
Provincial regulations have helped create the enabling environment for driving action at the municipal level. In fact, municipalities have identified the Ministry of Energy's O.Reg. 397/11 – Energy Conservation and Demand Management Plans as the most significant contributor to a higher level of interest in sustainable energy development.

Despite the progress that has been made since 2006, municipalities still have significant opportunities remaining to reduce utility spending, cut greenhouse gas emissions, and upgrade infrastructure. Municipalities will also face new challenges and opportunities such as the electrification of space heating and transportation which is being driven by new regulations and climate change mitigation targets.

Municipal Energy Performance

In 2014, the primary source of energy for municipal operations (facilities, social housing, and street lighting) in Ontario was electricity (63%) and natural gas (35%), with minor use of other fuels including hot water and steam from district heating, chilled water from district cooling, propane, and fuel oils. Municipalities spent an estimated $917 million on electricity and $105 million on natural gas in 2014.

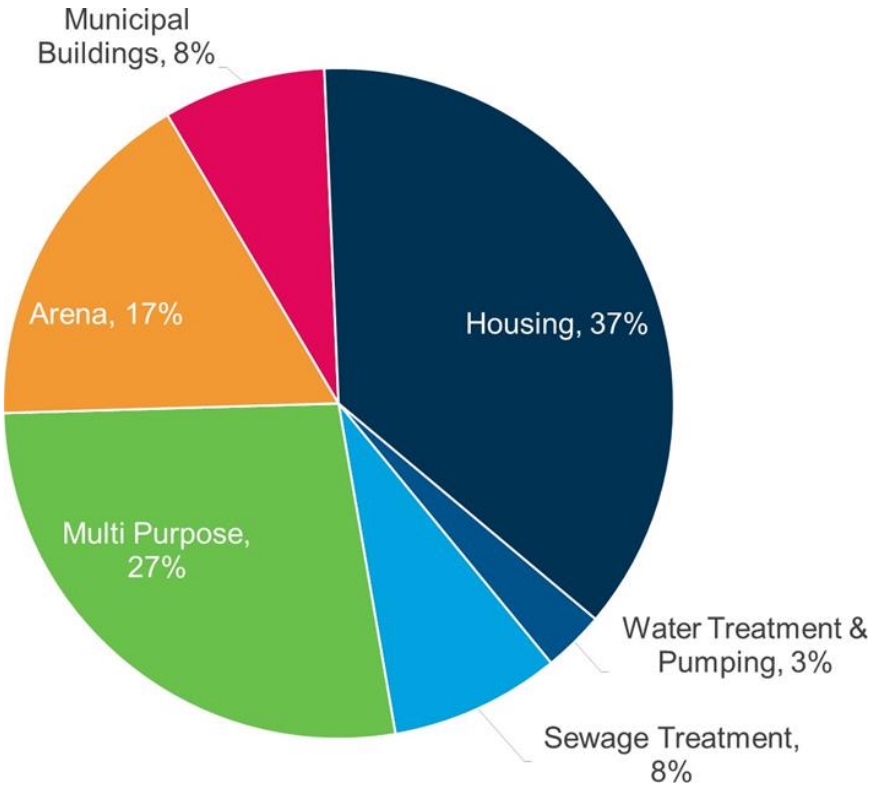
Electricity consumption in 2014 was 6% less than the baseline municipal electricity consumption of 6,653 GWh estimated in 2006. Municipal electricity use continues to represent 3.7% of Ontario's total electricity consumption. Social housing, water and wastewater treatment and pumping, and street lighting continue to be the major electricity end uses.



Municipalities increased their electricity spending by 35% between 2006 and 2014, from an estimated $680 million to $917 million. The 2006 estimate is based on electricity consumption and cost data provided in the 2008 Power Application Group Inc. report. This increase would have been higher if not for a 6% reduction in electricity consumption, as rates increased by an

estimated 43% over the same period1. It should be noted that there were significant differences in the methodologies used to determine electricity rates in the 2008 PAGI study and this study, which should be taken under consideration when making comparisons between electricity spending.

Municipalities and municipal service boards consumed approximately 425 million m3 of natural gas in 2014, of which an estimated 156 million m3 was consumed by municipal social housing. Gas was not included in the scope of the 2008 PAGI report, so there is no 2006 baseline for comparison. Based on reporting to the Ministry of Energy under O.Reg. 397/11, which excludes social housing municipalities saw an estimated 12% reduction in natural gas consumption in 2014 compared to 2011. Gas consumption data from the Housing Services Corporation suggests that gas use for social housing is rising year on year.



[1] The average rate was 10.2 cents/kWh in 2006 according to the PAGI report, and 14.6 cents/kWh according to this study.

Energy Efficiency

The 2008 Power Application Group Inc. report estimated an energy efficiency potential of 780 GWh based on 2006 consumption data. To date, 42% of this estimated potential (330 GWh of annual savings) has been achieved through the municipal energy efficiency projects completed through the Save On Energy Retrofit Program alone. Municipalities in Southwestern Ontario have exceeded the estimated potential savings by 5%, whereas municipalities in Central/GTA have achieved 31% of the estimated potential.

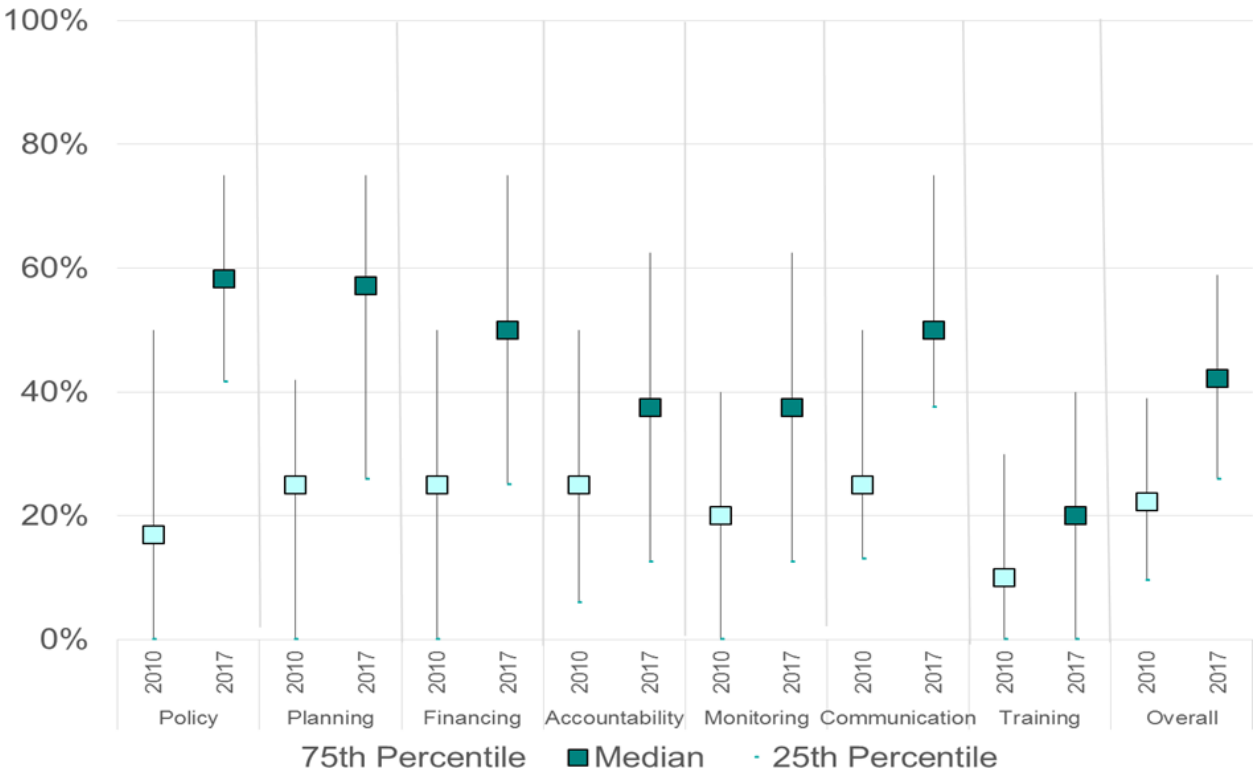
Between 2010 and 2017, approximately 74% of municipalities and municipal service boards have completed at least one project through the IESO's Save On Energy programs, receiving approximately $44 million in incentives and achieving annual electricity savings of 330 GWh. The majority of these incentive dollars (91%) were delivered through the Save On Energy Retrofit Program. The Save On Energy incentives program has now become part of a "normal dialogue" when seeking funding opportunities for many municipalities including the Region of Durham, the City of London, the City of Hamilton, and more recently, Village of Burk's Falls.

Between 2011 and 2015, municipalities have achieved estimated cumulative natural gas cost savings of $4.0 million through participation in Enbridge and Union Gas conservation programs, receiving $2.3 million in incentives and achieving annual savings of 16.1 million m3. Over 65% of the municipal projects completed through natural gas incentive programs were space heating projects.

Over the last decade, Ontario municipalities have successfully achieved significant electricity savings opportunities in street lighting while benefitting from other non-energy benefits such as reduced light pollution and better visibility. As of 2016, municipalities have achieved a 27% reduction in energy consumption from street lighting compared to 2006. Approximately 54% of municipalities have conducted retrofit projects and have retrofitted an estimated 49% of street light fixtures. Municipalities in Northeastern and Northwestern Ontario have retrofitted over 85% and 75% of their street lighting fixtures, respectively, surpassing progress made in other parts of the province.

Organizational Best Practices

Between 2010 and 2017, municipalities across Ontario have improved their median performance in Organizational Best Practices (OBP) by 20%. OBP is a qualitative assessment of corporate-level organizational practices related to strategic energy management performance. The highest increases in their median scores occurred in the following categories: Policy (41%), followed by Planning (32%), and Financing and Communication (25% each). The lowest increases in median scores occurred in the Accountability (8%) and Training (10%) categories.



Several municipalities including the Town of Caledon, the City of Pickering, the City of Guelph, and the York Region have developed revolving funds for sustainable energy projects, where the revenues are “recycled” back into a reserve fund to finance additional sustainability projects.

Impact of Policy

Most municipalities jointly ranked Ontario Regulation 397/11 compliance and bill savings and fiscal responsibility as the most influential drivers to pursuing sustainable energy projects in their municipality. O.Reg.397/11 has helped to equip municipalities with the data needed to make the business case to Council for approval of sustainable energy projects.

Municipalities feel more confident in setting achievable targets and goals and defining the scope for the upcoming 2019 CDM plan, thanks to the previous 2014 CDM cycle, which provided an opportunity to better understand their own municipal competencies as well as resource and capacity constraints. Municipalities also viewed the process of preparation for their 2014 CDM plans as an opportunity for staff from other departments to learn about facility management challenges. A mutual interest of meeting CDM targets has also led to a higher level of cooperation and general level of involvement between municipalities and their stakeholders, as was seen by municipalities like the Region of Durham and their Local Distribution Companies.

Many municipalities would like to see more clarity in the link between energy efficiency, energy conservation and climate change efforts. A few municipalities suggested incorporation of GHG emissions reporting in O.Reg 397/11. Other municipalities would like to see more funding support for fuel switching opportunities such as fleet transitioning and electrification of space heating.

Looking Forward – What's next for Municipalities?

Despite the progress that has been made since 2006, municipalities still have significant opportunities remaining to reduce utility spending, cut greenhouse gas emissions, and upgrade infrastructure. Municipalities will also face new challenges and opportunities such as the electrification of space heating and transportation which is being driven by new regulations and climate change mitigation targets.

Energy Efficiency Savings Potential

ICF estimated the electricity savings potential for each of the end uses, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 1,176 and 2,620 GWh per year, representing a reduction of between 19% and 42% compared to 2014 consumption. The largest opportunities for electricity savings lie in water and wastewater treatment and pumping, building lighting, and street lighting.

ICF estimated the natural gas savings potential for each of the end uses, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 75.1 million m3 and 156.7 million m3 per year, representing a reduction of between 18% and 37% compared to 2014 consumption. The largest opportunities for natural gas savings lie in space heating.

Data Gaps

Social Housing: Municipalities are not required to report their energy consumption from housing under O.Reg. 397/11. Since social housing represents the largest use of both electricity and natural gas for municipalities, this is a significant data gap which acts as a barrier to implementing energy efficiency. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including social housing in the regulation would be a good way to reduce this gap. Collaborating with other entities such as the Housing Services Corporation who have energy use statistics for over 42,000 social housing units would provide a starting point for municipalities that do not already have tracking systems in place.

Water and Wastewater Pumping: Municipalities are not required to report electricity consumption from water and wastewater pumping under O.Reg. 397/11. It was originally a requirement, but was removed by the time 2013 data was to be reported. Considering that pumping is one of the largest electricity end uses, and given the importance of water quality to municipalities, this is a significant data gap. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including social housing in the regulation would be a good way to reduce this gap.

Street Lighting: Municipalities are not required to report electricity consumption from street lighting under O.Reg. 397/11. In addition, there are significant gaps in information about Ontario's municipal street lighting system including which municipalities operate street lights, and how many fixtures there are in total. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including street lighting in the regulation would be a good way to reduce this gap. In addition, there is no central repository for information related to street lighting retrofit projects. As many municipalities are likely to seek Save On Energy funding for retrofits, tracking street lighting projects explicitly in the Save On Energy program database would provide more insight on street lighting retrofits going forward.

Capacity Building and Training

Of all the Organizational Best Practice categories, municipalities scored the lowest in Training, where their median Training scores increased by a mere 10% since 2010 and their 25th percentile scores remained stagnant at 0%. Put differently, a quarter of municipalities scored 0% in the Training category in 2017. When prompted on the training material and format that they would like to see offered in the market, municipalities suggested the following:

- **Incentive Offerings and Applications:** Municipalities of all sizes expressed interest in informational sessions on provincial incentive programs and funding offerings. Larger municipalities such as the Region of York recommended capacity building training for municipalities to establish internal structures dedicated to provincial grant applications (Region of York, 2017). Medium municipalities such as the Town of Caledon and the City of Sault Ste. Marie want to know how to effectively find matching provincial incentives and

make successful business cases to Council for more complex projects (Town of Caledon, 2017), (City of Sault Ste. Marie, 2017). Smaller municipalities often feel constrained in their internal capacity and technical knowledge to apply to provincial funding programs.

- **Knowledge Sharing:** The highest spread between 25th and 75th percentile Organizational Best Practice scores (a difference of ~50%) occurred in the Planning and Financing categories, suggesting knowledge sharing opportunities for municipalities in those two categories. Knowledge sharing could be done remotely through an online platform, an idea that was brought up by several municipalities including the Town of Richmond Hill.
- **Northern Ontario:** Municipalities in Northern Ontario find it exceptionally challenging to get their staff trained on energy management practices because of huge gaps in the resource availability from utilities and the ally network including consultants, distributors, and contractors. What is more is that many of the training courses are typically offered in-person in Southern Ontario. Staff will receive approval for training expenses but not travel expenses, so will be unable to attend as a consequence.
- **Content-Specific Training:** When it comes to training content, municipalities felt that they have general knowledge of energy conservation opportunities but lack specific in- house knowledge to identify, design, plan, and make the business case for more complex sustainable energy projects. For instance, behavioral programs have started to gain momentum in several municipalities such as the Town of Caledon and the City of Guelph; however, more support from the provincial government or other entities in launching these programs will make them more widespread and common among other municipalities.
- **Operational Training for Facility Staff:** Efficient operation of electrical and mechanical systems presents an otherwise missed opportunity not only in energy savings but also cost savings. Local training can be provided to facility operators on load shedding, scheduling, proper start-up and shutdown, troubleshooting, and preventative and predictive maintenance of electrical and mechanical equipment, particularly in arenas.

Recommendations

The following section includes specific recommendations to improve energy efficiency in the municipal sector.

Achieving Further Energy Savings

Approaches to energy savings and generation opportunities need to take a holistic approach to the present and future needs of the municipality, and need to be imbedded into other long term, strategic decision making processes such as capital replacement. Without an overall strategy, capital replacement decisions tend to be made at or near end of life, without adequate time or budget to implement energy efficiency or consider longer term goals. As a consequence, significant energy savings opportunities are often missed. Similarly, energy generation opportunities need to take into account longer term objectives due to the long lifetimes of the measures, and the capital costs involved. To facilitate this decision making, accurate and up to

date information on energy consumption is essential. This study has identified that despite the progress made in recent years in energy data tracking and reporting, there are still significant gaps. With so many competing priorities for municipalities, identifying the focus areas for energy conservation can be challenging. Some strategies are listed below:

- **Improve data tracking and use:** Accurate and up to date information on utility consumption and costs is required in order to identify and prioritize opportunities. This needs to be achieved in a variety of ways, including investing in tracking systems such as utility meters and databases, providing increased funding and staff to facility operations, and empowering facility staff to act on identified opportunities. In order to contribute effectively to energy savings, the data cannot simply be tracked, but needs to be acted upon.
- **Take a portfolio approach:** Prioritize facilities that have high energy consumption compared to the rest of the stock, either because they are large or are poor performers compared to their peers. Water and wastewater treatment, social housing, and street lighting are the biggest electricity consumers, while social housing, multi-purpose buildings, and arenas are the biggest users of natural gas. Barriers to implementation should also be considered. For example, although social housing is one of the largest energy users, it consists of multiple smaller buildings and often includes additional stakeholders and decision makers.
- **Prioritize new construction and natural capital replacement:** Energy efficiency is much more cost effective when only the incremental cost compared to standard efficiency equipment has to be funded. Incremental costs for many measures are often negligible. Planning for energy efficiency should be undertaken when designing new facilities and planning for major capital replacement.
- **Establish priorities in reduction targets:** Due to the nature of Ontario's electricity generation mix and market factors, electricity has significantly lower GHG emissions compared to natural gas, while natural gas costs about 20% of electricity on a purchased unit energy basis. Therefore, electricity measures should be favored when seeking to maximize utility cost reductions, and natural gas savings measures should be prioritized when the objective is to maximize GHG emission reductions.
- **Focus on significant end uses:** Similar to the portfolio approach, the largest energy end uses should be prioritized. Wastewater treatment process loads, street lighting, and water and wastewater pumping are the largest end uses outside of the building portfolio. Within the building portfolio (multipurpose, municipal buildings, arenas, and housing), lighting, ventilation, and arena process loads such as ice rink cooling are the largest end uses. Space heating is by far the largest end use for natural gas, followed by domestic hot water heating and wastewater treatment.
- **Focus on reduction, efficiency, and then generation:** The most cost effective way to save energy is not to consume it in the first place, so measures that reduce waste, such as turning lights off in unoccupied spaces, should be prioritized. These savings can be accomplished through awareness campaigns or the use of technologies such as occupancy

sensors. After waste reduction, the use of energy efficient equipment such as LED lighting should be implemented. Without implementing waste reduction strategies first, or in parallel, the benefits of equipment upgrades are not maximized as they may simply be wasting energy more efficiently, such as illuminating unoccupied spaces. Generation is the last option to consider due to high capital costs and complexity of implementation. Holistic retrofits will minimize energy use through waste reduction and energy efficiency prior to the implementation of generation. This allows for smaller generating systems or a larger proportion of facility energy use to be produced than would have occurred without these retrofits.

- **Include non-energy benefits in decision making:** Energy efficiency can have important non-energy benefits such as improved light levels, better indoor air quality, and improved equipment reliability. This can have an impact on diverse area such as occupant comfort, health and safety, and potable water quality. Factoring in non-energy benefits can be crucial to getting buy in from decision makers and stakeholders, as well as making the business case for efficiency more compelling.

Addressing Data Gaps

Despite the progress made in recent years in energy data tracking and reporting, there are still significant data gaps particularly in social housing, street lighting, and water and sewage treatment. ICF proposes that either the mandatory requirement for municipalities to report on energy data from social housing, street lighting, water and sewage pumping is introduced under O.Reg 397/11 or that inventory studies are routinely conducted to fill in the critical data gap and provide accurate and up to date information on energy consumption in these sectors.

Capacity Building and Training

The following recommendations are proposed to address the low scores in Training identified during the Organizational Best Practices survey.

- **Webinar on Incentive Offerings:** ICF proposes developing a webinar on all provincial incentive offerings available for gas and electricity savings and emissions reduction opportunities, targeting municipalities as the audience.
- **Targeted Support on Incentives and Grant Applications:** In addition to the webinar noted above, ICF recommends working with municipalities of different population groups to offer the following targeted support:
- **Large Municipalities:** Provide training for larger municipalities on how to establish internal structures dedicated to provincial energy and climate change- related grant applications;
- **Medium Municipalities:** Provide training for medium municipalities on how to make the business case to get their Council buy-ins for more complex projects such as behavioral programs;
- **Small Municipalities:** Include supplementary material with grant applications that explain the technical terminology and offer smaller municipalities the opportunity to call-in and

inquire about applicability of their project ideas to obtain specific grants.

- **Special Attention to Northern Ontario:** Given the gap in resource availability in the Northern Ontario region, ICF recommends the following:
- **Online Training:** Offer more online training courses to reduce the cost of traveling and training and allow more staff to be trained in matters related to energy management.
- **Localized Support:** ICF also recommends that the IESO, MOE, AMO/LAS, and utilities work in partnership to offer more localized and readily available support specifically dedicated to this region. Focus areas to include: arena technological upgrades, operational and maintenance support for facility staff, and training on procurement of energy efficiency products and services to help small and rural municipalities expand the scope of their energy conservation projects.
- **Pairing of Municipalities:** Findings from the Organizational Best Practice survey questions indicate that for Northern Ontario specifically, the lowest 25% scoring municipalities could use the support of the highest 25% scoring municipalities in improving their energy-related organizational practices. ICF proposes pairing of high performing municipalities with municipalities that are lagging behind to allow for knowledge sharing of best practices and help boost the performance of the lowest scoring municipalities in Northern Ontario.
- **Content-Specific Training:** In line with the Long-Term Energy Plan, ICF proposes offering training on the following content: Net-Zero attributes, beneficial electrification, fleet transitioning, integration of life cycle costing in asset management, behavioral programs, and developing community energy plans.

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List of Exhibits

I. Purpose & Scope

Because of the IESO's electricity conservation mandate, it has an interest in investigating the electricity consumption in various sectors, including the focus of this report, which is the municipal sector. Previous research published by the IESO in 2008, the Power Application Group Study (PAGI) concluded that Ontario's municipalities represented 4.3% of total electricity consumption in Ontario (PAGI, 2008). The report further identified that municipalities have the potential to reduce electricity consumption by 12% with a simple payback of approximately 6.5 years[2]. This study was carried out at a time when many municipalities were still on the Regulated Price Plan (RPP), while others were shifting to, or were fully integrated with, hourly electricity pricing.

The landscape of electricity generation and use in Ontario has changed significantly since the 2008 study and continues to evolve. Federal and provincial climate policy and energy efficiency initiatives, as well as individual outlooks towards energy use and conservation have influenced the energy use profile in the municipal sector. At the same time, the installation of smart metering infrastructure and energy reporting requirements such as O. Reg. 397/11 have resulted in more municipal energy consumption data being available for analysis. As such, the IESO retained and funded ICF Canada (ICF) to build on, update and expand the investigation that was conducted in 2008. The mandate of the study was further broadened to include all fuel types reported under O. Reg. 397/11, with additional funding provided by the Ministry of Energy.

The goal of this report is to develop an updated energy profile for municipalities in Ontario to not only observe any changes that have occurred since the last profile, but also to equip municipalities with valuable information to inform their next round of energy conservation plans and climate change adaptation and greenhouse gas (GHG) reduction plans.

This report includes a review of activities within municipal corporate portfolios, and in some cases extends to municipal service boards.

The following data sources were included in the analysis:

- Municipal energy use data (2011-2014) self-reported under O. Reg. 397/11
- Every Drop Counts, Environmental Commissioner of Ontario, 2017
- IESO Save On Energy program participation data
- IESO Industrial Conservation Initiative participation data
- LSNetwork (formerly Lightsavers Canada) National LED & Connected Streetlight Inventory
- A survey of Ontario municipalities

[2] It should be noted that this conservation estimate is an order-of-magnitude estimate only and was based on the best available information at the time of writing

- Interviews with Ontario municipalities

The remainder of this report is structured as follows:

Section II. Municipal Energy Performance

Section II provides a detailed overview of municipal profiles of gas and electricity consumption and spending, and how they have changed over the last decade.

Section III: Municipal Technical Best Practices

Section III provides a detailed overview of the technical best practices municipalities have implemented to improve their energy efficiency and reduce their greenhouse gas emissions. The section also explores future opportunities for expanding the municipal adoption of these technical best practices in areas of Energy Efficiency, Demand Response, District Energy, Renewable Energy Generation, Electrification, and Net Zero Buildings.

Section IV: Municipal Energy Management Performance

Section IV presents results of the organizational best practices (OBP) survey questions in 2017 relative to 2010. The results inform corporate-level organizational competencies for improving energy performance.

Section V: Conclusions and Recommendations

Section V summarizes the findings of the study, presents conclusions on the progress made since 2006, and provides recommendations for improving energy efficiency in the municipal sector going forward.

Section VI: References

Many sections are written to be self-contained, so there is some repetition and redundancy between certain sections.

1. Municipal Energy Use Data, O.Reg. 397/11

Since 2013, Ontario municipalities and municipal service boards have been required to report annually to the Ministry of Energy on their energy use and greenhouse gas emissions. This provides a wealth of data for anyone interested in public sector energy performance. However, it is important to note that this is self-reported data and may contain some data errors. Data assessment is conducted by the Ministry of Energy and large data anomalies are resolved with organizations before the data is posted publicly. This section describes the steps taken by ICF to address remaining data issues for the purposes of using the data in this study.

Exhibit 1: O.Reg. 397/11 Data Issues and ICF's Approach

Data Issue	Approach
Municipalities are required to report data from 2 years prior to the reporting year	The most recent data (2014 consumption, reported in 2016) was used to provide a current profile.
Municipalities are not required to report on street lighting, social housing, long-term care facilities, and outdoor recreation facilities	Electricity use from street lighting was estimated from other data sources, as described in III.1.2. Electricity and natural gas consumption from municipal housing was estimated based on data from Housing Services Corporation, as described in Section III. There was insufficient data to compare social housing energy consumption by geographic region and municipal size, so it was excluded from those exhibits.
O.Reg. 397/11 was amended to exclude the mandatory requirement for municipalities and municipal service boards to report energy use associated with water and sewage pumping	This regulation affected the 2013 and 2014 data, and a small drop off in reporting of energy use associated with water and sewage pumping can be observed in the data. Electricity use from water and/or sewage pumping that was reported in 2012, but was not reported in 2014, was added to the 2014 total to address the data gap.
Self-reported data can contain entry errors (incorrect units, number of decimal places, etc.)	One major outlier was identified and corrected. It was a single data point that was 1,000 times greater in 2011 compared to later years. All other data was accepted as reported, as it is difficult to determine whether some variances in data are errors or are due to real changes in energy use.

Data Issue	Approach
	The data was analyzed to determine which municipalities had missing reports in the 4 years of available reports (2011-2014). The data from these municipalities was removed from this analysis, as it might skew the results when comparing data from various years. The remaining “complete” dataset was pro-rated based on population to arrive at regional and provincial totals

2. 2017 Municipal Energy Profile Survey

ICF designed a survey in consultation with the project Steering Committee to elicit feedback from municipalities regarding largely qualitative aspects of their energy management activities. The survey was created as a self-administered online survey. All 444 municipalities were invited to complete the survey. The survey had a 29% response rate (including 5% partial responses). The distribution of respondents quite closely resembled the actual distribution of Ontario municipalities. For example, 22% of survey respondents were representatives of Northeastern municipalities, and Northeastern municipalities make up 24% of the total number of municipalities in Ontario. Exhibit 2 lists the distribution of survey respondents compared to actual distribution of Ontario municipalities by geographic region. Exhibit 3 shows the same information by municipal size.

Exhibit 2: Survey Respondent Distribution by Geographic Region

Geographic Region	Percentage of Survey Respondents	Actual Percentage of Ontario Municipalities
Central/GTA	27%	18%
Eastern	16%	26%
Northeastern	22%	24%
Northwestern	14%	8%
Southwestern	21%	24%

Exhibit 3: Survey Respondent Distribution by Municipal Size

Municipal Size	Percentage of Survey Respondents	Actual Percentage of Ontario Municipalities
Small	52%	60%
Medium	26%	31%
Large	21%	10%

3. Municipal Energy Profile Phone Consultations

ICF designed a phone interview guide with guidance from the IESO and the Steering Committee as part of the "Phone Consultations" phase of the project. This phase served two main purposes:

1) to examine the research topics that were not covered by the online survey component such as asset management, revolving funds, and arena technologies. These research topics were compiled from the following sources: request for services, the kick-off meeting, a review of the 2008 Municipal Electricity Profile, and other communications with IESO and the Steering Committee;
2) to delve into some of the interesting findings from the open ended questions in the online survey including innovative case studies such as a fleet fuels transitioning project and a behavioral program; next-generation technologies of interest; financing of sustainable energy projects; and training material.

Using the phone interview guide, phone consultations were conducted with a total of 25 municipalities in Ontario. The selection process was based on the municipalities' open-ended survey responses while ensuring a representative mix of the three population sizes (Small, Medium, and Large) and the five geographic regions (Central/GTA, Eastern, Northeastern, Northwestern, and Southwestern). Each phone consultation typically took around an hour and included several email exchanges to follow up on the interview material as well as receive approvals for use of their content in this report. Results from these phone consultations are presented as case studies throughout this report.

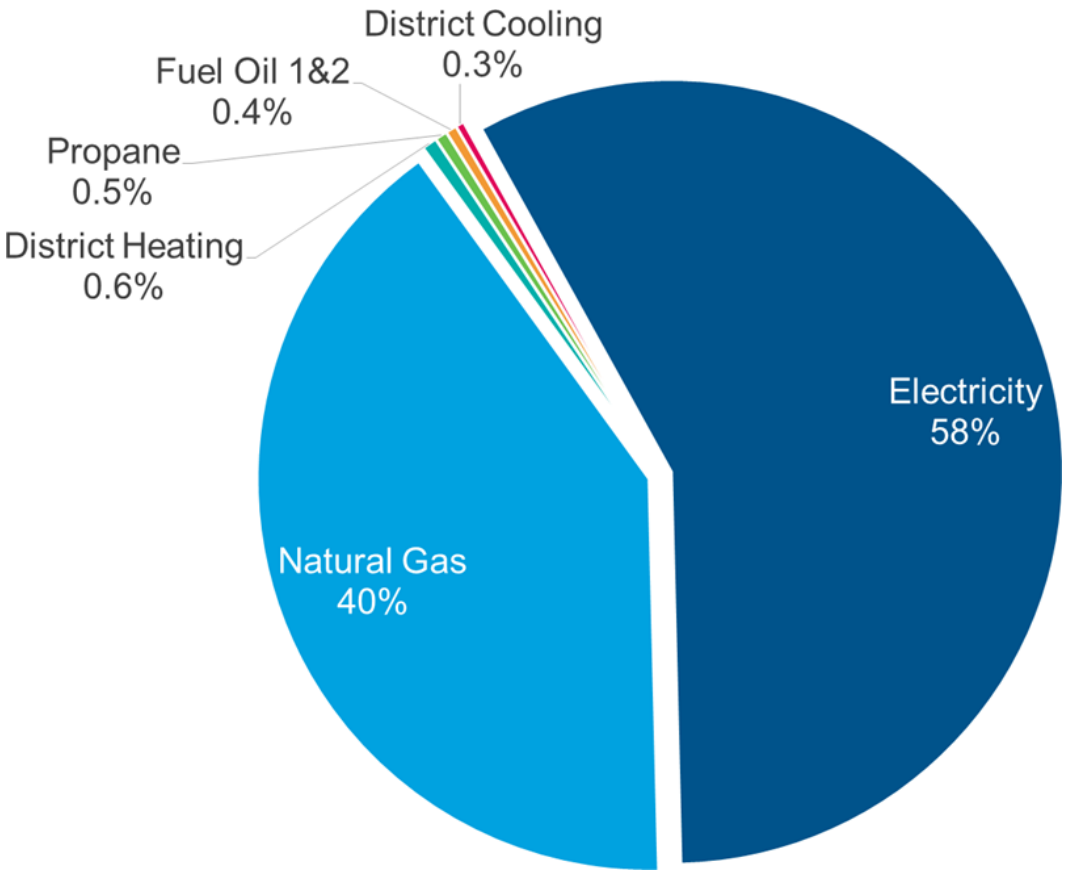
II. Municipal Energy Performance

This section provides a detailed overview of municipal energy use, and how it has changed over the last decade.

1. Municipal Energy Use

Ontario municipalities use a variety of fuel sources in their operations including electricity, natural gas, hot water and steam from district heating, chilled water from district cooling, propane, and fuel oils. However, the majority of municipal energy is provided by electricity (58%) and natural gas (40%). Exhibit 4 shows the 2014 municipal usage by fuel type in gigajoules, reported to the Ministry of Energy under O.Reg. 397/11, and includes 2014 consumption estimates for municipal street lighting and social housing. Please refer to Section I.1 and Section III for details of the methodology used to develop these estimates.

Exhibit 4: Exhibit 4 Municipal Energy Consumption (GJ) by Fuel, 2014



1.1 Electricity

1.1.1 Consumption

Municipalities and municipal service boards consumed approximately 6,275 GWh in 2014. As shown in Exhibit 5, this is a 6% reduction from the baseline municipal electricity consumption of 6,653 GWh in 2006 (Power Application Group Inc. 2008). The 2011 – 2014 data is taken from "complete" (as defined in Exhibit 1), self-reported data submitted to the Ministry of Energy, under O.Reg. 397/11, and was pro-rated based on population to arrive at regional and provincial totals. Municipalities are not required to report electricity consumption from street lighting, so these values were estimated (this is explained in Section III). Electricity consumption from municipal social housing is broken out in Exhibit 5 because municipalities are not required to report consumption from social housing, and data from other sources was not available to provide an estimate of municipal housing consumption in 2011, 2012, and 2013. 2014 electricity consumption from municipal housing was estimated based on data provided by the Housing Services Corporation (2018), as explained in Section III.

Exhibit 5: Municipal Electricity Consumption (GWh) by Year

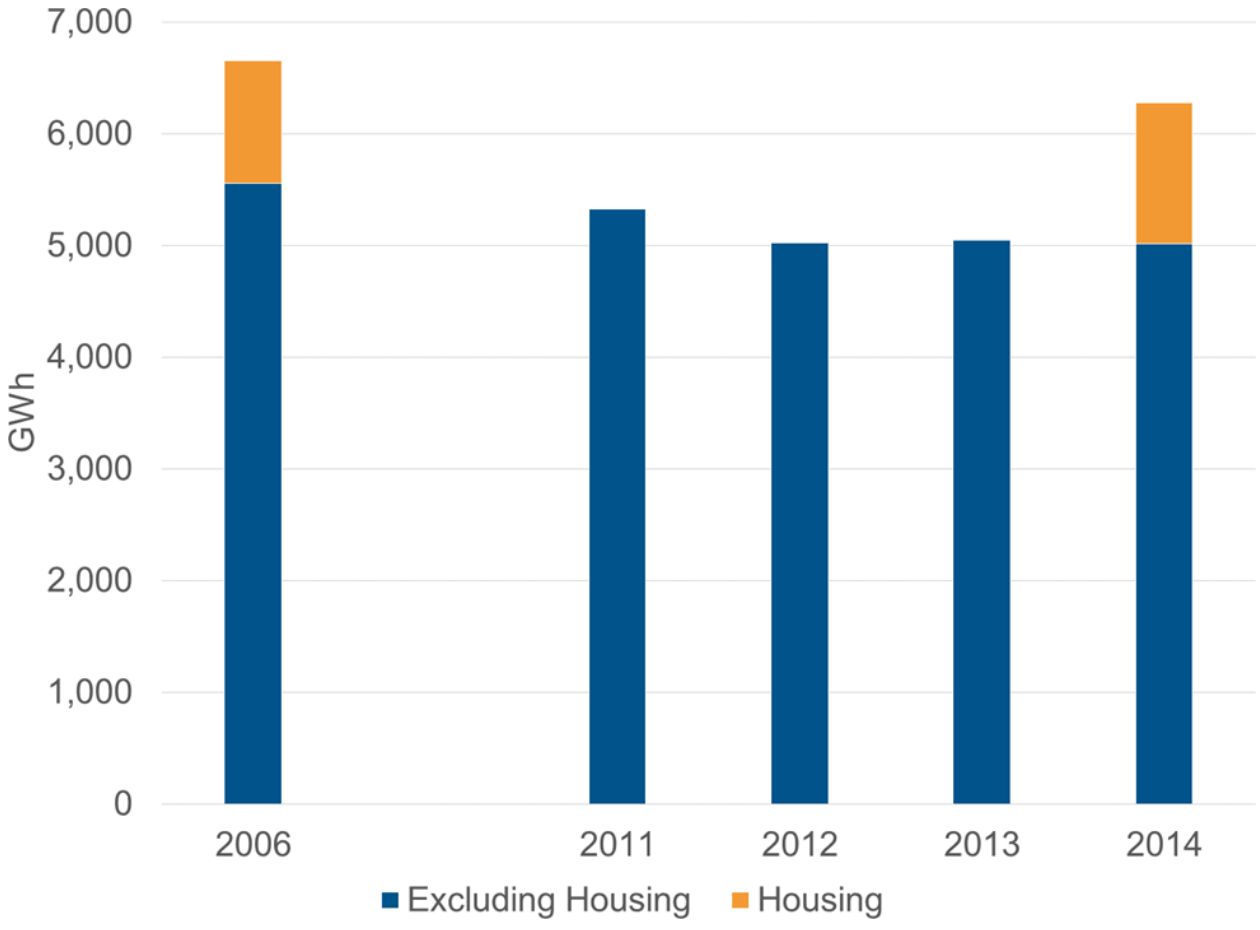


Exhibit 6 illustrates the differences in municipal electricity consumption per capita between the five geographic regions, excluding electricity consumption from social housing. Northwestern region had the highest electricity consumption per capita (560 kWh per capita), followed by Northeastern (482 kWh per capita), Southwestern (385 kWh per capita), Central/GTA (375 kWh per capita), and Eastern (318 kWh per capita). In 2014, municipal electricity consumption in the province as a whole was 469 kWh per capita including social housing; this is presented in the stacked bar on the far right.

Exhibit 6 illustrates the differences in municipal electricity consumption per capita between the five geographic regions, excluding electricity consumption from social housing. Northwestern region had the highest electricity consumption per capita (560 kWh per capita), followed by Northeastern (482 kWh per capita), Southwestern (385 kWh per capita), Central/GTA (375 kWh per capita), and Eastern (318 kWh per capita). In 2014, municipal electricity consumption in the province as a whole was 469 kWh per capita including social housing; this is presented in the stacked bar on the far right.

Exhibit 6: Municipal Electricity Consumption (kWh) per capita by Geographic Region, 2014

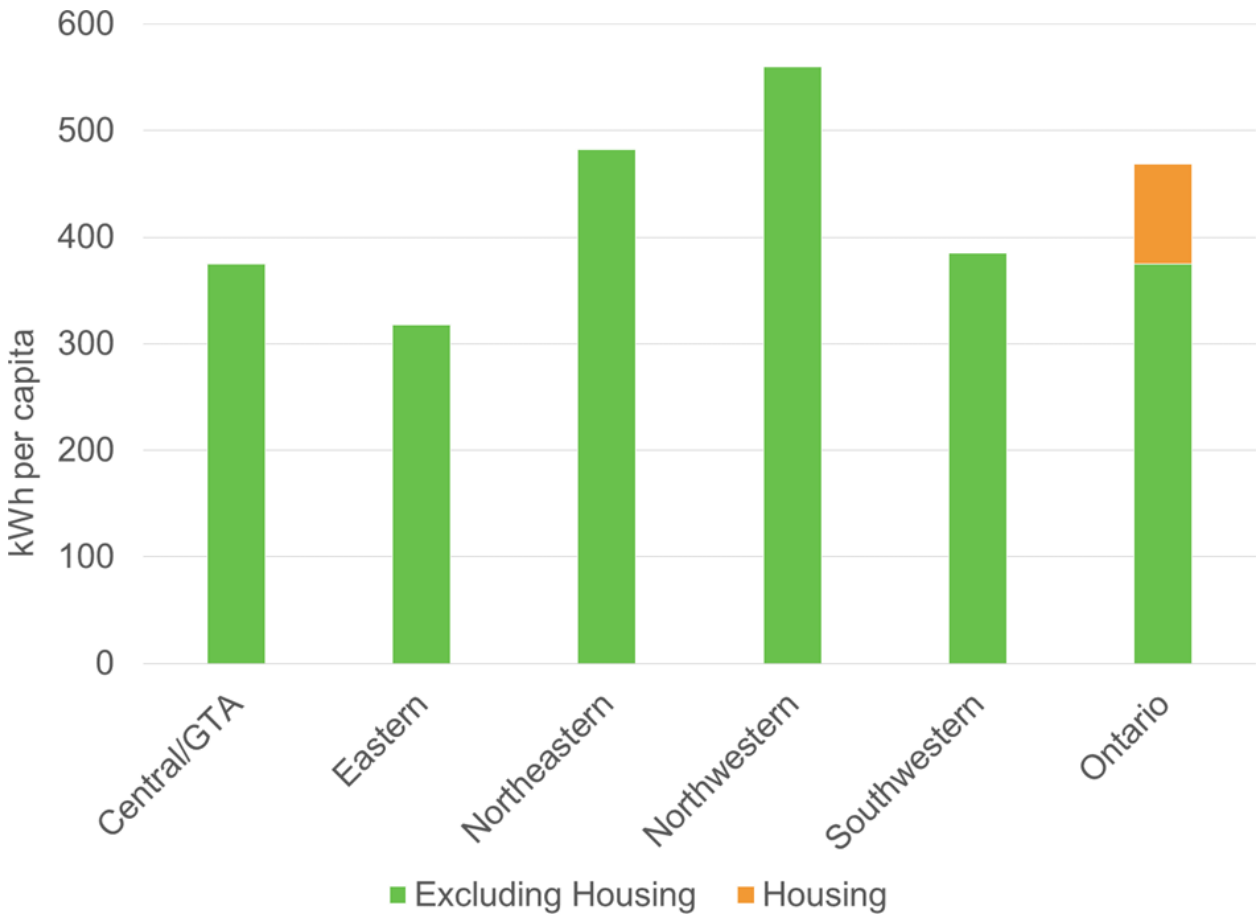
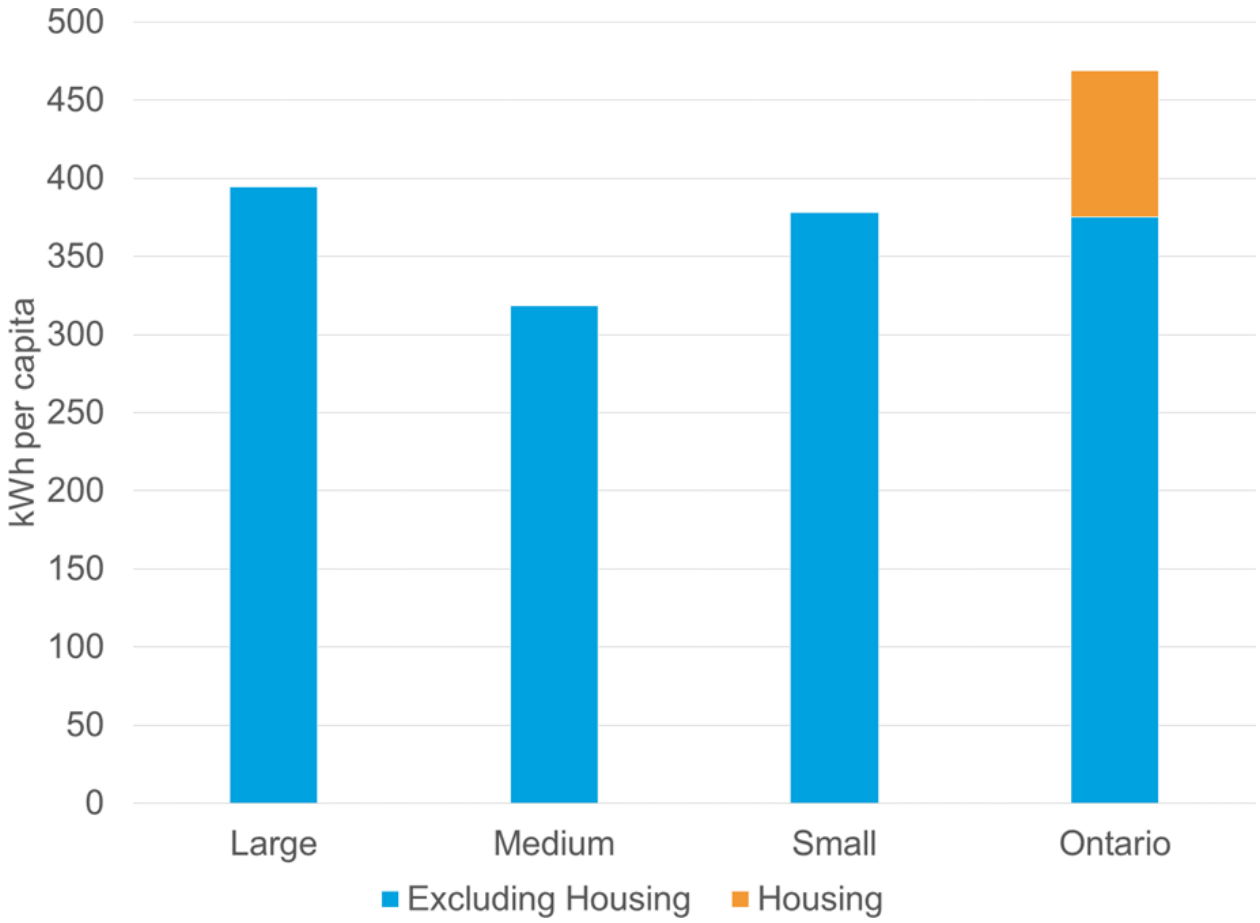


Exhibit 7 illustrates the differences in per capita municipal electricity consumption by municipality size, excluding social housing. Municipalities with populations under 10,000 are

considered Small, between 10,000 and 100,000 are considered Medium, and over 100,000 are considered Large. Upper tier municipalities and municipal service boards are included in the Large category. Large municipalities have relatively higher electricity consumption per capita (395 kWh/capita), followed by Small municipalities (378 kWh/capita), and Medium municipalities (318 kWh/capita). Municipal electricity consumption in the province as a whole is 469 kWh per capita including social housing; this is presented in the stacked bar on the far right.

Exhibit 7: Municipal Electricity Consumption (kWh) per capita by Municipality Size, 2014



1.1.2 Comparison with 2006 Baseline

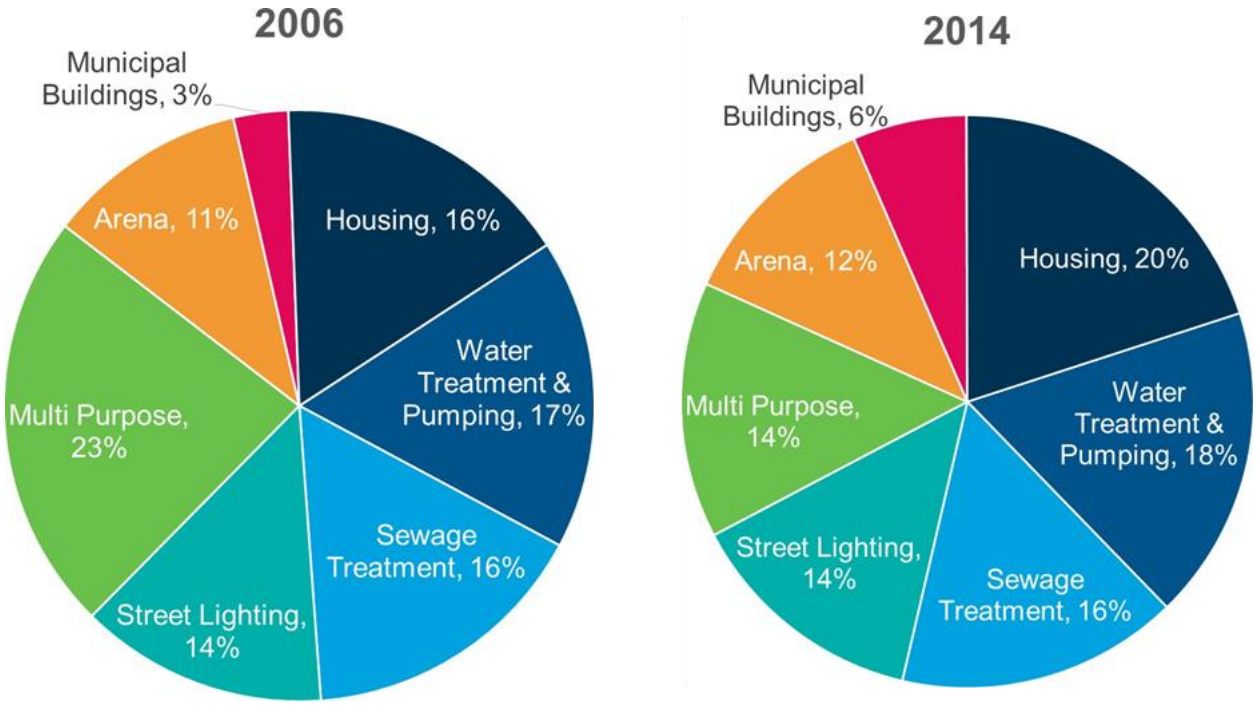
Exhibit 8 shows a comparison between the municipal electricity profile data from 2006 and that of 2014. The 2014 data is taken from “complete” (as defined in Exhibit 1) self-reported data submitted to the Ministry of Energy, under O.Reg. 397/11, pro-rated based on population to arrive at regional and provincial totals. A description of how the energy use estimates were arrived at is summarized below:

- **Sewage Treatment and Water Treatment & Pumping:** This data was sourced from O.Reg. 397/11 data reported under the following categories: facilities related to the pumping of sewage, facilities related to the treatment of sewage, facilities related to the pumping of water, and facilities related to the treatment of water. Due to a change in the regulation, municipalities were not required to report on energy consumption associated with water and sewage pumping in their 2014 data, although some municipalities continued to do so voluntarily. The approach taken to rectify this gap was to combine pumping energy use reported in 2012 with treatment energy use reported in 2014.
- **Street Lighting:** Municipalities are not required to report electricity consumption from street lighting under O.Reg. 397/11, so these values were estimated from a variety of data sources (this is explained in Section III.1.2).
- **Multi Purpose:** The 2008 Power Application Group Inc. report included a separate category called “Works”. The self-reported data under O.Reg. 397/11 does not include the category “Works” in the list of Operation Types; in order to do a fair comparison, electricity consumption from “Works” was included in the “Multi Purpose” category in the 2006 data. The 2014 data included electricity consumption from the following operation types: ambulance stations and associated offices and facilities; art galleries; auditoriums; community centres; cultural facilities; fire stations and associated offices and facilities; long-term care; parking garages; performing arts facilities; police stations and associated offices and facilities; public libraries; storage facilities where equipment or vehicles are maintained, repaired or stored; and other.
- **Arena:** The 2014 data included electricity consumption from the following operation types: gyms and indoor courts for playing tennis, basketball or other sports; indoor ice rinks; Indoor recreational facilities; indoor sports arenas; and indoor swimming pools.
- **Municipal Buildings:** The 2014 data included electricity consumption from the following operation type: administrative offices and related facilities, including municipal council chambers.
- **Housing:** Municipalities are not required to report their energy consumption from housing under O.Reg. 397/11. Estimates were developed based on the Housing Service Corporation’s 2014 electricity and natural gas average energy usage intensity values for over 42,294 social housing units with a total gross floor area of 3,394,871 m2 participating in the Utility Management Program (Housing Services Corporation, 2018). This data was extrapolated to the total estimated number of municipal social housing units, where Local

Housing Corporations operate more than half (ICF assumed 55%) of the 260,000 units in Ontario (Housing Services Corporation, 2018).

Water and wastewater treatment and pumping continue to make up roughly 33% of municipal electricity consumption, and street lighting remained at 14% of municipal electricity consumption. The “Multi-Purpose” category follows the definition that was used in the 2008 Municipal Electricity Profile, and “includes a broad range of facilities and load profiles such as fire halls, police stations, medical clinics, airports, senior’s complexes. However, there are still some inaccuracies in both datasets that make it challenging to draw conclusions. Although one might expect to see a more dramatic reduction in electricity consumption from street lighting, the number of retrofit projects started to rise exponentially after 2014. This is discussed in Section III.1.2.

Exhibit 8: Municipal Electricity Profiles: 2006 vs. 2014



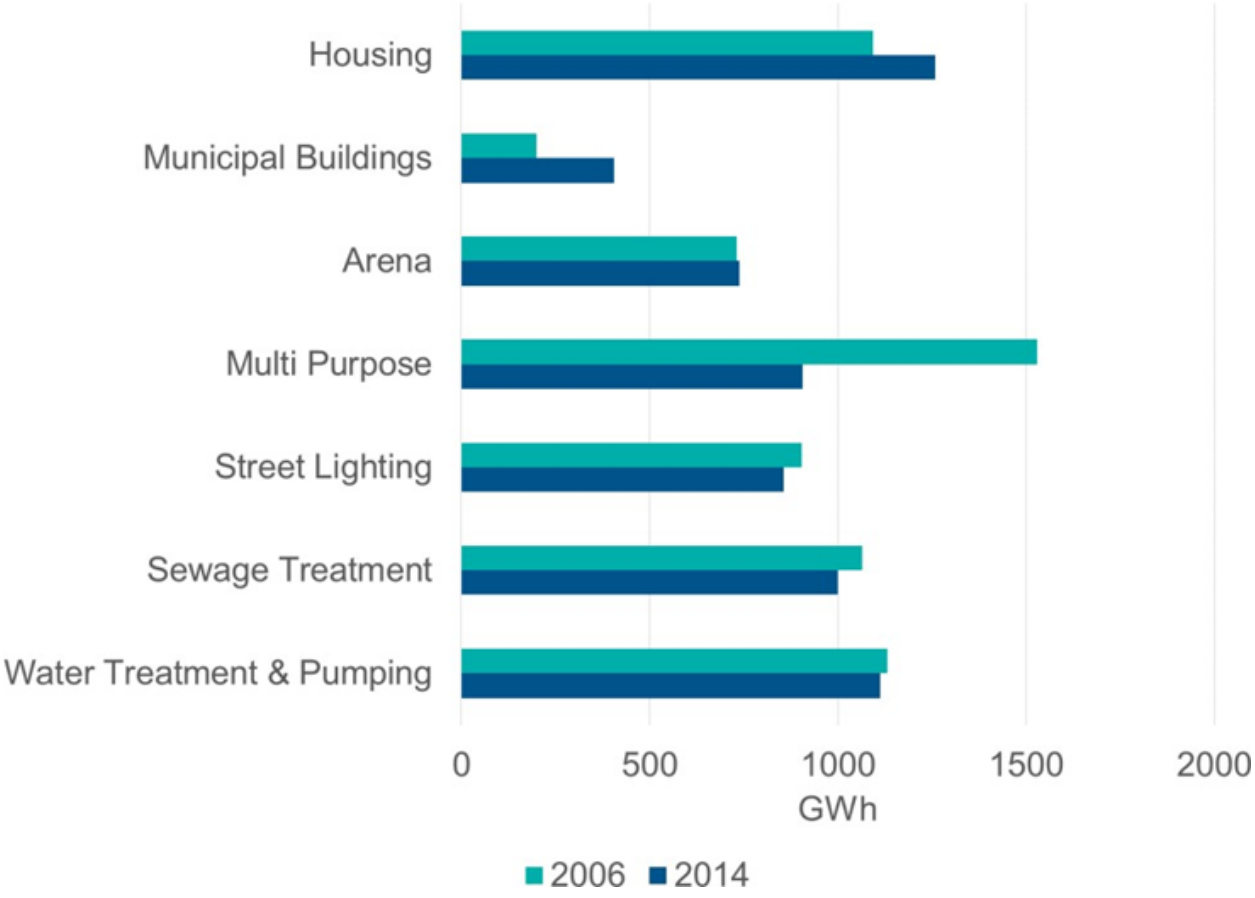
One of the challenges with comparing the electricity profiles as pie charts is that it captures both relative and absolute changes in energy use. Therefore energy consumption can be reduced in a category, but the category’s relative size can remain the same. It is therefore important to also compare the consumption estimates for each category, which is presented in Exhibit 9.

The most dramatic differences in electricity consumption, are in Housing and Municipal Buildings, both of which saw an increase in estimated electricity consumption between 2006 and 2014. Multi Purpose saw a significant drop in estimated electricity consumption between 2006 and 2014. Further investigation is required to fully understand these discrepancies, but it is

quite likely that they are not solely indicative of electricity consumption. The discrepancies in the Multi Purpose and Municipal Building consumption could be explained by the following possible occurrences:

- Differences in the categorization method used in the 2008 PAGI report and this study. No definitions for the categories were provided in the PAGI report, and no clear definitions of the categories used by O.Reg. 397/11 are available. This is particularly evident when comparing the energy use for Municipal Buildings and Multi Purpose. The differences in energy consumption across these categories are reduced if they are considered together, suggesting that energy use has migrated between the categories rather than having changed significantly between the studies.
- Gaps in the data collected for the 2008 PAGI report.
- Errors or inconsistencies in the consumption values and/or categorization provided in the self-reported data under O.Reg. 397/11.

Exhibit 9: Municipal Electricity Profiles: Consumption (GWh) in 2006 vs. 2014



1.1.3 End Use Breakdown

In order to gain a better understanding of the energy savings opportunities, it is useful to be able to estimate the electricity consumption by end use. The following end uses were chosen:

- **Water treatment:** Electricity required to treat water to meet drinking water standards, typically through mechanical filtration.
- **Wastewater treatment:** Electricity required for the treatment of wastewater (sewage). Major components of wastewater treatment include[3]:
    - **Primary:** Removal of solids via filters, screens, sedimentation tanks, and dissolved flotation tanks.
    - **Secondary:** Biological processes to remove dissolved organic matter through technologies such as an aeration tank, trickling filter, and activated sludge process, followed by settling tanks.
    - **Tertiary:** Additional treatments to remove nutrients, such as nitrogen, phosphorous, and suspended solids through technologies including sand filtration or membrane filtration. Disinfection is often the final step before discharge.
- **Pumping:** Electricity required for the distribution of water and wastewater.
- **Street lighting:** Electricity required for municipal owned street lighting.
- **Ventilation:** Electricity required for mechanical ventilation systems in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Lighting:** Electricity required for interior and exterior building lighting (excluding street-lighting) in in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Space heating:** Electricity required to heat occupied spaces in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Space cooling:** Electricity required to cool occupied spaces in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Plug loads and miscellaneous:** Electricity required for office equipment, appliances, and miscellaneous equipment in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Arena:** Electricity required for process specific loads in arenas such as ice rink refrigeration and pool water treatment.

Estimates for the proportion of electricity use for each end use and subsector are presented in Exhibit 10below.

[3] Water Energy Nexus (excerpt from World Energy Outlook 2016), International Energy Agency, p.35

Exhibit 10: Electricity End Use Breakdown by Subsector

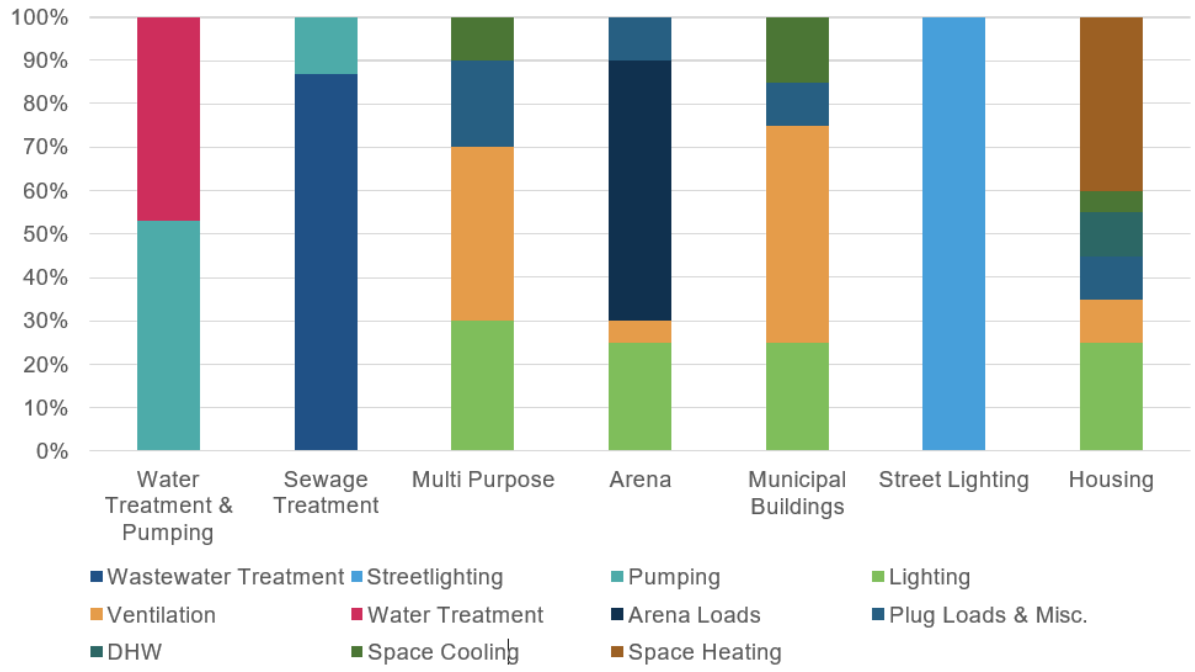
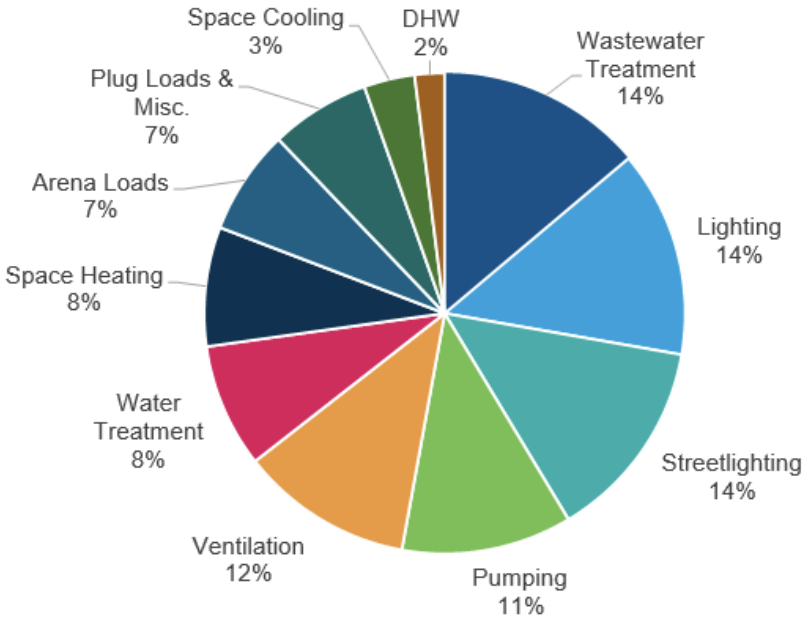


Exhibit 11below presents a breakdown of total municipal electricity consumption for all subsectors by end use category, estimated by mapping the end use breakdown from Exhibit 10 onto the electricity profile shown in Exhibit 8.

Exhibit 11: Municipal Electricity End Use Breakdown, 2014



1.2 Natural Gas

1.2.1 Consumption

Municipalities and municipal service boards consumed approximately 425 million m3 of natural gas in 2014, of which an estimated 156 million m3 was consumed by municipal social housing. As shown in Exhibit 12, natural gas consumption in 2011, 2012, and 2013 excludes social housing, because municipalities are not required to report consumption from social housing, and data from other sources was not available to provide an estimate of consumption for those years. Excluding housing, municipalities saw an estimated 12% reduction in natural gas consumption in 2014 compared to 2011. The 2008 Power Application Group Inc. study did not include natural gas, so in this case there is no 2006 baseline data to compare against. The 2011 to 2014 data is taken from “complete” (as defined in Exhibit 1) self-reported data submitted to the Ministry of Energy, under O.Reg. 397/1 and pro-rated based on population to arrive at regional and provincial totals. Natural gas consumption data was weather normalized for operations that are strongly influenced by weather patterns (e.g., municipal buildings). Natural gas consumption from municipal housing was estimated based on data provided by the Housing Services Corporation (2018), as explained in Section III.

Exhibit 12: Municipal Normalized Natural Gas Consumption (m3) by Year

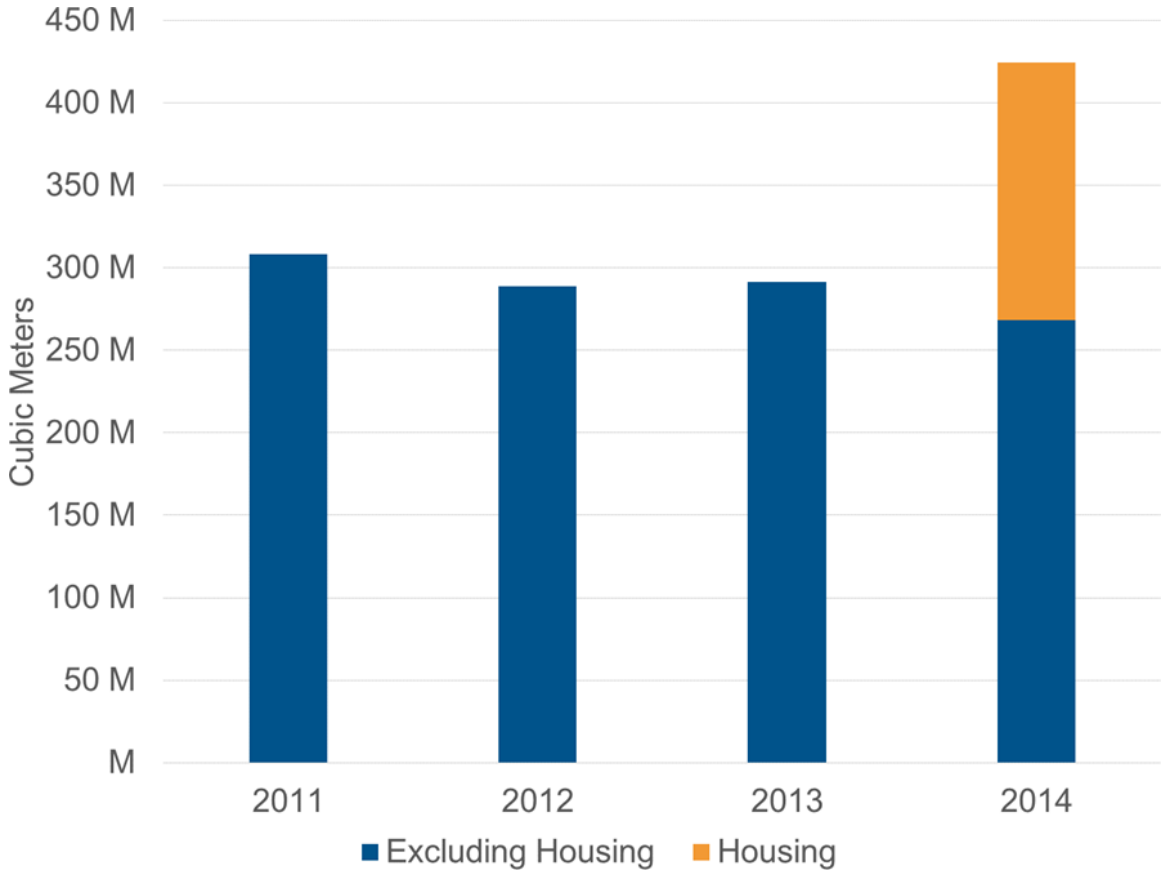


Exhibit 13 illustrates the differences in municipal natural gas consumption per capita among the five geographic regions in 2014, excluding natural gas consumption from social housing. Northwestern region has the highest natural gas consumption (46 m3 per capita), followed by Northeastern (39 m3 per capita), Eastern (22 m3 per capita), Southwestern (21 m3 per capita), and Central/GTA (19 m3 per capita). In 2014, municipal natural gas consumption in the province as a whole was 33 m3 per capita including social housing; this is presented in the stacked bar on the far right.

Exhibit 13: Municipal Normalized Natural Gas Consumption per capita by Geographic Region, 2014

Exhibit 14illustrates the differences in municipal natural gas consumption per capita in 2014 by municipality size, excluding social housing. Municipalities with populations under 10,000 are considered Small, between 10,000 and 100,000 are considered Medium, and over 100,000 are considered Large. Upper tier municipalities and municipal service boards are included in the Large category. Small municipalities have the highest natural gas consumption per capita (25 m3 per capita), followed by Medium sized municipalities (22 m3 per capita), and then Large municipalities (21 m3 per capita). In 2014, municipal natural gas consumption in the province as a whole was 33 m3 per capita including social housing; this is presented in the stacked bar on the far right.

Exhibit 14: Municipal Normalized Natural Gas Consumption per capita by Municipality Size, 2014

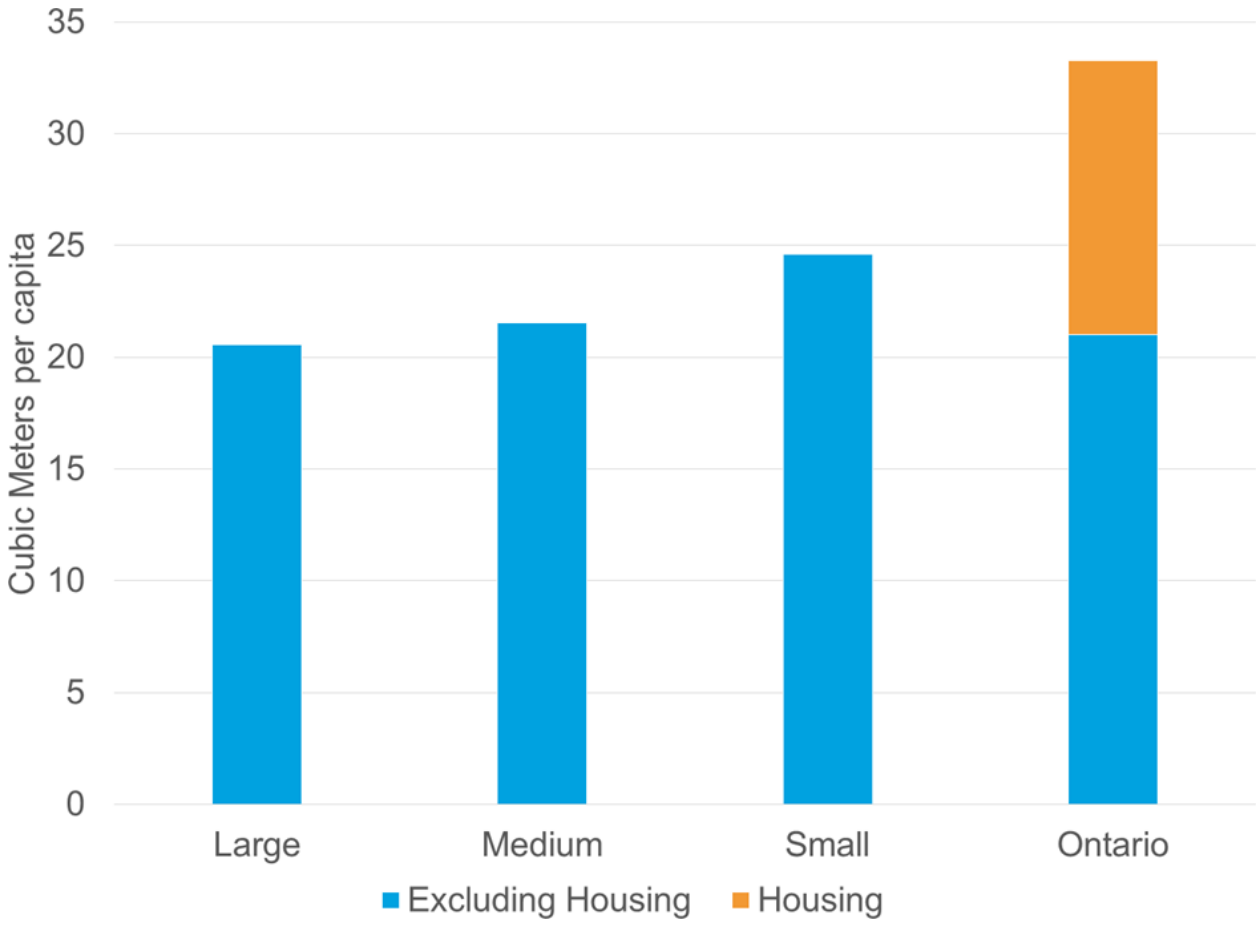
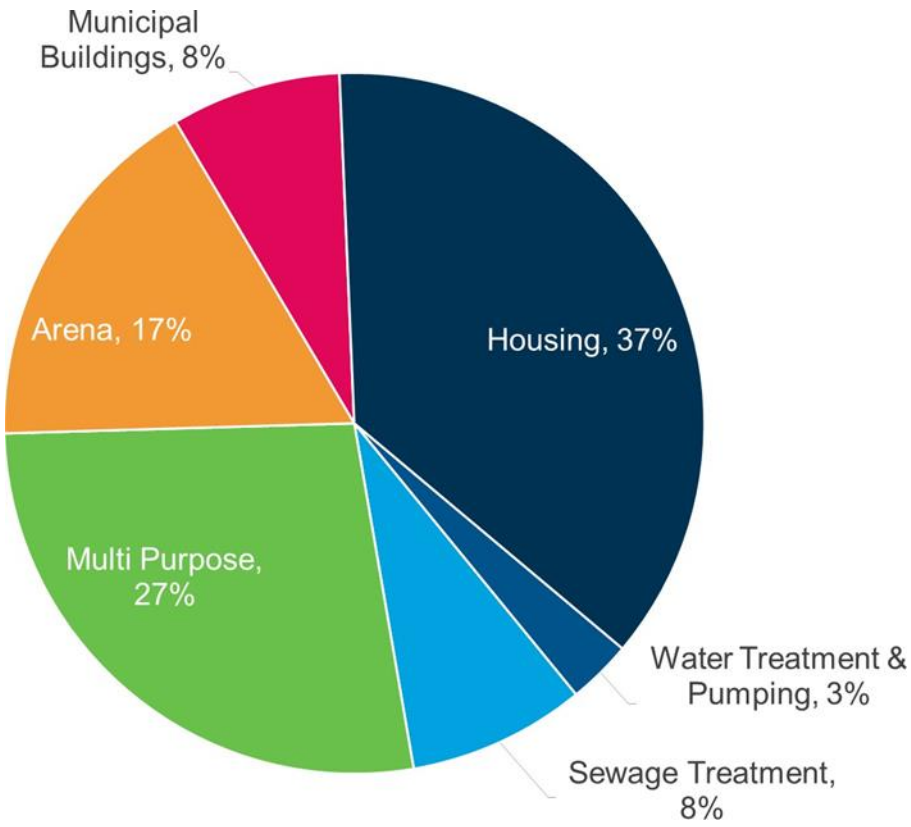


Exhibit 15shows the 2014 municipal natural gas profile. The 2014 data is taken from “complete” (as defined in Exhibit 1) self-reported data submitted to the Ministry of Energy, under O.Reg. 397/11, and pro-rated based on population to arrive at regional and provincial totals. The data was weather normalized for operations that are strongly influenced by weather patterns (e.g. municipal buildings). 2014 natural gas consumption from municipal housing was estimated based on data provided by the Housing Services Corporation (2018), as explained in Section III. The 2008 Power Application Group Inc. study did not include natural gas, so in this case there is no 2006 baseline data to compare against. The same methodologies identified in Section I.1 were used to address data issues for each category.

Municipal social housing makes up the largest portion of natural gas usage (37%), followed by Multi-Purpose (27%). The “Multi-Purpose” category includes the following operation types: Ambulance stations and associated offices and facilities; Art galleries; Auditoriums; Community Centres; Cultural facilities; Fire stations and associated offices and facilities; Long-term care; Parking garages; Performing arts facilities; Police stations and associated offices and facilities; Public libraries; Storage facilities where equipment or vehicles are maintained, repaired or stored; and Other.

Exhibit 15: Municipal Natural Gas Profile, 2014



1.2.2 End Use Breakdown

In order to gain a better understanding of the energy savings opportunities, it is useful to be able to estimate the natural gas consumption by end use. The following end uses were chosen:

- **Space heating:** Natural gas required to heat occupied spaces in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Wastewater treatment:** Natural gas required for wastewater treatment processes such as sludge drying.
- **Water treatment:** Natural gas required for water treatment processes such as solids drying.
- **Domestic hot water:** Natural gas required to heat domestic hot water for use in municipal buildings, multi-purpose buildings, arenas, and housing.
- **Arena:** Natural gas required for process specific loads in arenas such as pool water heating.

Estimates for the proportion of natural gas use for each end use and subsector are presented in Exhibit 16below.

Exhibit 16: Natural Gas End Use Breakdown by Subsector

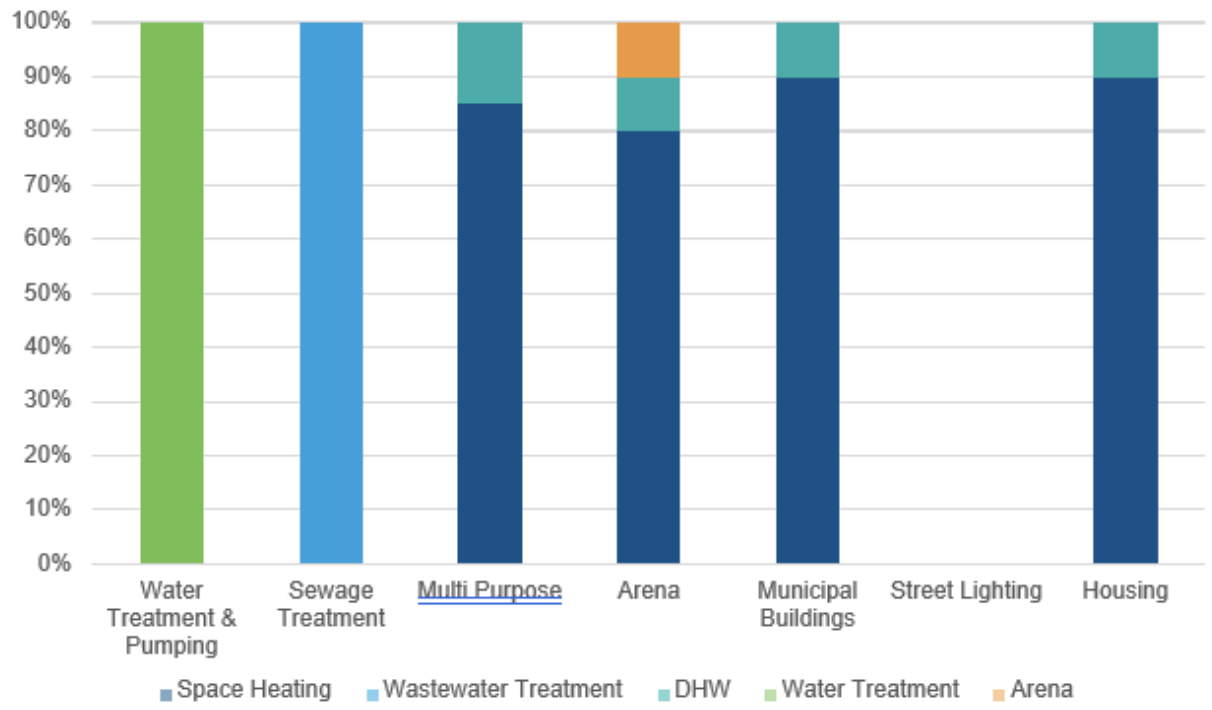
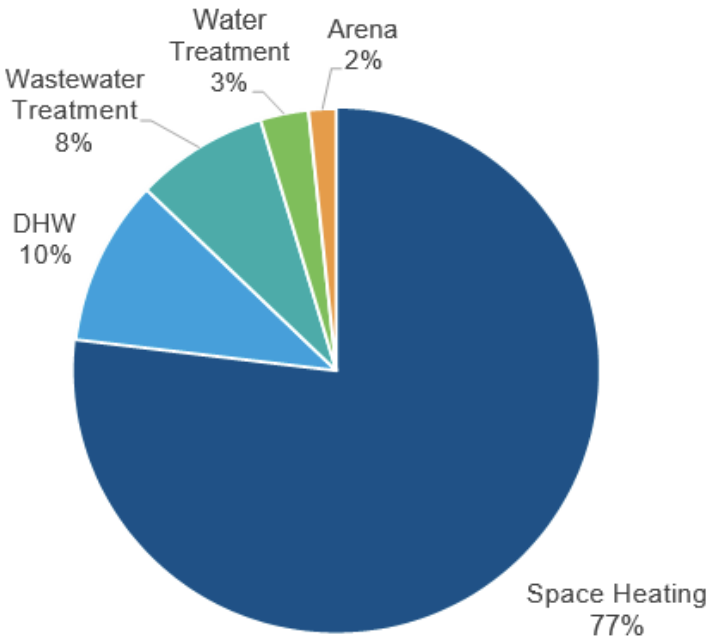


Exhibit 17 below presents a breakdown of total municipal natural gas consumption for all subsectors by end use category, estimated by mapping the end use breakdown from Exhibit 16 onto the natural gas profile shown in Exhibit 15.

Exhibit 17: Municipal Natural Gas End Use Breakdown, 2014



1.3 District Energy

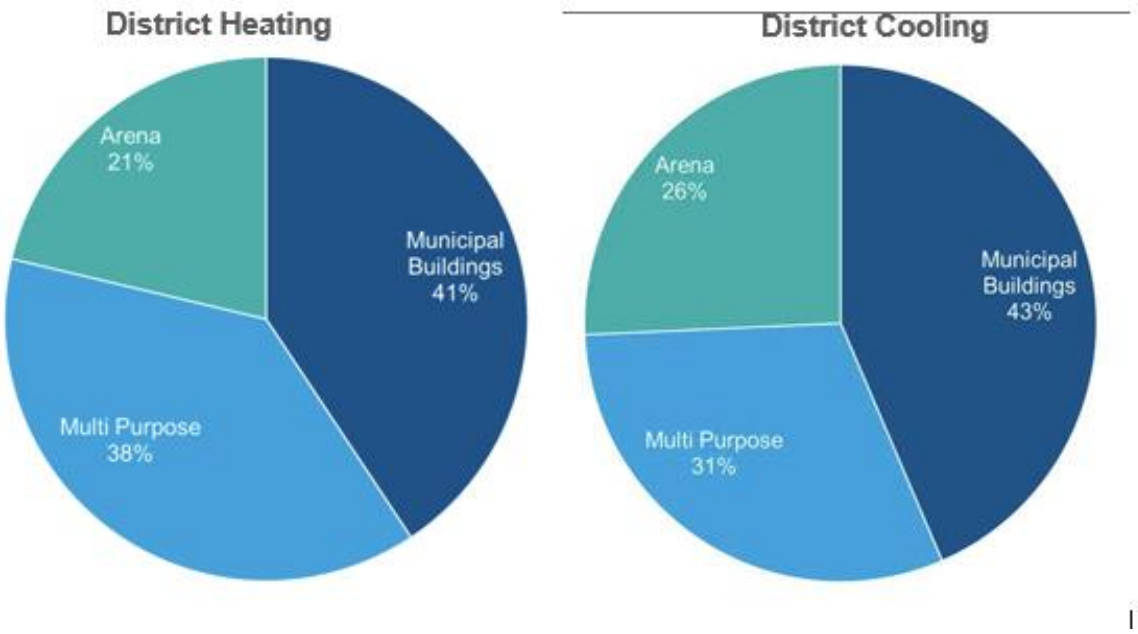
According to the data reported to the Ministry of Energy, under O.Reg. 397/11, municipalities used 243,989 GJ from hot water or steam and 137,522 GJ from chilled water in 2014. These municipalities are using district heating and cooling for operations related to municipal buildings, multi-purpose facilities, and arenas.

Exhibit 18: Municipal District Heating and Cooling (GJ), 2014

Municipality	District Heating (GJ), 2014	District Cooling (GJ), 2014
Cornwall	18,495	-
Greater Sudbury	14,029	680
Guelph	4,043	1,266
Hamilton	44,664	7,227

London	18,700	3,931
Markham	31,624	18,996
Parry Sound	144	-
Toronto	99,260	78,535
Uxbridge	-	19,250
Windsor	13,030	7,636
Grand Total	**243,989**	**137,522**

Exhibit 19: Municipal District Heating and Cooling (GJ), by Usage Category, 2014



District heating energy use will be dominated by space heating, with the balance being used for DHW heating and process loads. The majority of district cooling energy is used for space cooling, with the balance being used for process cooling such as in data centres.

2. Energy Costs

2.1 Electricity

Municipalities spent an estimated $917 million (2014 dollars) on electricity in 2014. The following methodology was used to estimate the electricity costs for 2014:

- 2014 consumption data was estimated based on self-reported electricity consumption data submitted to the Ministry of Energy (see Exhibit 1).
- 2014 rates for selected local electricity distribution companies in each of the 5 geographic regions (London Hydro, Toronto Hydro, Hydro Ottawa, Thunder Bay Hydro, Greater Sudbury Hydro, and Hydro One). Rates were blended based on the estimated portion of electricity consumed in Hydro One's service territory compared to the other LDCs.
- Three rate classes were used: commercial/general service customers over 50kW, street lighting, and residential.
- Demand and administration charges were estimated in addition to consumption charges.

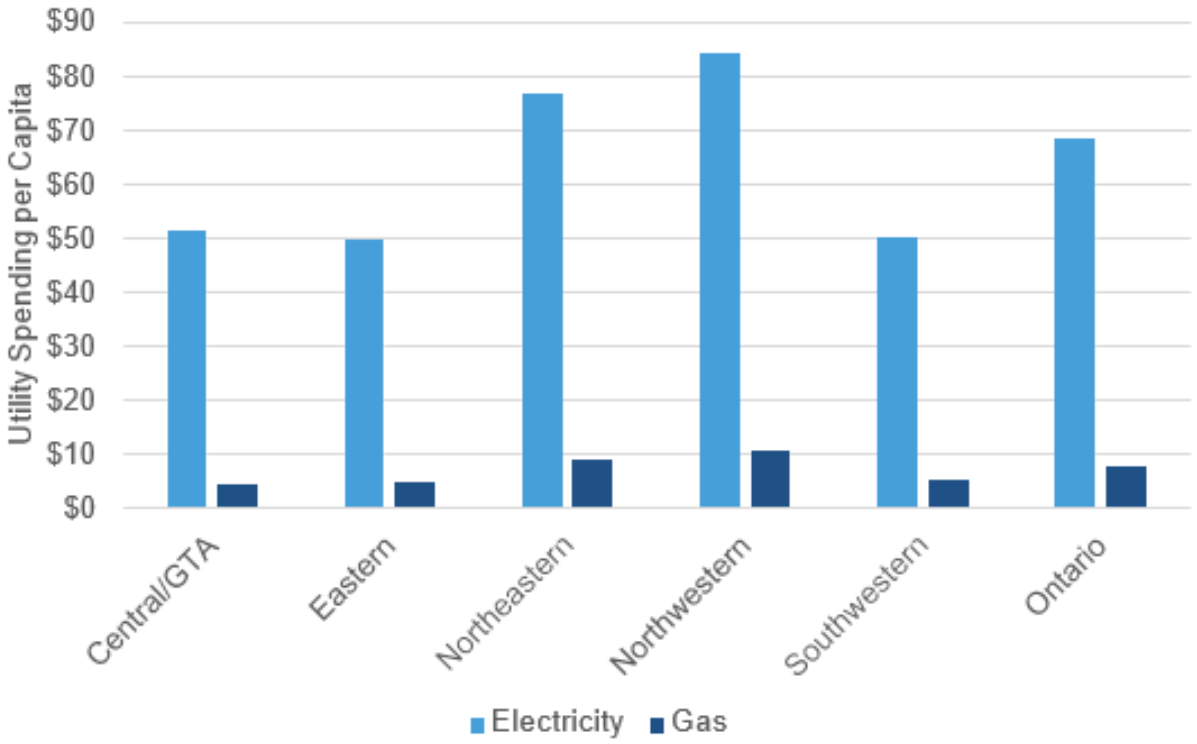
2.2 Natural Gas

Municipalities spent approximately $105 million in natural gas in 2014. This estimate is based on self-reported gas consumption data submitted to the Ministry of Energy, and the 2014 natural gas rates for Union Gas and Enbridge Gas Distribution.

The 2014 municipal electricity cost and natural gas estimates per capita, by geographic region are presented in Exhibit 20. Regional values exclude spending on social housing as this information was not available. However, the Ontario values include spending on social housing utilities.

Municipal spending is considerably lower on natural gas compared to electricity, which can be attributed to the comparatively much lower natural gas rates. Despite rate differences between some geographic regions, the electricity and natural gas usage has the most significant influence on municipal utility costs.

Exhibit 20: Municipal Energy Spending by Geographic Region, Electricity vs. Natural Gas (2014)



2.3 Comparison with 2006 Baseline

Municipalities increased their electricity spending by 35% between 2006 and 2014, from an estimated $680 million to $917 million. The 2006 estimate is based on electricity consumption and cost data provided in the 2008 Power Application Group Inc. report. This increase would have been higher if not for a 6% reduction in electricity consumption, as rates increased by an estimated 43% over the same period[4]. The rate of inflation in Canada was 13.8% between 2006 and 2014[5]. It should be noted that there were significant differences in the methodologies used to determine electricity rates in the 2008 PAGI study and this study, which should be taken under consideration when making comparisons between electricity spending.

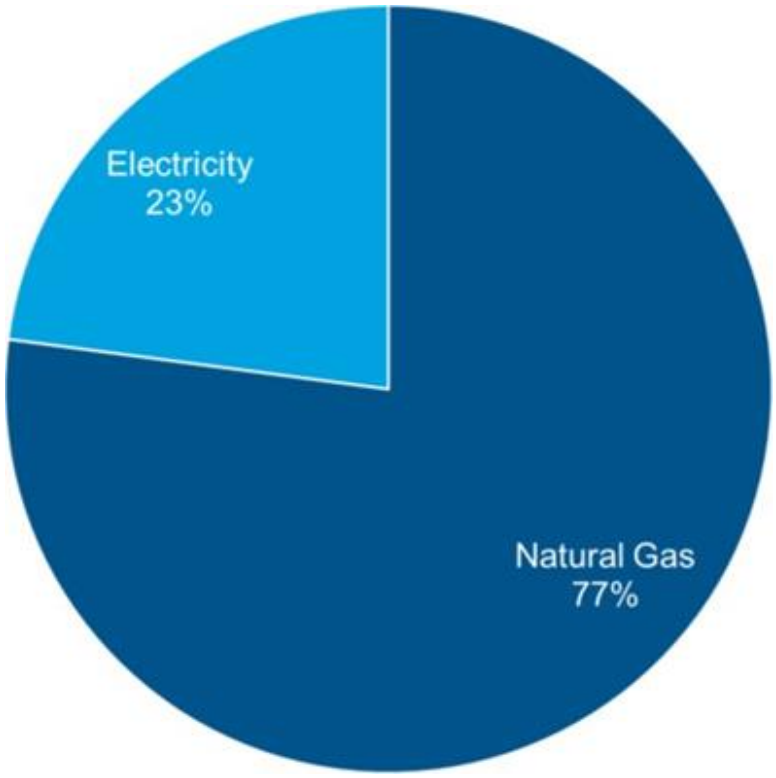
[4] The average rate was 10.2 cents/kWh in 2006 according to the PAGI report, and 14.6 cents/kWh according to this study.

[5] https://www.bankofcanada.ca/rates/related/inflation-calculator/

3. GHG Emissions

Considering only greenhouse gas (GHG) emissions from electricity and natural gas as reported to the Ministry of Energy under O.Reg. 397/11, electricity accounts for 23% of GHG emissions and natural gas accounts for 77% of GHG emissions. The 2014 emissions factors for Ontario were used: 38 gCO2eq/kWh (Environment Canada, National Inventory Report 1990–2015: Greenhouse Gas Sources and Sinks in Canada Part 3, Table A13-7, p.99, 2017) and 1,888 gCO2eq/m3 (Environment Canada, 2016 National Inventory Report Part 2, Table A6-1, P.194, 2017). Other fuel types reported under O.Reg. 397/11 are not a significant source of GHG emissions because they account for only 2.4% of municipal energy use, although they do have higher emissions intensities than electricity, which is the most consumed fuel. One significant source of direct GHG emissions for municipalities not captured in this study[6] is fleet vehicles, which are most commonly powered by gasoline and diesel. Municipalities also have fugitive GHG emissions from sources such as landfills and wastewater treatment.

Exhibit 21: Municipal GHG Emissions by Fuel Type



[6] ICF reviewed a variety of data sources but was unable to locate transportation fuel or transportation GHG data specific to municipal fleet vehicle use.

III. Municipal Technical Best Practices

This section provides a detailed overview of the technical best practices municipalities have implemented to improve their energy efficiency and reduce their greenhouse gas emissions. The section also explores future opportunities for expanding the municipal adoption of these best practices. Technical best practices refer to sustainable energy projects in the following areas:

- Energy Efficiency
- Demand Response
- Renewable Energy Generation
- Electrification
- Net Zero Buildings
- Drivers

1. Energy Efficiency

Over the last decade, Ontario municipalities and municipal service boards have achieved energy savings through a number of energy efficiency projects, either independently, or through various incentive and support programs. Throughout this section, participation in the IESO's Save On Energy programs is used as the main indicator of volume and type of energy efficiency project that municipalities have undertaken to reduce electrical energy consumption in their facilities. Energy efficiency in the area of street lighting was not estimated using Save On Energy data because street lighting projects are not specifically broken out within the IESO's database, making it challenging to extract this information from the balance of the lighting projects. In addition, there is uncertainty about what proportion of street lighting retrofits received Save On Energy funding. The approach taken for street lighting is explained in more detail in Section III. 1.2. Note that for this reason, the achieved savings for street lighting cannot be directly combined with the savings achieved through the Save On Energy program, as there is likely to be overlap between the two.

1.1 Electrical Energy Efficiency - Save On Energy Participation

Between 2011 and 2017, 74% of municipalities and municipal service boards had completed at least one project through the IESO's Save On Energy programs (67% completed multiple projects, and only 7% completed a single project). These municipalities received approximately $44 million in incentives, and have achieved annual savings of 330 GWh, to date. The majority of these incentive dollars (91%) were delivered through the Save On Energy Retrofit Program.

Exhibit 22 illustrates the level of participation of municipalities and municipal service boards in Save On Energy programs, by geographic region. Central/GTA municipalities have the highest percentage of participating municipalities, while Northeastern Ontario has the lowest percentage of participating municipalities.

Exhibit 22: Percentage of Municipalities and Municipal Service Boards that have Completed Save On Energy Projects (2010-2017), by Geographic Region

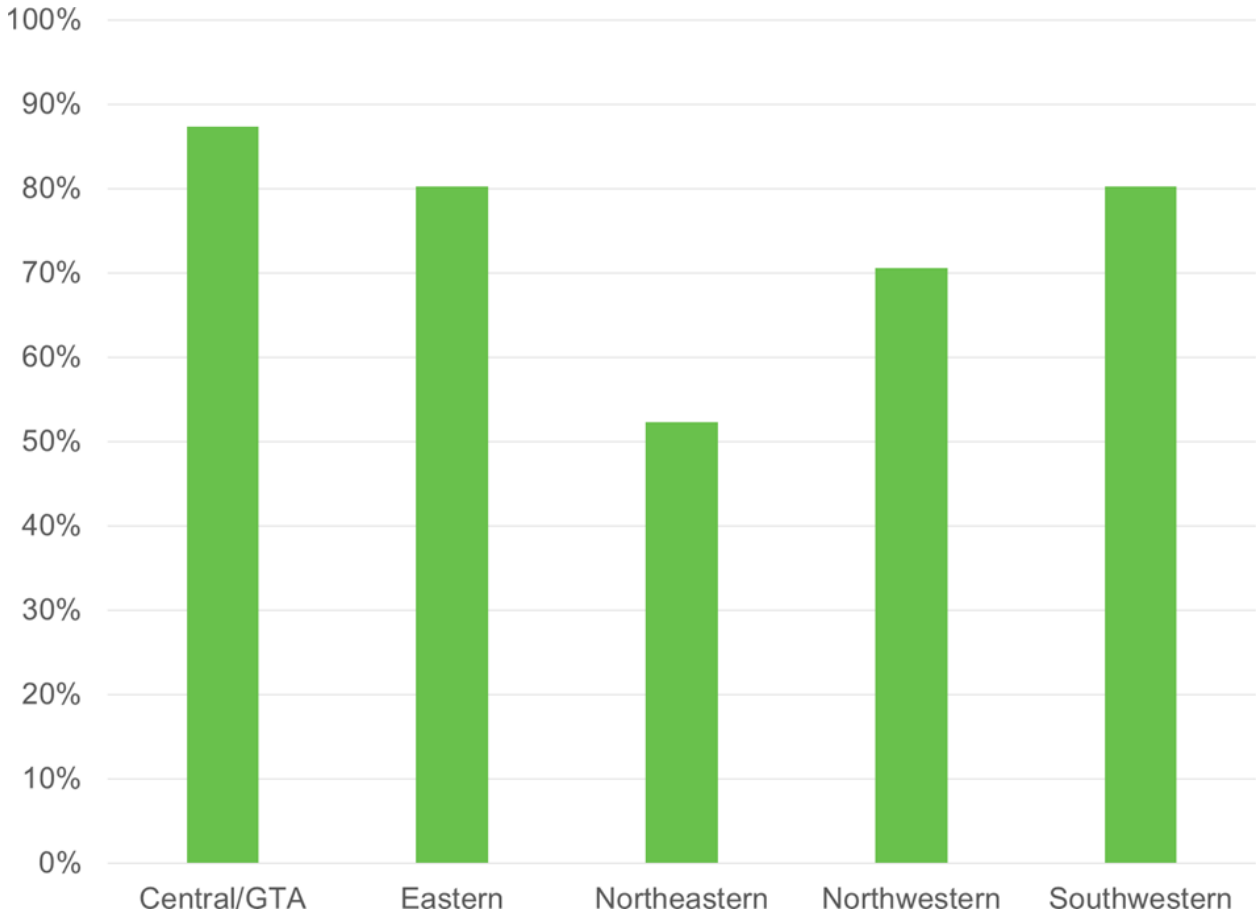
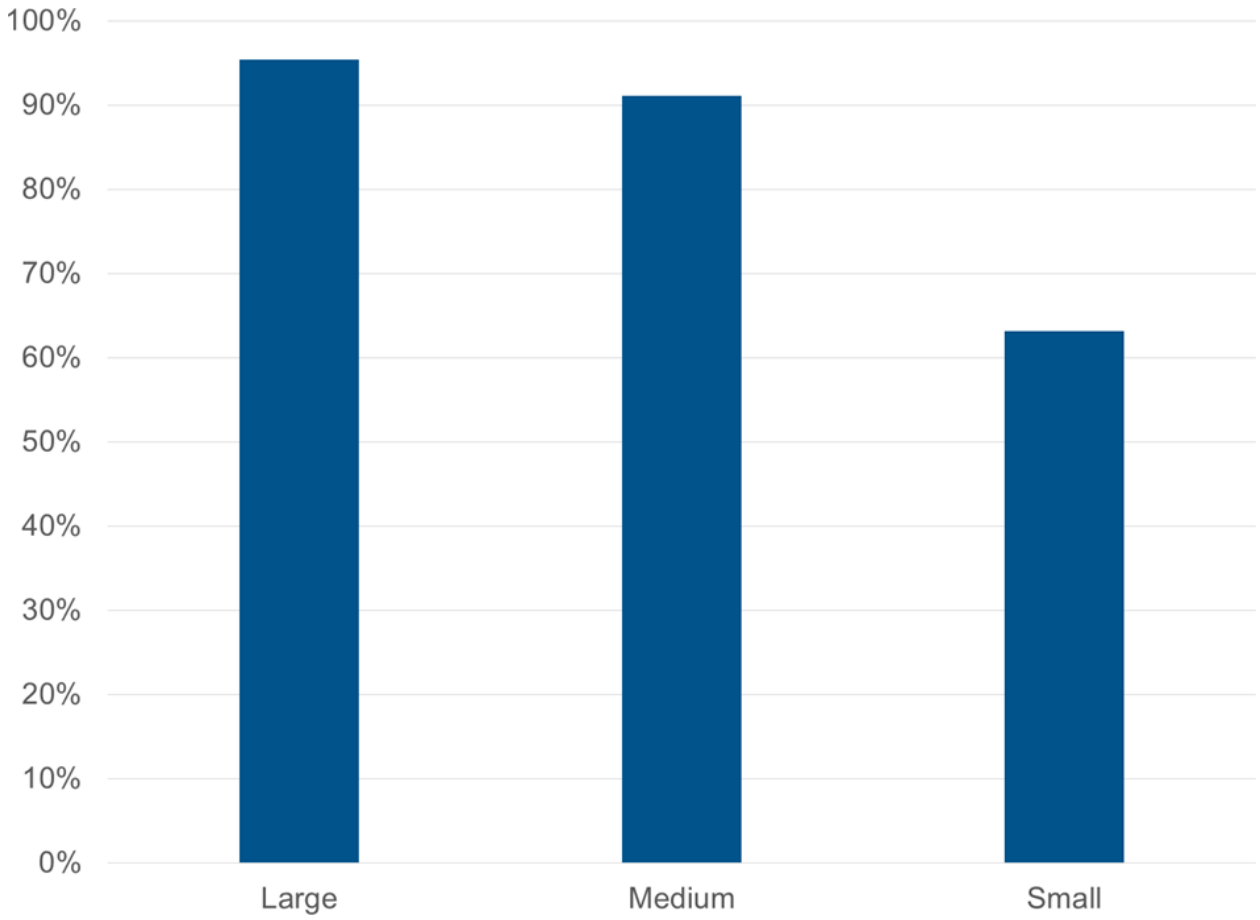


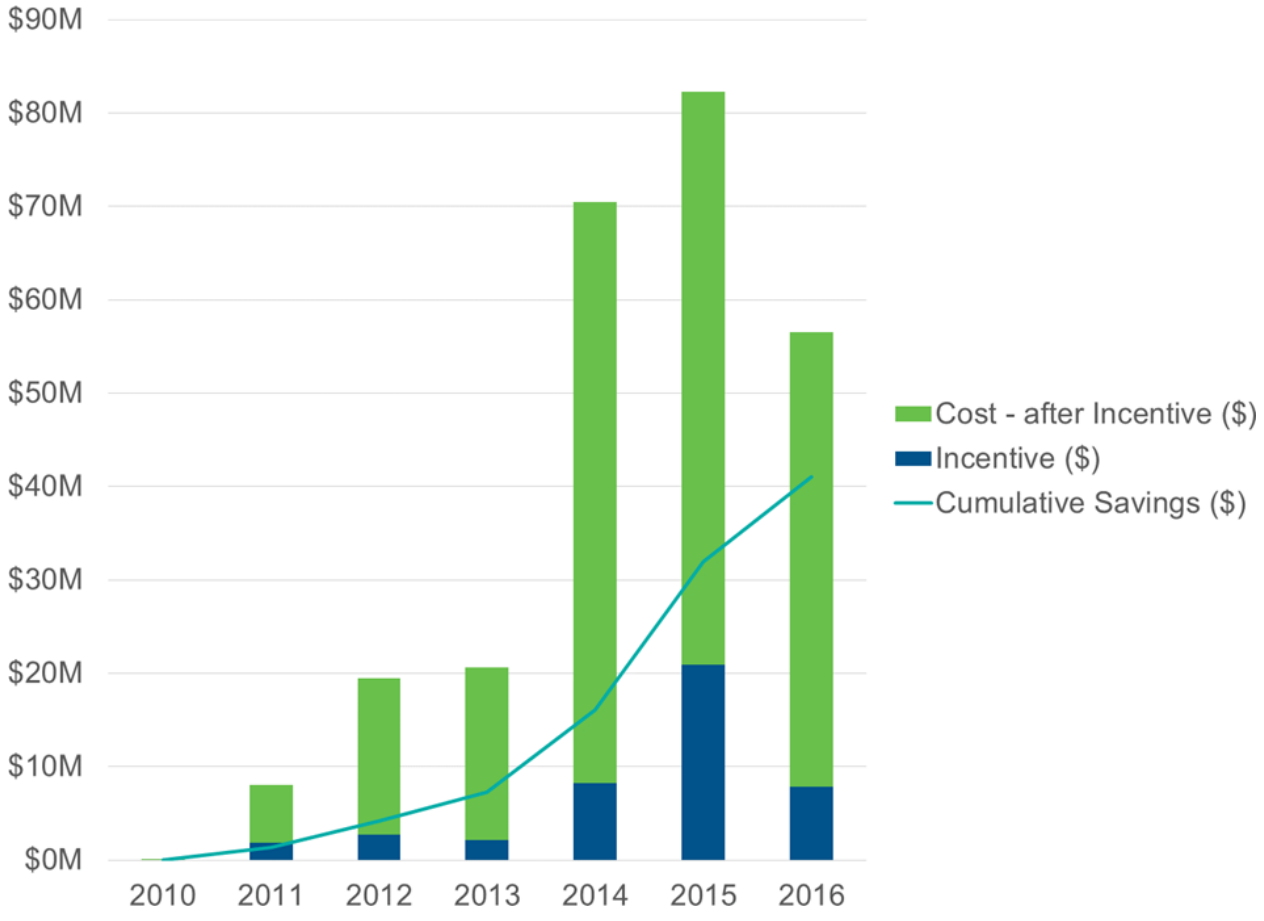
Exhibit 23 illustrates the level of participation of municipalities in Save On Energy programs, by municipality size. Municipalities with populations under 10,000 are considered Small, between 10,000 and 100,000 are considered Medium, and over 100,000 are considered Large. A very high percentage of Medium (91%) and Large municipalities (95%) has completed at least one Save On Energy project. Small municipalities have a lower rate of participation, at 63%.

Exhibit 23: Percentage of Municipalities that have Completed Save On Energy Projects (2010-2017), by Municipality Size



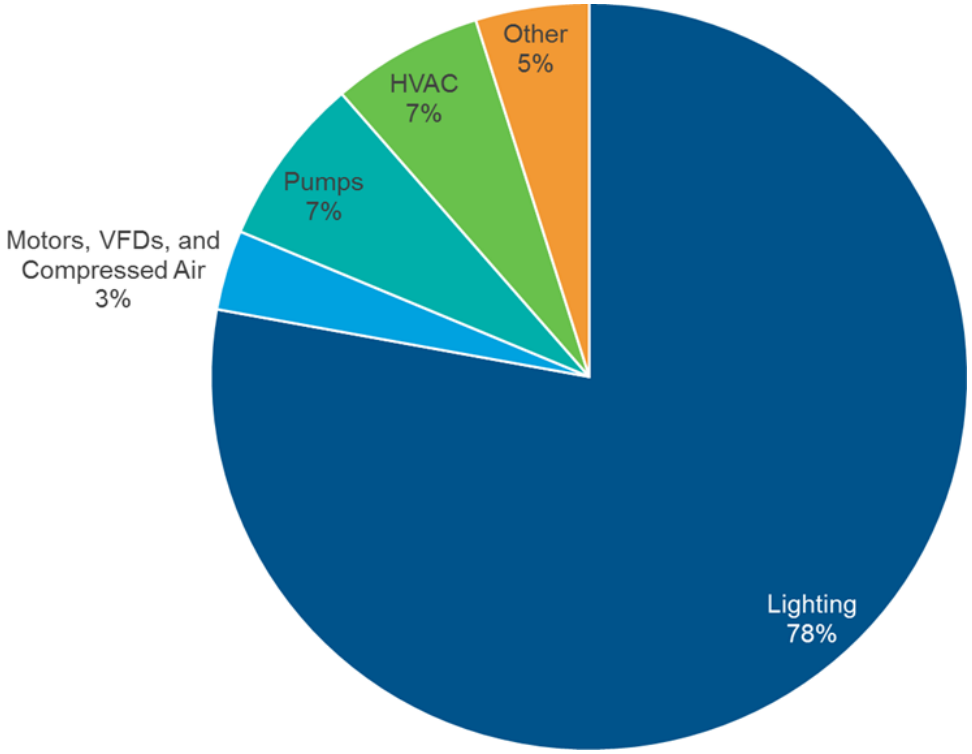
Through the Retrofit Program alone, Ontario municipalities have invested over $200 million in retrofit projects over the last 6 years. This is demonstrated in Exhibit 24. The spike in investment in 2015 is likely due in part to the fact that there was a significant effort to complete projects before the end of the first program framework. However, it can also be attributed to the introduction of O.Reg 397/11 and the introduction of mandatory annual reporting on municipal energy consumption, and the development of municipal conservation and demand management plans. Similarly, the apparent drop in investment in 2016 could be at least partly attributable to projects being incomplete at the time of reporting, and therefore not yet captured in the data set. The savings numbers are associated with the electricity cost savings for projects completed that year, as well as the annual savings accrued from previous years' projects. So, in addition to the $44 million municipalities have received in incentives, they have achieved over $100 million in electricity savings over the last 6 years.

Exhibit 24: Municipal Investment and Savings through Save On Energy Retrofit Program



A majority of retrofit projects completed by municipalities are lighting projects. Exhibit 25shows the profile of types of retrofit projects municipalities have completed, based on electricity savings. This pattern is consistent with other subsectors in Ontario.

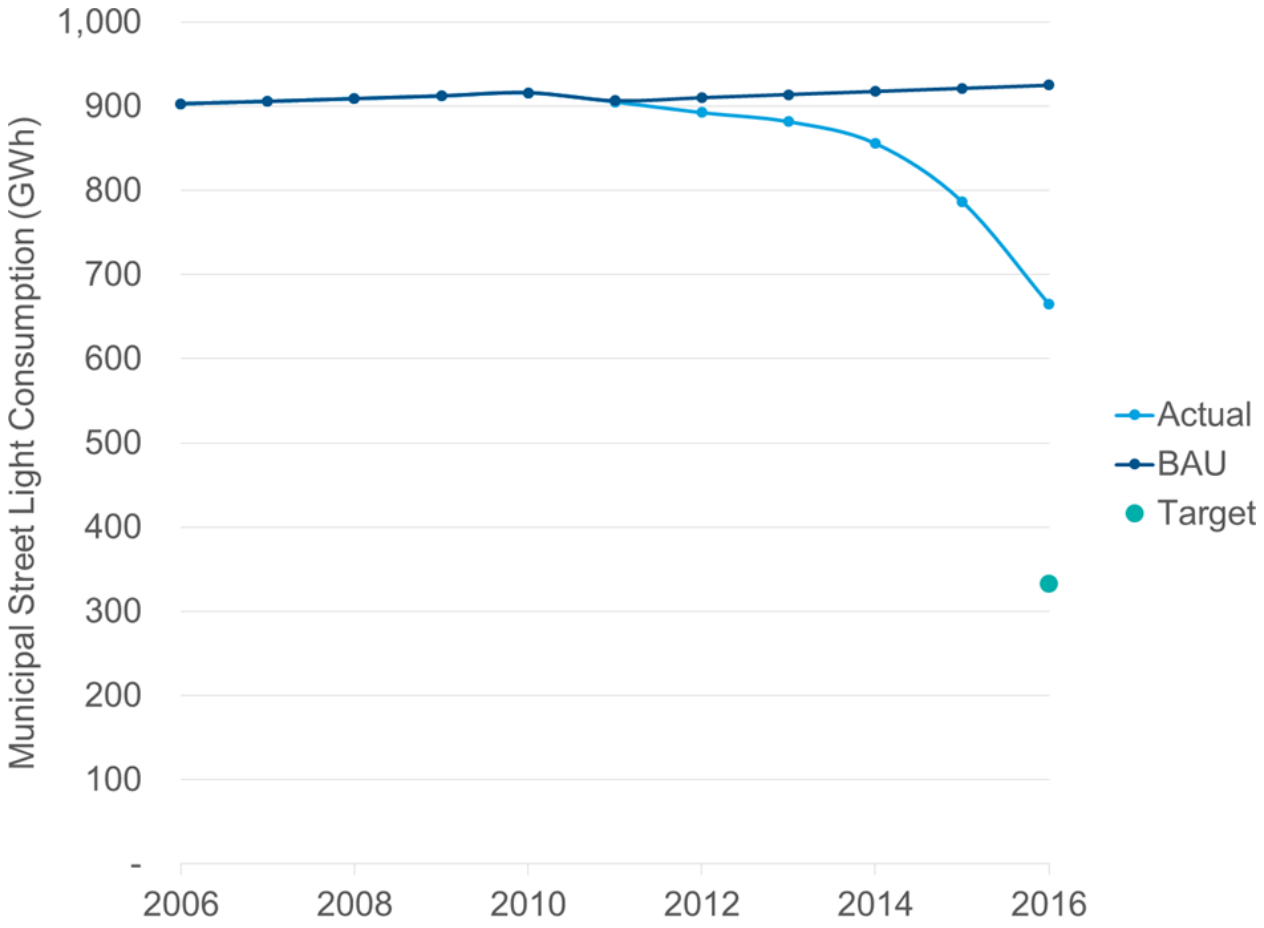
Exhibit 25: Municipal Electricity Savings from the Retrofit Program (2010-2017), by Measure



1.2 Street Lighting

For the last decade, street lighting has been a well-acknowledged and pursued opportunity for municipalities to achieve electricity savings, as well as other non-energy benefits (e.g. reduced light pollution, better visibility, etc.). The last Ontario municipal electricity profile report, completed in 2008, estimated that municipal street lights were consuming a total of over 903 GWh/year, which represented approximately 14% of total municipal electricity consumption (Power Application Group Inc. 2008). In 2014, municipal street lights were consuming an estimated 856 GWh, which continues to represent 14% of the total municipal electricity consumption. There is not a dramatic reduction because 2014 was just the beginning of more widespread municipal LED street lighting retrofit projects, as illustrated in Exhibit 26.

Exhibit 26: Municipal Street Lighting Electricity Consumption (GWh)



If municipalities had not completed any LED streetlight retrofits (the business-as-usual or “BAU” scenario) municipal street lighting would have been consuming approximately 932 GWh/year in 2016. Instead, due to the estimated 570,000 fixtures retrofitted to date, municipal street lighting is consuming an estimated 658 GWh/year as of 2016 (the “Actual” scenario).

Between 2006 and 2016, municipalities have achieved a 27% reduction in street lighting

consumption, representing $50 million in annual energy spending at 2014 rates. Although municipalities have made significant progress over the last 5 years, there is still an opportunity for further savings. If 100% of estimated municipal streetlight fixtures were converted to LED, consumption would be further reduced to an estimated 333 GWh (the “Target” Scenario).

The following assumptions were used in the analysis:

- Baseline of 903 GWh in 2006 (Power Application Group Inc. 2008)
- 0% of municipal street lights in 2006 are LED
- Baseline fixtures are on average 191 W HPS; similar to the 185W lamps used to evaluate Natural Resources Canada’s Contributions to LED Roadway Initiatives (ICF Marbek 2012)
- New municipal street lights were added each year at a rate of 0.1 lamps/person (ICF Marbek 2012), based on population growth. All new fixtures were assumed to be LED.
- Street lights operate for 4100 hours (ICF Marbek 2012)
- 64% savings factor, based on the average project savings listed by LAS

The number of contracted street light fixtures and the locations of these projects were taken from the LSNetwork (formerly Lightsavers Canada) National LED Streetlight Inventory[7](http://www.lightsavers.ca/map , accessed July 2017), IESO Retrofit Program participation data,LAS’s Streetlight Program participation data, and additional research (e.g., news articles, municipal websites, and municipal Council meeting minutes). Although best efforts were made to capture municipal LED streetlight projects in Ontario, further research is required to develop a more accurate inventory of the number of municipal fixtures that have been retrofitted as well as the total inventory of municipal streetlights in the Province.

City of Hamilton: Solar Street Lighting

In 2015, the City of Hamilton installed 40 solar-powered LED street lights with built in wireless connectivity creating one of the largest municipal smart off-grid lighting installations in Canada (The City of Hamilton, 2017). The location of the project on a rocky hill top is the anchor to the business case. Acquired from Illumient, a division of Clear Blue Technologies, the PV battery-LED system was more cost-effective than using the conventional underground wires that connect each streetlight to the central grid. As an off-grid system, there are zero purchased electricity costs with estimated annual savings of $1,500. The remote access to the system has increased resiliency of the project in the event of excessive consecutive cloud cover by

[7] LSNetwork’s data is provided with the following disclaimer: “We have made best efforts to ensure the accuracy of the information in the Inventory, and have indicated data sources, where possible. However, we are aware that project scopes of LED streetlights and adaptive controls may change and evolve, and that new projects are continually being announced. Therefore, our inventory may not be complete. We are committed to data accuracy and clarity of information. And so, encourage you to contact us if you identify an error or omitted project so that we can correct and/or include it.” (www.lsnetwork.org/map)

managing the energy use profile and leveraging the main functionalities of wireless controls such as multiple dimming functions, motion sensors and hybrid smart controllers to ensure no lighting outages occurred. This project was the recipient of the 2016 Canadian Outdoor Lighting Project of the Year from the Canadian Urban Institute (City of Hamilton via email, 2018). For more information about the project please refer to the Lightsavers July 2017 case study, "Niagara Escarpment Goes Off-Grid with Smart Pathway Lighting" (Lightsavers Canada, 2017).

Exhibit 27 below illustrates the current penetration of LED retrofit projects by geographic region, estimated in two ways. The green bars show the percentage of municipalities in each region that have contracted a streetlight retrofit project. 15% error bars are provided to account for the likelihood of contracted retrofit projects that were not identified in the research, as well as the possibility of additional municipalities that do not have municipal street lighting. The orange bars show the estimated percentage of fixtures that have been retrofitted in each region; this uses a baseline of municipal streetlight consumption in each region provided in PAGI's 2008 Municipal Electricity Profile, and the assumptions listed in the bullets above.

Based on these estimates, approximately 54% of municipalities have conducted retrofit projects and have retrofitted 49% of street light fixtures, to date. Municipalities in Northwestern and Northeastern Ontario have made considerable progress and have surpassed municipalities in other parts of the province, particularly when looking at the percentage of retrofitted fixtures.

Exhibit 27: Percentage of Municipal LED Street Lighting Retrofitted, by Geographic Region

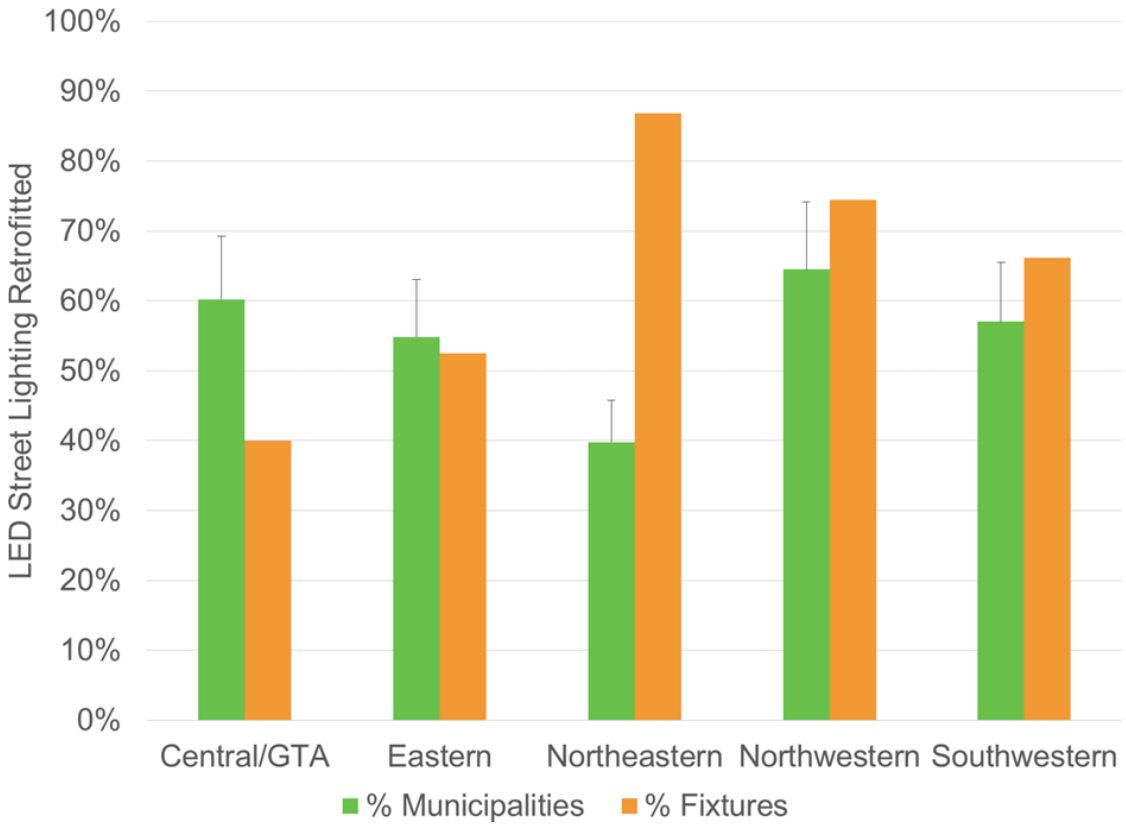
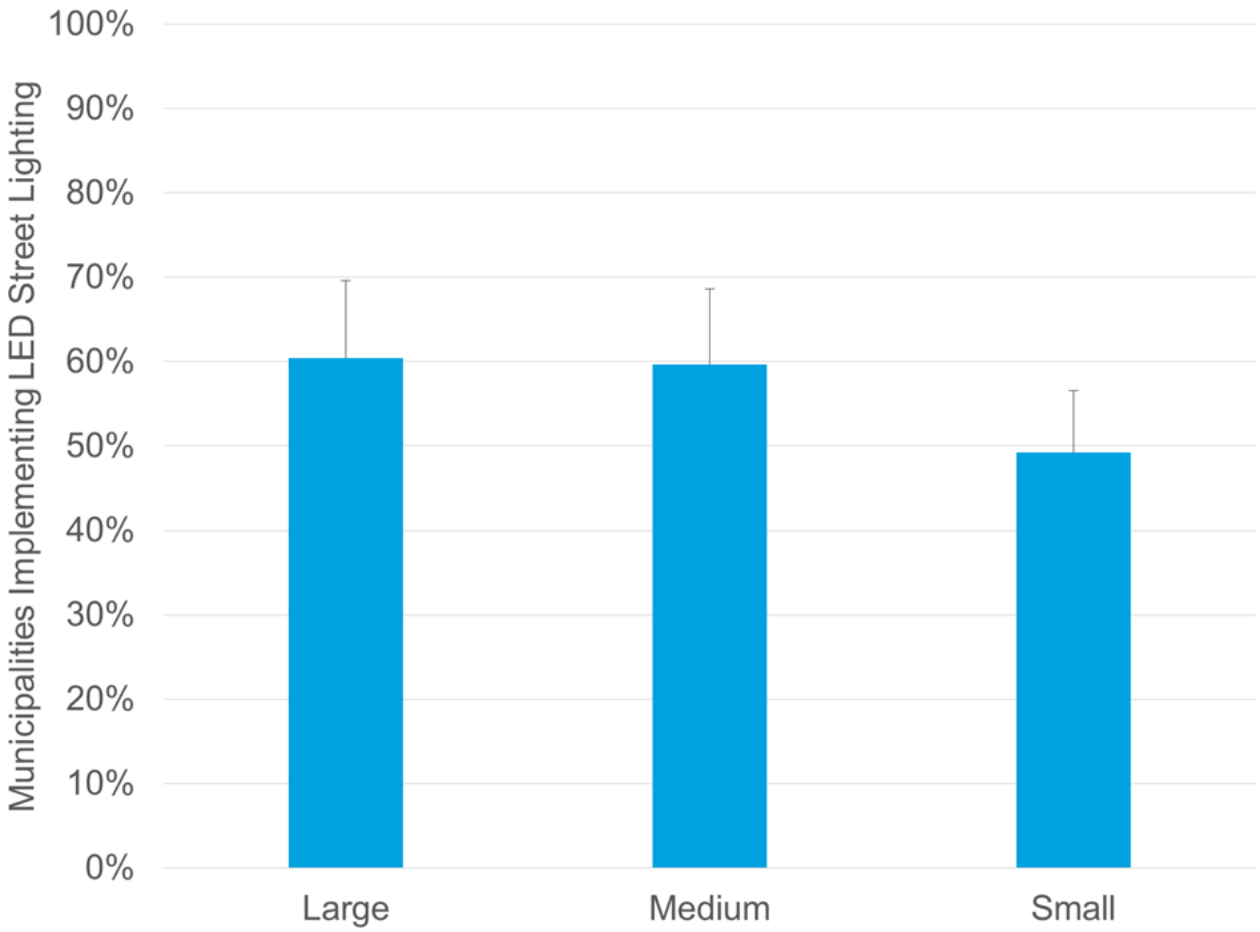


Exhibit 28presents the current level of participation in LED street lighting projects by municipality size. Large and Medium have roughly 60% participation rates in LED street lighting projects, whereas approximately 49% of Small municipalities have retrofitted their street lights.

Exhibit 28: Percentage of Municipalities Implementing LED Street Lighting, by Municipality Size



1.3 Social Housing

Local Housing Corporations are owned and managed by municipal or district Service Managers and operate over half of the social and affordable housing units in Ontario. In 2014, these units consumed an estimated 1,258 GWh of electricity and 156 million m3 of natural gas. This represents 20% of total municipal electricity consumption and 37% of total municipal natural gas consumption in 2014.

The electricity consumption represents a 15% increase from the 2006 estimated consumption of 1,093 GWh. Virtually no new social housing has been built in 20 years (Housing Services Corporation, Social and Affordable Housing Primer, 2018). The rise in electricity consumption can largely be attributed to aging building stock, old and inefficient equipment, as well as greater plug loads.

Utility costs have been identified as the single largest, controllable expense in social housing (Housing Services Corporation, 2018). There are a number of challenges that make implementing energy efficiency in social housing more challenging than in other municipal subsectors, including:

- A large number of smaller buildings which are more difficult and more costly to retrofit than a single, larger facility.
- More decision makers in the process, including social housing corporations which may not report to the municipality.
- Increased barriers to participation such as a lack of understanding about energy efficiency among tenants.
- Disincentives to complete retrofits, such as municipalities recovering incentives or achieving utility bill savings from measures that are funded by social housing corporations.

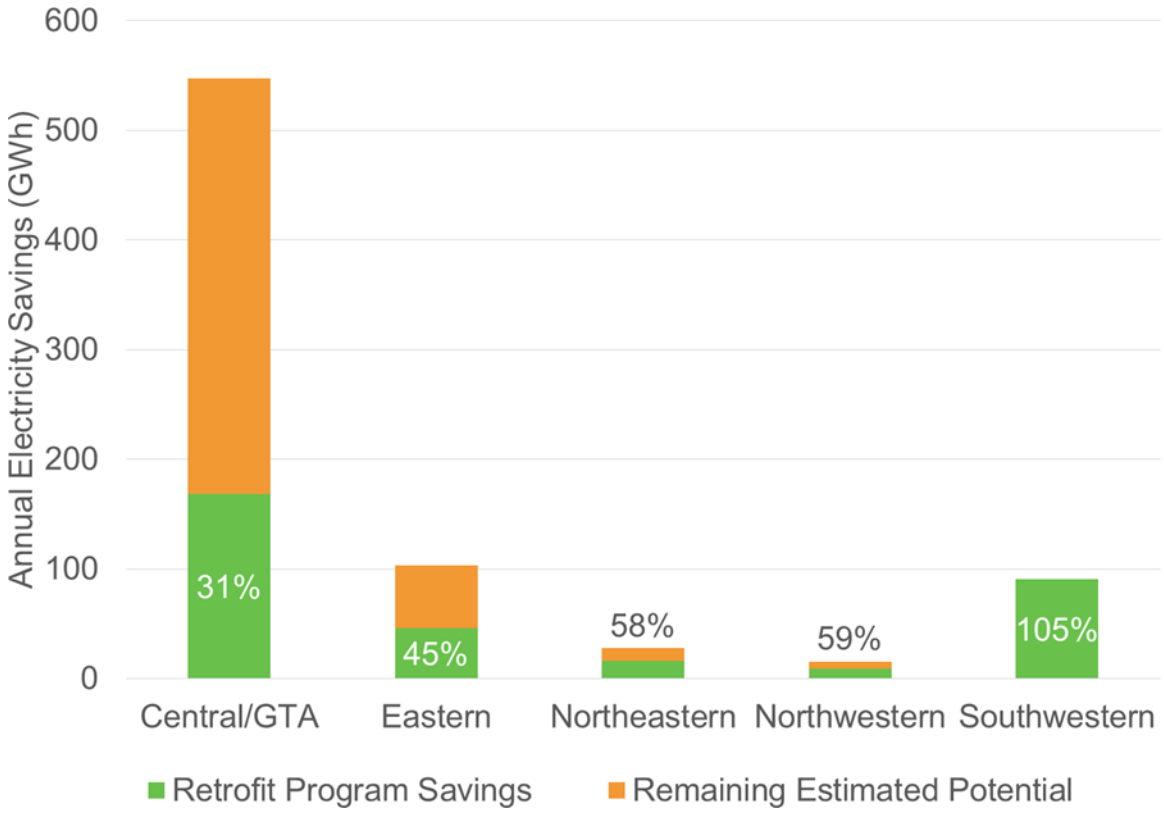
There are a number of programs and resources available to Service Managers, including the following:

- GreenON Social Housing Program
- Housing Services Corporation's Utility Management Program
- Housing Services Corporation's Community Champion Program
- Housing Services Corporation and Infrastructure Ontario's Green Loan Program
- Housing Services Corporation's quarterly Energy Services newsletter "Energy Matters"
- Sustainable Housing Asset Resource Exchange (SHARE)
- IESO Save On Energy Home Assistance Program
- Enbridge Gas Distribution's Affordable Housing Program
- Union Gas' Affordable Housing Conservation Program.

1.4 Comparison with 2006 Baseline

The 2008 Power Application Group Inc. report estimated an energy efficiency potential of 780 GWh based on 2006 consumption data. To date, 42% of this estimated potential (330 GWh of annual savings) has been achieved through the municipal energy efficiency projects completed through the Save On Energy Retrofit Program alone. Exhibit 29 illustrates the annual electricity savings achieved by municipalities through participation in the Retrofit Program, compared to the estimated energy efficiency potential identified in the 2008 Power Application Group Inc. report. According to this data, municipalities in Southwestern Ontario have exceeded the estimated potential savings by 5%, whereas municipalities in Central/GTA have achieved 31% of the estimated potential.

Exhibit 29: Municipal Electricity Savings Achieved through the Retrofit Program vs Estimated Potential, by Geographic Region



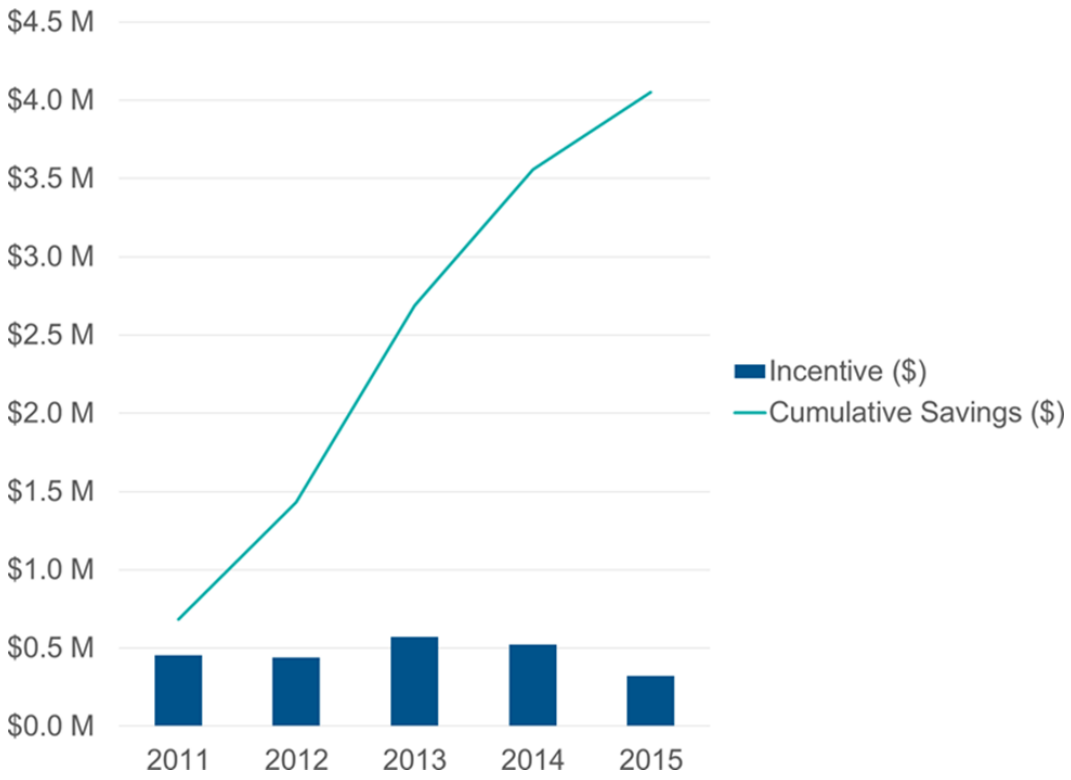
1.5 Natural Gas Energy Efficiency – Incentive Program Participation

Over the last decade, Ontario municipalities and municipal service boards have achieved natural gas savings through a number of energy efficiency projects, either independently, or through various incentive and support programs. Throughout this section, participation in the Union Gas' and Enbridge Gas Distribution's energy management programs is used as the main indicator of volume and type of energy efficiency project that municipalities have undertaken for their facilities. A summary of municipal participation in natural gas programs between 2011 and 2015[8] is provided below:

- Municipalities have completed a total of 1,105 projects
- Municipalities have received approximately $2.3 million in incentives
- Municipalities have achieved annual savings of 16.1 million m^3
- Municipalities have achieved estimated cumulative natural gas cost savings of $4.0 million

The project incentives and the cumulative estimated natural gas cost savings received by municipalities between 2011 and 2015 are illustrated below.

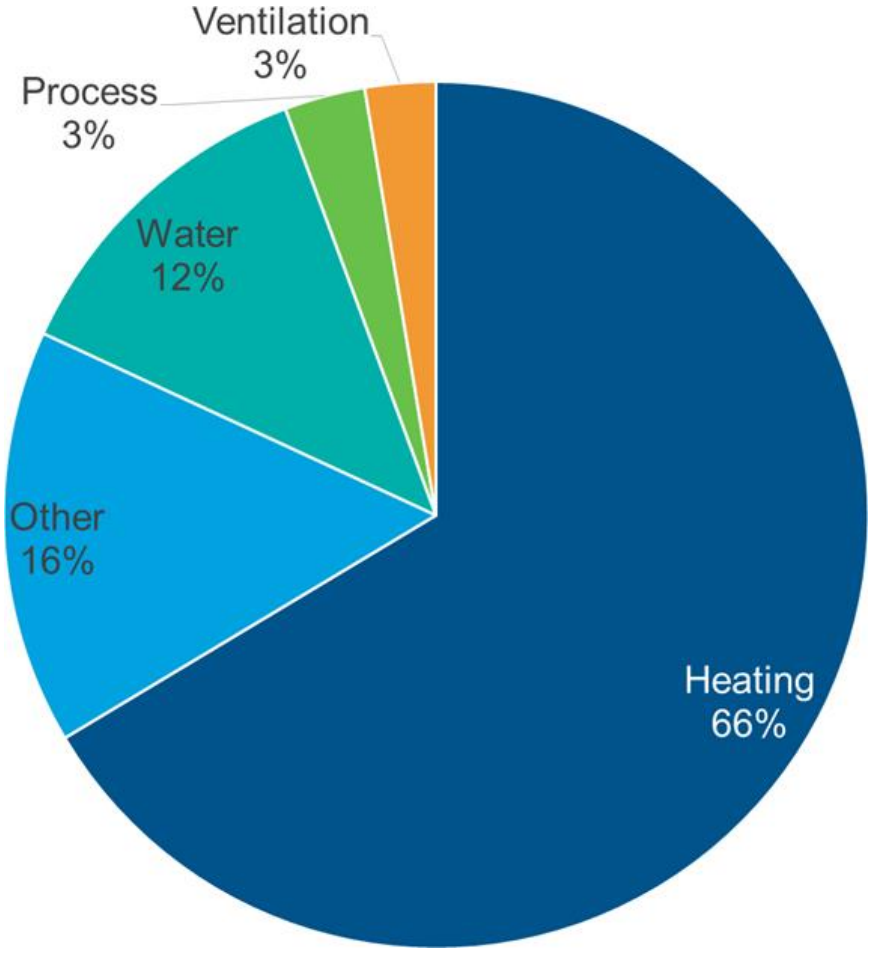
Exhibit 30: Municipal Incentives and Savings through Natural Gas Energy Efficiency Programs



[8] The 2015 data is on a pre-audit basis and savings values are subject to change once the audit is completed and finalized.

The majority of municipal projects completed through natural gas incentive programs have been heating projects, as shown in Exhibit 31 Data on the types of projects completed by municipalities was only available from Enbridge Gas Distribution (a total of 265 completed projects), and therefore does not necessarily represent all municipal projects.

Exhibit 31: Municipal Completed Projects from Enbridge Gas' Programs (2011-2015), by Measure



1.6 Looking Forward

In the 2017 Municipal Energy Profile survey, municipalities were asked if energy conservation project(s) have become easier or more difficult to schedule through the municipality's capital budget over the last 5 years, and if they expect them to be easier or more difficult in the next 5 years. 61% of respondents indicated that energy conservation projects have been easier to schedule over the last 5 years, and 57% expect it to be easier in the future.

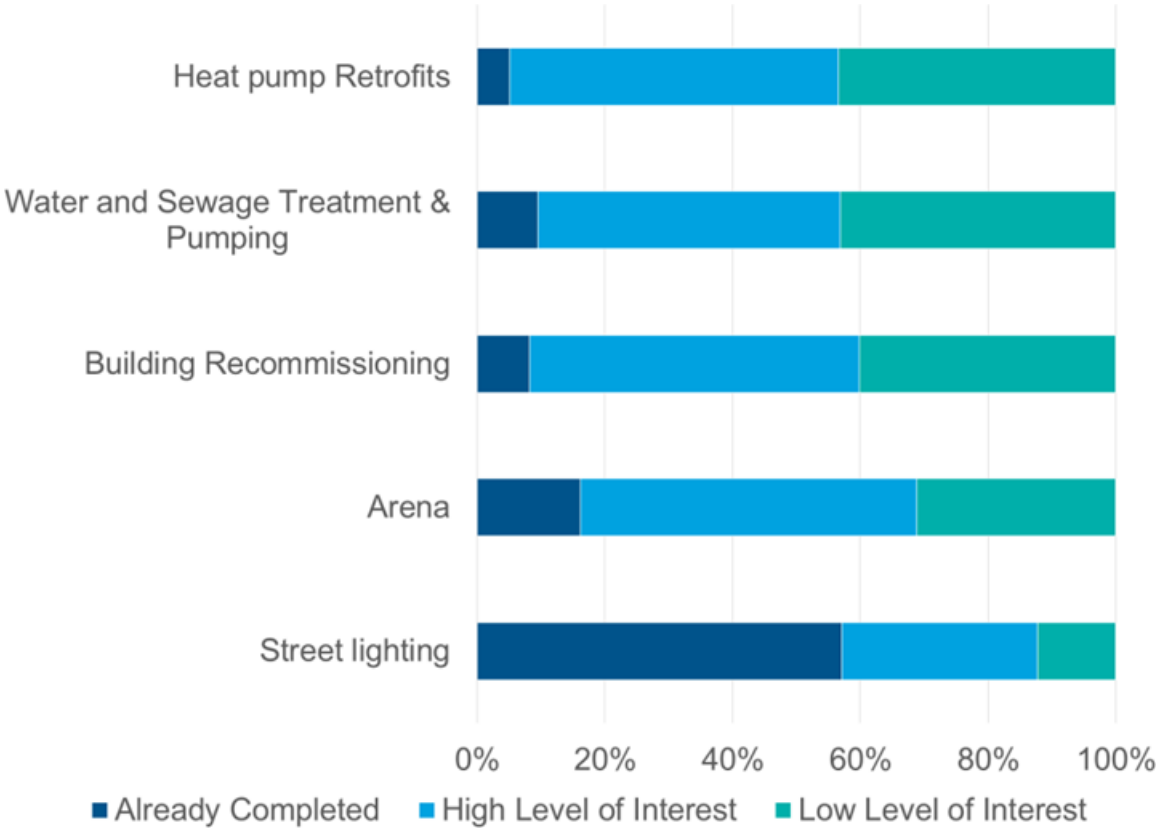
Exhibit 32 illustrates the level of municipal interest in energy efficiency projects. It is important to note that the "Already Completed" responses are based on self-reported municipal data from the 2017 Municipal Energy Profile survey based on a sample size of 104 respondents to this question and does not include extrapolation to all municipalities.

These responses reflect the fact that the majority of energy conservation projects completed to date have been lighting retrofit projects, which tend to be fairly straightforward projects to undertake with quick paybacks. Street lighting retrofit projects in particular have been a key priority for many municipalities.

Moving forward, municipalities should continue to pursue lighting retrofit projects where opportunities remain, while exploring the next generation of energy efficiency retrofit projects which tend to have higher capital costs, longer simple payback periods, and more complicated installation. These include energy efficiency projects in the following categories: building heating ventilation and air conditioning (HVAC), domestic hot water, building envelope, and arena and pool technologies.

Although the list is not comprehensive, municipalities were surveyed on their level of interest for pursuing, or continuing to pursue, energy efficiency retrofit projects over the next five years. Municipal respondents had a generally high level of interest in each of the types of retrofit projects. The majority of respondents have completed or have a high level of interest in street lighting energy efficiency retrofits, followed by arena/ice rink refrigeration plan energy efficiency retrofits.

Exhibit 32: Municipal Interest in Energy Efficiency Projects (n=104)



Approaches to energy savings and generation opportunities need to take a holistic approach to the present and future needs of the municipality, and need to be imbedded into other long term, strategic decision making processes such as capital replacement. Without an overall strategy, capital replacement decisions tend to be made at or near end of life, without adequate time or budget to implement energy efficiency or consider longer term goals. As a consequence, significant energy savings opportunities are often missed. Similarly, energy generation opportunities need to take into account longer term objectives due to the long lifetimes of the measures, and the capital costs involved. To facilitate this decision making, accurate and up to date information on energy consumption is essential. This study has identified that despite the progress made in recent years in energy data tracking and reporting, there are still significant gaps. With so many competing priorities for municipalities, identifying the focus areas for energy conservation can be challenging. Some strategies are listed below:

- **Improve data tracking and use:** Accurate and up to date information on utility consumption and costs is required in order to identify and prioritize opportunities. This needs to be achieved in a variety of ways, including investing in tracking systems such as utility meters and databases, providing increased funding and staff to facility operations, and empowering facility staff to act on identified opportunities. In order to contribute effectively to energy savings, the data cannot simply be tracked, but needs to be acted upon.
- **Take a portfolio approach:** Prioritize facilities that have high energy consumption compared to the rest of the stock, either because they are large or are poor performers compared to their peers. As noted in Exhibit 8 and Exhibit 15, water and wastewater treatment, social housing, and street lighting are the biggest electricity consumers, while social housing, multi-purpose buildings, and arenas are the biggest users of natural gas. Barriers to implementation should also be considered. For example, although social housing is one of the largest energy users, it consists of multiple smaller buildings and often includes additional stakeholders and decision makers.
- **Prioritize new construction and natural capital replacement:** Energy efficiency is much more cost effective when only the incremental cost compared to standard efficiency equipment has to be funded. Incremental costs for many measures are often negligible. Planning for energy efficiency should be undertaken when designing new facilities and planning for major capital replacement.
- **Establish priorities in reduction targets:** Due to the nature of Ontario's electricity generation mix and market factors, electricity has significantly lower GHG emissions compared to natural gas, while natural gas costs about 20% of electricity on a purchased unit energy basis. Therefore, electricity measures should be favored when seeking to maximize utility cost reductions, and natural gas savings measures should be prioritized when the objective is to maximize GHG emission reductions.
- **Focus on significant end uses:** Similar to the portfolio approach, the largest energy end uses should be prioritized. As noted in Exhibit 11, wastewater treatment process loads, street lighting, and water and wastewater pumping are the largest end uses outside of the

building portfolio. Within the building portfolio (multipurpose, municipal buildings, arenas, and housing), lighting, ventilation, and arena process loads such as ice rink cooling are the largest end uses. As noted in Exhibit 17, space heating is by far the largest end use for natural gas, followed by domestic hot water heating and wastewater treatment.

- **Focus on reduction, efficiency, and then generation:** The most cost effective way to save energy is not to consume it in the first place, so measures that reduce waste, such as turning lights off in unoccupied spaces, should be prioritized. These savings can be accomplished through awareness campaigns or the use of technologies such as occupancy sensors. After waste reduction, the use of energy efficient equipment such as LED lighting should be implemented. Without implementing waste reduction strategies first, or in parallel, the benefits of equipment upgrades are not maximized as they may simply be wasting energy more efficiently, such as illuminating unoccupied spaces. Generation is the last option to consider due to high capital costs and complexity of implementation. Holistic retrofits will minimize energy use through waste reduction and energy efficiency prior to the implementation of generation. This allows for smaller generating systems or a larger proportion of facility energy use to be produced than would have occurred without these retrofits.
- **Include non-energy benefits in decision making:** Energy efficiency can have important non-energy benefits such as improved light levels, better indoor air quality, and improved equipment reliability. This can have an impact on diverse area such as occupant comfort, health and safety, and potable water quality. Factoring in non-energy benefits can be crucial to getting buy in from decision makers and stakeholders, as well as making the business case for efficiency more compelling.

Specific measures of particular benefit to municipalities are discussed in more detail below. This list is by no means exhaustive, but includes cost effective savings opportunities for each of the major end uses within the municipal sector, and can be used to inform sustainability planning in conjunction with the guidelines provided above.

1.6.1 Water conservation

With 34% of municipal electricity consumption and 11% of natural gas consumption being used for water and wastewater treatment and pumping, water conservation can have a significant impact on municipal energy use. Despite improvements in household water conservation, Canada remains one of the largest per capita users of fresh water in the world. Per capita consumption in 2011 was estimated at 250 Litres/day[9]. Concurrently, commercial and industrial operators are paying to dump raw or partially treated industrial wastewater directly in the municipal sewers. Reducing water and wastewater means less energy consumed for pumping and treatment. Savings opportunities include:

- **Resident awareness:** Continuing to educate consumers on how to conserve water, what is appropriate to flush into the wastewater system, fixing leaks, using pool covers, maintaining low-water gardens, and practices such as saving rainwater for gardening.
- **Water efficient fixtures:** Installing low flush toilets and urinals, low flow faucet aerators, motion sensor activated fixtures.
- **Diversion and collection:** Installing water collection and oil/water separators in commercial operations such as gas stations and automotive repair shops. Diversion of industrial wastewater to onsite water treatment facilities prior to discharging to the sewer.
- **Non-potable water use:** Installation of infrastructure to capture and distribute non-potable water such as greywater and rainwater for non-drinking applications such as gardening and toilet flushing.

1.6.2 Water treatment

Water treatment is a significant electricity end use at 8% of municipal consumption. Natural gas use for water treatment is 3% of overall municipal consumption. Savings opportunities include:

- Require more detailed tracking and reporting of plant performance. This should include a breakdown of critical metrics such as power use, process efficiency, daily flows, and influent/effluent characterization.
- Incentivize end users to conserve water. This will decrease demand for fresh water, resulting in lower operating capacity and energy draw. Added benefits included improved reliability of treated water for plants operating near maximum capacity.
- Reducing leaks through improved monitoring, which can include new technologies and regular inspection programs.
- Installing additional storage capacity tanks to decrease the variability of the process. Also allows greater control over the flow process which can allow processing to be shifted to off

[9] https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/residential-water-use.html

peak periods.
- Introduction of new, more energy efficient technologies where opportunities exist.
- Improved automation and controls.
- Operator training and awareness of energy efficiency.

1.6.3 Wastewater treatment

Wastewater treatment is the largest single electricity end use at 14% of all municipal electricity consumption. Natural gas use for wastewater treatment is also significant, at 8% of municipal natural gas use. It is the third largest end use after space heating and DHW. Savings opportunities include:

- Require more detailed tracking and reporting of plant performance. This should include a breakdown of critical metrics such as power use, process efficiency, daily flows, and influent/effluent characterization.
- Incentivize end users to conserve water. This will decrease the volume of wastewater delivered to the plant, resulting in lower operating throughput and energy draw. Added benefits include reduced overflow events, where raw sewage is discharged directly to the environment.
- Sludge aeration is a major energy user in wastewater treatment plants, typically accounting for over 50% of electrical energy consumption (Metcalf and Eddy, 2005). Most of the energy use is for blowers or compressors to circulate air, and fans to provide mixing. Typical energy savings opportunities for this area include:
    - Installing high efficiency fan blades (typically manufactured from lighter materials).
    - Right sizing and replacing motors with high efficiency models.
    - Installing high efficiency air compressors and fixing air leaks.
    - Installing VFDs on fan motors and turning down the speed at low flow rates.
    - Installing additional surge capacity tanks to decrease the variability of the process. Also allows greater control over the flow process which can allow operation to be shifted to off peak periods.
- Capture flared gas from anaerobic digestion and use it for energy generation. There are a variety of energy generating opportunities, but one of the most efficient would be combined heat and power (also known as CHP or cogeneration) where the gas is burned in an internal combustion engine or turbine to produce electricity, and the waste heat from the power plant is captured. Electrical and thermal energy can be used on site, transported to another facility, or sold to the grid or a district heating system.
- Pumping energy required within the facility for processing is also a significant energy user. Opportunities for savings include:
    - Right sizing and replacing motors and pumps with high efficiency models.

    - Installing VFDs on pump motors and turning down the speed at low flow rates.
    - Replacing end of life and repurposed equipment not designed for the application. Typical examples include reagent delivery pumps or slurry pumps used for transfer, and transfer pumps used for reagent delivery and slurry pumping.
    - Carrying out preventative maintenance such as replacing seals.

- Site specific process improvements. Proper implementation of these measures require specialized expertise in municipal wastewater treatment strategies, best practices, and codes and standards. Opportunities include process optimization with respect to energy efficiency, improved automation and controls, and new technology such as attached growth media.
- Operator training and awareness of energy efficiency.

1.6.4 Water and wastewater pumping

Collectively, water and wastewater pumping represents 11% of municipal electrical use, the fourth highest end use. Savings opportunities include:

- Right sizing and replacing motors and pumps with high efficiency models.
- Installing VFDs on pump motors and turning down the speed at low flow rates.
- Carrying out preventative maintenance such as replacing seals.

1.6.5 Street lighting

Despite the progress made in recent years with regards to retrofitting metal halide and high pressure sodium street lighting fixtures with LED fixtures, street lighting still represents a significant portion of municipal electricity use at 14%, and significant opportunities for LED retrofits remain. A typical LED retrofit can achieve savings of 60%, and this study suggests that as many of 51% of the municipally owned streetlights in Ontario remain to be retrofitted. ICF estimates that the savings potential of retrofitting the remaining streetlights is between 243 and 287 GWh. Nexant's 2016 Achievable Potential Study identified a potential savings from street lighting of 258 GWh, based on all technically feasible retrofits between 2015 and 2020.(Nexant, 2016)

Municipalities that have not retrofitted their street lights can learn from the experiences of the numerous municipalities that have completed projects. A variety of case studies can be found through the LSNetwork (http://www.lsnetwork.org/casestudies). Municipalities can continue to benefit from participating in the LAS Streetlight Program or apply directly to the IESO Save On Energy Retrofit Program.

Municipalities can also explore adaptive controls, which automatically adjust light output using motion detectors or photocells; and innovative off-grid solutions, such as solar-powered LED street lights.

1.6.6 Space heating and cooling

Space heating represents by far the largest single end use for natural gas at 77% and electric space heating is also significant in social housing, at 8% of total municipal electricity use. Space cooling is not a large energy end use relative to other end uses, but as it occurs on peak, it is disproportionately more expensive than other end uses due to demand charges and time of use rates. Savings opportunities include:

- Improved control systems such as smart thermostats, economizers, and demand controlled ventilation, especially when control strategies such as scheduling, temperature setback, and occupancy based controls are full utilized.
- Envelope upgrades such as air sealing, adding insulation to roofs and walls, and high performance windows. Low cost measures such as air sealing tend to have very quick payback periods, and can be undertaken by existing maintenance staff. Replacing envelope components is significantly more complicated and expensive, and is usually best undertaken in conjunction with other major capital improvements such as roof replacements.
- Replacing heating systems with high performance equipment such as heat pumps and condensing natural gas fired equipment.
- Waste heat recovery from exhaust air.

1.6.7 Ventilation

Ventilation energy for circulating indoor air is a significant electrical energy end use at 12% of municipal electricity consumption. Savings opportunities include:

- Scheduling ventilation fan runtime based on building occupancy schedules.
- Removing inlet vane dampers and installing VFDs on fan motors to control air flow rates.

1.6.8 Lighting

Indoor and exterior building lighting energy use is a significant electrical energy end use at 14% of municipal electricity consumption. Savings opportunities include:

- Installing control systems such as occupancy sensing and daylighting sensing to shut off and dim lighting in unoccupied or over lit areas.
- Replacing light fixtures and lamps with LED models. LEDs can save approximately 30% compared to T8 lighting, 40% compared to metal halide lighting, and 85% compared to incandescent lighting. LED fixtures are also better suited for control systems due to their quick strike time and ease of dimming.

1.6.9 Arena loads

Despite being applicable to a relatively small portion of the municipal building stock, arena specific loads such as ice rink refrigeration and swimming pool heating are still a significant portion of electricity use at 7%, and contribute 2% to natural gas use. Savings opportunities include:

- Optimization of ice rink refrigeration equipment through measures such as slab temperature and thickness optimization, brine pump controls, and using the appropriate hot water flood volume for ice resurfacing.
- Minimizing swimming pool water evaporation through the use of pool covers.
- Waste heat recovery from refrigeration equipment which can typically be used for space heating, domestic hot water preheat, and ice and snow melting. Because heat recovery is most cost effective when the loads are close to the heat source, arena complexes that include ice rinks and swimming pools are a particularly good opportunity as waste heat from ice rink refrigeration can be used for swimming pool water preheating.

SaskPower runs an audit program for municipal ice rinks in Saskatchewan which includes sharing best practices for operating efficient ice rinks (SaskPower)

1.6.10 Domestic hot water

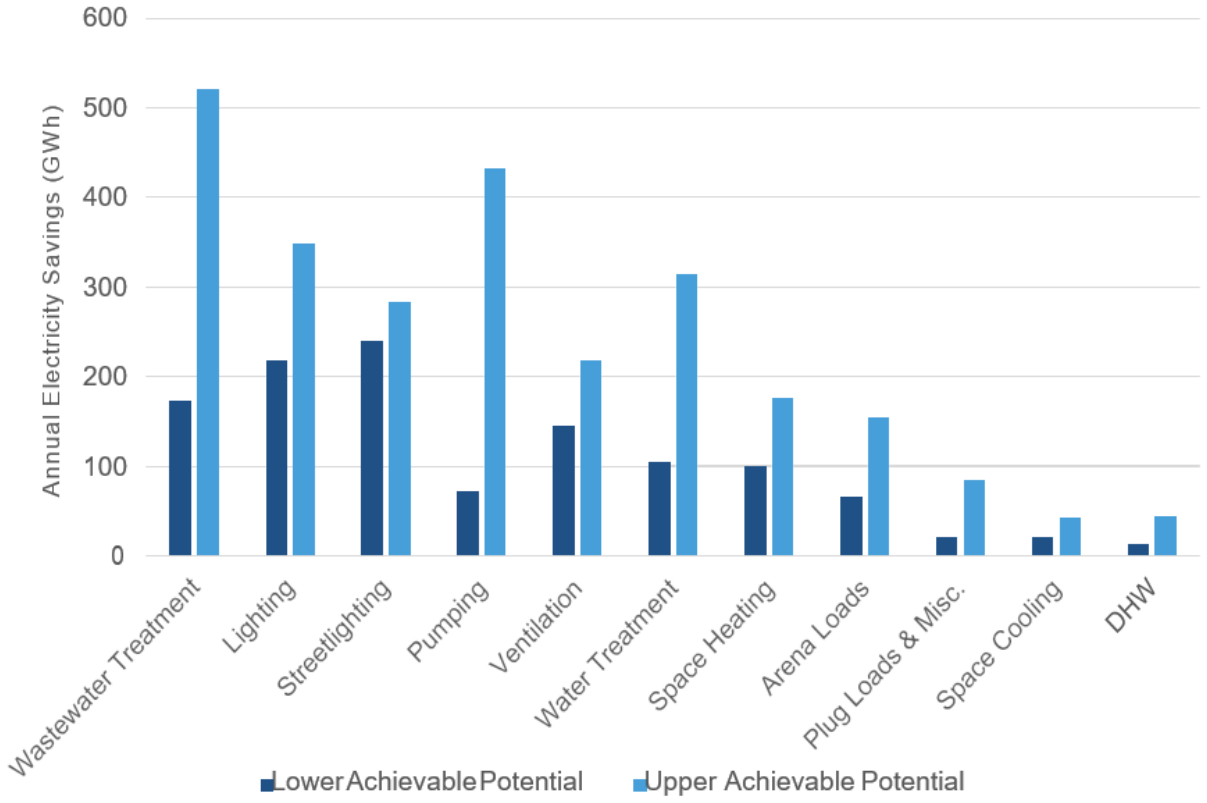
DHW is a relatively large end use for natural gas, at 10%. Penetration of electric DHW heating systems is low among municipal buildings, except for social housing buildings, which are less likely to have a natural gas supply than other building types. Electric DHW heating is estimated to be 2% of municipal electricity use. Savings opportunities include:

- Water conservation through the use of low flow aerators, showerheads, and spray nozzles.
- Installing DHW recirculation system controls such as temperature control, demand control, and temperature modulation control.
- Replacing DHW heating systems with high performance models such as tankless and condensing units.

1.7 Electricity Savings Potential

ICF estimated the electricity savings potential for each of the end uses presented in Exhibit 33, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 1,176 and 2,620 GWh per year, representing a reduction of between 19% and 42% compared to 2014 consumption. The results are presented in Exhibit 33 below.

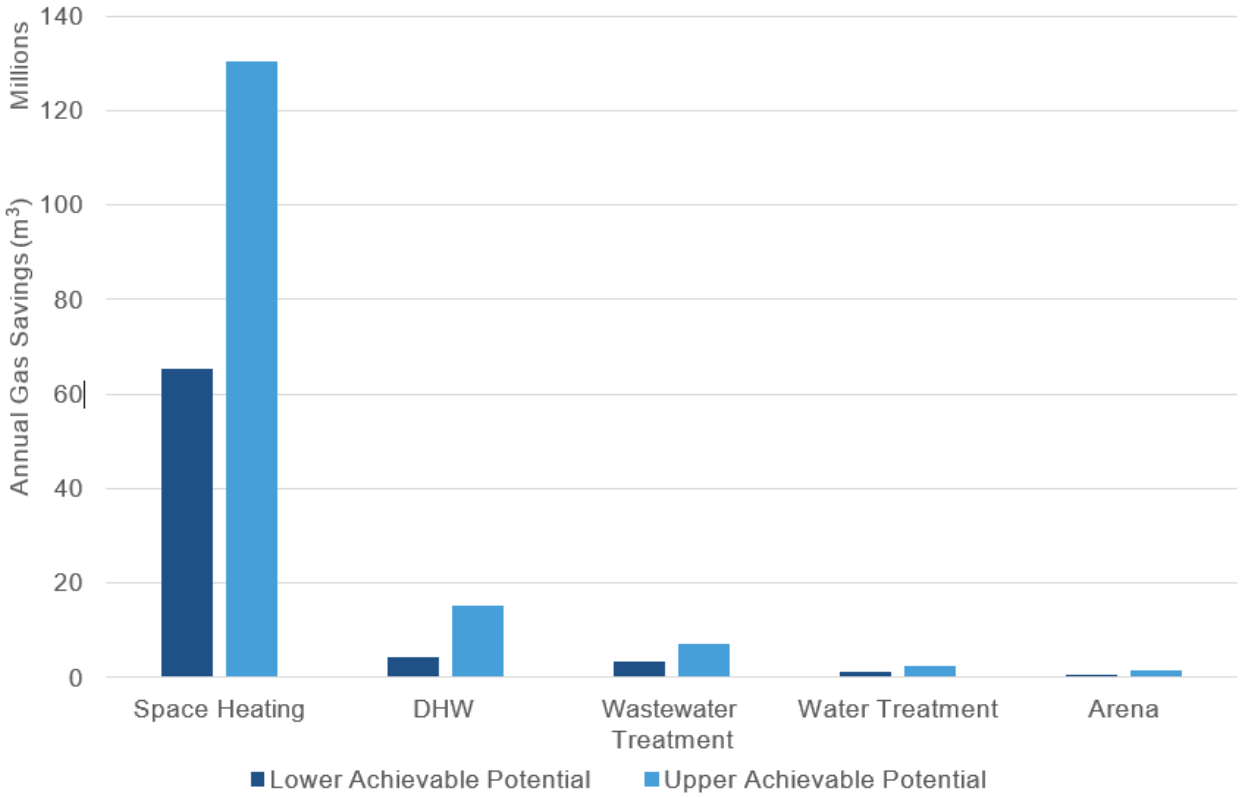
Exhibit 33: Electricity Savings Potential



1.8 Natural Gas Savings Potential

ICF estimated the natural gas savings potential for each of the end uses presented in Exhibit 34, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 75.1 million m3 and 156.7 million m3 per year, representing a reduction of between 18% and 37% compared to 2014 consumption. The results are presented in Exhibit 34below.

Exhibit 34: Natural gas Savings Potential



2. Demand Response

The 2008 Ontario municipal electricity profile report identified a potential for municipalities to save over 221 GWh through demand response (Power Application Group Inc. 2008). Demand response, where power demand is reduced during peak periods, can be accomplished through the management of equipment and processes, shifting operations to non-peak hours, or using off-grid energy sources (on-site generation or battery technology).

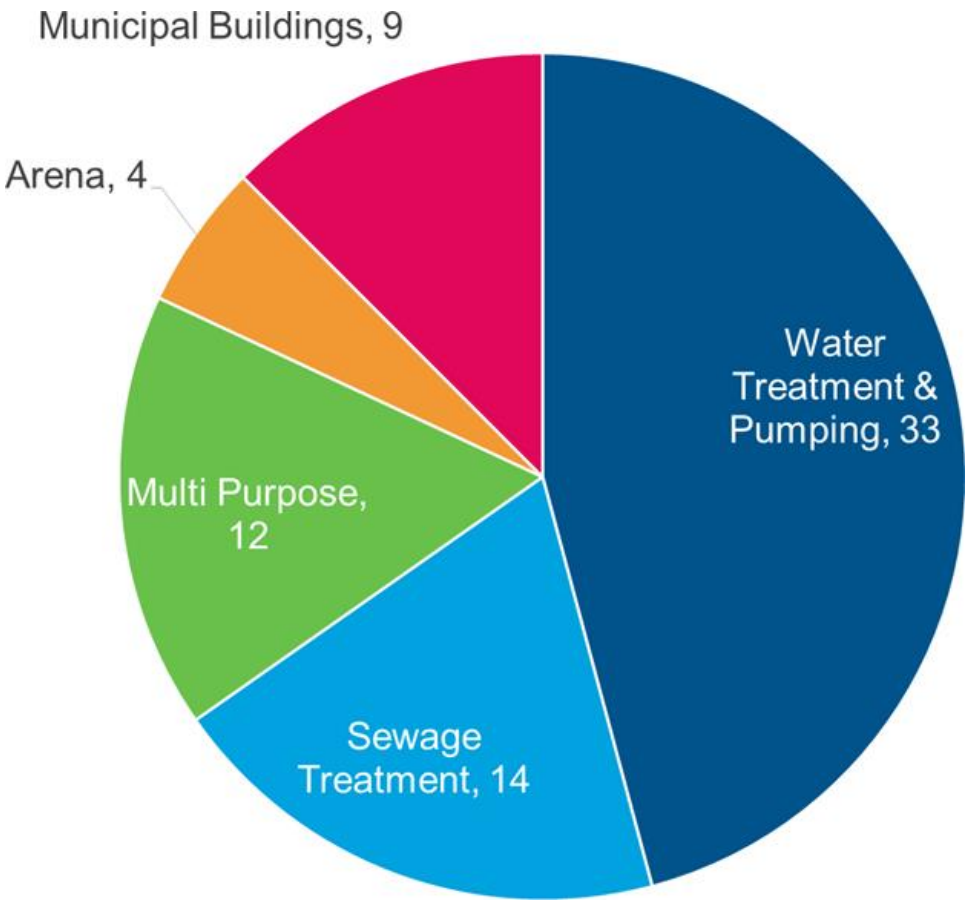
2.1 ICI and DR Participation

The IESO offers two initiatives where municipalities can reduce their electricity costs by shifting/curbing demand during peak periods: the Industrial Conservation Initiative (ICI) and the Demand Response (DR) Auction. ICI allows participants to save on their Global Adjustment costs if they are able to reduce their demand during the top 5 hours of peak demand in the year. The DR Auction is a competitive process through which resources are selected to be available to reduce their electricity demand, as needed during certain peak periods of the year.

Effective January 1, 2017, the ICI was expanded by the Government of Ontario to include all electricity consumers with an average monthly peak demand over 1 MW. To date, a total of 72 municipal facilities are participating in ICI (from 22 municipalities and 1 municipal service board). The majority of these municipalities are from Central/GTA (12, compared to 1 Eastern, 1 Northeastern, and 9 Southwestern municipalities). The majority of these municipalities are Large (18, compared to 4 Medium municipalities and 0 Small municipalities).

Exhibit 35 illustrates the types of municipal facilities that are participating in ICI. Sewage treatment and water treatment facilities make up 67% of municipal facilities participating in ICI. The majority of municipal water and sewage treatment facilities that would likely be eligible for ICI are already current participants. This is based on a preliminary analysis of the electricity consumption from municipal sewage and water treatment facilities, as self-reported to the Ministry of Energy under O.Reg. 397/11, and an estimate of 8,760 annual operating hours, to determine if the facilities meet the 1 MW demand threshold.

Exhibit 35: ICI Participating Municipal Facilities by Category



A small portion of Ontario municipalities have participated in the IESO's Demand Response (DR) Auctions, either directly or through an aggregator. Of the 102 municipalities that provided a response to the DR Auction questions in the 2017 Municipal Energy Profile survey, only 10 indicated that they have participated in an IESO DR Auction – 7 of which won and are currently active DR participants. 6 of these municipalities are Large (populations greater than 100,000).

Out of the 10 participating municipalities in an IESO DR Auction, half of them also participated in the Industrial Conservation Initiative.

2.2 Looking Forward

In the 2017 Municipal Energy Profile survey, municipalities were asked if peak electricity curtailment project(s) have become easier or more difficult to schedule through the municipality's capital budget over the last 5 years, and if they expect them to be easier or more difficult in the next 5 years. Out of 118 responses, only 18% of respondents indicated that peak electricity curtailment projects have been easier to schedule over the last 5 years, but 32% expect it to be easier in the future. It is important to note that over half of the respondents answered "not applicable" or "unknown", which implies that greater awareness of demand

response, and investigation into DR opportunities may be of value.

For municipalities that are currently not pursuing electricity cost savings through demand response (i.e. peak electricity curtailment), the first step would be to examine the peak demand data for their facilities and identify the greatest opportunities for savings. Municipalities should then identify and pursue demand management and opportunities for load shifting. Where applicable, they can investigate participation in the IESO's DR program offerings:

- Submit an application to the Demand Response Auction, the opportunity for which occurs annually starting on the first Wednesday of December
- For municipal facilities with an average monthly peak demand over 1 MW, consider participating in the Industrial Conservation Initiative

2.3 Account and Metering Characteristics

One of the key objectives of the 2008 Ontario municipal electricity profile study was to educate municipalities about moving from the Regulated Price Plan (RPP) to the hourly price. At the time the study was completed, municipalities had over 26,000 electricity accounts/meters; of which 820 were interval meters, accounting for 56% of the total consumption (Power Application Group Inc. 2008). On August 4, 2010 the Ontario Energy Board issued a determination that set mandatory dates by which local electricity distribution companies must implement time-of-use (TOU) billing. According to the Ontario Energy Board's Smart Meter Deployment and TOU Pricing Monitoring Report, 99% of RPP eligible consumers had smart meters installed and 91% were on TOU pricing as of August 31, 2012. Distributors were not required to file monthly reports to the Ontario Energy Board, once they achieved TOU implementation for 98% of their RPP eligible customers, so it is difficult to access current data. However, it his highly likely that the vast majority of municipal electricity accounts are currently on TOU pricing.

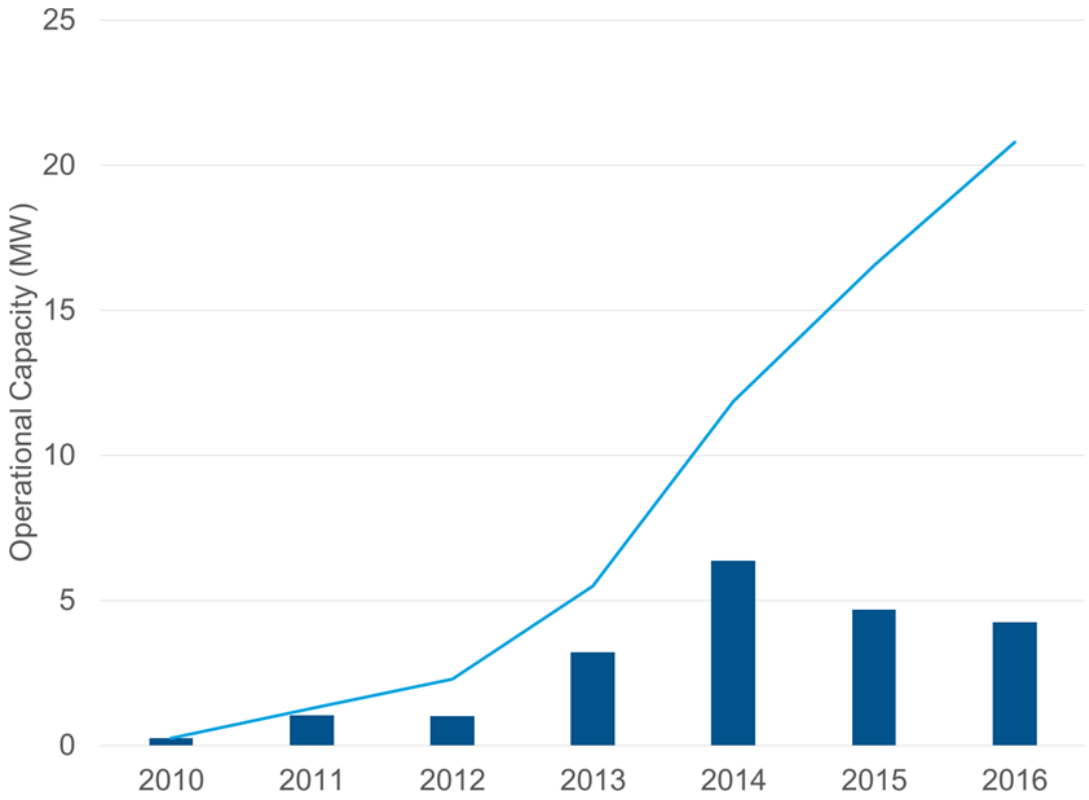
3. Energy Generation

Over the last decade, Ontario municipalities have become engaged in decentralized and renewable energy generation projects. This remains an area of untapped potential. Certain cities have emerged as leaders in this area and programs through the IESO have attracted participation from additional municipalities. New renewable energy installations and retrofitting existing infrastructure (such as municipal wastewater facilities) have been shown to be particularly beneficial.

3.1 Energy Procurement Programs and Contracts Participation

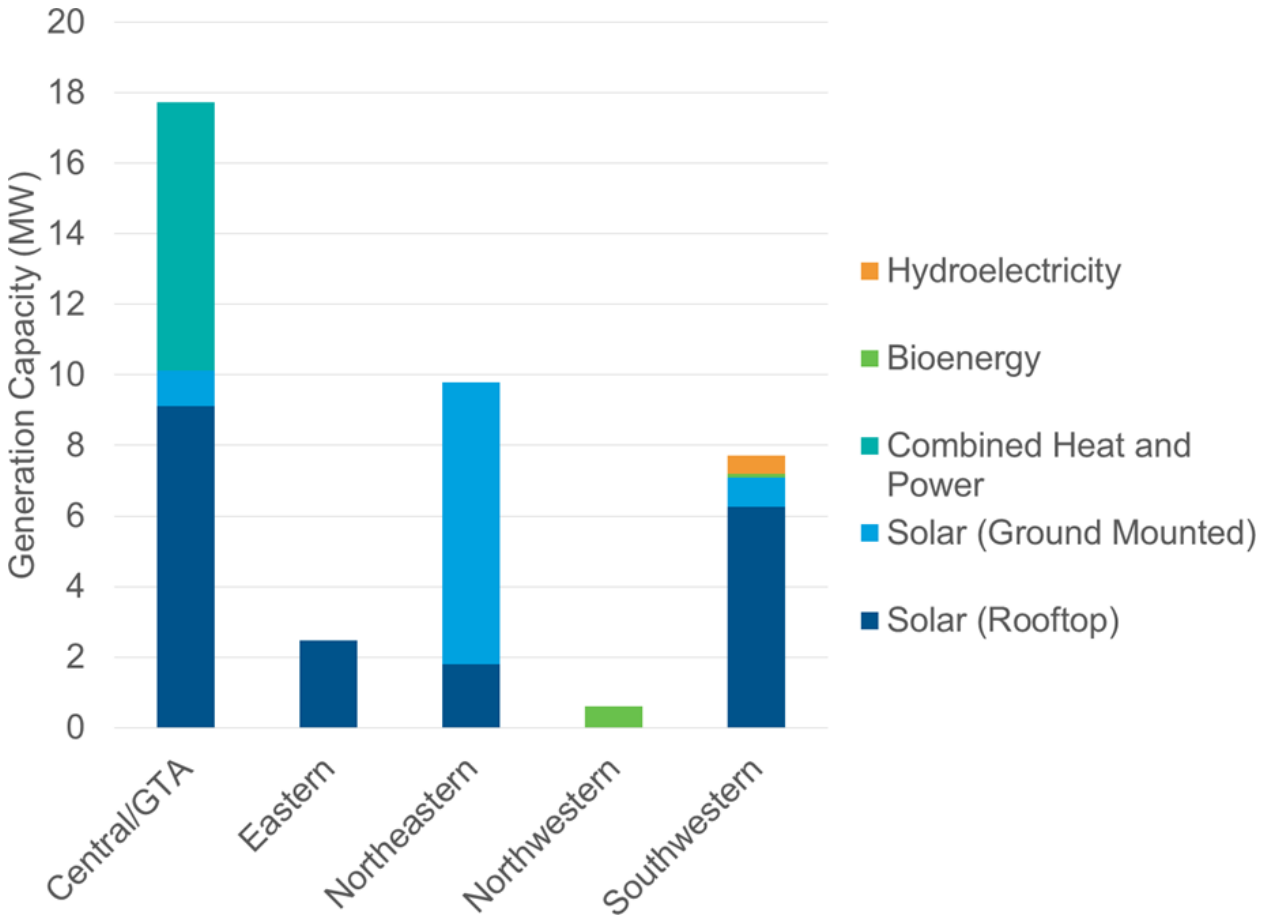
The following information is based on municipal participation in the IESO's Energy Procurement Programs and Contracts, including the Feed-in Tariff Program, Renewable Energy Standard Offer Program, Combined Heat and Power Standard Offer Program, and Combined Heat and Power. Municipalities have 21.6 MW of generation capacity that is currently operational, and another 16.6 MW that is contracted (but not yet operational). As shown in Exhibit 36, since 2013 municipalities have installed an average of 4.6 MW per year. This is a conservative estimate, as it does not include any generation capacity from municipalities that have leased their roofing space to third parties who hold the contracts.

Exhibit 36: Municipal Generation Capacity (MW) of Projects Completed each Year, and Cumulative Generation



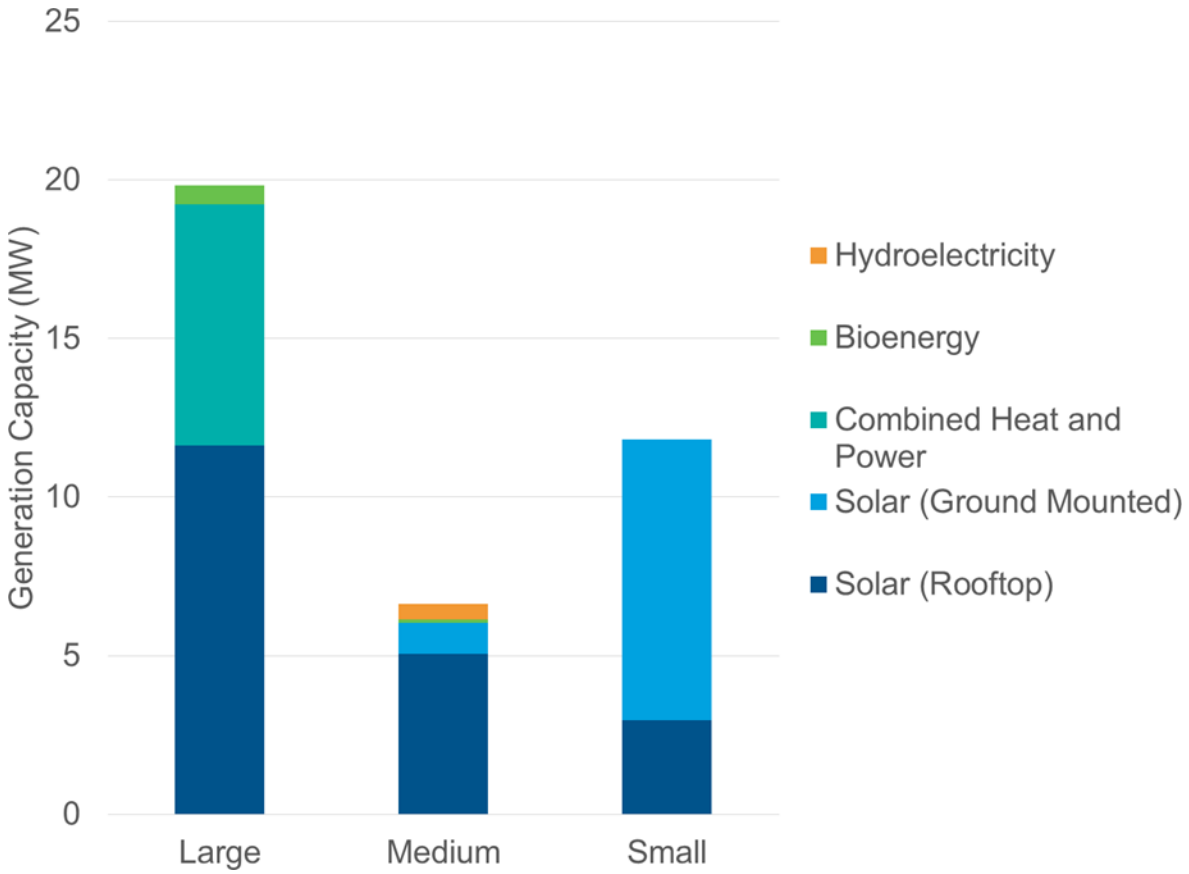
A majority of these projects are solar (predominantly rooftop), followed by combined heat and power (aka cogeneration). Exhibit 37 shows the generation capacity (MW) by technology type and by geographic region. This represents projects from 43 different municipalities. The Central/GTA region has the highest generation capacity, and the highest percentage of municipal participation in generation projects. The Northwestern region has the lowest generation capacity and the lowest percentage of municipal participation in generation projects. Again, this is based on participation in the IESO's Energy Procurement Programs and Contracts. It is not a complete reflection of municipal interest or desire to complete power generation projects, as additional municipalities have applied to the IESO's Energy Procurement Programs but have not won contracts.

Exhibit 37: Municipal Generation Capacity (MW) by Technology and Geographic Region



The following, Exhibit 38, shows the generation capacity (MW) by technology type and by municipal size. Municipalities with populations under 10,000 are considered Small, between 10,000 and 100,000 are considered Medium, and over 100,000 are considered Large. Again, this is based on participation in the IESO's Energy Procurement Programs and Contracts.

Exhibit 38: Municipal Generation Capacity (MW) by Technology and Municipality Size



Additional data about the number of municipalities participating in generation projects was gathered through the 2017 Municipal Energy Profile survey. Municipalities were asked if they have implemented renewable energy projects outside of the IESO's Energy Procurement Programs. Generation capacity data was not collected. 15 municipalities responded that they have implemented renewable energy projects in the past 10 years that were not submitted and did not participated in the IESO's FIT and microFIT programs; when combined with the 11 municipalities which have completed grounded solar projects through IESO Programs, a total of at least 26 municipalities are implementing projects. 17 municipalities responded that they are leasing their roof to a third party that participated in FIT/microFIT. When combined with the 33 municipal rooftop FIT projects, there are a total of at least 49 municipalities participating in rooftop projects. 6 municipalities responded that they have implemented behind-the-meter or on-site electricity generation projects in the past 10 years that were NOT submitted to the IESO's Combined Heat and Power Standing Offer Program.

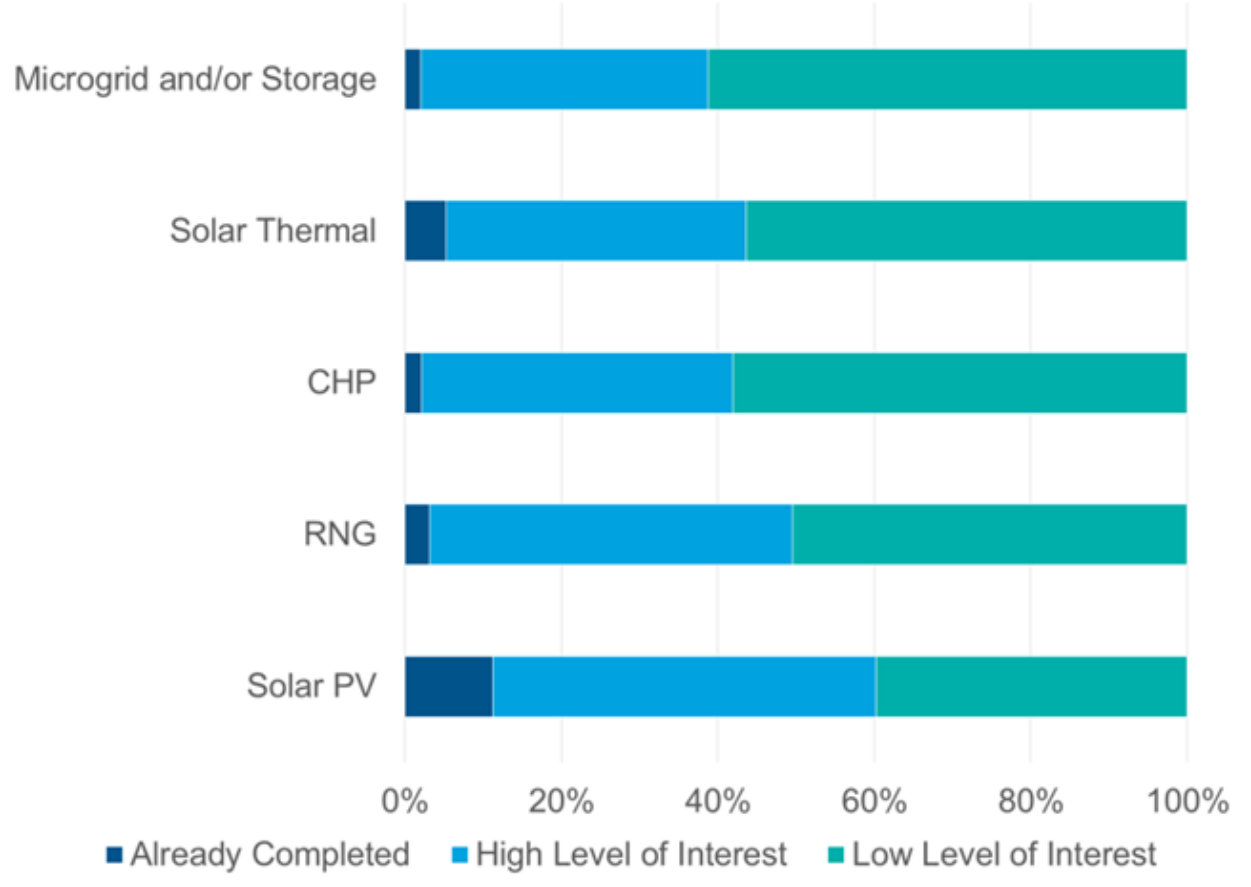
3.2 Looking Forward

In the 2017 Municipal Energy Profile survey, municipalities were asked if on-site electricity generation project(s) have become easier or more difficult to schedule through the municipality's capital budget over the last 5 years, and if they expect them to be easier or more difficult in the next 5 years. Only 20% of respondents indicated that on-site electricity generation projects have been easier to schedule over the last 5 years, and 27% expect it to be easier in the future. It is important to note that over 60% of the respondents answered "not applicable" or "unknown", which implies that on-site generation may not have been explored by the majority of municipal respondents.

Municipal survey respondents were also asked to comment on whether renewable energy project(s) have become easier or more difficult to schedule through the municipality's capital budget over the last 5 years, and if they expect them to be easier or more difficult in the next 5 years. The results are very similar to the responses provided regarding on-site electricity generation: 24% agreed that it has been easier to schedule through the municipality's capital budget in the last 5 years, and 26% expect it to be easier in the next 5 years. In both cases, at least 50% of the 120 respondents indicated not applicable or unknown. Renewable energy and on-site generation projects are associated with high levels of risk due to the large financial commitment that is required to implement such projects. Support from the provincial government would make it easier for a municipality to invest in these initiatives and to create a viable business case for the future (City of Sault Ste. Marie, 2017).

When asked to rate their level of interest in pursuing, or continuing to pursue, various renewable energy projects over the next 5 years, municipal survey respondents were predominantly interested in solar photovoltaics (PV), followed by renewable natural gas, and combined heat and power. This is illustrated in Exhibit 39. Municipalities were also surveyed about their level of interest in biomass heating, district heating, and wind energy; however, in each case their level of interest was lower than 30% so they were not included in the chart.

Exhibit 39: Municipal Interest in Renewable Energy Projects



3.3 Wastewater Generation Potential

Wastewater treatment plants represent a significant opportunity for energy generation. Modern plants are capable of using 85% less energy than the existing portfolio (Metcalf and Eddy, 2005), and have been designed to be net zero or energy surplus facilities (see City of Guelph case study below). The energy generating potential of the existing wastewater treatment is difficult to quantify with the current data available, partly because it is self-reported and the data quality is uncertain. However, extrapolating from available data, Ontario municipalities may have the potential to generate 124 GWh of electricity from sewage sludge if existing plants can match the levels of several European countries[10].

[10] 0.12 kWh generated per m3 of wastewater processed, Water Energy Nexus, International Energy Agency, p.43

City of Guelph: Designing a Net Zero or Surplus Energy Wastewater Treatment Facility

The City of Guelph has submitted a proposal for the Provincial Municipal Climate Change Challenge Fund to move toward a net zero or surplus energy scenario for their wastewater treatment facility. Of all the City's municipally owned assets, the wastewater treatment facility is the largest energy consumer. The facility has four plants and accounts for around 15% of the municipality's energy bill (City of Guelph, 2017). The City seeks to achieve a net zero energy consumption in its operations in two ways including improving energy efficiency and maximizing resource recovery by generating additional energy from treated waste. To improve the energy efficiency of operating the wastewater facility, the City would like to install variable frequency drives on aeration blowers to modulate the air input for optimal dissolved oxygen concentration. To generate energy onsite, the City of Guelph would like to harness the chemical energy stored in treated waste by enhancing the performance of the anaerobic digesters that currently generate renewable natural gas (RNG) including the addition of gas storage to reduce the need for flaring. Additionally, the city is considering to deploy on-site solar panels and battery storage to eliminate the treatment plant's use of energy during peak demand (City of Guelph, 2017). This is a great example of a municipality levering energy management practices and different forms of energy generation to reach a net zero energy scenario that will significantly reduce the City's cost for energy on their largest energy consuming asset.

City of London: Organics Waste Management – A Prefeasibility Study on Production of Renewable Natural Gas

The City of London conducted a pre-feasibility study on the use of green bin material to create biogas and renewable natural gas (RNG). The objective of the study was to identify the cost per tonne for managing the city's organics waste. Currently, the City of London is one of the few municipalities that does not have a green bin program. The two options explored for managing organics waste included composting (Business As Usual) vs. use of anaerobic digesters to create biogas which can then be upgraded to RNG. Among many other uses, the RNG generated onsite could be used to fuel waste collection trucks. The prefeasibility study findings provided the city with a price point for when the cost per tonne of producing RNG can become advantageous over composting, which depends on the size of the project and the volume of the fuel. The City is currently waiting on the province's projection on renewable natural gas production as well as decision on funding availability to RNG projects as part of the Ontario's Climate Change Action Plan. If RNG ends up with a value which is higher than pipeline gas, it would make more economic sense to generate RNG from the City's organics waste (City of London, 2017).

4. Beneficial Electrification

Ontario has set climate change mitigation goals of reducing greenhouse gas emissions to 15% below 1990 levels by 2020, 37% by 2030 and 80% by 2050. Municipalities will be crucial to achieving those objectives, and many have already set their own targets consistent with those of the Province. Ontario's relatively low intensity grid due to its low-carbon fuel mix creates both challenges and opportunities to GHG reductions. Low GHG emissions factors mean that electricity energy efficiency and generating measures do not have as significant an impact as they do in many other jurisdictions. The opportunities lie in the fact that switching more GHG intensive energy sources such as natural gas and automotive fuels to electricity can have a significant impact. This is known as beneficial electrification. In addition to GHG reductions, electrification often results in a reduction in local air pollution, for example by reducing tail pipe emissions from vehicles. Considering the municipal energy use profile, the largest opportunities for beneficial electrification are in vehicle electrification and space heating.

4.1 Vehicle Electrification

According to the Ontario Ministry of Energy, accelerating the shift to low- and zero-emissions vehicles will be critical to achieve the Province's climate change goal of reducing greenhouse gas emissions to 15% below 1990 levels by 2020, 37% by 2030 and 80% by 2050 (http://www.mto.gov.on.ca/english/vehicles/electric/index.shtml). Many municipalities are demonstrating leadership by introducing electric and hybrid vehicles to their fleet and installing charging stations.

Ontario municipalities were asked a series of questions regarding their level of adoption of electric vehicles and infrastructure. Out of 102 survey respondents, 25 municipalities answered "yes" to the question, "Does your municipality currently own road or non-road electric vehicles, hybrid vehicles or electric vehicle infrastructure?" Responses are illustrated in Exhibit 40 and Exhibit 41 by geographic region and municipal size, respectively. The survey responses indicate that large municipalities, and municipalities in Central Ontario/GTA have the highest level of adoption of electric/hybrid vehicles and charging stations, compared to other municipalities.

Exhibit 40: Number of Surveyed Municipalities with EV/HybridV/EV Infrastructure, by Geographic

Region

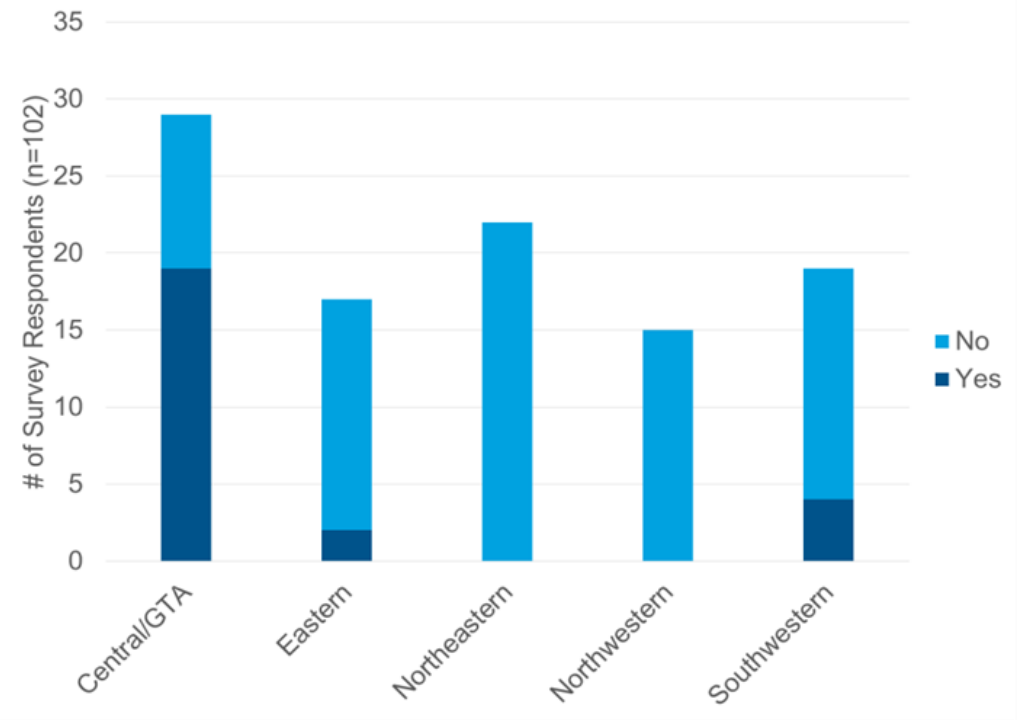
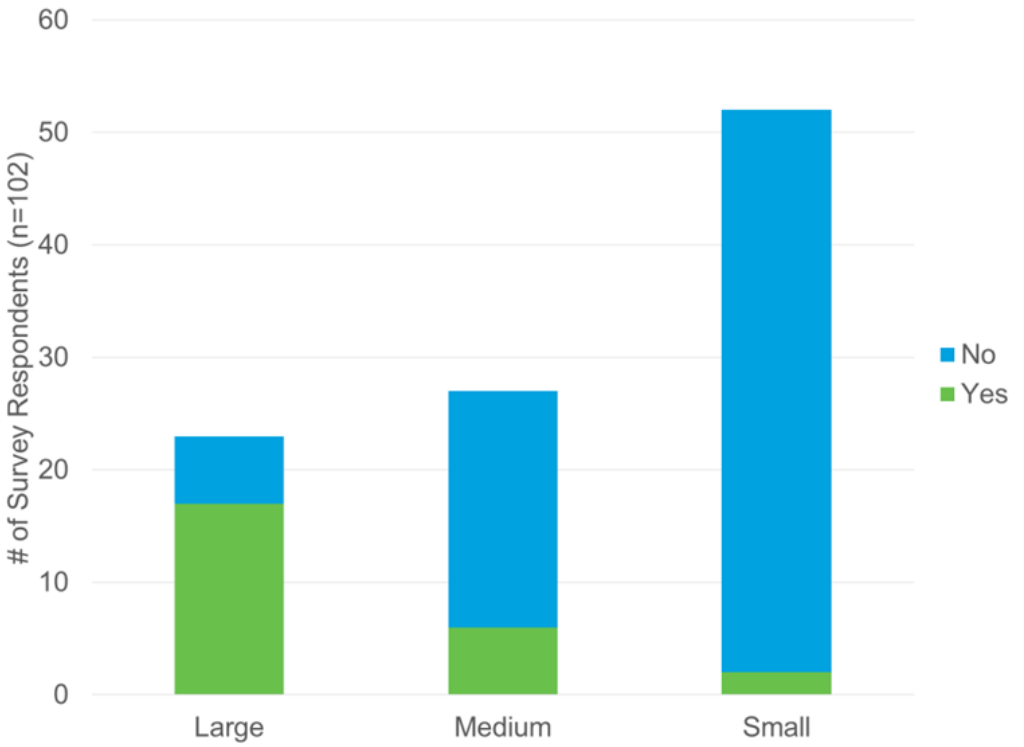


Exhibit 41: Number of Surveyed Municipalities with EV/HybridV/EV Infrastructure, by Municipality Size



Of the 25 municipalities that indicated in the 2017 Municipal Energy Profile survey that they currently own electric/hybrid vehicles or electric vehicle infrastructure, the highest level of adoption has been in road hybrid cars (see Exhibit 42).

Exhibit 42: Number of EV/HybridV/EV Infrastructure

	Non-road battery electric vehicles	Road battery electric vehicles	Road hybrid cars	Plug-in hybrid cars	Hybrid city buses	Battery electric city buses
Number of vehicles/charging stations	16	6	111	17	0	10
Number of municipalities	5	4	12	6	0	1

Fleet Fuel Transitioning - A Feasibility Study

Inspired by the new cap-and-trade program in Ontario, the City of Guelph performed a quantitative analysis of greenhouse gas emissions from various sources in its municipal operations. Findings from the analysis revealed that a significant portion of the City's emissions come from fuel usage and natural gas.

In response, the City initiated a Fleet Fuel Transitioning Feasibility Study, which will examine the City's fleet vehicles and determine the percentage that could technically be replaced with electric vehicles and where car sharing would be a more financially attractive option. Given the variation in the City's fleet vehicles, an adequate market characterization study will be necessary. Additionally, EV maintenance was identified as a key concern by the City's facility team. The City's staff involved in the feasibility study believe that further education and training could address the knowledge gap on EV operation and maintenance (City of Guelph, 2017).

Municipal survey respondents currently have 110 municipally-owned charging stations, and there are plans for additional charging stations. The Electric Vehicle Chargers Ontario (EVCO) grant program launched in December 2015, and the following municipalities' applications were selected to receive EVCO funding for 27 municipal charging stations (see Exhibit 43). Level 2 charging stations use a 240 volt system, and Level 3 charging stations (also known as Direct Current Fast Chargers) use a 480 volt system[11].

[11] http://www.mto.gov.on.ca/english/vehicles/electric/charging-electric-vehicle.shtml , accessed

All of the chargers are in service, as of November 2017, except the Simcoe County's chargers which are "coming soon"[12]

Exhibit 43: Municipal EVCO Grant Program Recipients

Municipality	EVCO Funding	Number of Chargers	
City of Kawartha Lakes	$58,700	Level 2: 0	Level 3: 1
City of Vaughn	$17,000	Level 2: 2	Level 3: 0
Corporation of the County of Prince Edward	$75,000	Level 2: 0	Level 3: 1
Corporation of the County of Simcoe	$267,350	Level 2: 0	Level 3: 3
Corporation of the County of Wellington	$215,076	Level 2: 0	Level 3: 3
Oxford County	$350,760	Level 2: 4	Level 3: 2
Corporaton of the City of Brampton	$90,000	Level 2: 4	Level 3: 0
Town of Amherstburg	$65,592	Level 2: 0	Level 3: 1
Town of Caledon	$230,920	Level 2: 0	Level 3: 2
Town of Essex	$252,820	Level 2: 0	Level 3: 2
Township of Russell	$9,429	Level 2: 2	Level 3: 0
TOTAL	**$1,633,147**	**Level 2: 12**	**Level 3: 15**

September 2017

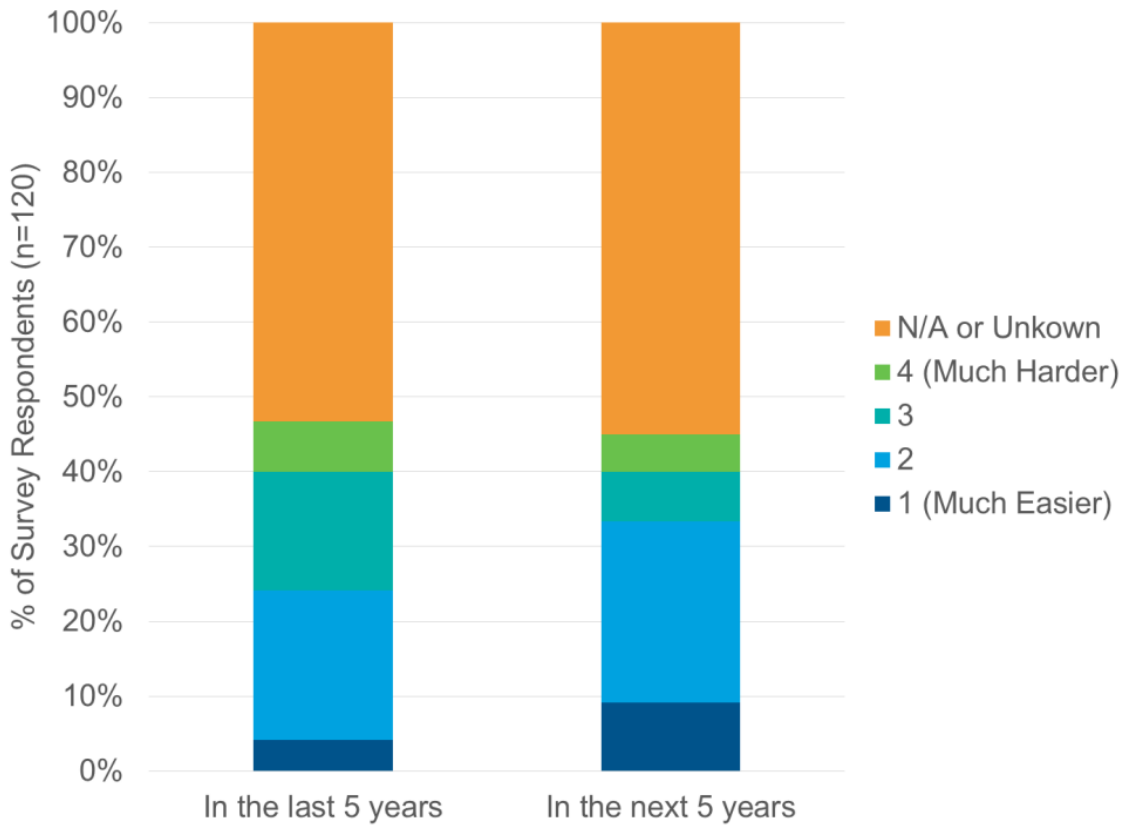
[12] http://www.mto.gov.on.ca/english/vehicles/electric/electric-vehicle-chargers-ontario.shtml#chargertable

4.2 Electrification of space heating

Space heating is the largest source of GHG emissions for municipal buildings, consuming the majority of natural gas, as well as other GHG intensive fuels such as propane and fuel oil. Meeting the GHG emissions reductions targets set by the Province and many municipalities will be challenging without the electrification of at least a portion of the space heating load. Electrification of space heating currently presents a challenge as it typically results in increased energy costs, even as overall energy consumption is reduced. Combining electrification with deep energy retrofits of buildings to reduce the space heating load can mitigate these costs.

In the 2017 Municipal Energy Profile survey, municipalities were asked if beneficial electrification project(s) have become easier or more difficult to schedule through the municipality's capital budget over the last 5 years, and if they expect them to be easier or more difficult in the next 5 years. Only 24% of respondents indicated that beneficial electrification projects have been easier to schedule over the last 5 years, and 33% expect it to be easier in the future (see Exhibit 44). More than half of the respondents answered "not applicable" or "unknown", which implies that beneficial electrification projects may not have been explored by these municipal respondents.

Exhibit 44: Beneficial Electrification Project(s) – Ease/Difficulty to Schedule through Municipality's Capital Budget



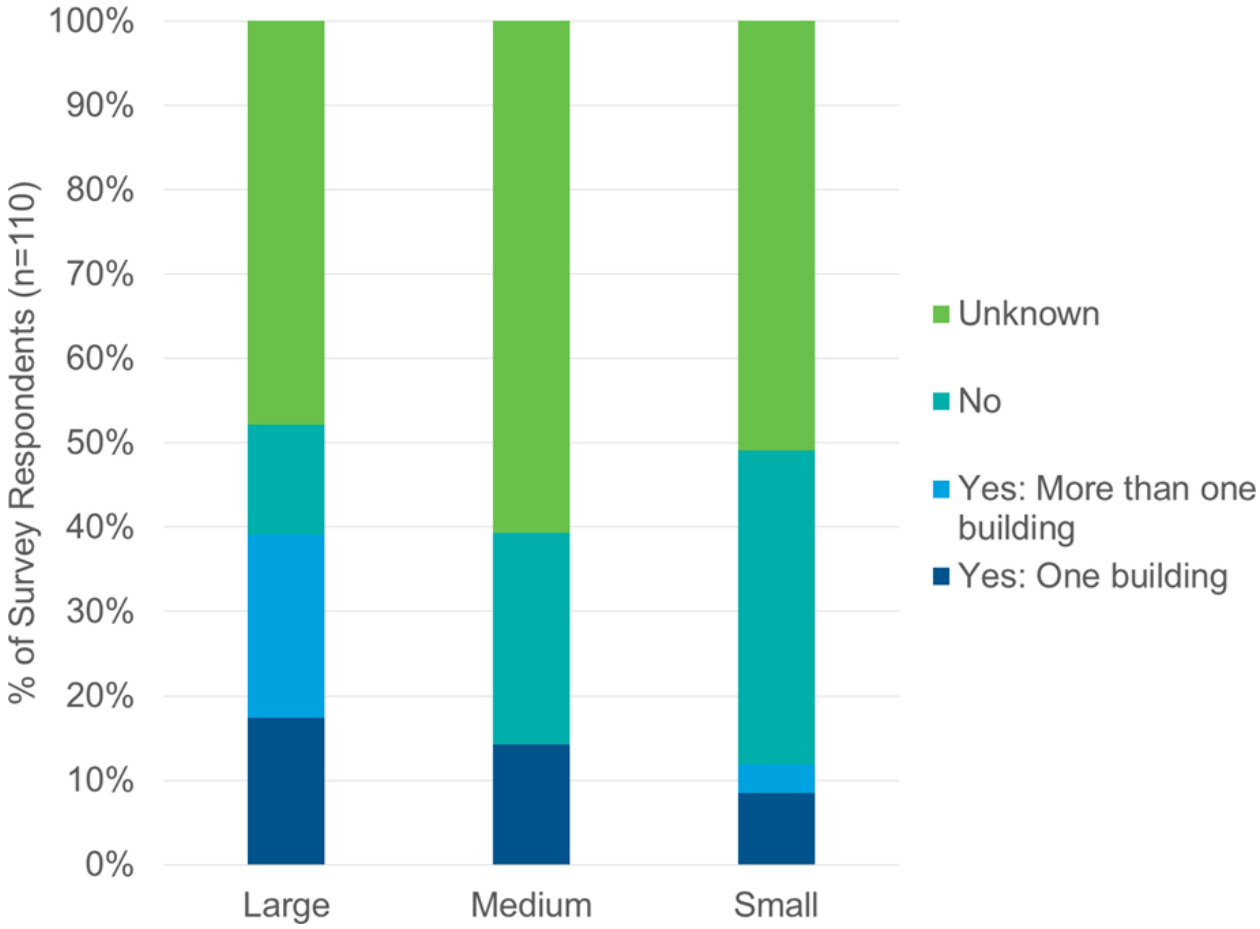
5. Net Zero Buildings

In the 2017 Municipal Energy Profile Survey, municipalities were asked to indicate if they will seek the Net-Zero attribute for one or more buildings in their municipally-owned portfolio in the next 5 years. As shown in Exhibit 45, 12% of Small municipal respondents and 14% of Medium sized municipal respondents will pursue the Net-Zero attribute for one or more of their buildings. 39% of Large municipal survey respondents will pursue the Net-Zero attribute in the next 5 years. 53% of survey respondents indicated that they did not know the answer to the question, which could indicate that this topic warrants further exploration with municipalities. One challenge for municipalities is the high risk of including Net-Zero

Oxford County: Net Zero Building

Oxford County is pursuing a 100% renewable energy goal by 2050. This goal is achievable in part through an aggressive pursuit of an 80-90% energy reduction through building retrofits and a net zero building standard for new municipal housing and facilities. The County is working towards the goal of eliminating the use of non-renewable energy sources in its buildings, and is currently developing a Net-Zero energy accreditation for a municipal administrative building. Oxford is leveraging Net-Zero buildings to leading the way to a renewable energy future, just one component of its broader Future Oxford Community Sustainability Plan (Oxford County, 2017) attributes in their long term plans for their municipal buildings without guaranteed energy incentives. In Ontario, energy incentive frameworks tend to be 5 years long or less.

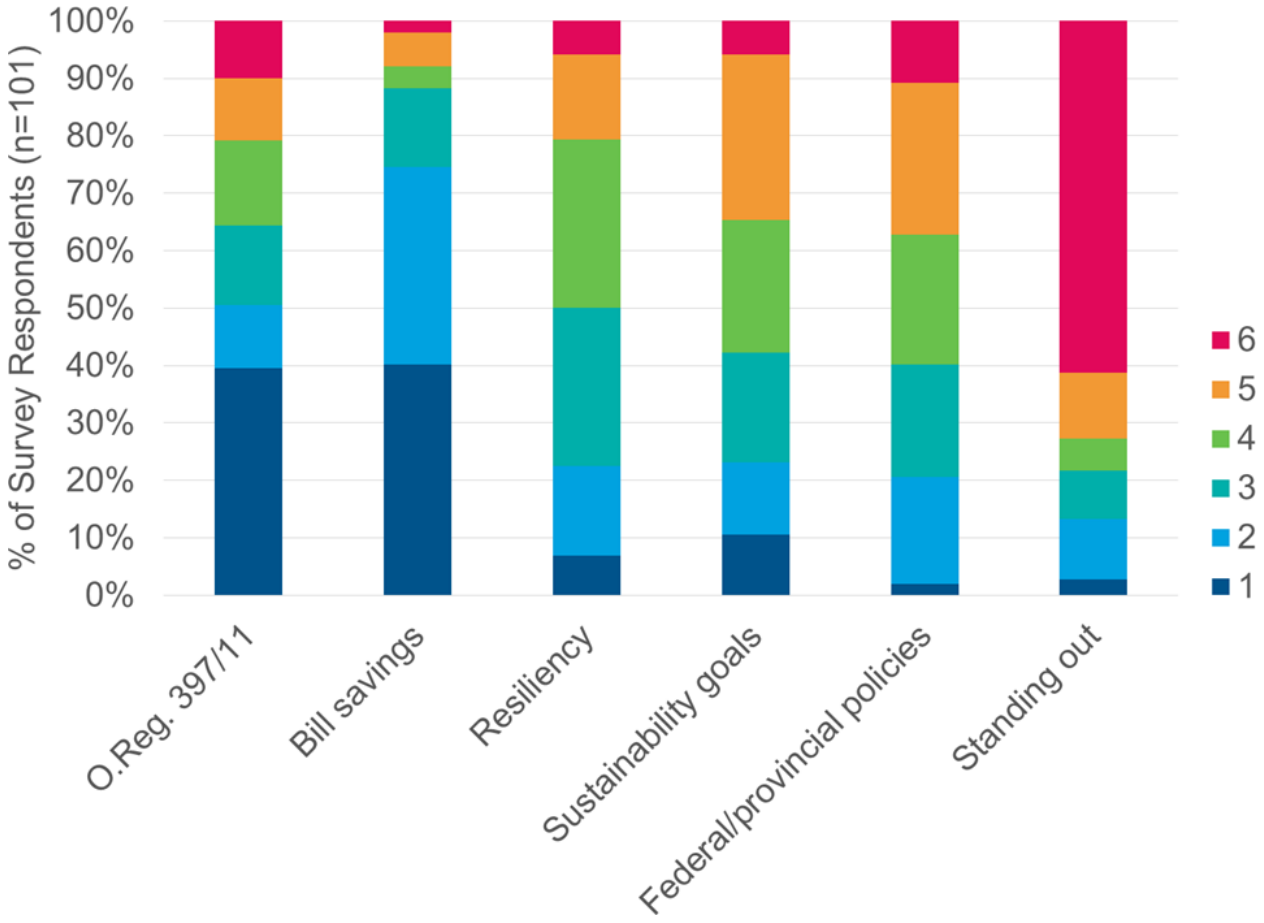
Exhibit 45: Percentage of Municipalities that will Pursue Net-Zero, by Municipality Size



6. Drivers

In the 2017 Municipal Energy Profile survey, municipalities were asked to rank options from the most influential to the least influential driver to pursue sustainable energy projects in their municipality (1 being the most influential, and 6 being the least influential). The options included: compliance with Ontario Regulation 397/11; bill savings and fiscal responsibility of municipal administrators toward tax payers; resiliency to foreseen or unforeseen energy price increases; contribution to achieving their own municipal environmental protection, climate change mitigation and/or sustainability goals; new federal or provincial climate change and/or greenhouse gas mitigation policies; and standing out amongst peer municipalities as a “leader” or an “innovator”. As shown in Exhibit 46, most municipalities ranked Ontario Regulation 397/11 compliance and bill savings and fiscal responsibility as the most influential drivers. Most municipal survey respondents ranked standing out amongst peer municipalities as the least influential driver to pursue sustainable energy projects.

Exhibit 46: Rankings of Influential Drivers to Pursue Municipal Sustainable Energy Projects



IV. Municipal Energy Management Performance

This section provides a comparison of organizational best practices (OBP) in municipal corporate operations of average and median benchmarks for the years 2010 and 2017. The results inform corporate-level organizational competencies for improving energy performance.

1. Design & Methodology

The 2017 Municipal Energy Profile Survey assessed the performance of Ontario's municipal sector in corporate energy management practices through a set of questions in what is known as the Organizational Best Practices or 'OBP'. These questions were taken verbatim from the Appendix C "Organizational Best Practices" of the 2010 LAS Energy Performance Benchmarking of Ontario's Municipal Sector report. The next series of exhibits in this section highlight the progress of the Province's municipal energy management performance over the last seven years by providing a comparison of OBP scores from 2010 to 2017.

1.1 Organizational Best Practice (OBP) –Median and Average Scores

Organizational Best Practice (OBP) is a qualitative assessment of corporate-level organizational practices related to the strategic energy management performance.

OBP performance is explored through the following seven competency areas or "categories":

1. Policy
2. Planning
3. Financing
4. Accountability
5. Monitoring
6. Communication
7. Training and capacity development

Each competency area is examined for trends by comparing municipal performance data based on either: (i) population sizes (Small, Medium, and Large); or (ii) geographic regions in Ontario (Central/GTA, Eastern, Northeastern, Northwestern, and Southwestern).

The results are intended to provide insights into the internal conditions of energy performance in Ontario's municipal sector and where the gaps are for continual improvement of sustained growth over the long term.

1.2 Scoring System

Using a two-point scoring system, the questions were presented as a series of close-ended statements to which participants would select one of three levels of implementation of energy management best practices. The options offered, along with their associated score-points, included the following:

- Yes – Developed and/or implemented (2 points);
- No – Not developed or implemented at all (0 points);
- Partial – Partially developed and/or implemented (1 point).

A final score on a scale of 1% to 100% was evaluated by summing the total score received for each category and dividing it by the total number of possible points in that category. The 25th, 50th (median), and 75th percentiles of the 2010 and 2017 scores are presented in the following subsections in what is referred to as 'median' exhibits.

An overall OBP score was determined by averaging all categories.

2. Overall OBP

Overall Organizational Best Practices (OBP) is an average of scores achieved by municipalities in all of the seven categories.

Exhibit 47 shows the 25th, 50th (median), and 75th percentiles of overall OBP scores in 2010 and 2017 broken down by municipality size. As shown, there have been performance improvements in the median as well as 25th and 75th percentiles of overall OBP scores for municipalities of all population sizes (Small, Medium, and Large) from 2010 to 2017. The median scores of overall OBP for all three municipality sizes have improved by a similar rate of 20%-22%.This means that in 2017, 50% of municipalities are performing 20%-22% better in their overall OBP scores than their 2010 scores.

In 2017, the highest median, 25th and 75th percentiles of overall OBP scores were achieved by Large municipalities followed by Medium municipalities and then Small municipalities.

It can also be seen that the median of overall OBP scores for Medium municipalities in 2017 just reached or slightly surpassed the median of overall OBP scores for Large municipalities in 2010. In other words, 50% of Medium municipalities performed similarly in their overall OBP scores in 2017 to what 50% of Large municipalities were performing in 2010. The 75th percentile of Small (54%) and Medium (57%) municipalities are performing slightly better than the 25th percentile of Large municipalities (51%).

Exhibit 47: OBP Score by Municipality Size, 2010 vs. 2017

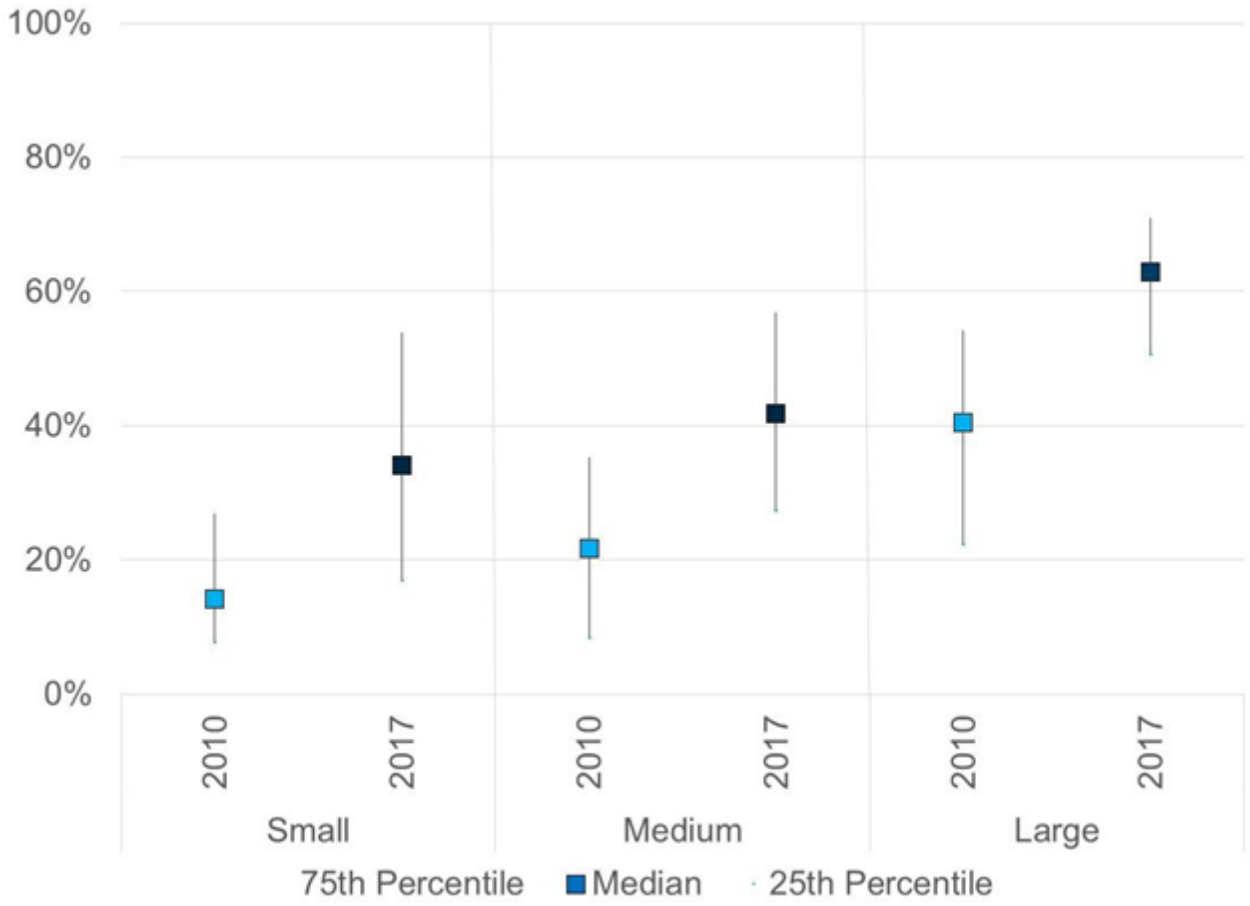


Exhibit 48 demonstrates the breakdown of overall OBP median as well as 25th and 75th percentile scores by geographic region. There has been an improvement of implementation of overall OBP by municipalities in all geographic regions in 2017 relative to 2010.

The highest increase in median overall OBP scores from 2010 to 2017 was achieved by the Central/GTA region, where there was an increase of 31%. This was closely followed by the Eastern region, where there was an increase in median overall OBP scores of 28%. In 2017, half of municipalities in the Central/GTA region scored lower than 62% in their overall OBP scores, an increase of 31% from 2010, and half of municipalities in the Eastern region scored lower than 42%, an increase of 28% from 2010. The Eastern region has also seen a significant increase of its 25th percentile overall OBP score from 7% in 2010 to 36% in 2017, an increase of 29% score points over the last seven years.

Over the last seven years, the 75th percentiles of overall OBP for all regions have improved by a similar figure of 17% to 20% for all regions except for the Northeastern region, where there was an improvement of 11%.

Exhibit 48: OBP Score by Region, 2010 vs. 2017

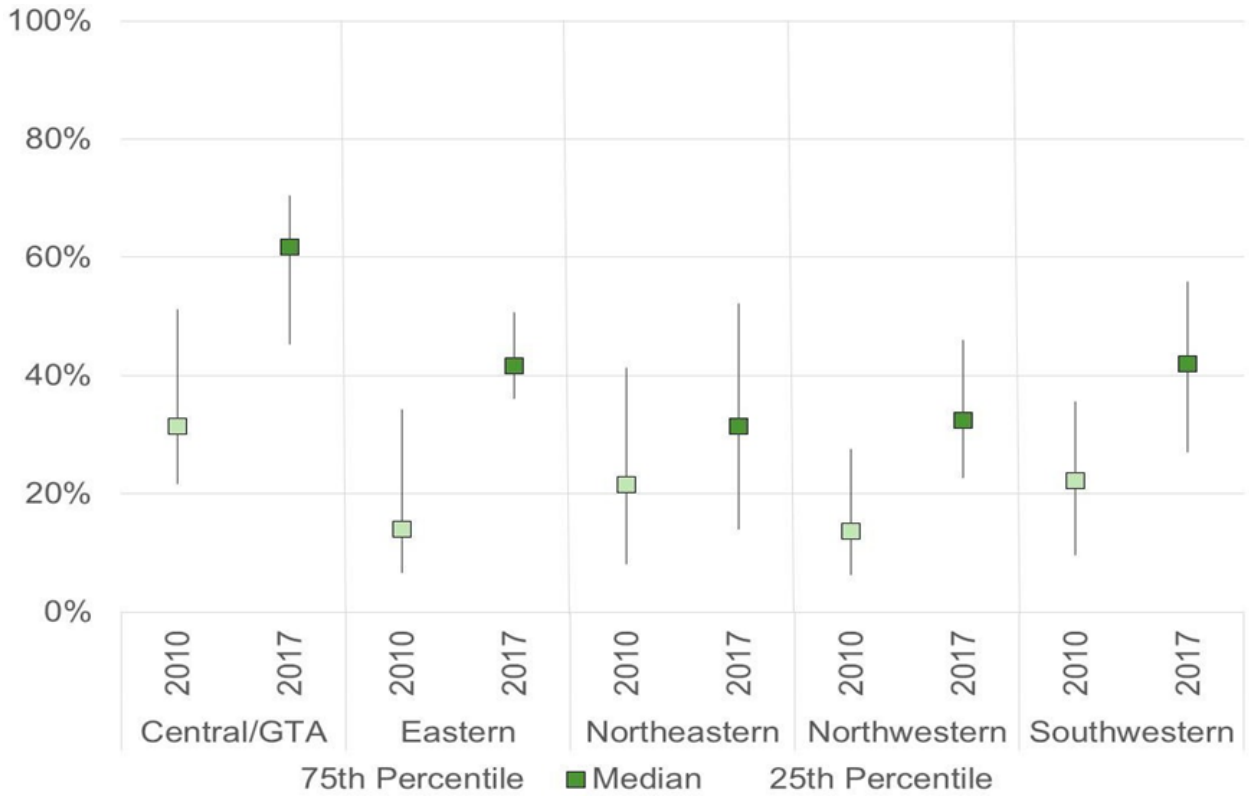


Exhibit 49 shows the median as well as 75th and 25th percentiles of organizational practices achieved by participating municipalities for each category in 2010 and 2017. As shown, municipalities have an improved median performance score in all seven OBP categories from 2010 to 2017. Similarly, the 25th and 75th percentile scores have also improved in all OBP categories from 2010 to 2017 except for training, where the 25th percentile appears stagnant at 0%. In other words, a quarter of municipalities were scoring 0% in training in 2017. The median of the overall OBP score in 2017 is 42%, indicating that half of the participating municipalities scored lower than 42% in their overall OBP, an improved performance of 20% from their 2010 overall median OBP score.

The highest increases in median scores occurred in the following categories: Policy (41%), followed by Planning (32%), and Financing and Communication (25% each). Policy and Planning categories relate to O.Reg.397/11 and conservation and demand management (CDM) planning, which is discussed in the following subsections. The least increases in median scores occurred in the Accountability (8%) and Training (10%) categories.

In 2017, 75% of municipalities scored 75% or less in four categories including: Policy, Planning, Financing, and Communication. The highest spread between 25th and 75th percentile scores - a difference of ~50% - occurred in the Planning and Financing categories, suggesting knowledge sharing opportunities for municipalities in those two categories.

Exhibit 49: 49 Median OBP by Category, 2010 vs. 2017

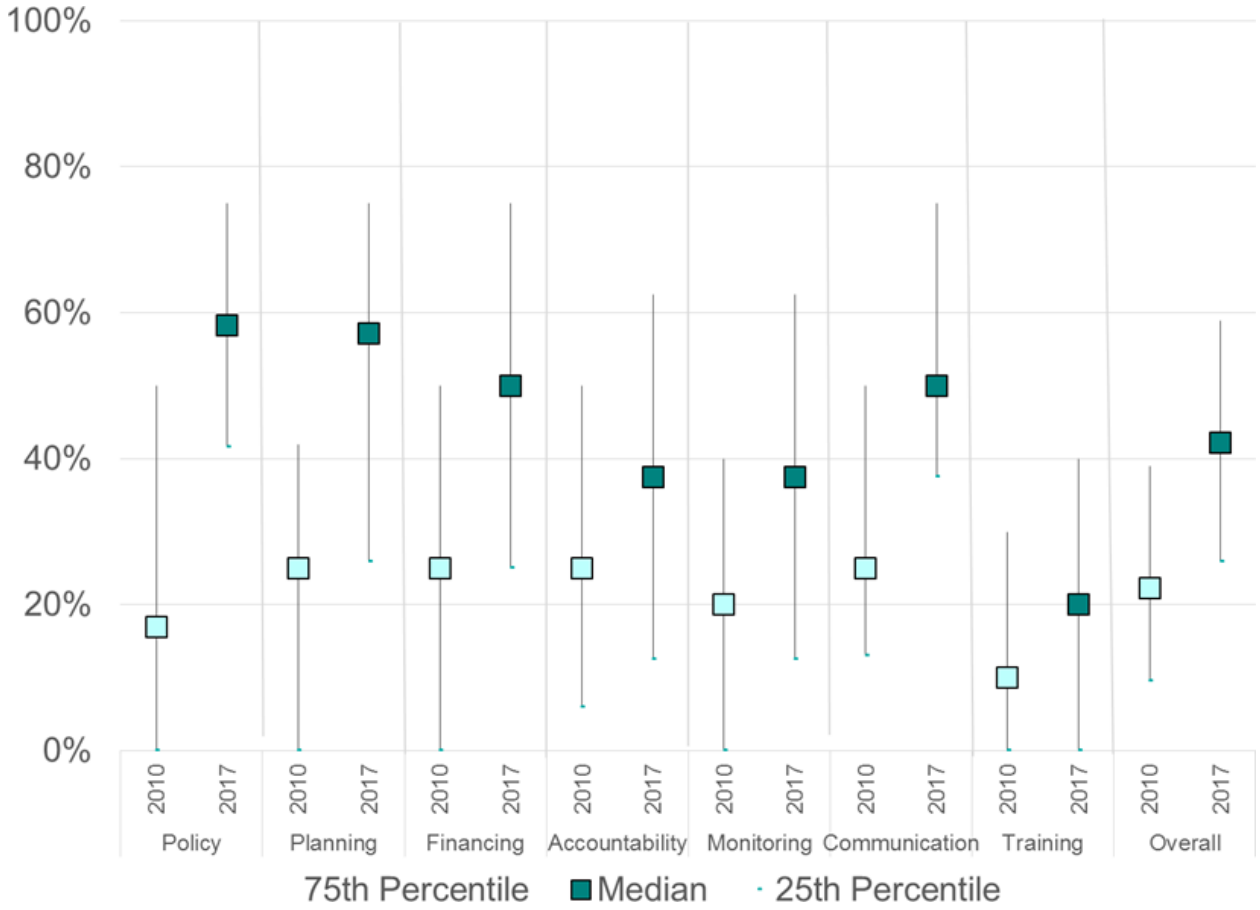


Exhibit 50 and Exhibit 51 show the breakdown of averages of OBP scores for each category by population size in 2010 and 2017, respectively. In 2010, Small municipalities performed better than Medium and Large municipalities in the implementation of Communication best practices. In 2017, Medium municipalities caught up with Small municipalities while Large municipalities exceeded the performance of Small municipalities in the Communication category. In 2017, Large municipalities outperformed Medium and Small municipalities in all categories. In both 2010 and 2017, implementation of Training best practices had consistently the lowest average scores for municipalities of all population sizes.

Exhibit 50: OBP Score by Category & Size, 2010

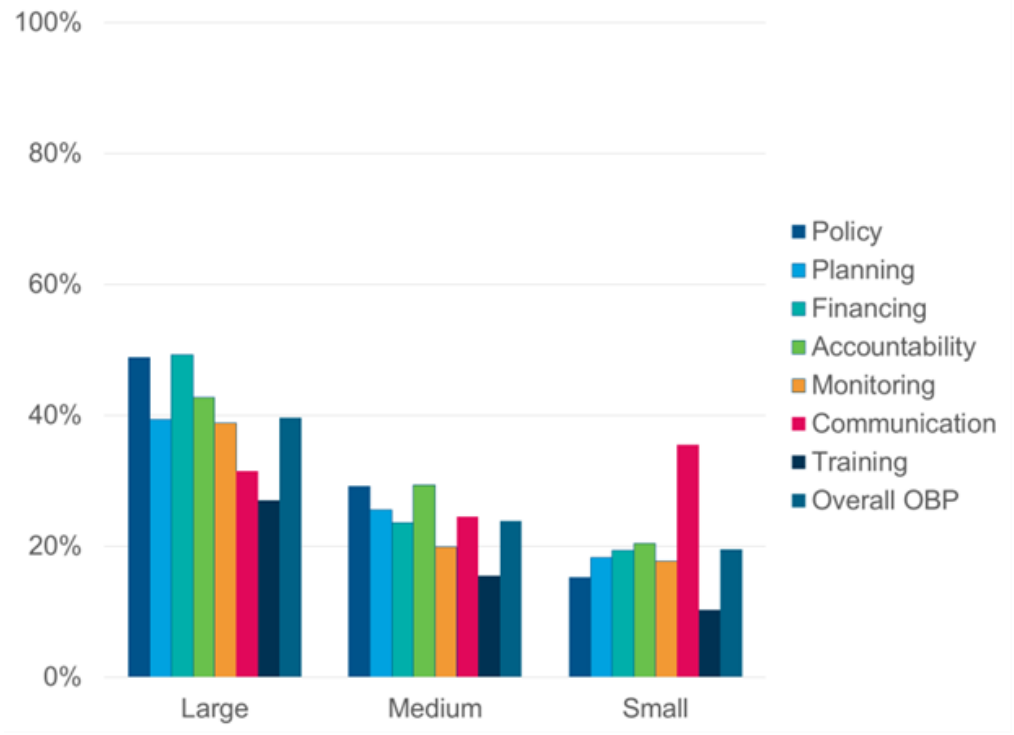


Exhibit 51: OBP Score by Category & Size, 2017

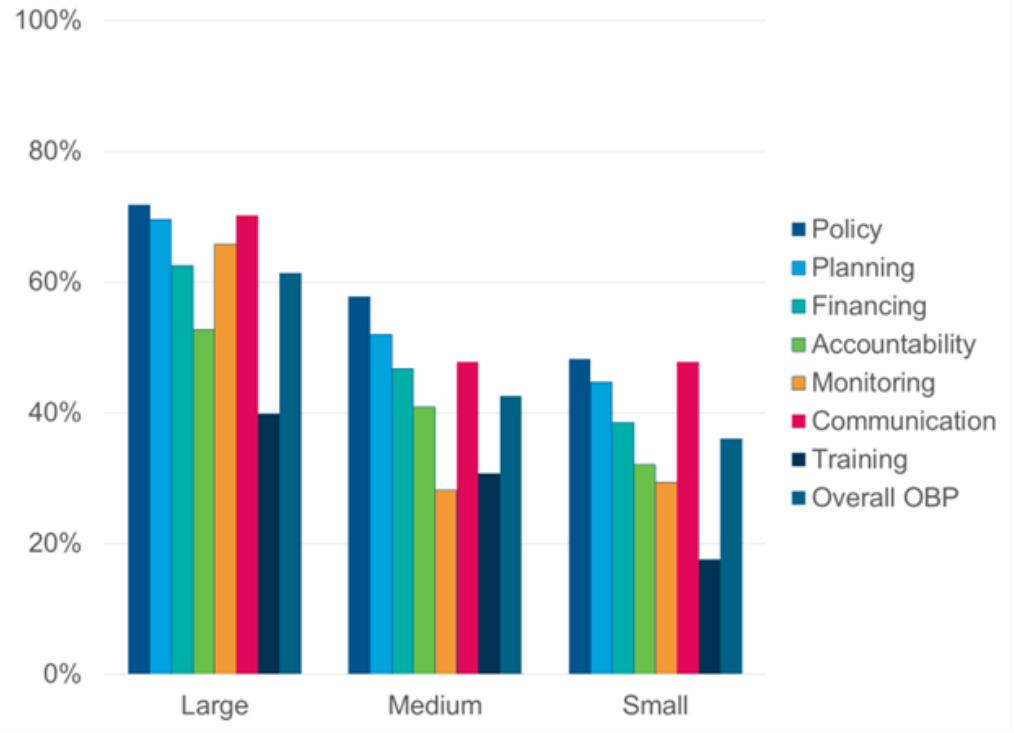


Exhibit 52 and Exhibit 53 show the breakdown of averages of OBP scores for each category by geographic region in 2010 and 2017, respectively. In both 2010 and 2017, municipalities in the Central/GTA region outperformed all other municipalities in every category. Similar to the trend in previous figures, implementation of Training best practices had consistently the lowest score in municipalities across all geographic regions in both 2010 and 2017.

Exhibit 52: OBP Score by Category & Region, 2010

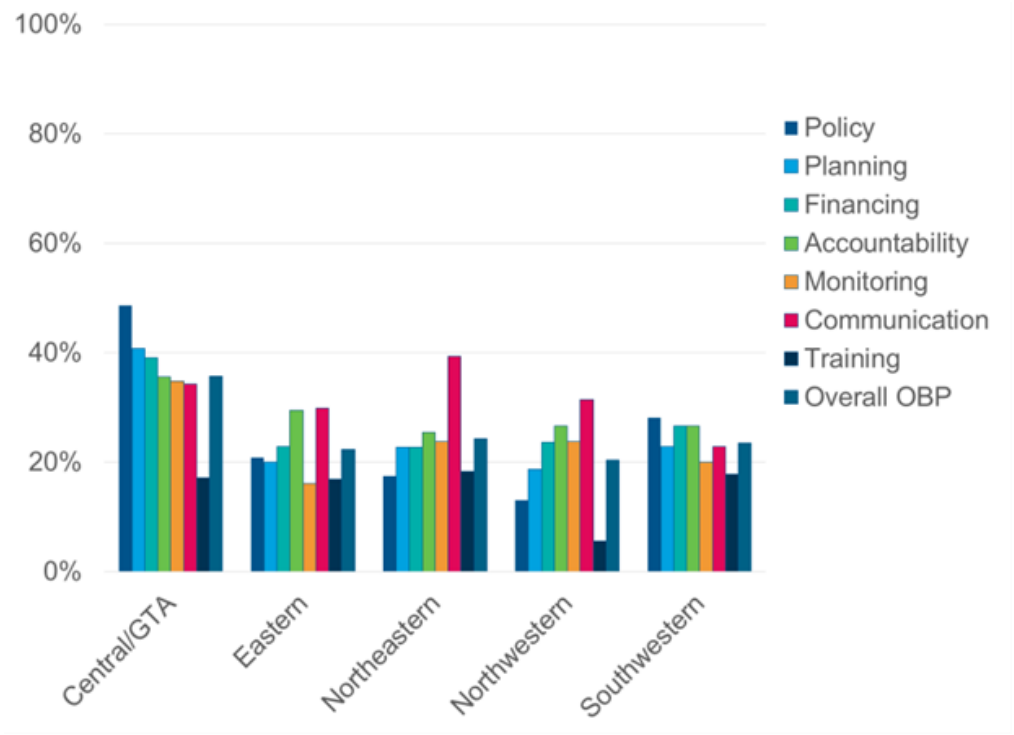


Exhibit 53: OBP Score by Category & Region, 2017

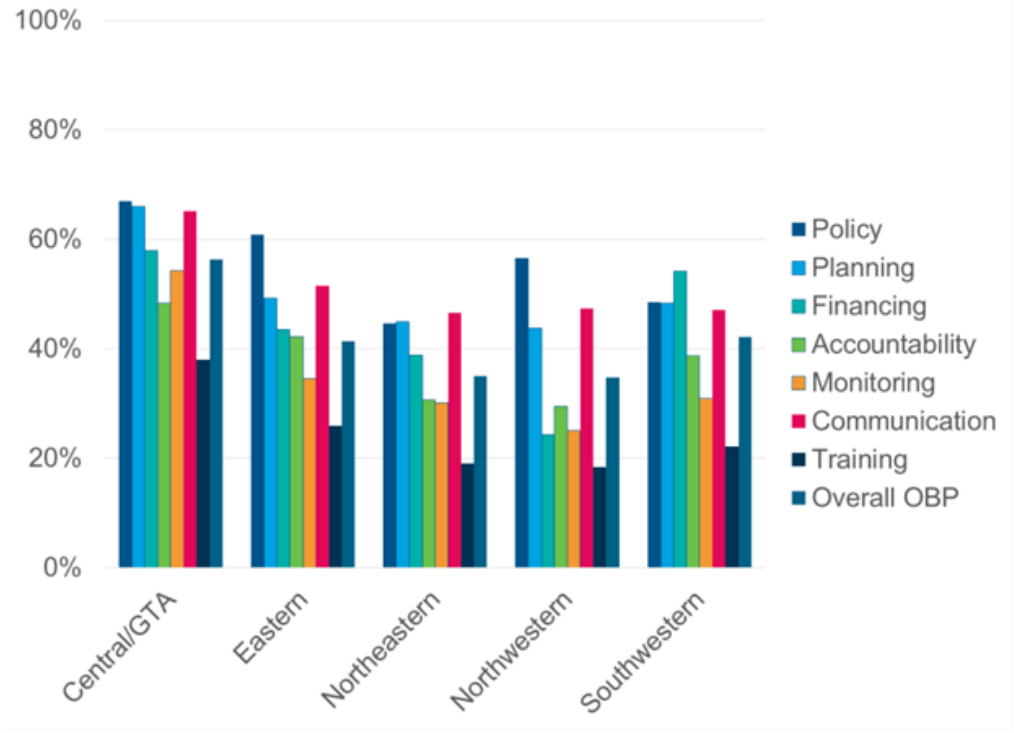
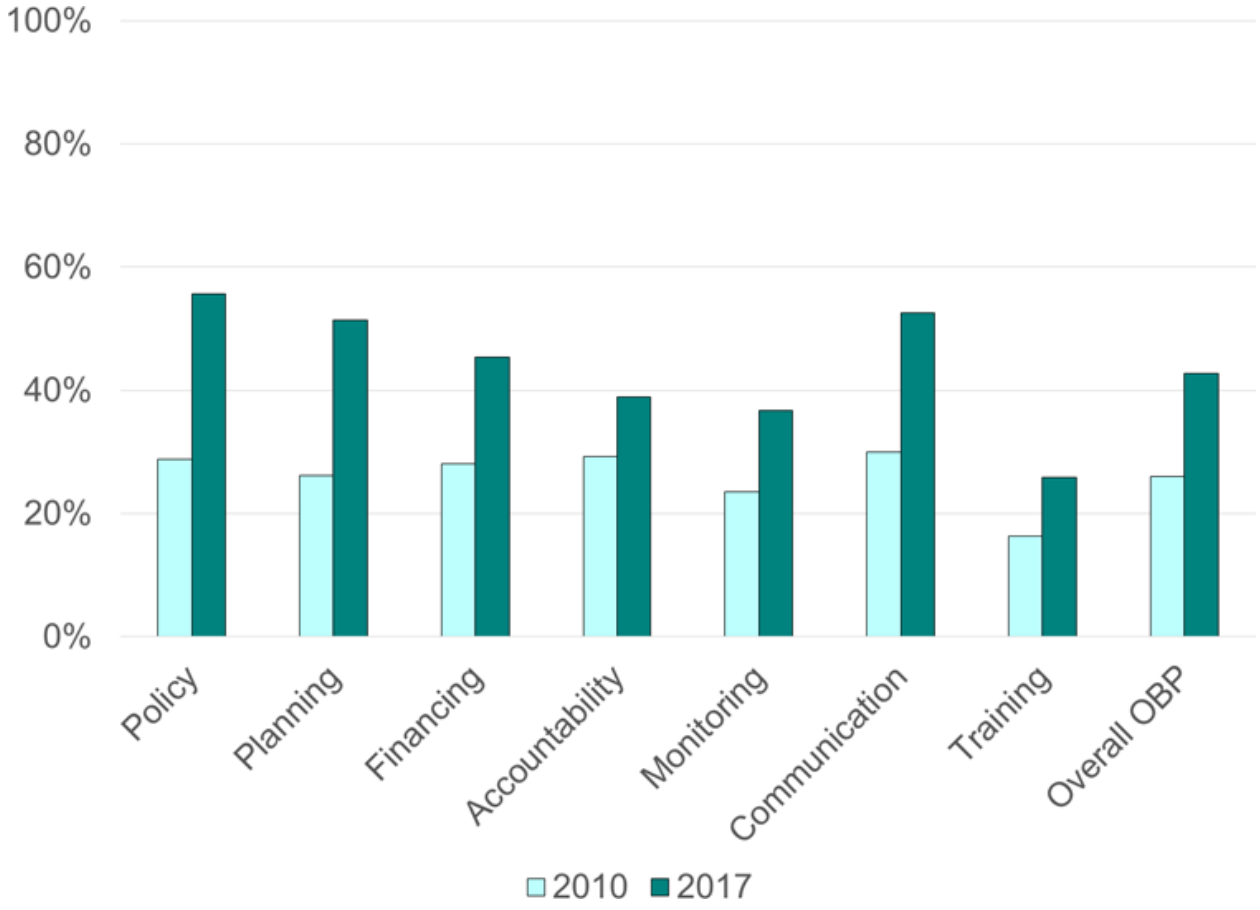


Exhibit 54 shows a comparison of average OBP scores in each category between 2010 and 2017. In 2010, the averages for all categories hovered between 16% (Training) and 30% (Communication). In 2017, the averages for all categories increased to a range of 26% (Training) and 56% (Policy).

Exhibit 54: OBP by Category, 2010 vs. 2017



3. Policy

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding the interaction of energy management with broader municipal policies and decisions by answering "Yes", "No", or "Partial" to the following statements:

- The Mayor and/or Council have made a documented commitment to implementing sustainable energy policies and plans.
- The Municipality has a documented strategy (including the 2014 Energy Conservation and Demand Management Plan), which:
    - defines long-term strategic energy management commitments and goals;
    - specifies responsibilities and sets targets for controlling energy use and cost;
    - includes in scope; both conservation AND demand management;
    - includes in scope; high performance standards for new building construction; and/or
    - includes in scope; the review of procurement and purchasing guidelines to incorporate energy performance standards.

Exhibit 55 shows the change in Policy median, 25th and 75th percentile scores from 2010 to 2017 broken down by population size. The implementation of Policy best practices has been improved for municipalities of all population sizes in 2017 relative to 2010. Small municipalities experienced the most significant increase (42%) in their median Policy scores from 8% in 2010 to 50% in 2017. This was followed by Medium municipalities, which performed 29% better in 2017 compared to 2010. In 2017, Large municipalities illustrated the highest Policy competency with a 25th percentile score of 58%, a median of 75%, and a 75th percentile of 88%.

Exhibit 55: Policy Score by Municipality Size, 2010 vs

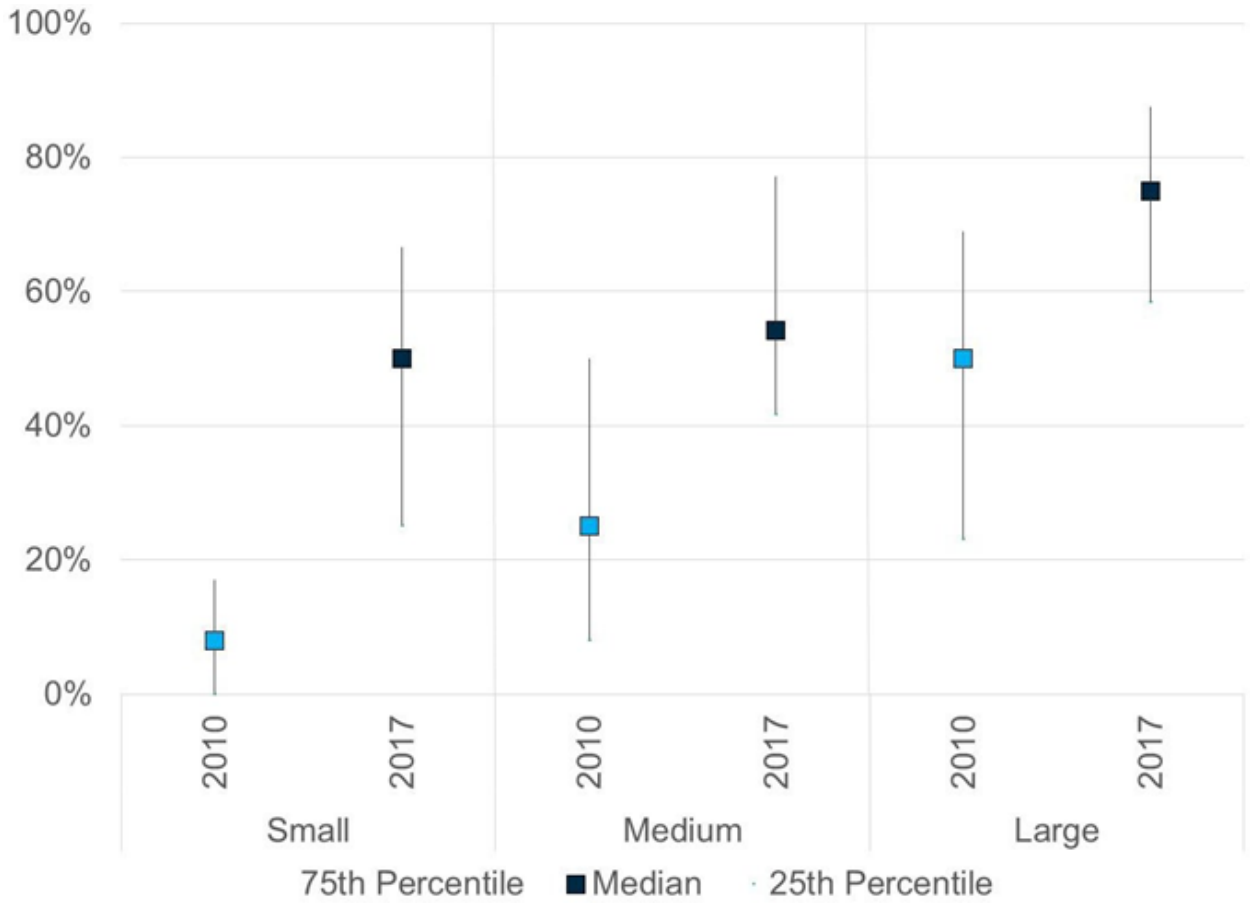
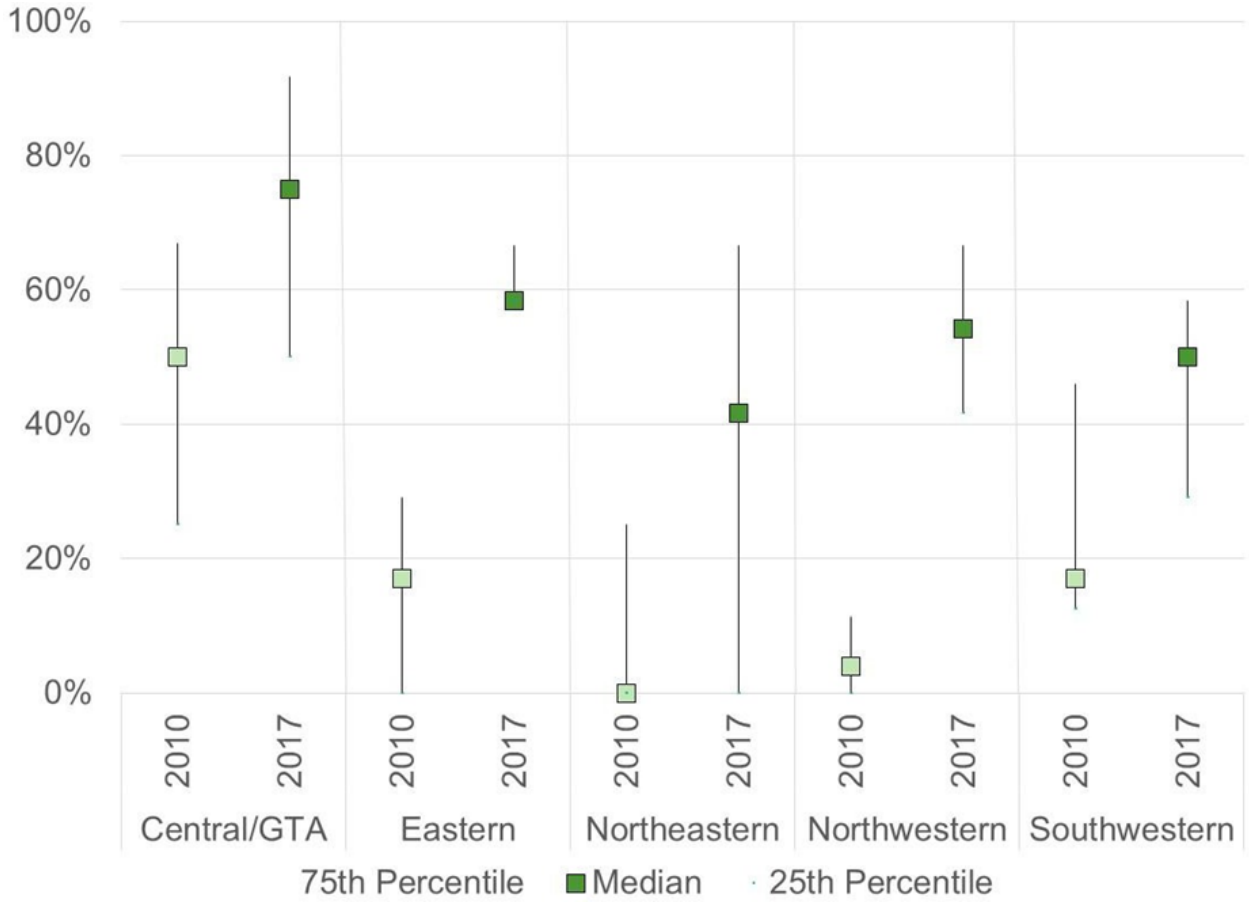


Exhibit 56 shows the median, 25th, and 75th percentile Policy scores in different geographic regions across the province in 2010 and 2017. Implementation of Policy best practices was improved for municipalities in all geographic regions in 2017 relative to 2010.

In 2017, the highest increases in median Policy scores were achieved by municipalities in the Northern regions including Northwestern (by 50%) and Northeastern (by 42%), with a close follow-up by the Eastern region (41%). In 2017, 75% of municipalities in the Northern and Eastern regions scored lower than 67% in their implementation of Policy best practices. The largest spread of scores between the 25th and 75th percentile was seen in the Northeastern region, suggesting knowledge sharing opportunities within the Policy competency area among municipalities within that region.

In 2017, municipalities in the Central/GTA region showed the highest competency in the Policy category, with a 25th percentile score of 50%, a median of 75%, and a 75th percentile of 92%.

Exhibit 56: Policy Score by Region, 2010 vs. 2017



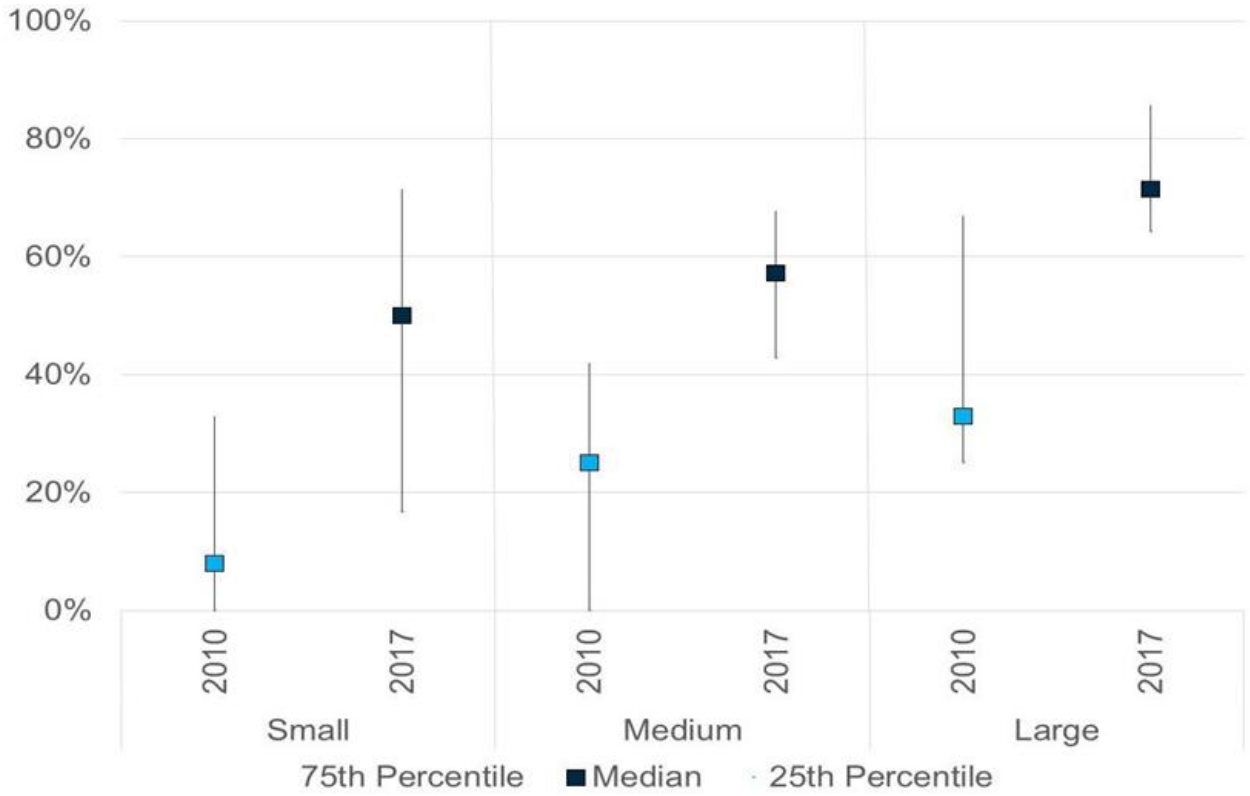
4. Planning

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding energy conservation and demand management (CDM) planning by answering "Yes", "No", or "Partial" to the following statements:

- The municipality has adopted a formal Energy Conservation and Demand Management (CDM) Plan.
- The municipality has adopted a Community Energy Plan.
- The municipality has a documented CDM planning process, which annually:
    - conducts energy performance benchmarking;
    - reviews facility and portfolio-level energy performance reports;
    - sets targets for reducing energy use and cost in facilities/operations;
    - defines measures or actions to reduce energy costs and achieve the energy performance targets in facilities/operations; and/or
    - identifies candidate facilities for energy audits.

Exhibit 57 shows that implementation of Planning best practices was improved by municipalities of all population sizes in 2017 relative to 2010. The highest increase of median scores was achieved by Small municipalities (42%), followed by Large (38%) and Medium (32%) municipalities. In 2017, 75% of Small municipalities scored slightly better in the implementation of planning best practices than 75% of Medium municipalities. Small municipalities also had the largest spread of scores between their 25th (17%) and 75th (71%) percentile scores, suggesting learning opportunities in the Planning competency area among Small municipalities in the province. Large municipalities achieved the highest Planning competency with a 25th percentile score of 64%, a median of 71%, and a 75th percentile of 86%.

Exhibit 57: Planning Score by Municipality Size, 2010 vs. 2017



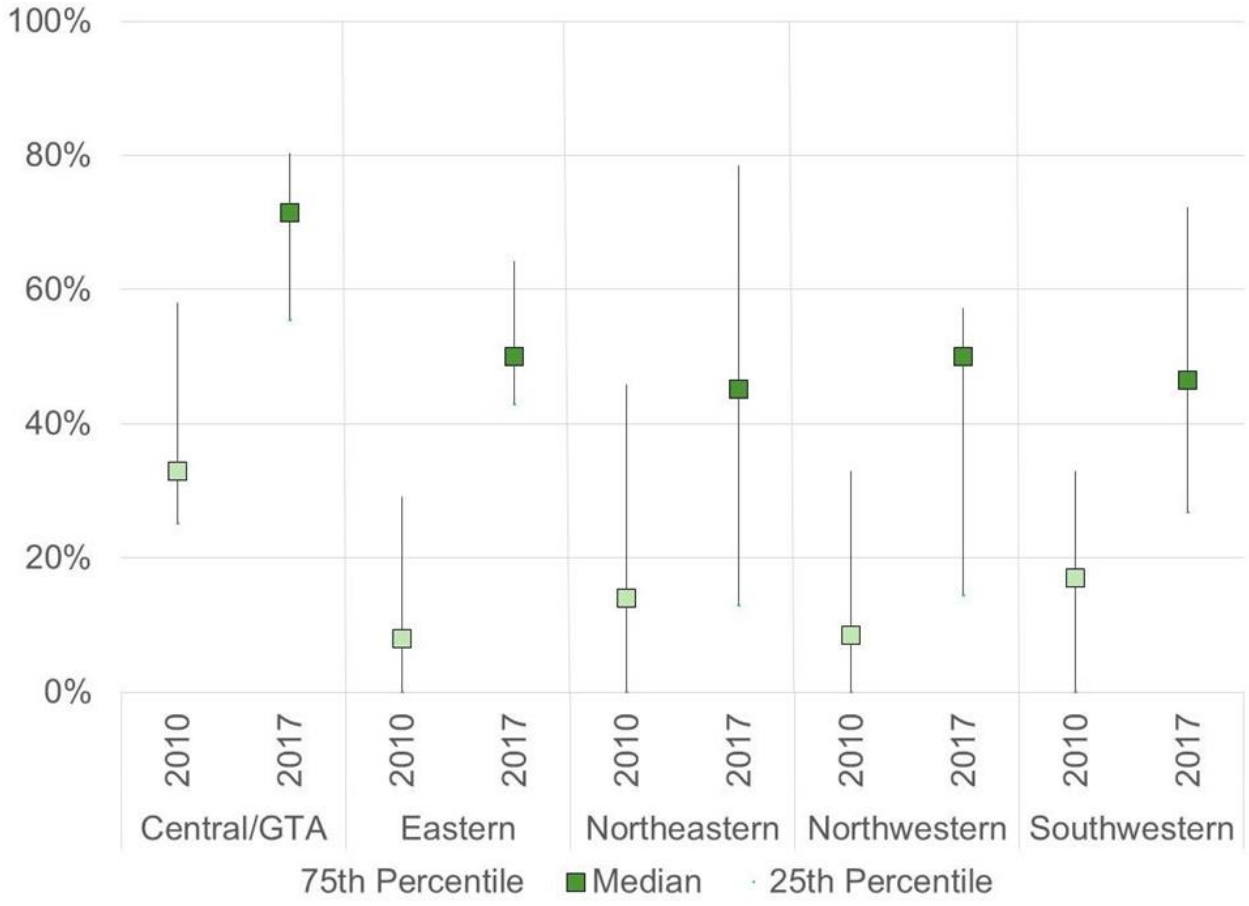
As shown in Exhibit 58, implementation of Planning best practices improved for municipalities in all regions across Ontario.

In 2010, the 25th percentile scores of municipalities in all regions except for the Central/GTA were at 0%. This was improved by 13% (Northeastern) to 43% (Eastern) in 2017.

In 2017, the 25th percentile score of municipalities in the Eastern region was higher than the region's 75th percentile in 2010. In other words, 25% of municipalities in the Eastern region performed better in their 2017 Planning scores than what 75% of them had achieved in 2010.

The highest increases in median Planning scores were achieved by municipalities in the Eastern region (by 42%) and Northwestern region (by 41%). Of note is the 75th percentile scores of municipalities in the Northeastern region (79%), which is almost identical to the 75th percentile scores of municipalities in the Central/GTA region (80%). However, municipalities in the Northeastern region also witnessed the highest spread of scores between their 25th (13%) and 75th (79%) scores, suggesting learning opportunities within the Policy competency area among municipalities in the region.

Exhibit 58: Planning Score by Region, 2010 vs. 2017

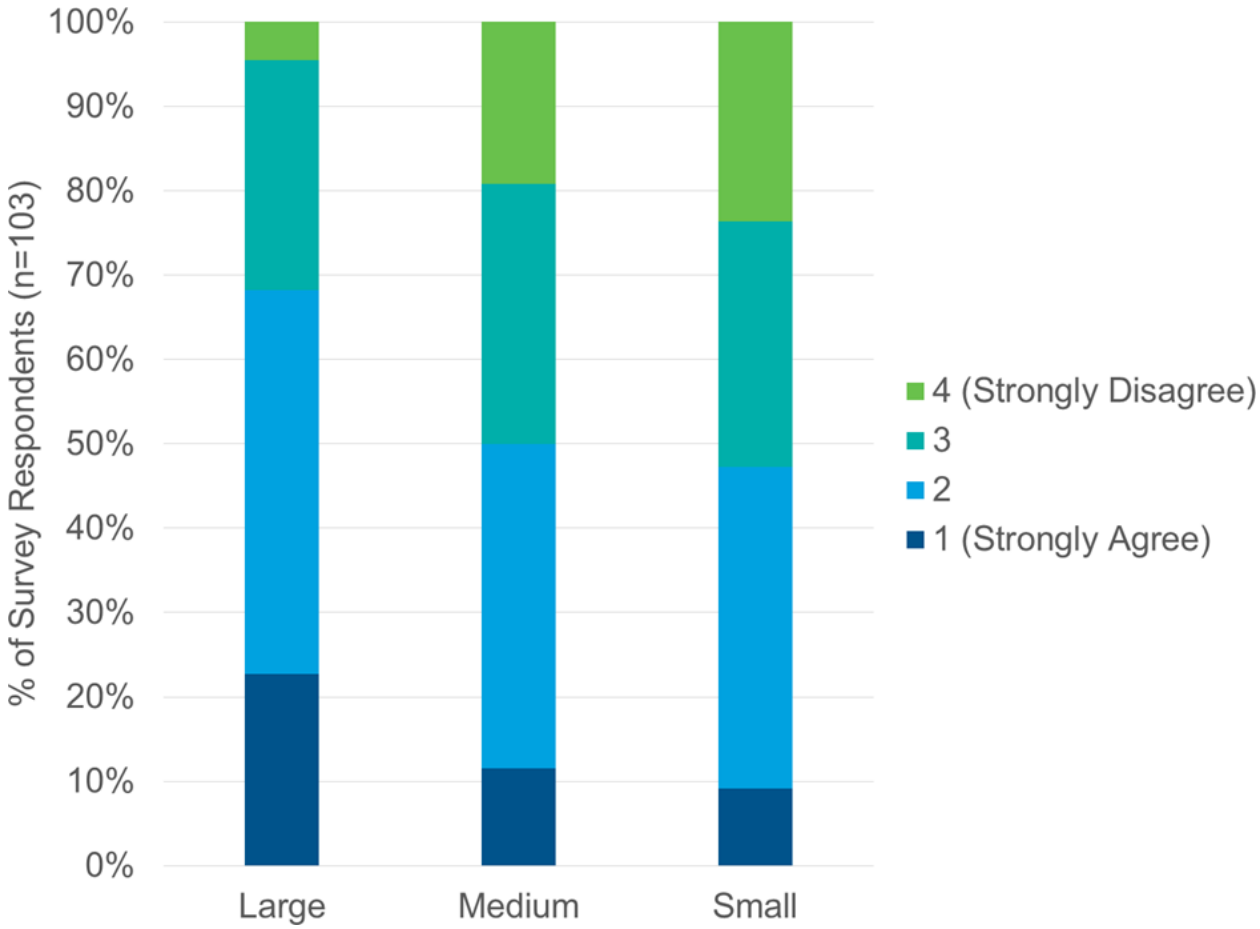


4.1 Impacts of Conservation and Demand Management Planning

In the 2017 Municipal Energy Profile survey, municipalities were asked to indicate to what extent they agree with statements relating to the impact that the development of their energy conservation and demand management plan has had on their municipal strategies and policies over the past 5 years, by selecting from a score from 1 (strongly agree) to 4 (strongly disagree). The results are presented in the following 6 exhibits.

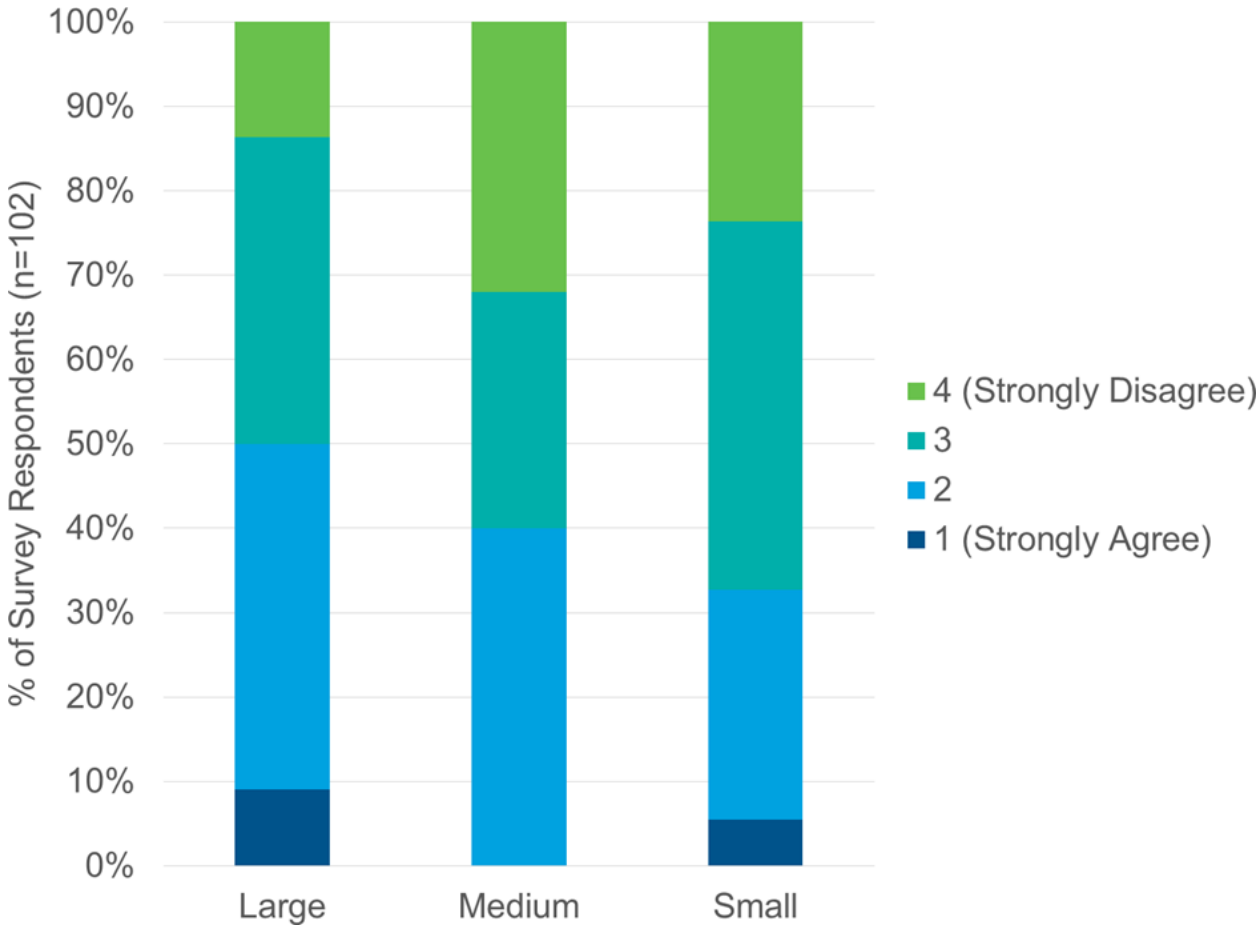
A majority of Large municipal survey respondents indicated that they agree that sustainable energy projects have increased in priority in their capital expenditure plan (see Exhibit 59). Less than half of Medium and Small municipal respondents agree with the statement.

Exhibit 59: Percentage of Municipalities that agree that Sustainable Energy Projects have increased in Priority in their Capital Expenditure Plan, by Municipality Size



A majority of municipal survey respondents disagreed with the statement that the level of attention and resources spent on energy management was increased to a level that is commensurate with the level of outlays associated with energy. This is shown in Exhibit 60.

Exhibit 60: Percentage of Municipalities that agree that Attention and Resources spent on Energy Management Increased, by Municipality Size



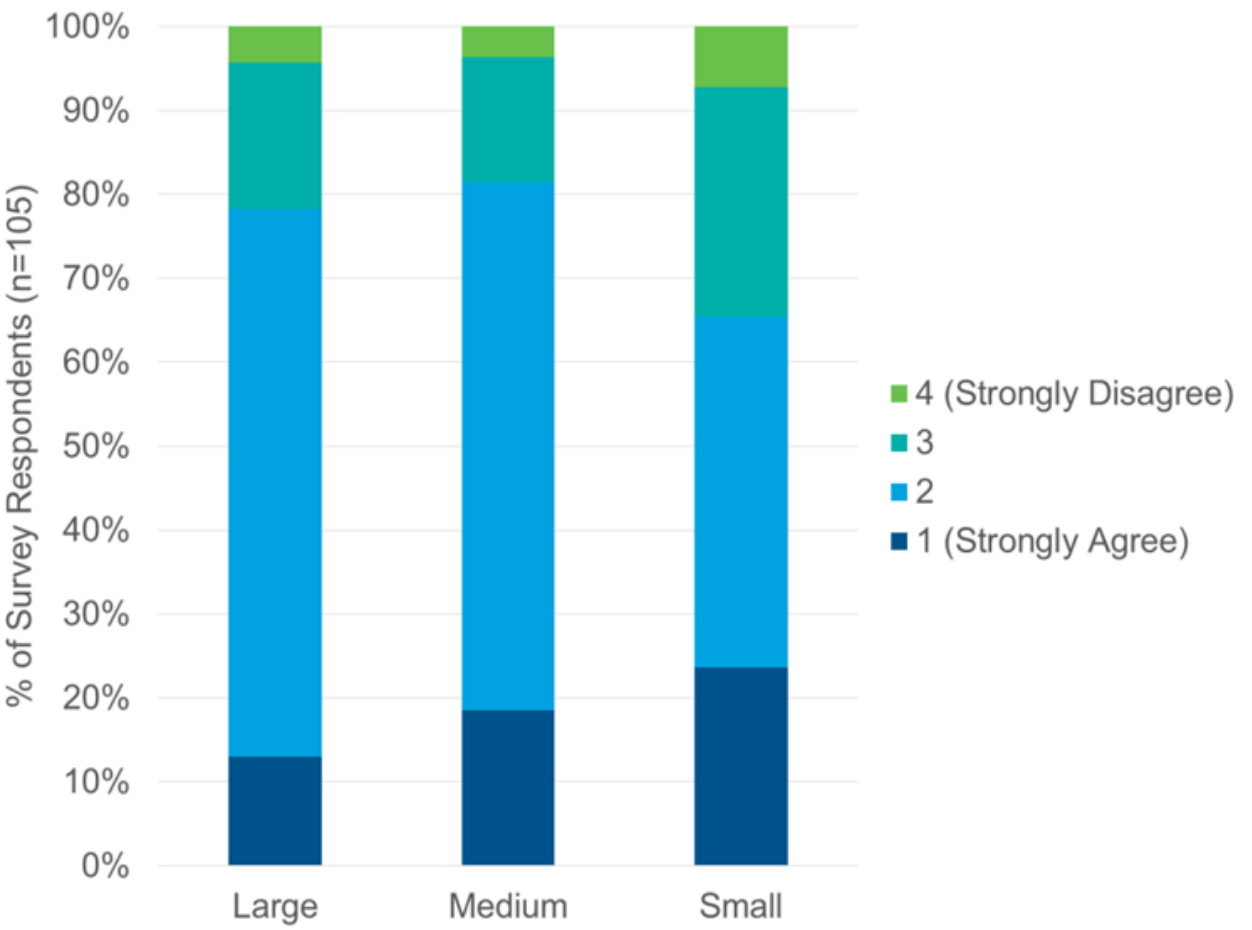
Policy Impacts - O.Reg 397/11 and CDM Planning

In 2011, a large energy audit was conducted for most of the municipal facilities in the Town of Fort Frances. The audit identified a total of 13 high energy consuming facilities as well as a several other low cost and quick-return energy saving opportunities. While the Town had been tracking energy consumption prior to the enforcement of O.Reg. 397/11, the annual energy consumption reporting requirement under the regulation has helped to equip the Manager of Operations and Facilities with the data needed to make the business case to persuade the Town Council to approve proposals for funding a large-scale energy retrofit project for end-of-life-cycle assets. One of the retrofits approved by Council was a $200,000 lighting retrofit for the Memorial Sports Centre at the Town of Fort Frances (Town of Fort Frances, 2017).

For the City of Sault Ste. Marie, the 2014 CDM plan was a good exercise to get a knowledge base of energy management practices and provide an update on the city's energy reporting capacity. As part of developing the 2014 plan, a Strengths-Opportunities-Weaknesses-Threats (SWOT) analysis was conducted by drawing expertise from facility managers to identify areas of strength and weaknesses as well as provide recommendations to further improve the implementation of energy management practices. This exercise helped transition knowledge across various departments, where department heads had an opportunity to learn about facility management challenges. From this exercise, a list of high-priority projects with large energy savings opportunities was provided by the asset management team to the City. Unfortunately, progress on these projects was de-prioritized due to local economic conditions (City of Sault Ste. Marie, 2017).

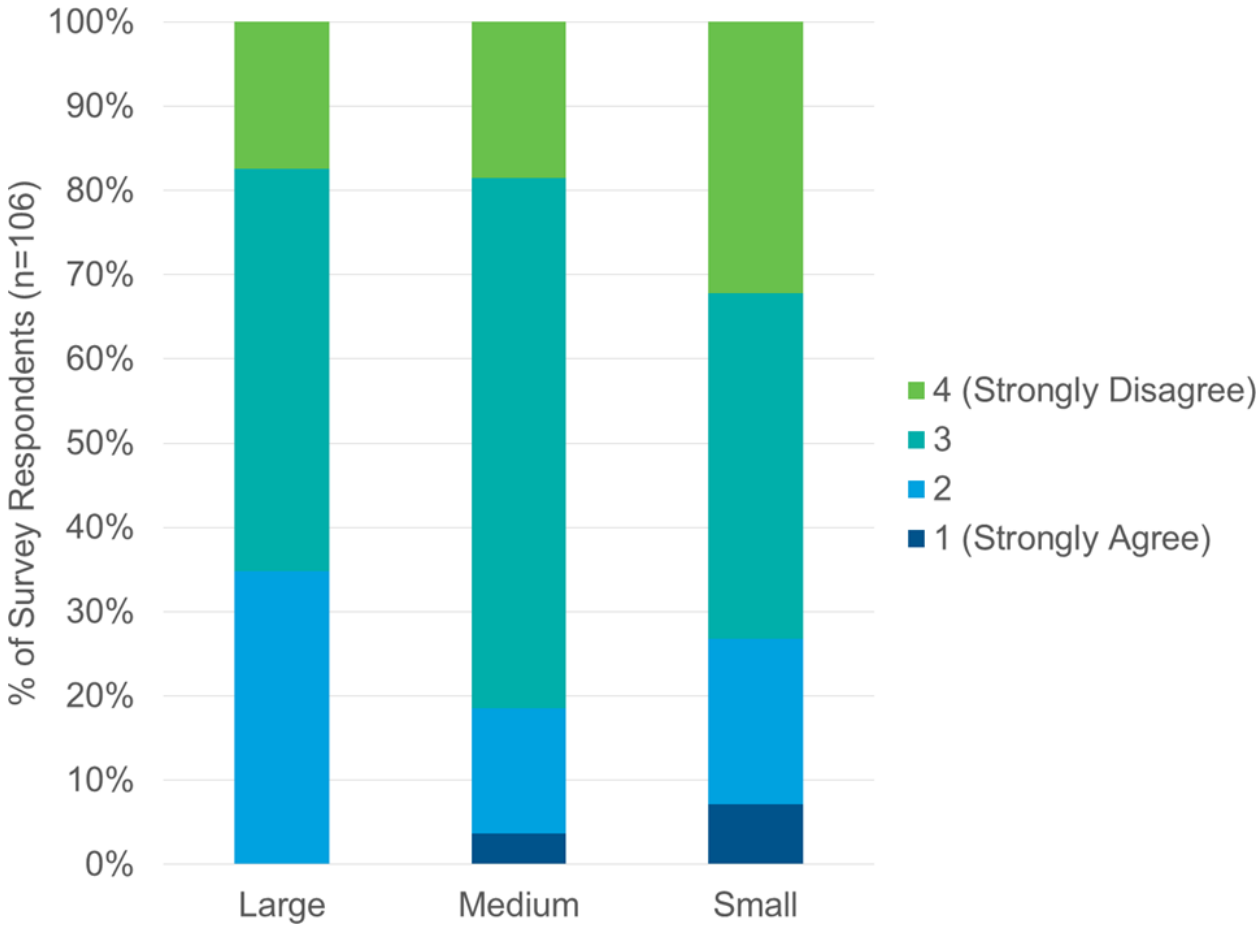
A majority of municipal survey respondents agreed with the statement that municipal personnel are more diligent at seeking energy savings through better day to day habits and improved operation procedures (see Exhibit 61).

Exhibit 61: Percentage of Municipalities that agree that their Municipal Staff are More Diligent at Seeking Energy Savings, by Municipality Size



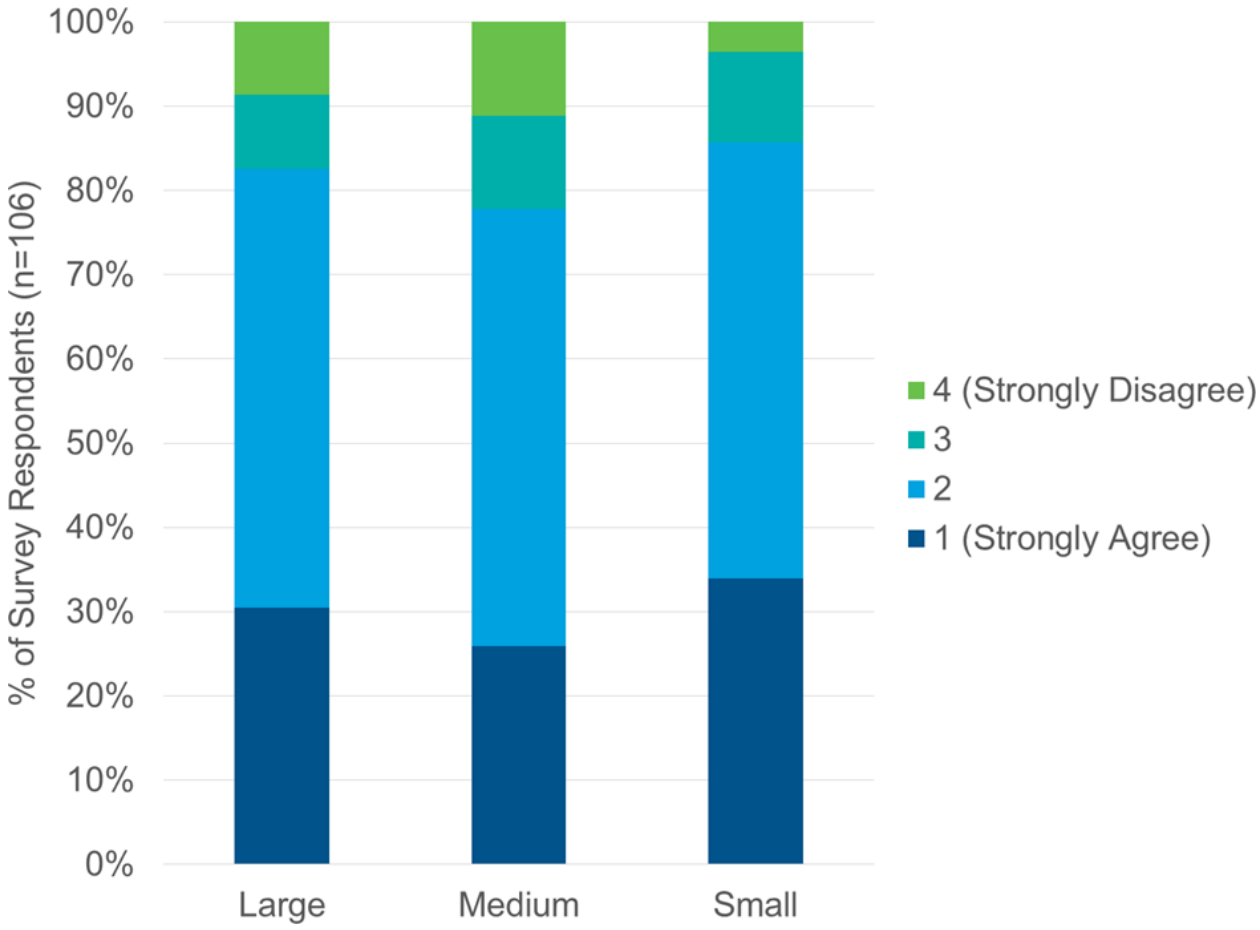
A majority of municipal survey respondents disagreed with the statement that they have revisited their contracts with current suppliers (e.g. municipal water, laundry, janitorial, or mechanical repair) to improve their energy performance (see Exhibit 62).

Exhibit 62: Percentage of Municipalities that agree that they have Revisited Contracts to Improve Energy Performance, by Municipality Size



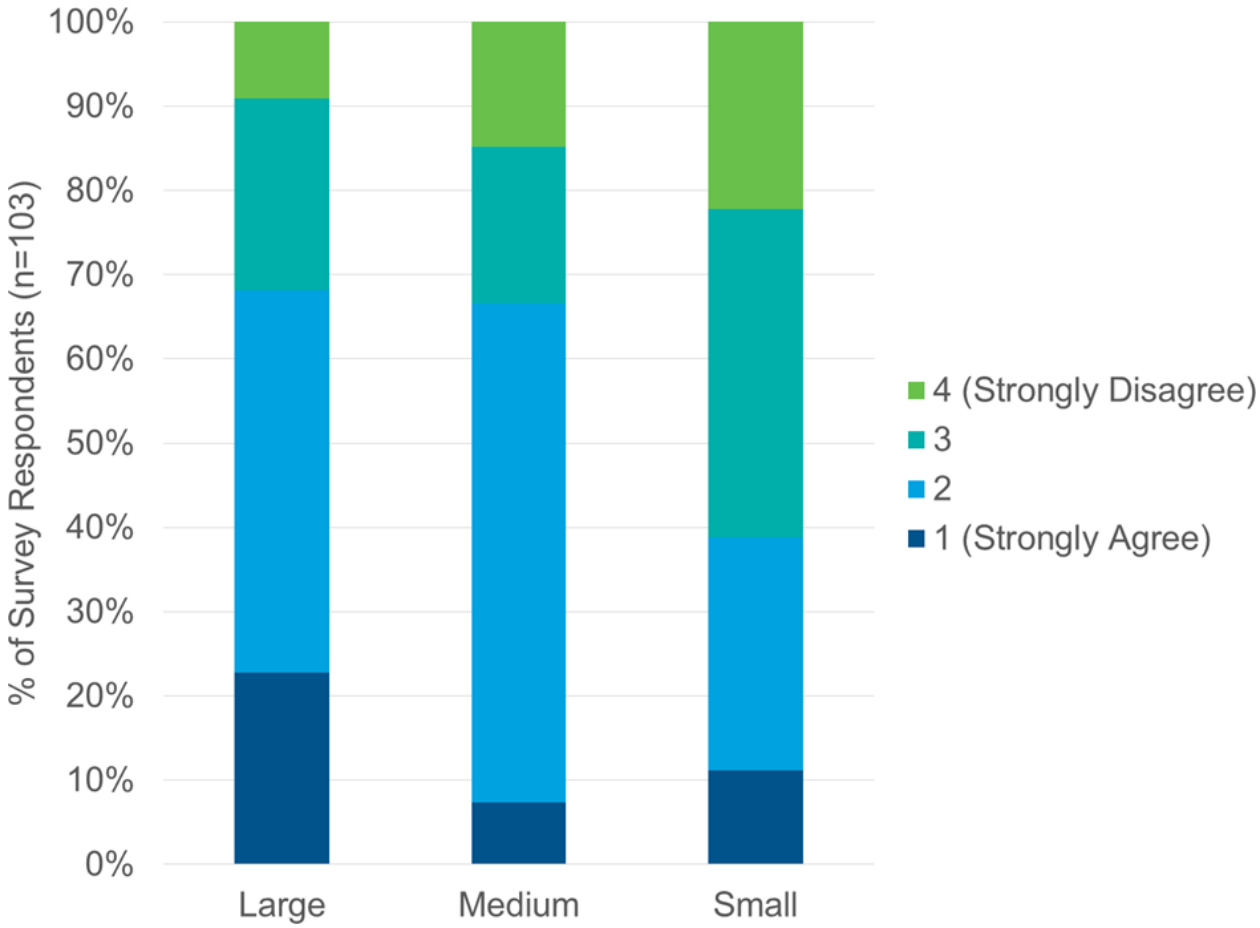
A large majority of municipal survey respondents agreed with the statement that they are more prone to considering comprehensive retrofit projects of ageing buildings or facilities to increase their energy performance. This is shown in Exhibit 63.

Exhibit 63: Percentage of Municipalities that agree that they are more likely to Consider Comprehensive Retrofit Projects, by Municipality Size



A majority of Large and Medium municipal survey respondents agreed with the statement that they learned how to access more sources of funding for capital projects in addition to the rate base. However, most Small municipal respondents disagreed with this statement as seen in Exhibit 64.

Exhibit 64: Percentage of Municipalities that agree that they Learned how to Access Additional Funding Sources, by Municipality Size



2019 Conservation and Demand Management Plans

Municipalities are required to update their five year conservation and demand management (CDM) plans by July 1, 2019. In the 2017 Municipal Energy Profile Survey, municipalities were asked if their 2019 CDM Plan will be exclusively focused on actions and measures that their municipality will intend to deploy, or if they will also use the planning exercise to establish a higher-level energy policy or framework. As shown in Exhibit 65, 65% of Large municipalities, 57% of Medium municipalities, and 40% of Small municipalities responded that they will work on actions and measures that they intend to deploy, and will also use the planning exercise to establish a higher- level energy policy or framework. A smaller proportion of municipalities indicated that their plan will exclusively focus on actions and measures that their municipality

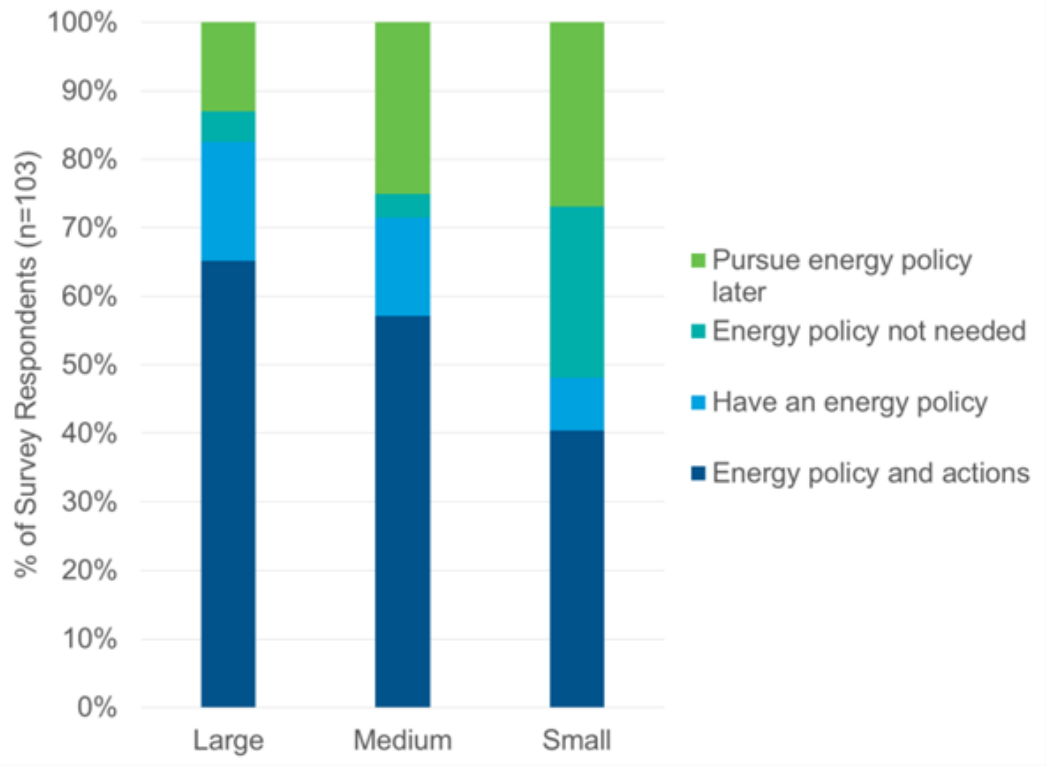
will intend to deploy because they already have a corporate energy policy. 25% of Small municipalities indicated that their plan will exclusively focus on actions and measures that their municipality will intend to deploy, and find a higher-level energy policy or framework not needed or relevant to their municipality. The remainder of municipal respondents indicated that their plan will exclusively focus on actions and measures that their municipality will intend to deploy, and may seek to work on a corporate energy policy later in the future.

Municipal Highlights: Lessons Learned and Plans for Upcoming CDM Cycle

Upon review, the City of Brampton realized that their 2014 CDM targets were too ambitious compare to the CDM targets of other similar sized municipalities. The City had set an energy consumption reduction target of 30%, but what was actually achievable was 10%. For the upcoming 2019 CDM plan, the City of Brampton will aim to set new targets in line with CEP and provincial GHG targets. (City of Brampton, 2017).

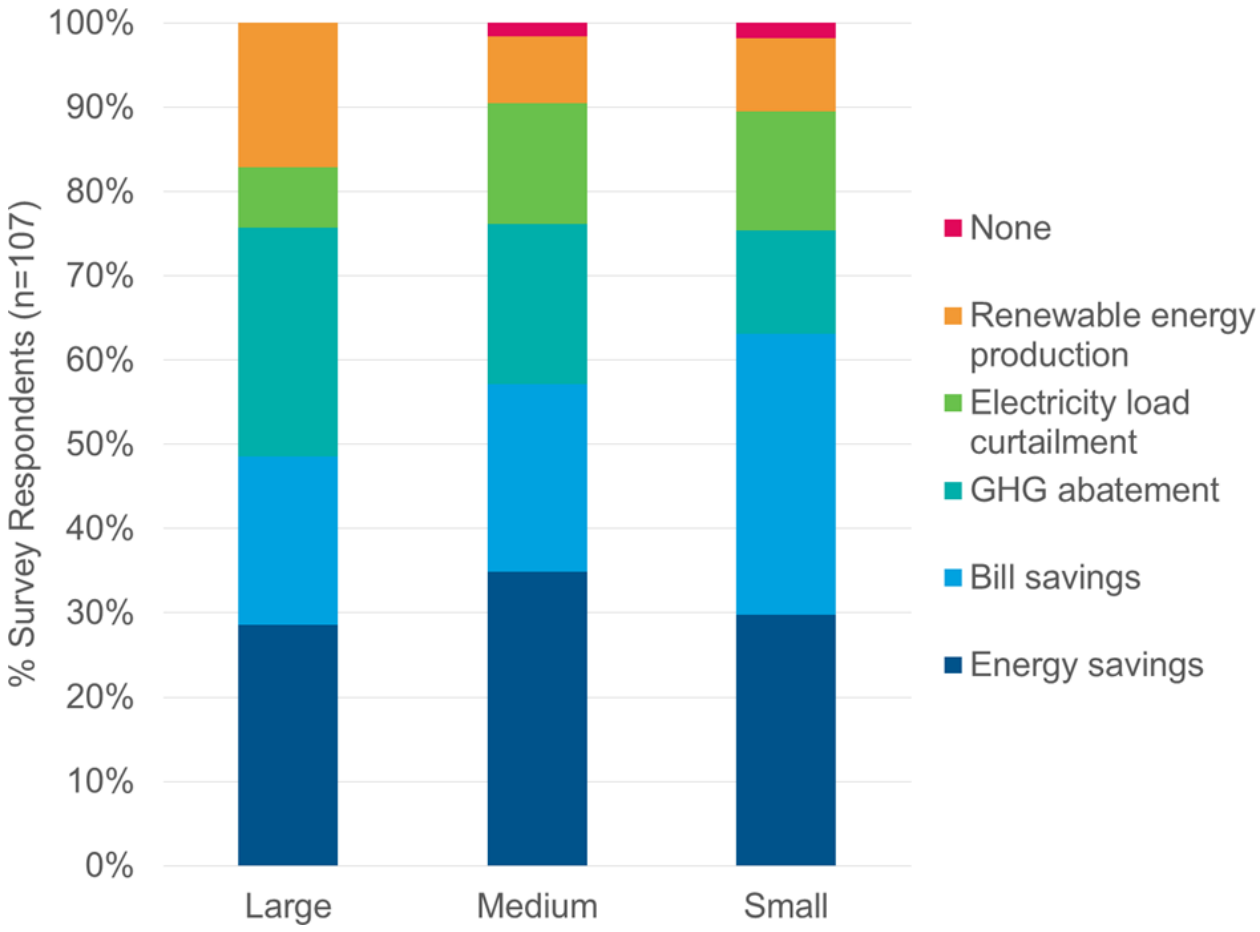
The City of Guelph identified that the scope of their 2014 CDM plan was too narrow and focused primarily on energy audits. For their upcoming 2019 CDM plan, the City has created a cross-functional advisory group that will include managers from departments across the corporation that have a stake in climate change and environmental sustainability, including but not limited to, Parks and Finance. The City would like to extend the scope of their CDM plan to include water and wastewater services as well as behavioural measures (City of Guelph, 2017).

Exhibit 65: Percentage of Municipalities Establishing Corporate Energy Policy through CDM Planning, by Municipality Size



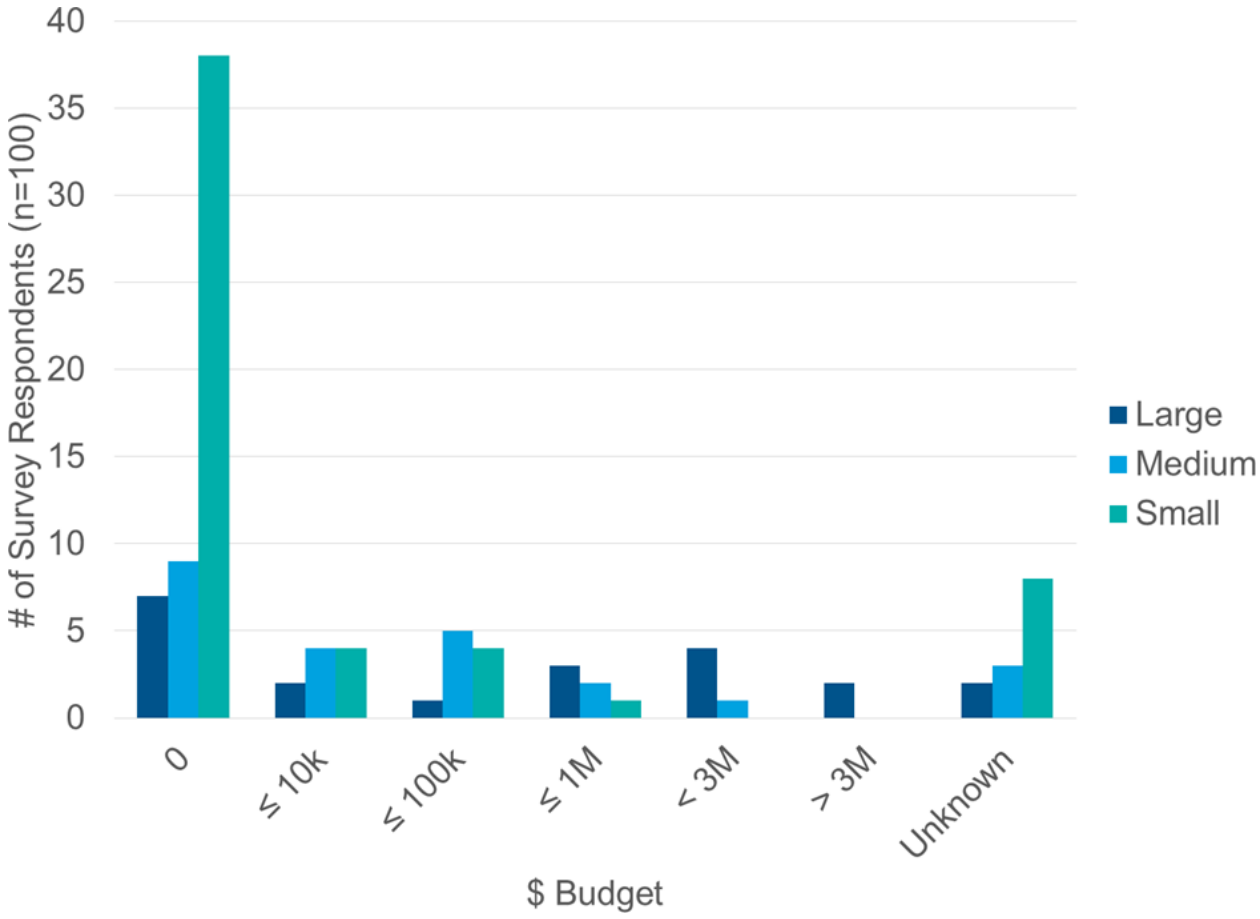
Surveyed municipalities were asked which metric(s) for measuring success they intend to use for their 2019 Conservation and Demand Management (CDM) Plan. The options included: energy consumption savings (in % of total, in kWh, cubic meters of gas, GJ and/or any other metric of energy consumption); electricity load curtailment (in % of total or in kW); bill savings (in % of energy bills, or in $); greenhouse gas abatement (in % of total, or in tonnes of carbon dioxide (CO2) equivalent); renewable energy production (in % of total consumption, in kWh, cubic meters of renewable gas, GJ or any other metric of energy production); and “we do not intend to use any metric”. Survey respondents were able to select multiple metrics, and the results are presented in Exhibit 66. The top 3 metrics that municipal survey respondents indicated that they intend to use for their 2019 CDM plan are energy consumption savings, bill savings, and greenhouse gas abatement.

Exhibit 66: Metrics Municipalities Intend to Use for the 2019 CDM Plan, by Municipality Size



Surveyed municipalities provided the dollar amount that their municipality has set aside in their capital budget for implementing sustainable energy measures and projects, in anticipation of their 2019 CDM plan. The results are presented in Exhibit 67. 54 municipalities indicated they have $0 set aside, and another 13 municipalities were unsure at the time of completing the survey. Budget amounts provided by Large municipalities ranged from $5,000 to $15.8 million. Budget amounts provided by Medium sized municipalities ranged from $200 to $2.1 million. Budget amounts provided by Small municipalities ranged from $1,000 to $250,000.

Exhibit 67: Municipal Capital Budget Intended for Sustainable Energy Projects in 2019 CDM Plan, by Municipality Size



4.2 Community Energy Planning

The Ministry of Energy offers funding to municipalities to assist their development of community energy plans through the Municipal Energy Plan Program. Municipal survey participants were asked if they were aware of the Municipal Energy Plan Program; 87% of Large municipal respondents answered “Yes”, whereas 54% of Medium sized municipal respondents and 47% of Small municipalities were aware of the program.

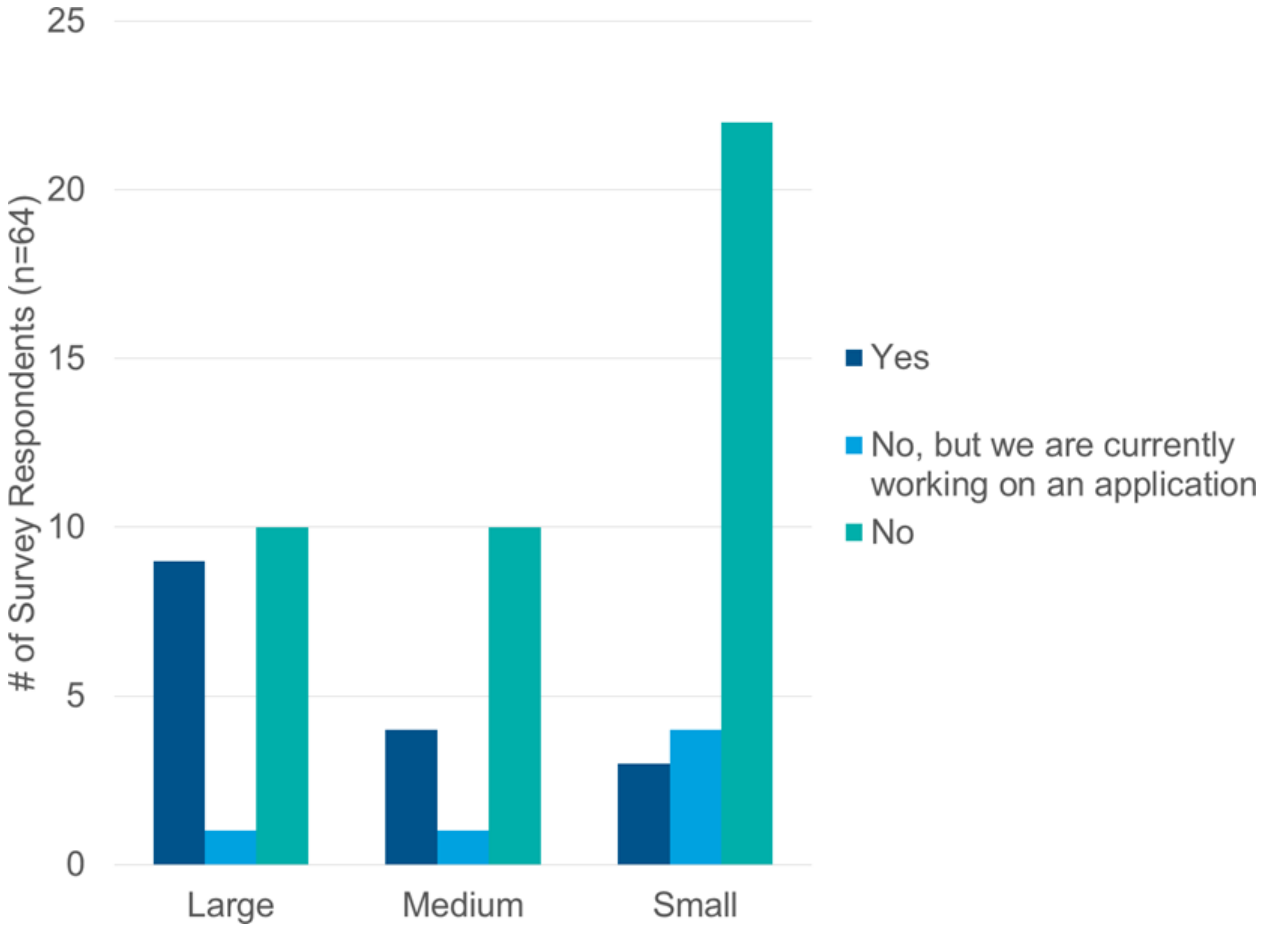
The municipal survey respondents that indicated that they were aware of the program were then asked if they had applied to the Municipal Energy Plan Program. As shown in Exhibit 68, 16 municipalities indicated that they had applied to the program, and another 6 are currently working on applications. The main explanation provided for the municipal respondents that indicated they had not applied to the program is their limited human resources.

The City of Brampton: Inspiration for developing a Community Energy Plan

In May 2014, Brampton City Council approved Brampton’s first Environmental Master Plan - “Brampton Grow Green”. Among the initiatives cited in the Plan is the development of a Community Energy Plan, which started in February 2018 and is developing. The municipal energy plan was conceived from an opportunity to collaborate with Sheridan College on a district heating project that is intended to connect the City’s South Fletchers Sport Plex with Sheridan College. The City is interested in merging its plan with that of the community to tap into similar opportunities (City of Brampton via email, 2018) (City of Brampton, 2017).

Exhibit 68: Municipal Survey Respondents Applying for the Ministry of Energy’s Municipal Energy

Plan Program, by Municipality Size



5. Financing

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding the financing of sustainable energy capital-intensive projects by answering "Yes", "No", or "Partial" to the following:

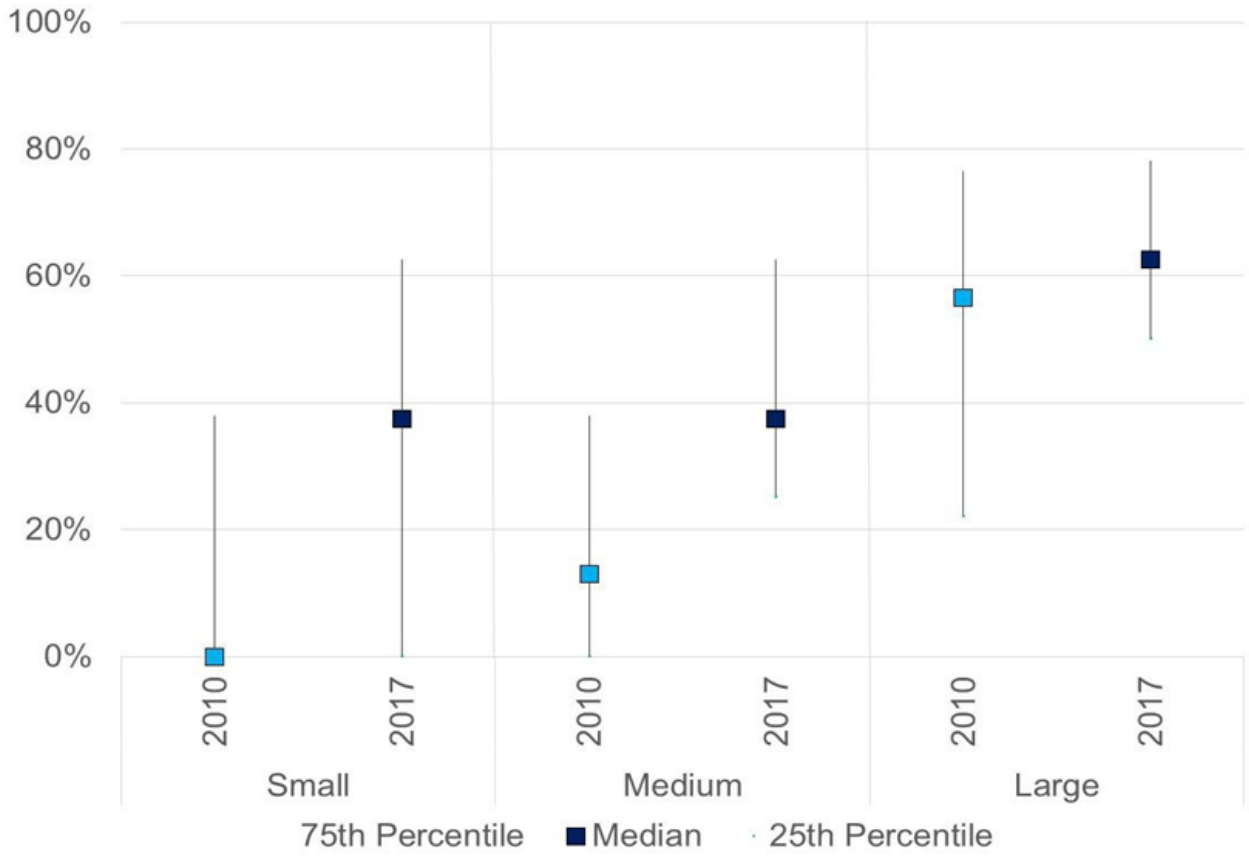
- The municipality has formalized procedures for funding energy management projects.
- Energy management projects have the same level of authority and importance than other projects when allocating funds of the capital and operational budget.
- The municipality requires the business case development for all energy management projects to include an assessment of energy cost avoidance, maintenance cost reduction, and greenhouse gas emissions.
- The municipality requires energy management investments to be assessed based on a life-cycle cost methodology.

Exhibit 69 illustrates a breakdown of the Financing category scores by municipality size. It can be seen that the median scores in implementation of Financing best practices have improved for municipalities of all population sizes in 2017 relative to 2010. Small municipalities had the highest increase in their median scores from 0% in 2010 to 38% in 2017.Small and Medium municipalities achieved the same median scores in 2017 (both at 38%) as their 75th percentile scores in 2010. In 2017, both Small and Medium sized municipalities had similar median (38%) and 75th percentile scores (63%).

Small municipalities had the highest spread of scores between their 25th and 50th percentile scores. While their median and 75th percentile Financing scores improved from 2010 to 2017, their 25th percentile Financing score remained at 0%. This suggests learning opportunities in sharing of Financing best practices among best and least performing Small municipalities.

Large municipalities achieved a 28% improvement in their 25th percentile Financing scores from 2010 to 2017. However, there were relatively immaterial improvements in their 75th percentile (1%) and median (6%) scores. This suggests that from 2010 to 2017, the least performing Large municipalities are getting caught up with the best performing Large municipalities in the implementation of Financing best practices.

Exhibit 69: Financing Score by Municipality Size, 2010 vs. 2017

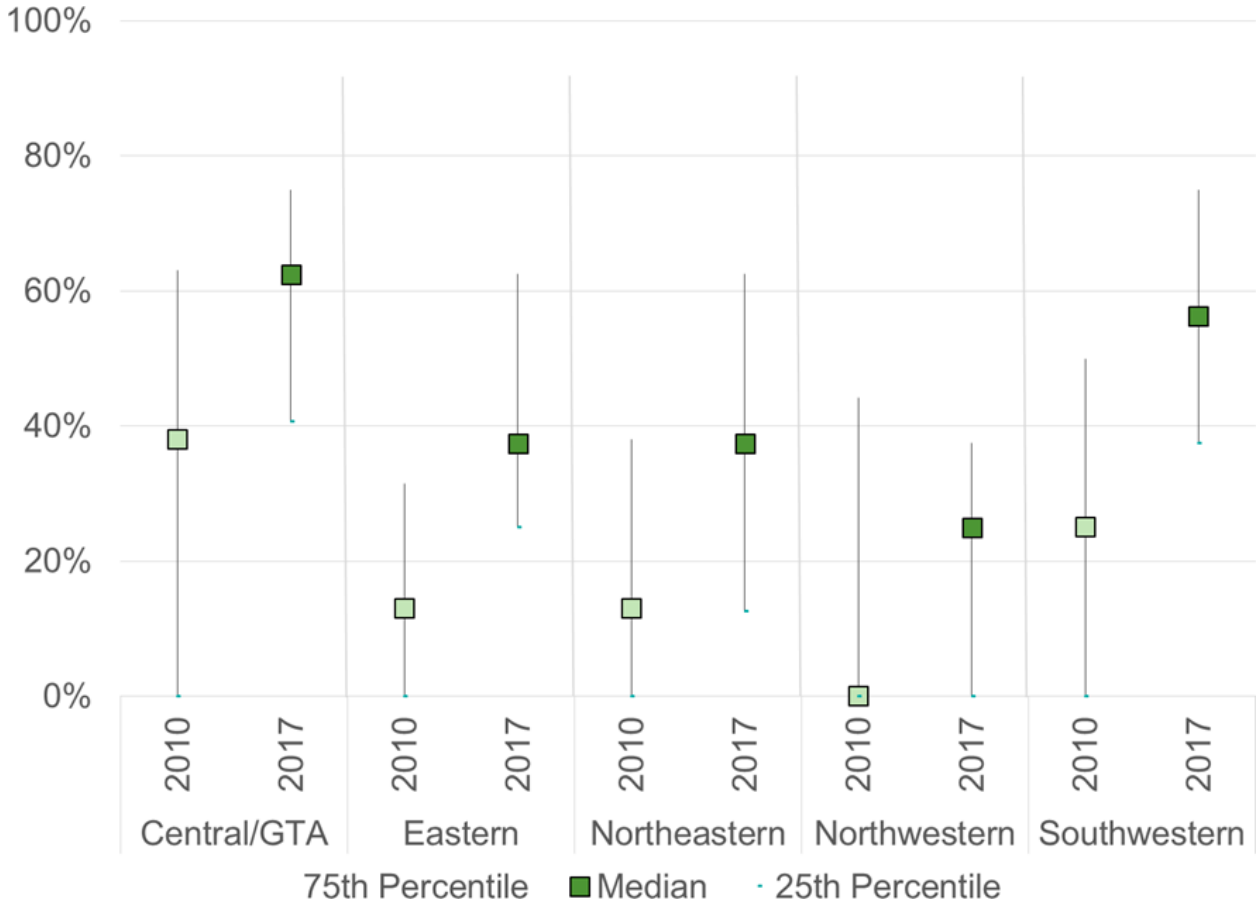


As shown in Exhibit 70, in 2010, municipalities in all regions had their 25th percentile Financing scores at 0%. By 2017, all regions managed to improve their 25th percentile Financing scores (by 13% in Northeastern and 41% in Central/GTA) except for the Northwestern region, where the 25th percentile Financing scores remained at 0%.

In 2017, municipalities in the Eastern and Northeastern regions both achieved the same 75th percentile Financing score of 63%, a similar score to the 2010 75th percentile Financing score of the Central/GTA region.

The highest Financing competency was achieved by municipalities in the Southwestern and Central/GTA regions, where both regions had a similar performance in their 25th percentile (38%-41%), median (56% to 63%), and 75th (75%) percentile Financing scores.

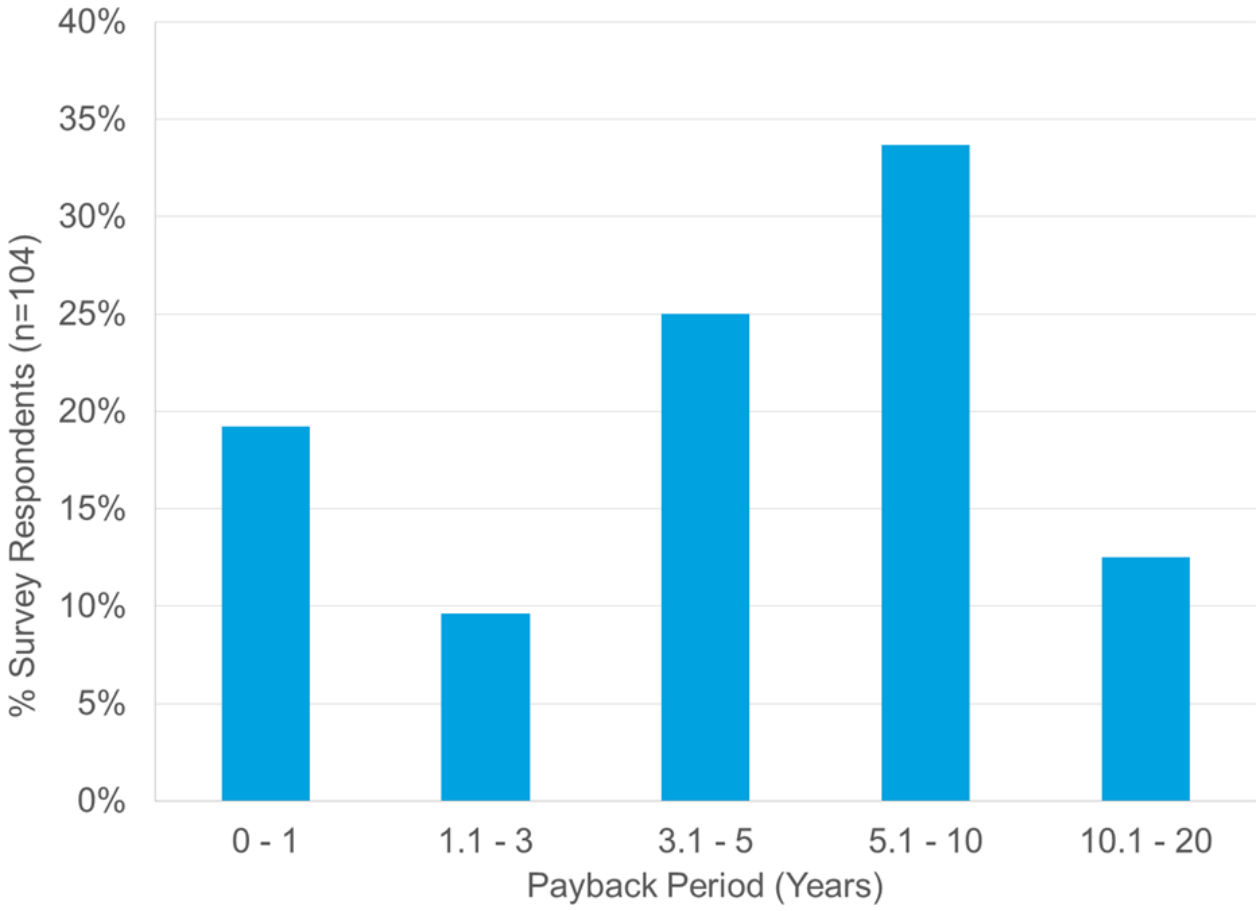
Exhibit 70: Financing Score by Region, 2010 vs. 2017



5.1 Municipal Hurdle Rates

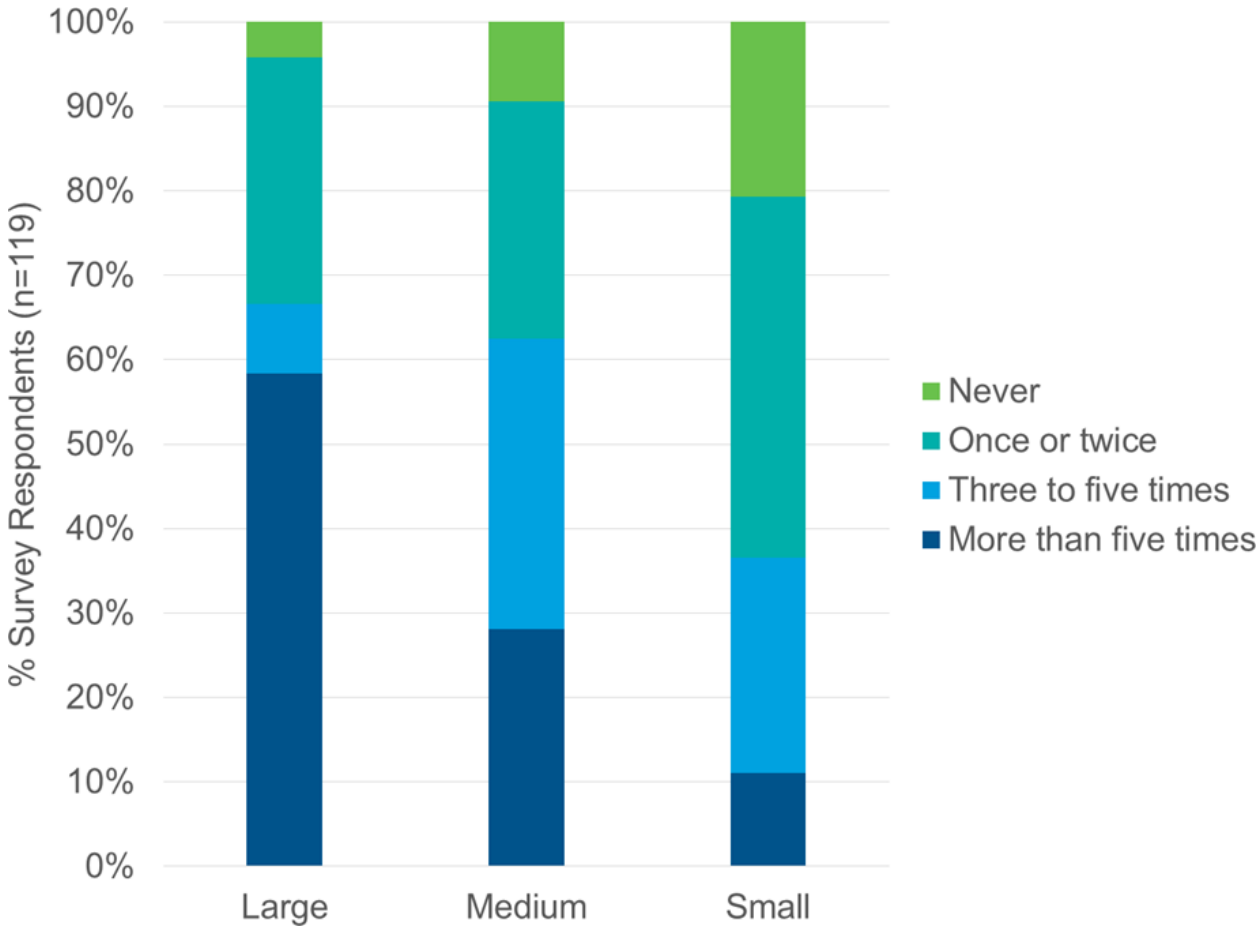
The 2017 Municipal Energy Profile survey asked municipalities to indicate on a scale between 0 and 240 months (20 years) the maximum simple payback period (the hurdle rate) tolerated by their municipality, when deciding whether or not to pursue a capital-intensive project in sustainable energy. As shown in Exhibit 71, most municipalities have a fairly high tolerance for projects with longer simple payback periods. 34% of survey respondents tolerate a maximum payback period of over 5 years and less than or equal to 10 years.

Exhibit 71: Maximum Simple Payback Period Tolerated by Municipalities for Sustainable Energy Projects



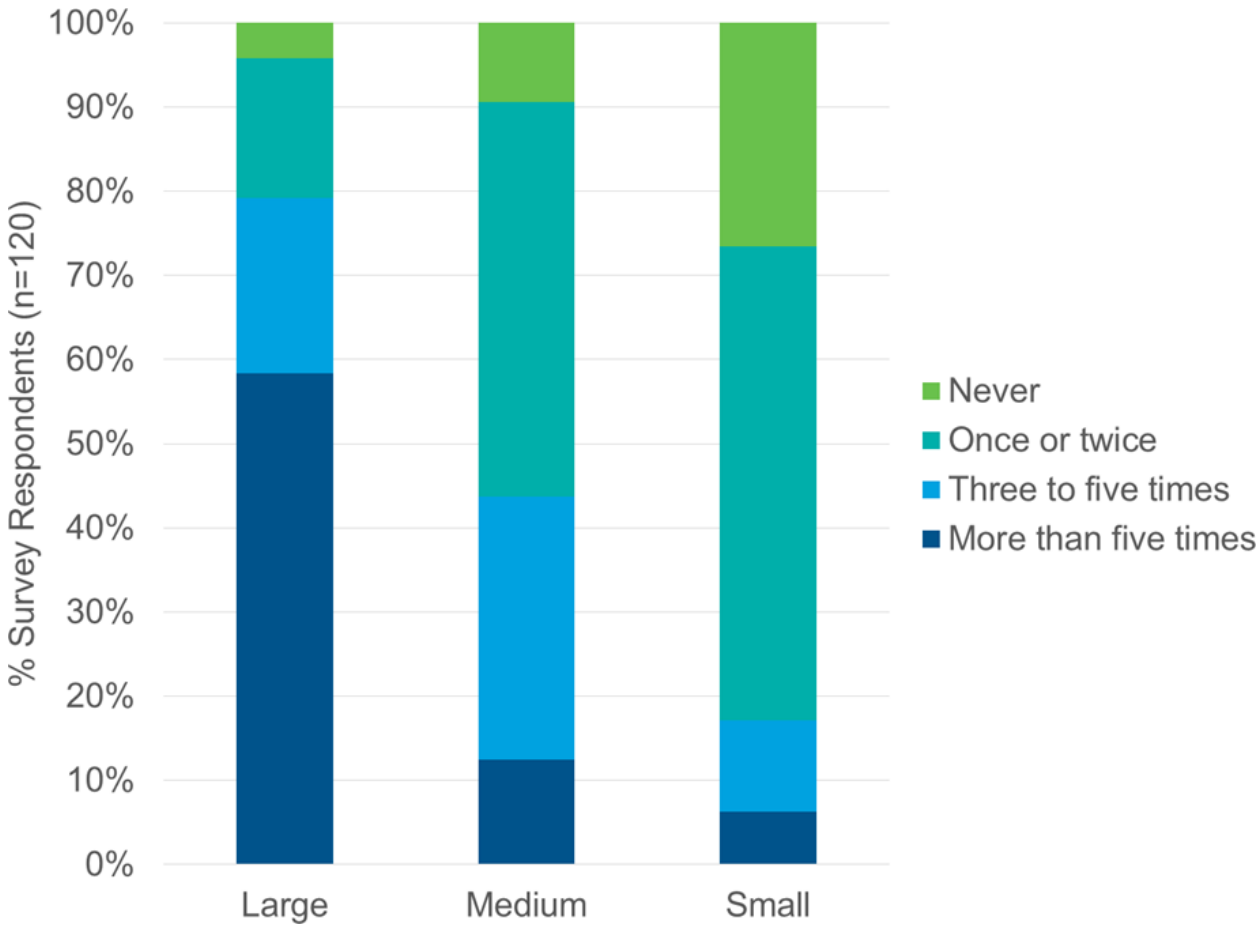
As demonstrated in Exhibit 72, a large majority of municipal survey respondents have funded at least one low-cost energy project through their municipal operational budget over the last 5 years. Large municipalities have funded the largest number of low-cost energy projects, relative to other municipal respondents.

Exhibit 72: Percent of Municipalities that have Funded Low-Cost Energy Projects through their Operational Budget over the Last 5 Years, by Municipality Size



Similar trends can be seen in municipal responses to the survey question regarding their frequency of scheduling capital-intensive projects through the municipal capital budget over the last 5 years (see Exhibit 73). However, in this case the majority of Medium and Small municipalities have scheduled capital-intensive energy projects through their capital budget just once or twice over the last 5 years.

Exhibit 73: Percent of Municipalities that have Scheduled Capital-Intensive Energy Projects through their Capital Budget over the Last 5 Years, by Municipality Size



5.2 Availability of Funding

In the 2017 Municipal Energy Profile survey, municipalities were asked to indicate to what extent they agree with statements relating to availability of funding, by selecting from a score from 1 (strongly agree) to 4 (strongly disagree). The results are presented in the following 3 exhibits. A majority of municipal survey respondents indicated that they agree that scarcity of tax payer funding is the most important hurdle precluding their municipality from implementing more sustainable energy projects (see Exhibit 74). This is particularly true for Small municipalities such as, Killarney and Burk's Falls, as 69% of Small municipal survey respondents agreed with the statement. The town of Killarney does not have trouble identifying sustainable energy projects, however, funding is a challenge. The municipality has a small tax base and raising taxes is unfavorable (Municipality of Killarney, 2017). The Village of Burk's Falls was interested in performing an energy audit of their mechanical equipment including HVAC systems and generators to identify energy savings opportunities, a project that was estimated would cost between $8,000 to $10,000. Due to lack of funding, however, the project was discontinued (Village of Burk's Falls, 2017).

Exhibit 74: Percentage of Municipalities that agree that Scarcity of Tax-payer Funding is the Most Important Hurdle to Implementing Sustainable Energy Projects, by Municipality Size

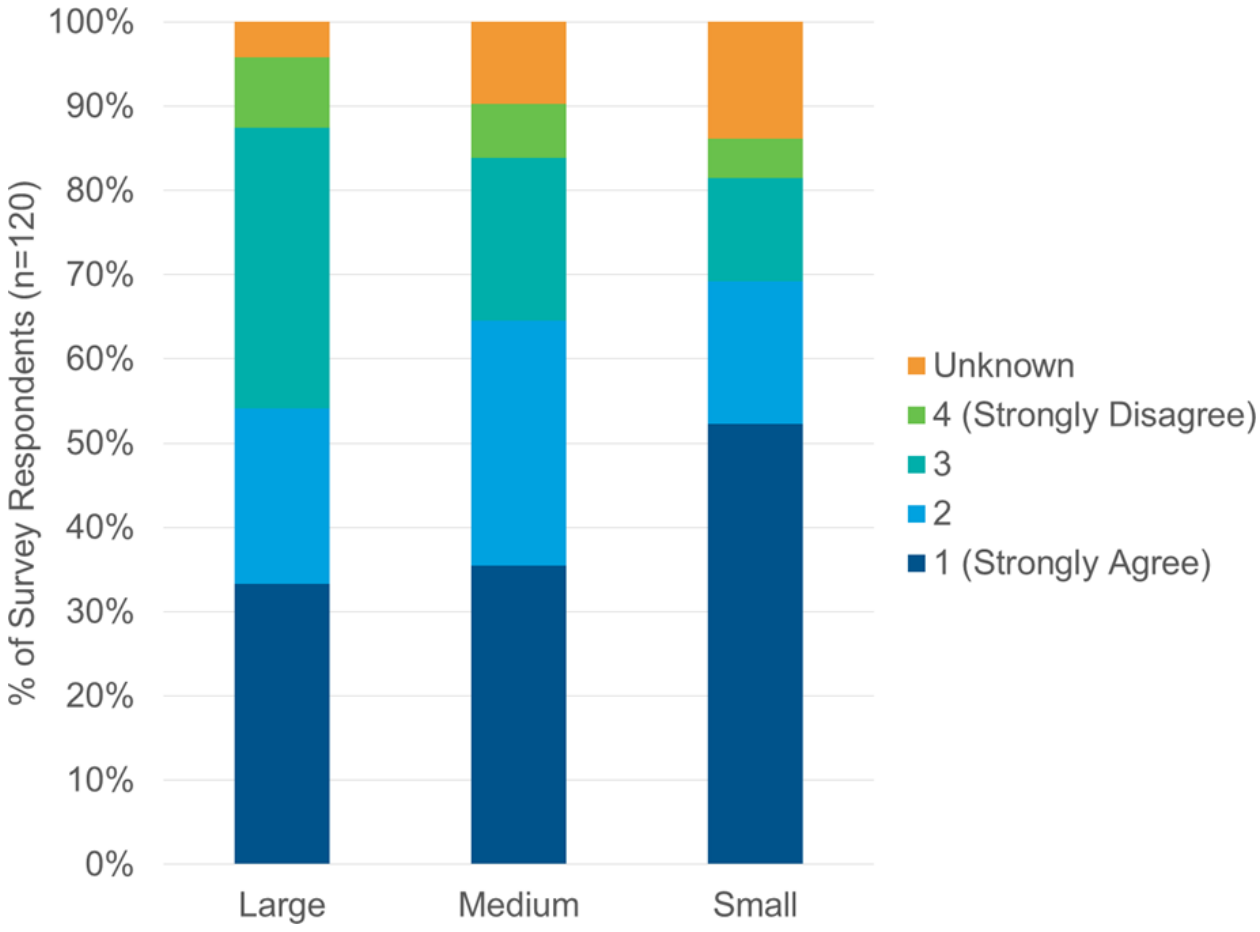
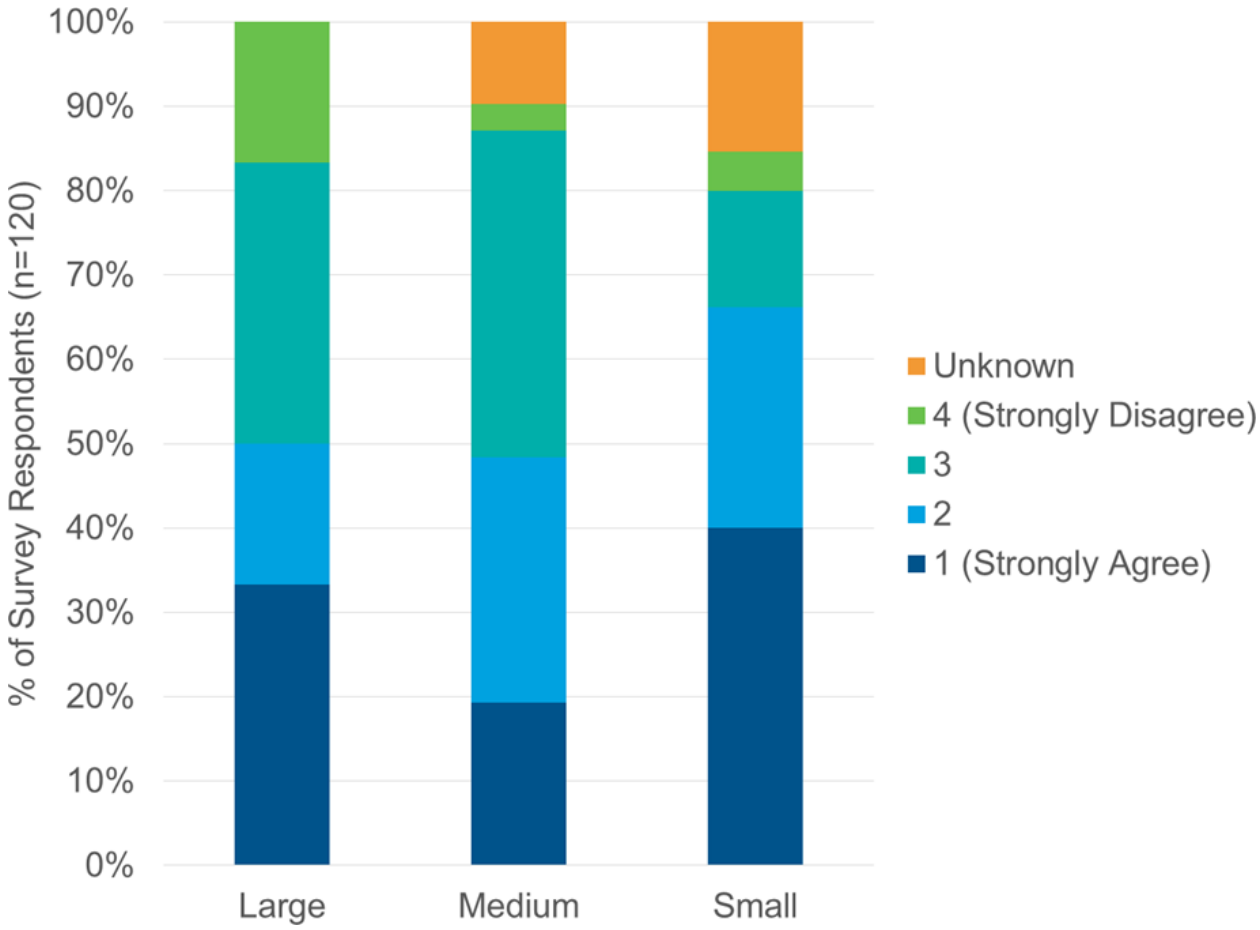


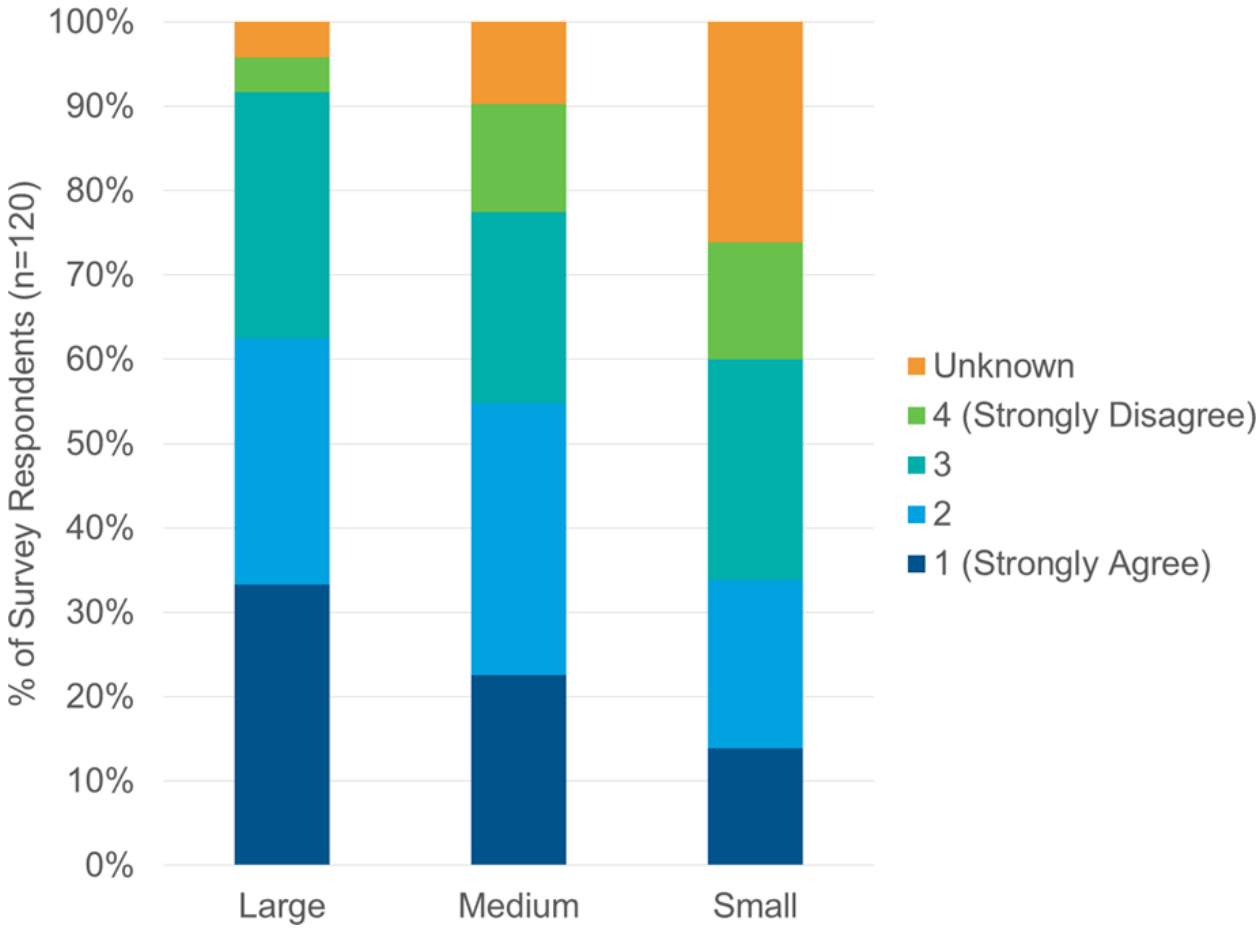
Exhibit 75 illustrates that approximately half of Large and Medium municipal survey respondents agreed that there is a lack of alternate sources of funding for projects in the market at the moment (grants, incentives or subsidies). A larger portion (66%) of Small municipal survey respondents agreed that there is a lack of alternate sources of funding.

Exhibit 75: Percentage of Municipalities that agree that there is a Lack of Alternate Sources of Funding for Projects in the Market, by Municipality Size



A majority of Large and Medium municipal survey respondents agree that in the last five years, they have found that incentives offered by their local distribution company have been a good source of funding for their projects (see Exhibit 76). In contrast, only 34% of Small municipal respondents agreed with that statement.

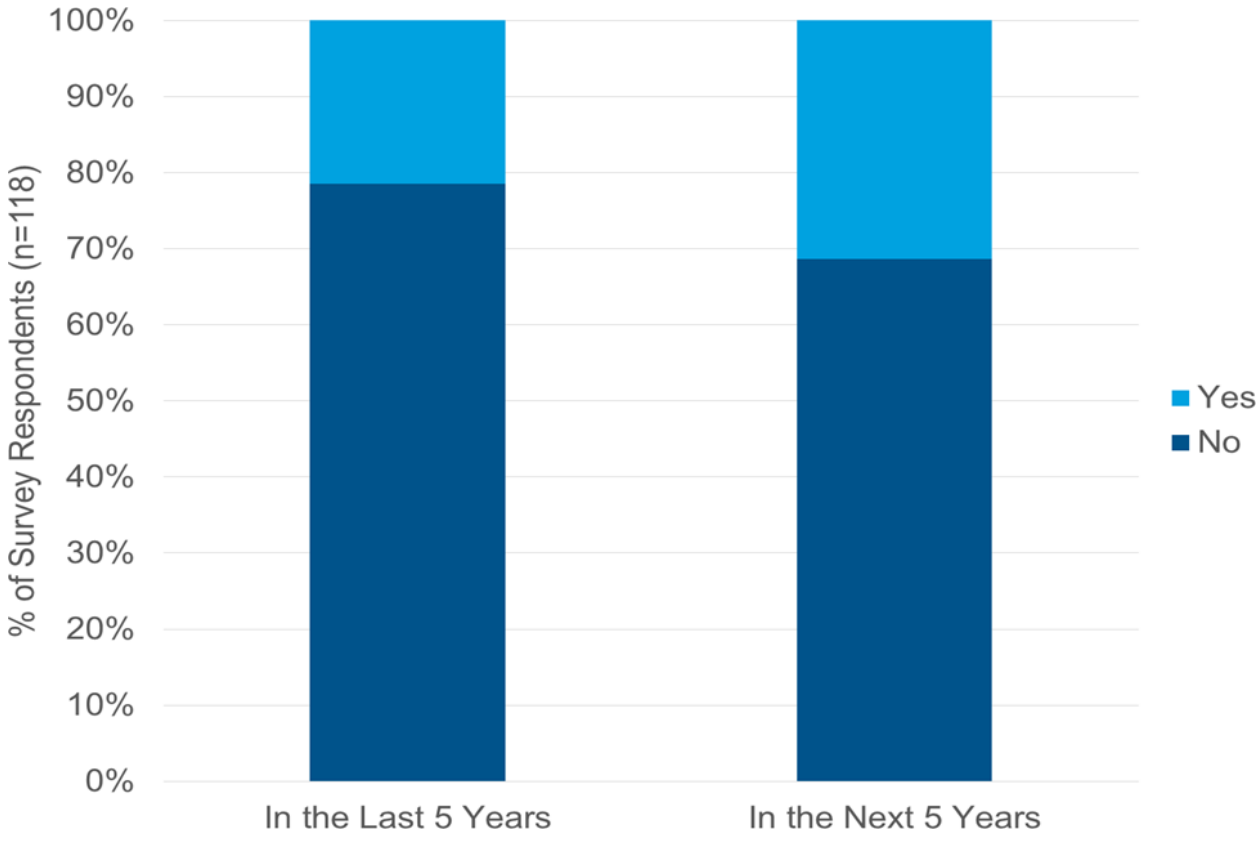
Exhibit 76: Percentage of Municipalities that agree that Incentives Offered by LDCs have been a Good Source of Funding for Projects in the Last 5 Years, by Municipality Size



5.3 Financing Options

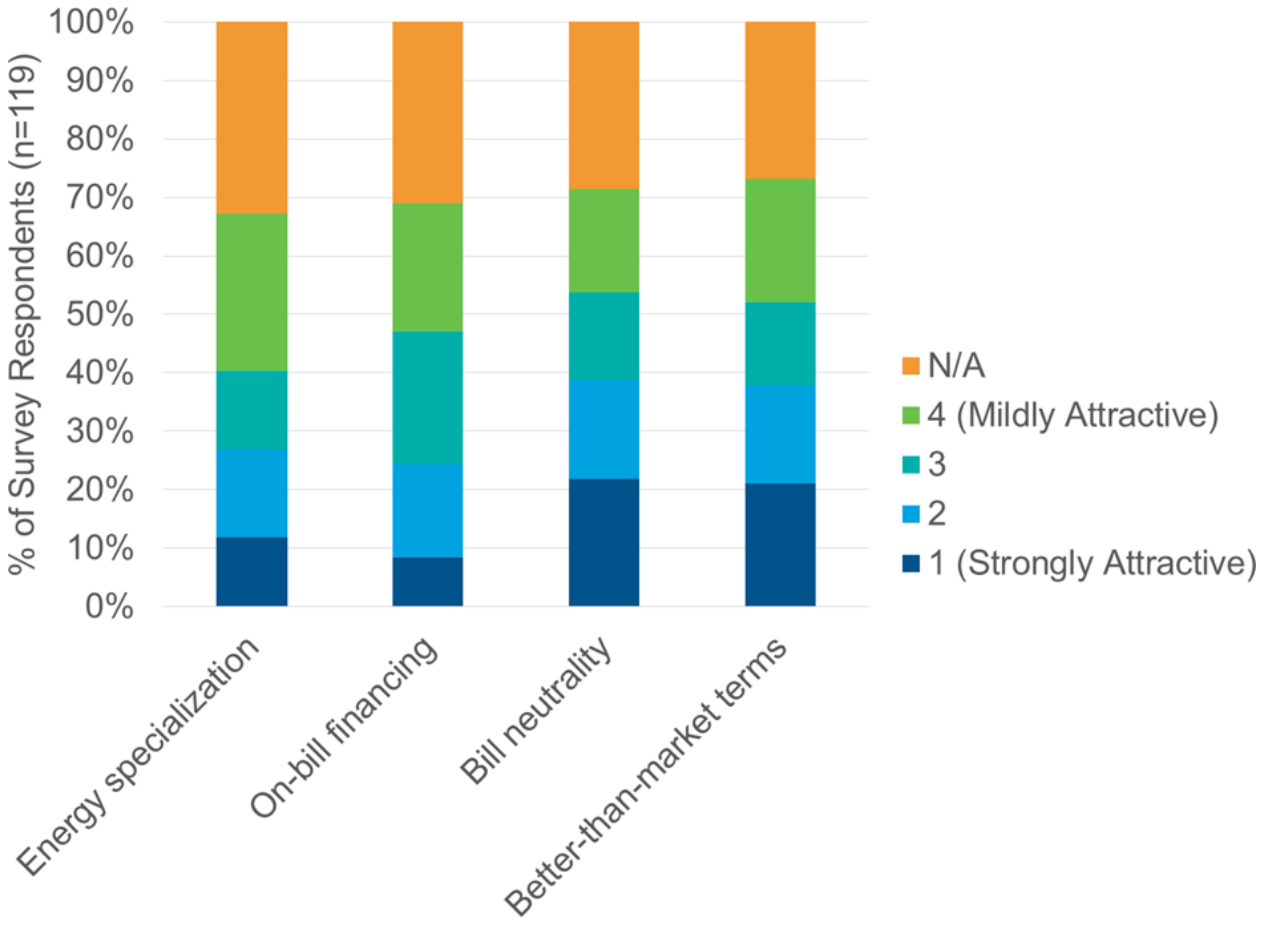
A large majority (79%) of municipal survey respondents indicated that their municipality has not raised debt (i.e. taken a loan) to fund sustainable energy projects. A slightly lower percentage (69%) indicated that their municipality cannot raise debt to fund sustainable energy projects. This situation is illustrated in Exhibit 77.

Exhibit 77: Percentage of Municipalities that Have Not and Will Not Raise Debt to Fund Sustainable Energy Projects



In the 2017 Municipal Energy Profile survey, municipalities were asked to rank the attractiveness of new debt financing options (loans) for their municipality from 1 (Strongly attractive) to 4 (Mildly attractive). The results are presented in Exhibit 78. The new debt financing options presented include a new lender or new services specializing in sustainable energy projects with whom it would be easier to discuss energy projects than it is to discuss such projects with the municipality's regular lender(s); a new lender or new services that would have the ability to incorporate loan payment installments as a line item within electricity or natural gas bills (known as "on-bill financing"); a new lender or new services that would offer loan payment installments that are lower or equal to the energy bill savings expected from projects (known as "bill neutrality"); and a new lender or new services that offers better-than-market loan terms such as lower interest rates and/or longer payment periods. Of the four options, municipalities seemed to be most interested in bill neutrality and better-than-market terms.

Exhibit 78: Municipal Opinions of New Debt Financing Options



5.4 Innovative Financial Markets

Municipality of Huron East: Solar Photovoltaic Reserve Policy

Since 2011, a total of eight microFIT projects were installed in the Municipality of Huron East. In 2016 with several of the initial installations now being within 2-3 years of the breakeven point and the balance shortly thereafter, revenues generated from these projects were directed to a reserve fund and the Municipality's Council formally adopted the Solar Photovoltaic Reserve Policy, which instructed that the reserve fund created from the microFIT projects would be dedicated for the sole purpose of funding energy retrofit and conservation projects (Municipality of Huron East, 2017). As part of the policy, there was a requirement for an annual report to Council to report the balance of the reserve and projects funded, which will also be used to update the Municipality's Municipal Energy Plan in 2019. Two projects, each with a total approximate cost of $30,000, have already been funded from the solar photovoltaic reserve, including: (1) Retrofit of a floating head pressure system and a variable frequency drive for condensers in the Seaforth arena; and (2) Replacement of 27 metal halide light fixtures over the ice pad with LED fixtures in the Brussels Arena (Municipality of Huron East via Email, 2017).

Region of York: Green Energy Reserve

The Region of York developed a 'Green Energy Reserve,' where revenues from FIT and microFIT programs and retrofitting savings are directed to a reserve, which will be used to fund additional sustainability projects. The Region's Council is matching these funds initially in order to build up the reserve. The anti-idling ambulances project, a $1.3M project that will include the potential for installing solar panels on top of paramedic and ambulance vehicles, is the type of project that could be supported by this fund (Region of York, 2017).

Town of Caledon: Energy Revolving Fund

In 2015, the Town of Caledon established the Energy Revolving Fund to finance energy retrofit projects with payback period of 10 years or less. The Fund was created using revenues generated from three solar microFIT projects, and is "revolving" in the sense that savings from the projects are returned ("recycled") back into the Fund

(Town of Caledon, 2017). The Fund will cover the cost of an energy retrofit, and the savings realized on the applicable utility line is then diverted back to the fund until the cost of the project is paid in full. Once the repayment period is complete, the utility budget is reduced, with a continuous 25% savings being allocated to the Fund. The Town of Caledon has distributed $97,010 of Energy Revolving Funds to support 5 Corporate Energy Team projects, including 3 LED retrofits and the installation of controls system on two ice plants. One key success factor is early engagement with facility operators. This provides a head start on soliciting project ideas and to address any potential challenges associated with the project (Town of Caledon via email., 2017).

Similar revolving funds have also been created in other municipalities including City of Pickering (City of Pickering, 2017) and City of Guelph (City of Guelph, 2017). The City of Guelph had to freeze its revolving fund due to unexpected high priority demands, and therefore recommends taking action (e.g. policy or bylaw) to define how the revenues will be used and steps that must be fulfilled to supersede those conditions (City of Guelph via email, 2017).

Town of Fort Frances: Bundling Costs

Bundling costs is a great way to get the buy-in from Council for large-scale projects of high capital costs. “The Honeywell Project”, a large-scale energy retrofit project for end of life cycle assets at the Town of Fort Frances, was an expensive project for the Town’s Council to approve, with a capital cost of over $3M. The Town’s operation and facilities staff strategically bundled high payback end of life asset replacement projects with high energy saving projects of shorter payback periods to reduce the overall payback period to 12 years, thus creating a successful business case for the project (Town of Fort Frances, 2017).

6. Accountability

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding energy management accountability answering "Yes", "No", or "Partial" to the following:

- The municipality has assigned accountability to a designated senior manager to implement the corporate energy conservation and demand management (CDM) plan and meet the energy use performance targets.
- The municipality additionally spreads the accountability to implement the CDM plan among other managers including facility managers.
- The municipality has documented standards for measurement and verification of energy initiatives in accordance with accepted standards such as the International Performance Measurement and Verification Protocol (IPMVP), or equivalent standards.
- The municipality has sufficient resources in place to adequately measure, track and report its energy performance.

Exhibit 79 provides a breakdown of the Accountability category scores by population size. There have been performance improvements in Accountability scores for municipalities of all sizes since 2010, except for the 25th percentile Accountability score of Small municipalities, which stayed at 0%.

In 2017, the 25% of Medium municipalities scored the same in implementation of Accountability best practices as what 50% of them had achieved in 2010. The 2017 Accountability scores of Medium municipalities are similar in performance to the 2010 Accountability scores of Large municipalities, with a slightly lower 75th percentile (59% vs. 66%).

The highest increases in Accountability scores since 2010 are in the 75th percentiles of Small (25%) and Medium (21%) municipalities. In 2017, Large municipalities had the highest Accountability competency with a 25th percentile of 31%, a median of 50%, and a 75th percentile of 75%.

Exhibit 79: Accountability Score by Municipality Size, 2010 vs. 2017

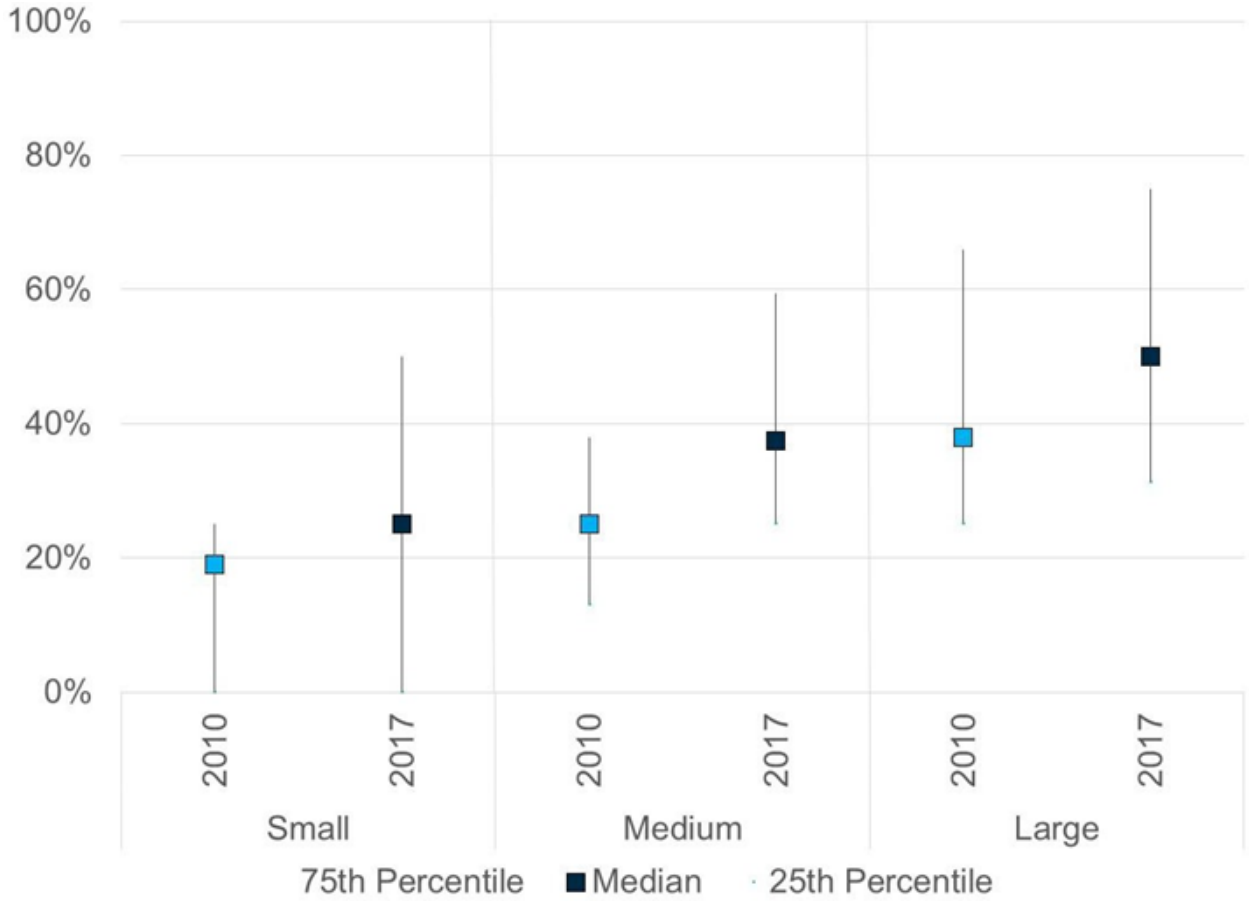


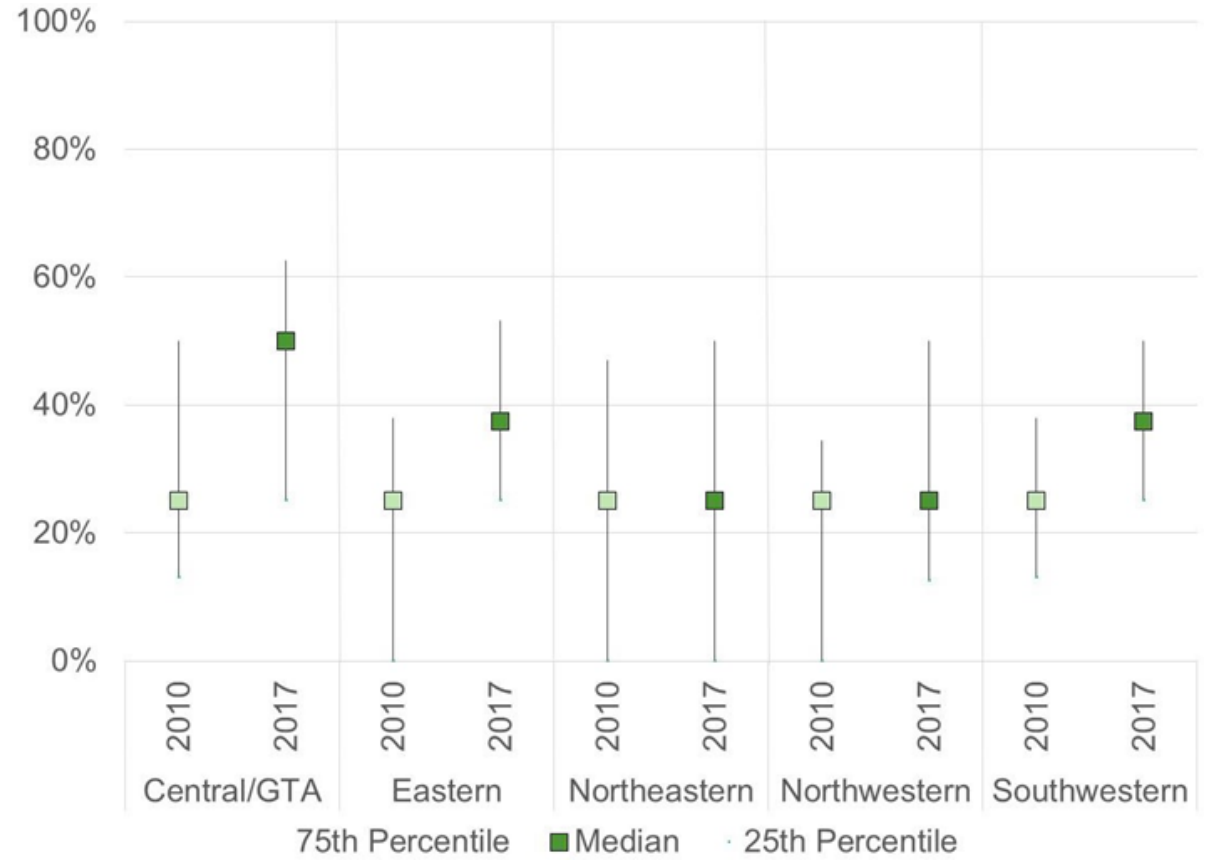
Exhibit 80 provides a breakdown of Accountability scores by geographic regions across the province in 2010 and 2017. It can be seen that in 2010, median Accountability scores for all regions were at 25%. Since then, there has been an improvement of median Accountability scores for all regions except for the Northern regions, where the median scores remained stagnant at 25th. However, municipalities in the Northwestern region achieved an improvement of 15% in their 75th percentile Accountability scores in 2017 relative to 2010. The highest increase of 25% in median Accountability scores was achieved by municipalities in the Central/GTA region.

In 2010, municipalities in the Northern and Eastern regions had a 25th percentile Accountability score of 0%. By 2017, the highest improvement of 25% in their 25th percentile Accountability scores was achieved by municipalities in the Eastern region.

The Accountability performance of municipalities in the Northeastern region remain stagnant from 2010 to 2017, as can be seen by their 25th, median, and 75th percentile scores.

All regions had a 75th percentile Accountability score in the range of 50% to 63%.

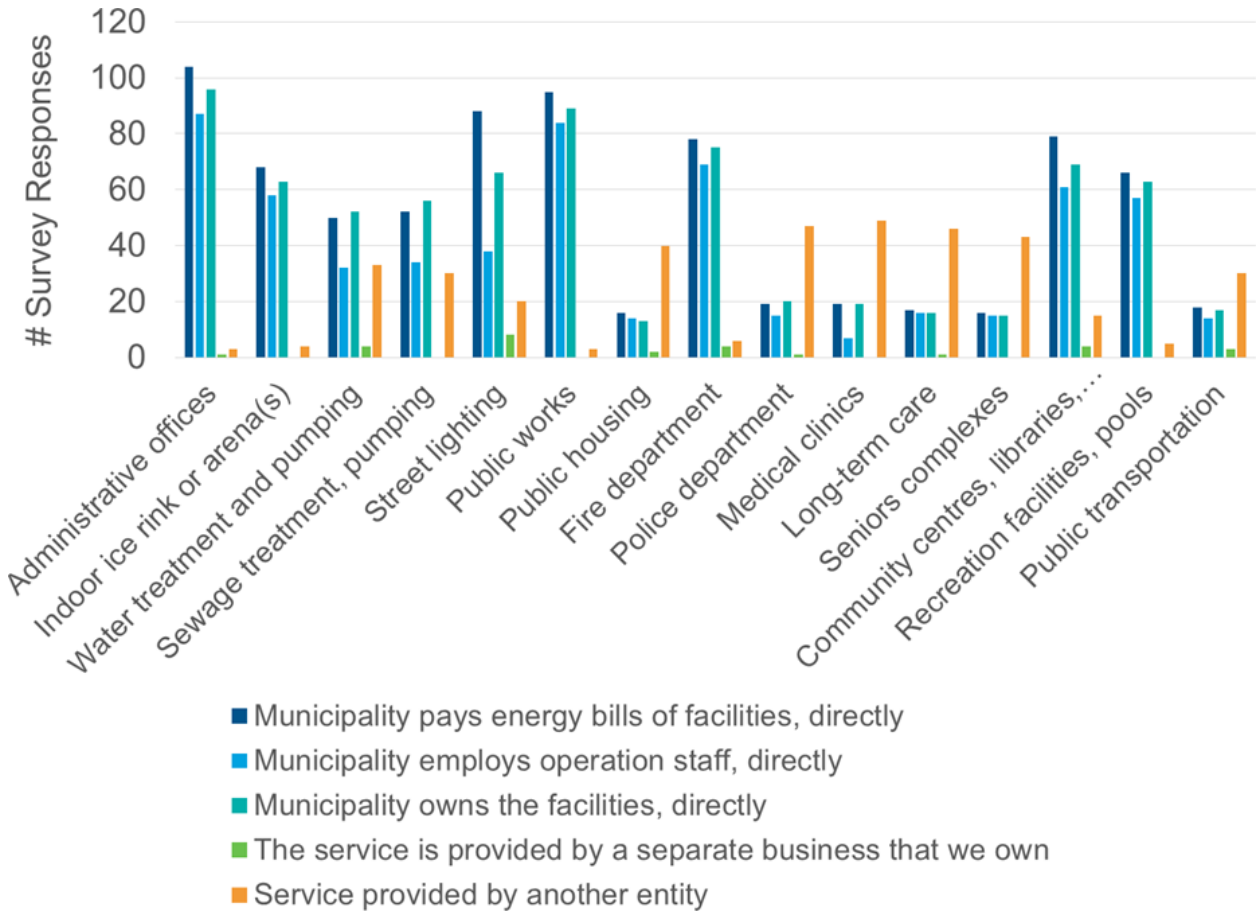
Exhibit 80: Accountability Score by Region, 2010 vs. 2017



6.1 Ownership Structure of Municipal Facilities/Services

In the 2017 Municipal Energy Profile survey, municipalities were asked to indicate whether certain statements, listed in the legend in Exhibit 81, apply to various facilities and services that municipalities may be responsible for. Municipalities were able to select multiple statements per service/facility. As shown in Exhibit 81, municipalities tend to own the facilities and pay energy bills directly. They also employ operation staff for administrative offices, indoor ice rinks or arenas, public works, fire departments, community centres/libraries/galleries/ auditoriums, and recreation facilities/pools. There is a higher rate of services/facilities being provided by another entity for water treatment and pumping, sewage treatment and pumping, street lighting, public housing, policed departments, medical clinics, long-term care, seniors' complexes, and public transportation.

Exhibit 81: Accountability for Municipal Facilities and Services



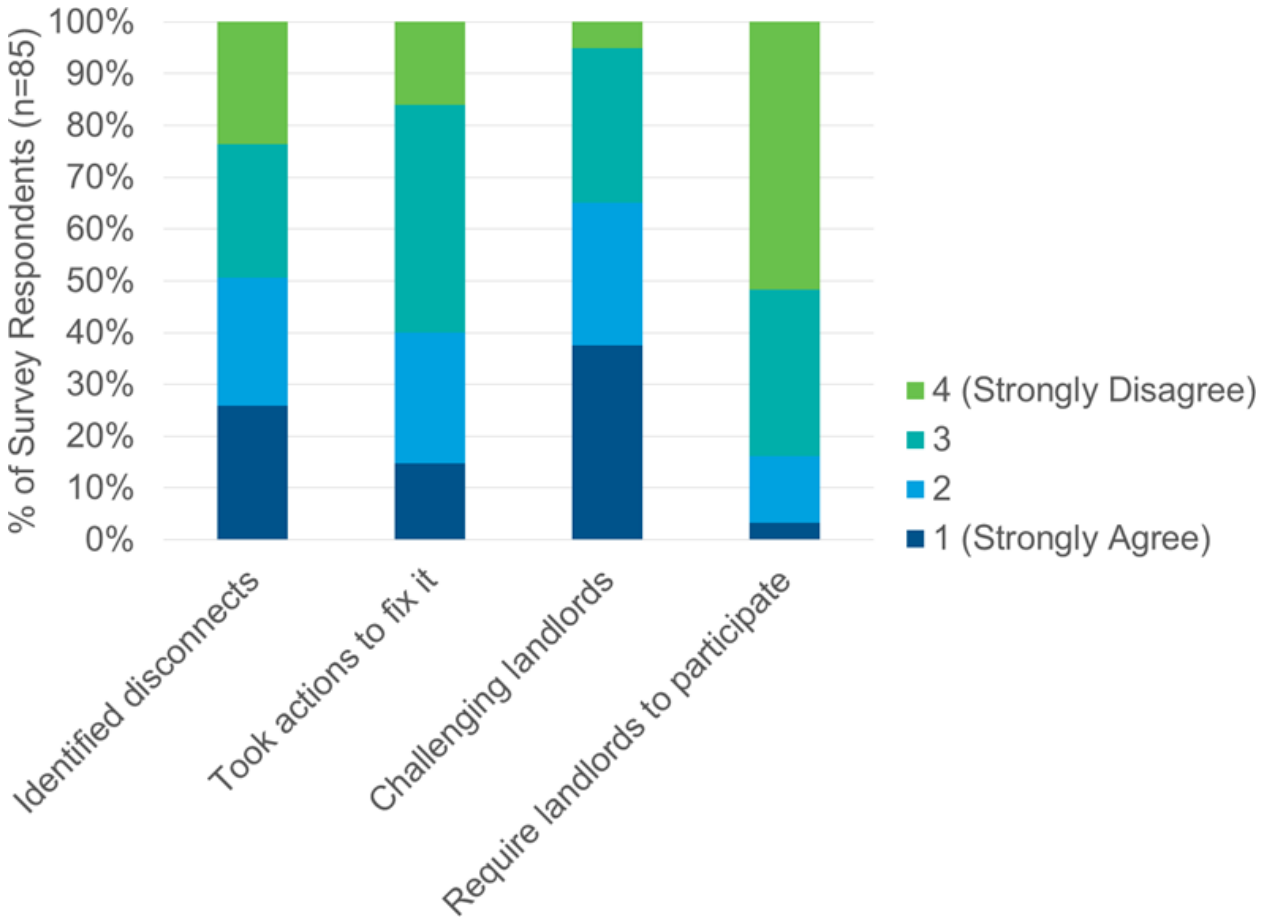
Municipal survey respondents indicated to what extent they agreed or disagreed with statements regarding energy accountability or lack thereof. The statements were as follows: “We identified disconnects between who pays the energy bills and operation staff that leads to carelessness with regard to energy consumption and cost”; “We took actions to fix the disconnects between who pays the energy bills and operation staff”; “We find it challenging to get landlords of leased space to invest in the energy performance of their commercial space”; and “We require landlords to invest in the energy performance of their commercial space”. The results are illustrated in Exhibit 82, and indicate that 50% of respondents identified disconnects between who pays energy bills and operation staff, but only 40% have taken actions to address this issue. 65% of municipal respondents find it challenging to get landlords to invest in energy savings, and only 16% of respondents require landlords to do so.

City of Markham: Asset Management and Lifecycle Assessment

The City of Markham has become highly effective at integrating sustainable energy technology and energy management practices across the municipality. A primary driver identified was the merging of the City’s Sustainability department with the Asset Management team, which led to the streamlining and integration of processes. As a result of this, life cycle analysis (LCA) has become fundamental to the City’s procurement approach to assessing potential energy management investments. For example, when an air-conditioner needs to be replaced in one of Markham’s municipally-owned facilities, the City evaluates the business case (incremental cost, energy savings, incentives, and payback) to upgrade the air- conditioner to a more energy-efficient model rather than replace with a business-as-usual equivalent model. Since 2011, the City has reduced its total municipal greenhouse gas emissions by 8% and made LCA an integral part of their procurement process (City of Markham, 2017).

Exhibit 82: Examples of Energy Accountability Challenges faced by Municipal Survey

Respondents



7. Monitoring

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding energy Monitoring and tracking by answering "Yes", "No", or "Partial" to the following:

- The municipality uses a software package to record and track energy consumption, demand and cost, for each facility.
- Data is gathered and input on a monthly basis.
- Energy consumption is normalized to floor area and adjusted for weather variables, as appropriate.
- Facility energy performance is reported monthly to the appropriate personnel accountable for energy budgets and facility operations.

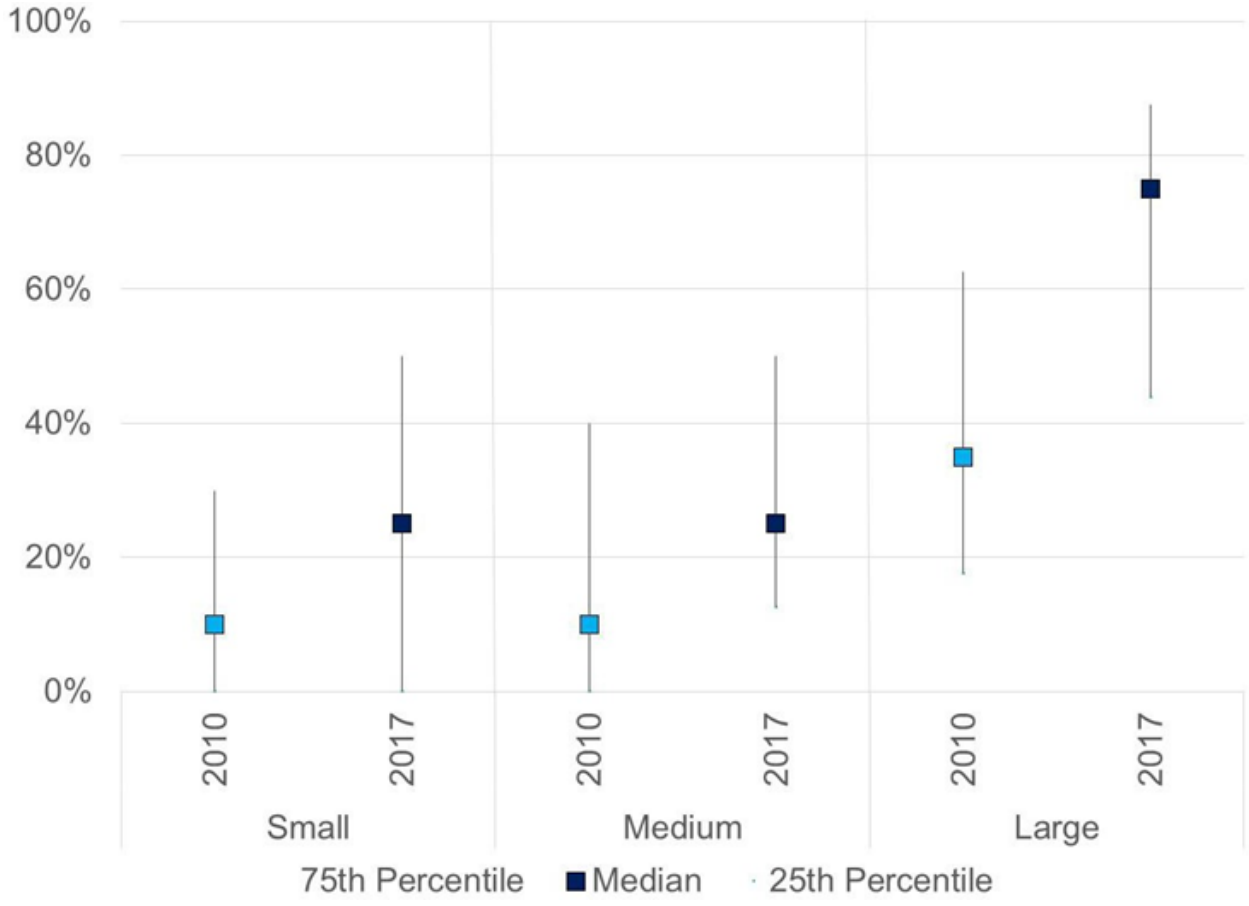
Exhibit 83 provides a breakdown of the Monitoring category scores by population size in 2010 and 2017. It can be seen that since 2010, there have been improvements in Monitoring scores for municipalities of all sizes, except for the 25th percentile Monitoring score of Small municipalities.

In 2017, Small municipalities performed in a similar manner to Medium municipalities in their Monitoring scores, except that the Small municipalities 25th percentile score remained stagnant at 0%, while that of Medium municipalities improved to 13% (up from 0% in 2010).

The highest Monitoring competency was achieved by Large municipalities with a 25th percentile of 44%, a median of 75%, and a 75th percentile of 88%.

For the town of Fort Frances, energy monitoring and tracking was not officially part of their 2014 CDM plan, even though staff were engaging in the practice at the time. The town wishes to integrate monitoring and targeting officially as part of their 2019 CDM plan (Town of Fort Frances, 2017).

Exhibit 83: Monitoring Score by Municipality Size, 2010 vs. 2017



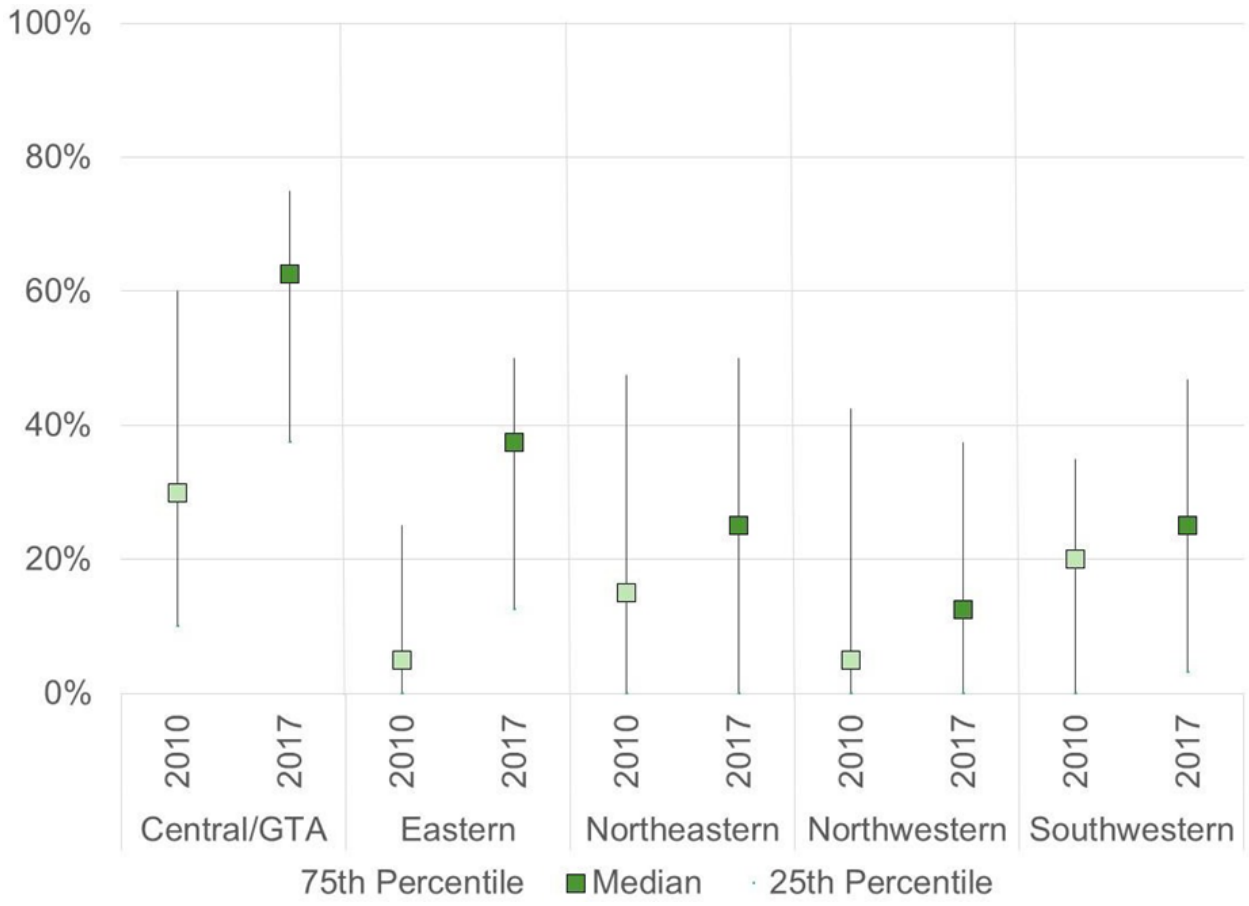
As shown in Exhibit 84, in 2010, the 25th percentile Monitoring scores of municipalities in all regions except for the Central/GTA were at 0%. By 2017, the only material improvement (of 13%) was achieved by municipalities in the Eastern region, and the 25th percentile Monitoring scores of the three other regions remained at or close to 0%. Meanwhile, the Central/GTA region achieved an improvement of 28% in their 25th percentile Monitoring scores in 2017.

In 2017, there were no performance improvements in the 75th percentile Monitoring scores of municipalities in the Northern regions.

While all regions improved their median Monitoring scores from 2010 to 2017, municipalities in both the Eastern and Central/GTA regions achieved the highest increase, both by 33%.

The highest Monitoring competency was achieved by municipalities in the Central/GTA region, with a 25th percentile of 38%, a median of 63%, and a 75th percentile of 75%.

Exhibit 84: Monitoring Score by Region, 2010 vs. 2017



8. Communication

Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding communication of the energy conservation and demand management plan by answering "Yes", "No", or "Partial" to the following:

- The energy management policy and plan is communicated externally; for instance, it is posted on the municipality's web-site.
- The municipality uses a consistent communications and reporting protocol to channel key performance indicator results and relevant energy use information to Council, managers and employees.
- The municipality actively encourages and supports staff awareness and participation in energy management at all organizational levels.
- Energy saving and other energy management ideas are actively solicited from employees.

The Town of Caledon: Corporate Energy Team and Behavioural Change program

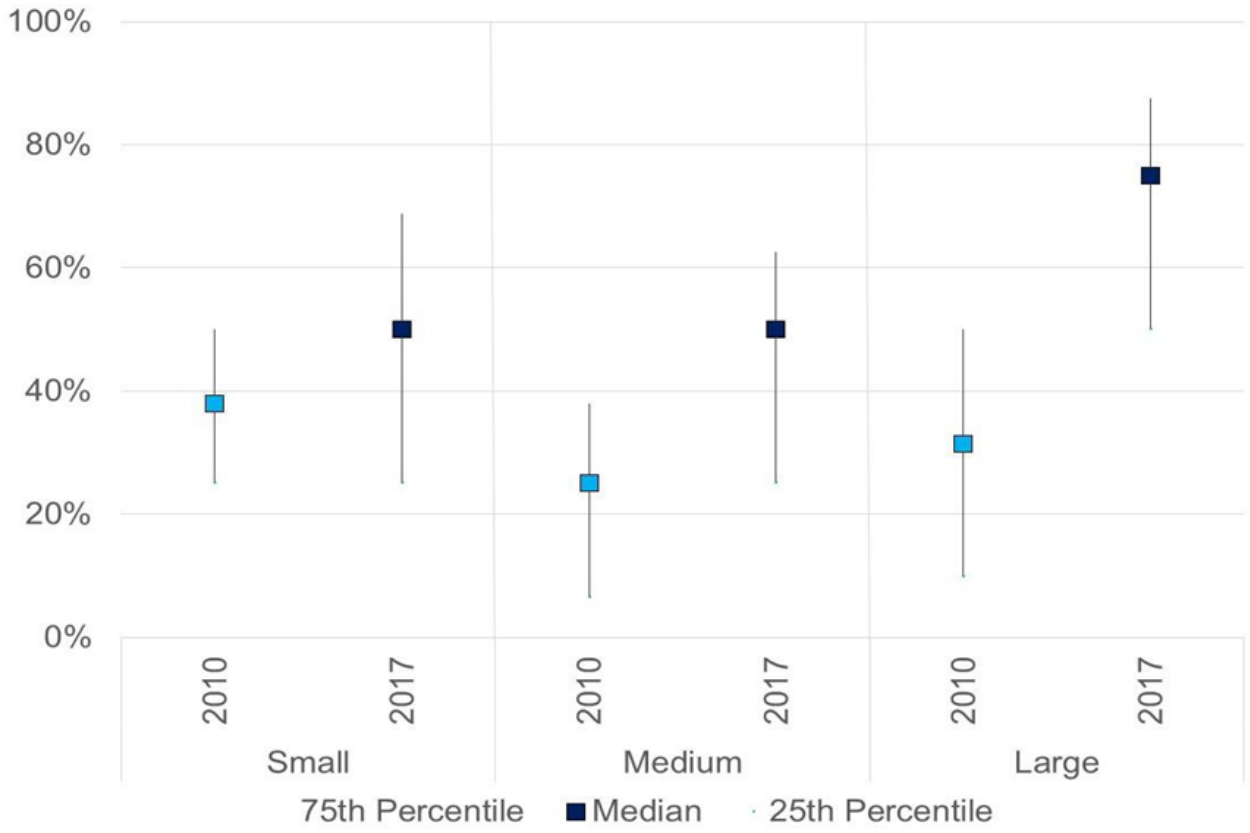
The Corporate Energy Team meetings run on a quarterly basis and often have municipal guest speakers to cover topics of interest for staff. These meetings present an opportunity for facility staff to learn from one another and share experiences and efforts in energy management. Additionally, facility operator staff get an opportunity to connect with staff from other departments, such as finance and purchasing, which creates a heightened understanding of energy conservation opportunities and their benefits. The Town has also created an informal Corporate Energy Awards program to recognize staff for their energy management practices and projects that they implement. These awards highlight the project savings and other key benefits such as avoided greenhouse gas emissions. (Town of Caledon, 2017).

As shown in Exhibit 85, in 2010, the best-in-class Communication scores ranged from 75% for Small and Medium municipalities to 88% for Large municipalities. By 2017, at least one high performing municipalities from all sizes was scoring 100%. On average, implementation of Communication best practices improved for municipalities of all population sizes in 2017 relative to 2010. In 2017, Large municipalities illustrated the highest Communication competency with an average score of 70%, an increase of 39% from 2010. As shown in Exhibit 85 since 2010, there have been performance improvements in implementation of Communication best practices by municipalities of all sizes in Ontario, particularly in their median and 75th percentiles. In 2017, the 25th percentile Communication score of Large municipalities reached what was their 75th percentile score (50%) in 2010. During the same timeframe, the 25th percentile Communication score of Medium municipalities reached what was their median Communication scores (25%) in 2010.

In 2017, Small and Medium municipalities achieved the same median Communication score of 50%. The 75th percentile Communication score of Small municipalities was slightly higher than that of Medium municipalities.

Large municipalities achieved the highest Communication competency with a 25th percentile score of 50%, a median of 75%, and a 75th percentile of 88%.

Exhibit 85: Communication Score by Municipality Size, 2010 vs. 2017



As shown in Exhibit 86, there have been performance improvements in the implementation of Communication best practices in all regions, except for the 25th percentile and median scores of municipalities in all geographic regions in 2017 relative to 2010.

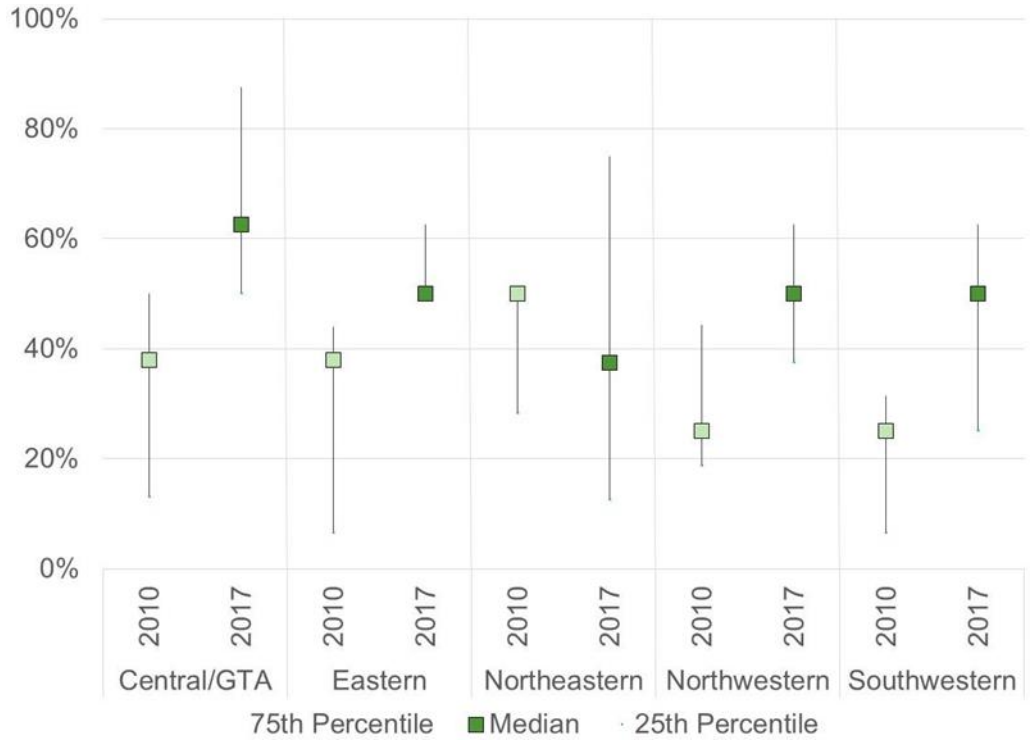
The most significant increase in average Communication scores was experienced by municipalities in the Central GTA (31%) followed by the Northeastern region. The 75th percentile of municipalities in the Northeastern region, however, improved by 25% from 2010 and is the second highest score after the Central/GTA region. Given the large spread of scores between their 25th and 75th percentile scores, municipalities in the Northeastern region could benefit from knowledge sharing of implementation of Communication best practices.

In 2017, municipalities in the Central/GTA achieved a 25th percentile Communication score that matched their 2010 50th percentile score. The 25th percentile and median Communication scores of the Eastern region slightly exceeded their 2010 75th percentile score. The 25th percentile Communication score of the Southwestern region matched their 2010 median score.

Municipalities in the Southwestern and Northwestern regions had a similar performance in their implementation of Communication best practices, except for their 25th percentile scores, where the Northwestern region scored 13% higher than the Southwestern region.

The highest Communication competency was achieved by municipalities in the Central/GTA region with a 25th percentile score of 50%, a median of 63%, and a 75th percentile of 88%.

Exhibit 86: Communication Score by Region, 2010 vs. 2017



9. Training & Capacity Building

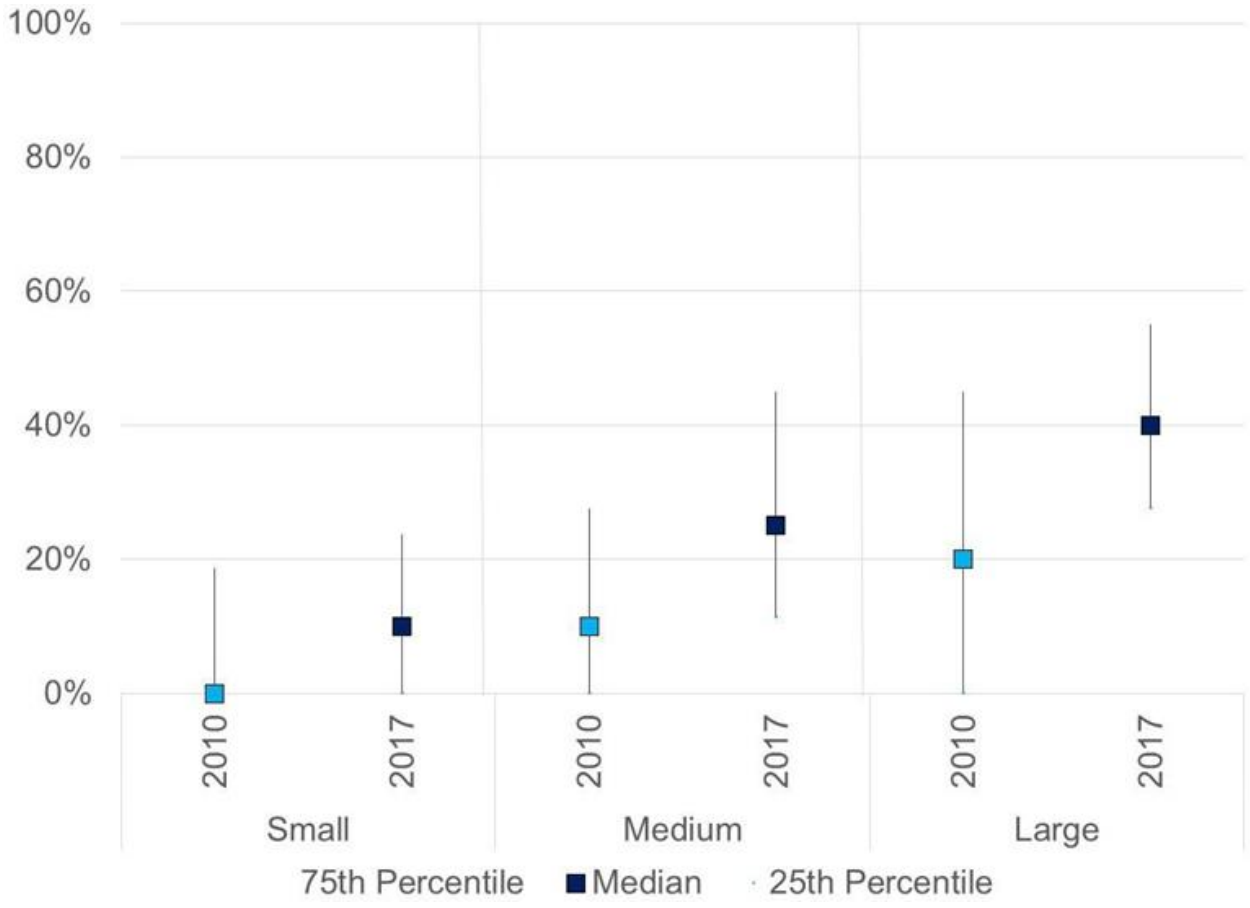
Survey respondents were asked to demonstrate their municipality's adoption of best practices regarding training and capability development by answering "Yes", "No", or "Partial" to the following:

- The municipality maintains a budget and plan for energy management training for employees.
- The training plan for energy management includes both management and technical training competencies.
- Senior-staff, accountable for energy use and cost performance targets, are trained to conduct energy conservation planning processes.
- Senior-staff are trained to prepare and submit a financial business case that is suitable to the municipality financial decision makers.

As shown in Exhibit 87 , 75% of all municipalities scored lower than 55% in their adoption of Training best practices. Half of Large municipalities scored lower than 40%, half of Medium municipalities scored lower than 25%, and half of Small municipalities scored lower than 10%. While 25% of municipalities of all sizes were scoring 0% in Training best practices in 2010, there were performance improvements in the 25th percentile of Medium (11%) and Large (28%) municipalities by 2017. Meanwhile, Training performance of 25% of Small municipalities remained at 0%. The median Training score of Small municipalities, however, improved by 10% from 2010 to 2017.

Medium and Large municipalities achieved an increase of 15% and 20% in their median Training scores, respectively. The highest increase in the 75th percentile Training score was achieved by Medium municipalities (17%).

Exhibit 87: Training Score y Municipality Size, 2010 vs. 2017



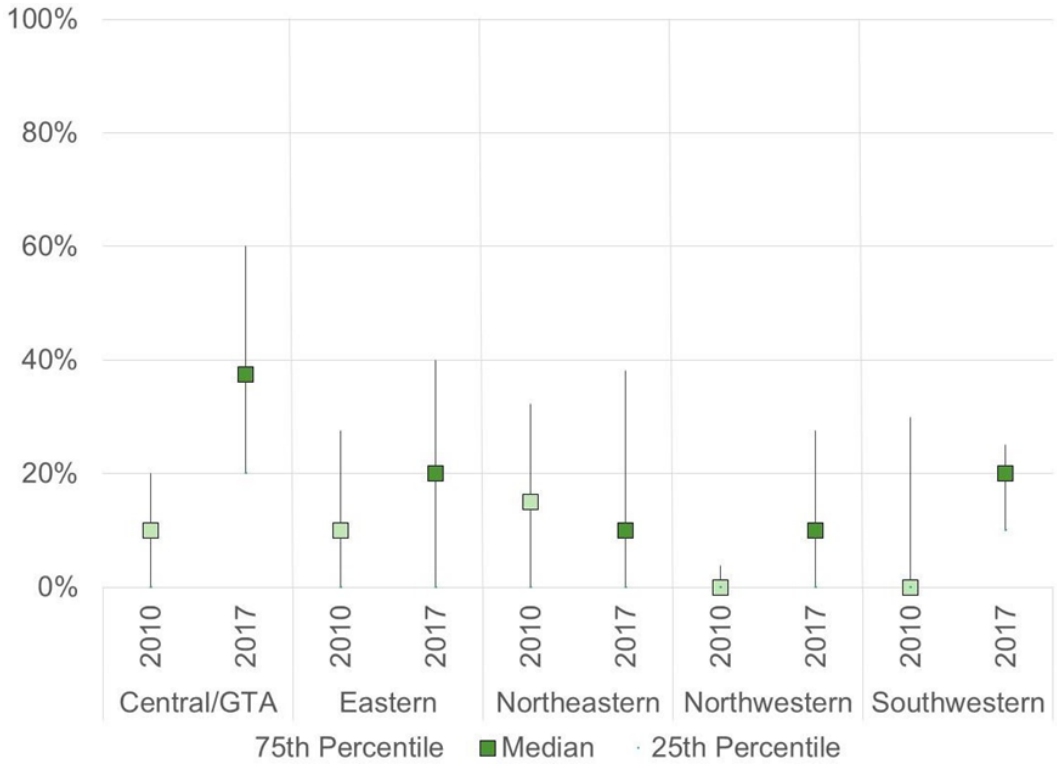
As shown in Exhibit 88, in 2010, 25% of municipalities in all regions had scored 0% in implementing Training best practices. By 2017, two regions improved their 25th percentile Training scores including the Central/GTA (20%) and Southwestern (10%). The 25th percentile Training scores of all other regions remained at 0%.

The Central/GTA region experienced the most improvement in their Training performance, with their 25th percentile score in 2017 matching their 75th percentile score in 2010, their median improving by 18%, and their 75th percentile score improving by 40%.The Northwestern region achieved an improvement of 24% in their 75th percentile Training score from 2010 to 2017.

The most significant increase in average Training scores was experienced by municipalities in the Central GTA (22%) followed by the Northwestern region (11%). In 2017, municipalities in the Central/GTA region outperformed all other municipalities with an average Training score of 39%. All other regions had an average Training score in the range of 17% to 26%.

Municipalities in Northern Ontario find it exceptionally challenging to get their staff trained on energy management practices because many of these training courses are typically offered in-person. More online training courses would reduce the cost of traveling and training and allow more staff to be trained in a subject matter related to energy management. Alternatively, more in-person training somewhere central in the North where they could send their staff to could also be a good option.

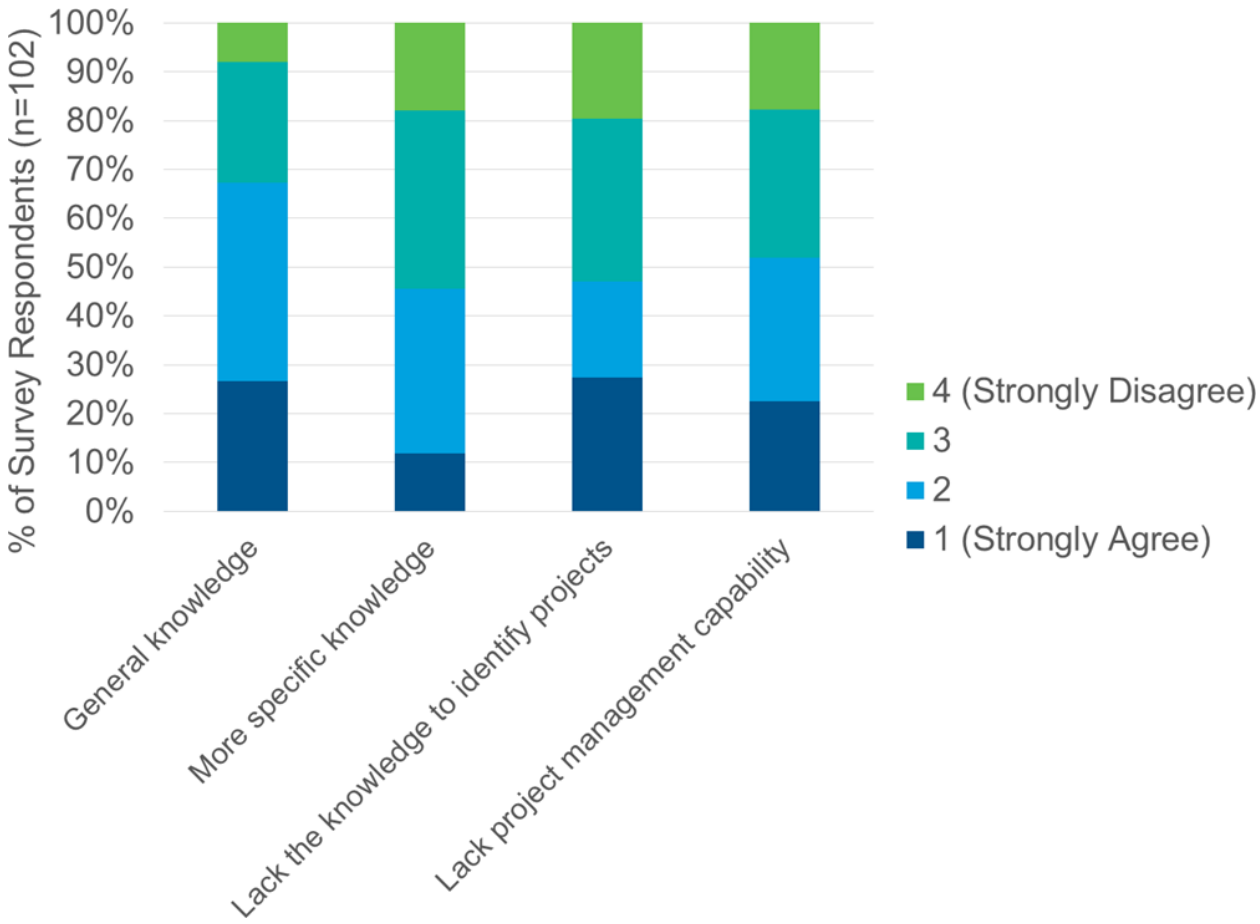
Exhibit 88: Training Score by Region, 2010 vs. 2017



9.1 Level of Sustainable Energy Knowledge and Capability

Municipal survey respondents were asked to indicate to what extent they agree with a series of statements regarding training and capability by providing a score from 1 (Strongly Agree) to 4 (Strongly Disagree). The statements included the following: “We have general knowledge of energy conservation opportunities and information is relatively easy to find when we need it”; “we have more specific knowledge of sustainable energy projects beyond traditional energy conservation and information is relatively easy to find when we need it”; “we lack the knowledge and expertise internally to identify, design and plan sustainable energy projects”; and “we lack the internal project management capability to coordinate the implementation of attractive sustainable energy projects with contractors and suppliers”. The results are presented in Exhibit 89, and demonstrate that 67% of municipal survey respondents feel that they have general knowledge of energy conservation opportunities. However, more than half of respondents lack specific knowledge on this topic and feel they do not have the in house knowledge to identify, design and plan sustainable energy projects.

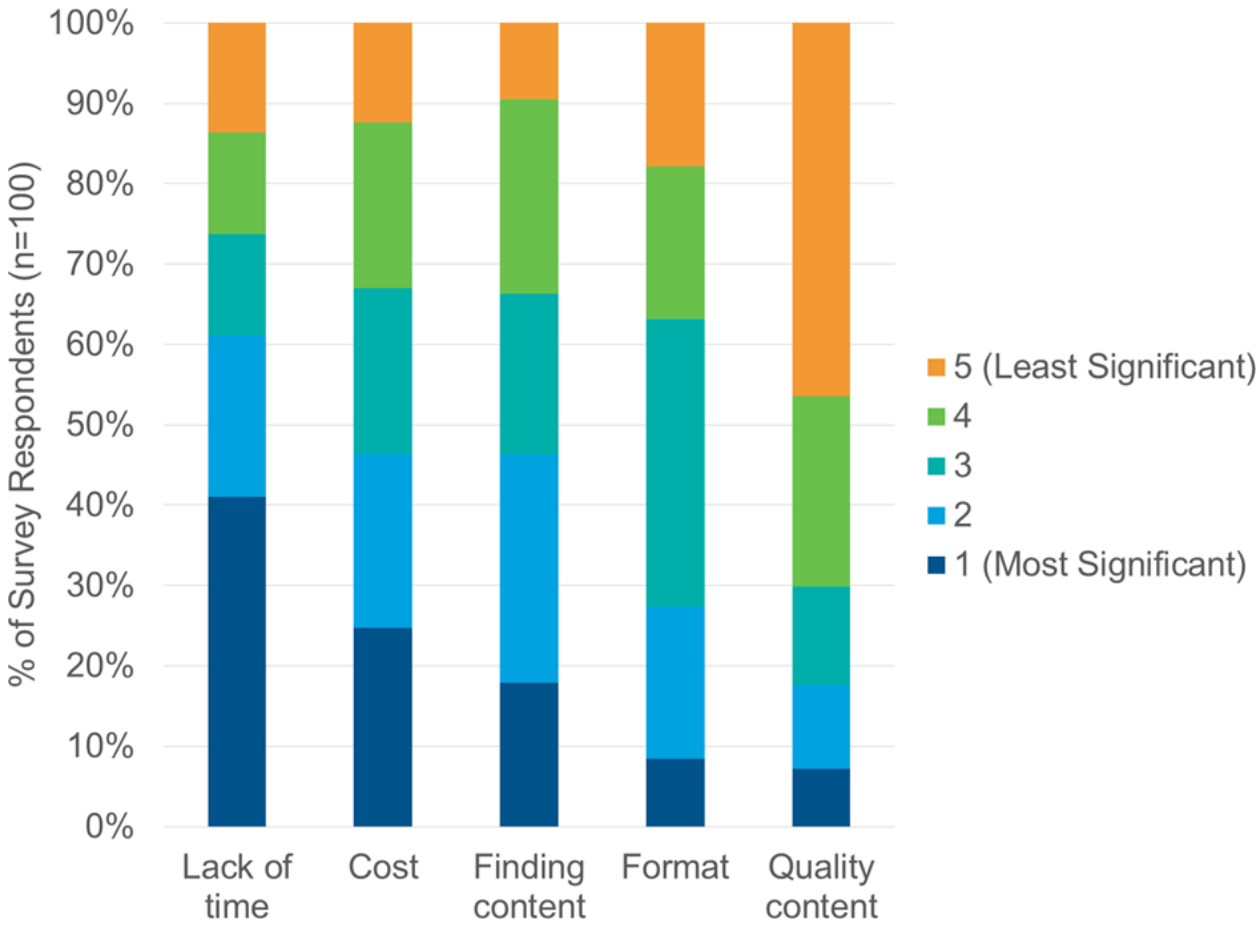
Exhibit 89: Municipal Level of Sustainable Energy Knowledge and Capability



9.2 Challenges to Obtaining Training

Municipal survey respondents were asked to rank a series of options from 1 (most significant) to 5 (least significant) challenge or barrier to obtaining energy management training in their municipality. Finding time to take part in training was the most significant challenge, followed by the cost of registration fees or logistics. Finding the training content/program that fits their needs and finding the training format (online, in-person, distance, etc.) that fits their needs were a less significant challenge. The least significant challenge, as ranked by the largest portion of survey respondents was “Doubt regarding the quality or relevance of the training offers currently in the market”.

Exhibit 90: ranked Challenges to Obtaining Energy Management Training



Training Content

What do Municipalities Want to See Offered in the Market? When asked about the training content most appealing to their needs, municipalities offered the following:

- Increased support for corporations and communities that are interested in implementing behavioural programs;
- Operational training in energy conservation for facility staff responsible in maintenance of arenas;
- Basic energy management knowledge targeted to senior staff; and
- Provincial incentive program offerings.

The Town of Richmond Hill recommended a centralized online repository that brings together all municipalities to serve as platform for knowledge sharing of energy management best practices and collaborative efforts (Town of Richmond Hill, 2017).

9.3 Training Offerings and Resources

Municipalities of all sizes expressed interest in informational sessions on provincial incentive programs and funding offerings. Larger municipalities such as the Region of York recommended capacity building training for municipalities to establish internal structures dedicated to provincial grant applications (Region of York, 2017). Medium municipalities such as the Town of Caledon and the City of Sault Ste. Marie want to know how to effectively find matching provincial incentives and make successful business cases to Council for more complex projects (Town of Caledon, 2017), (City of Sault Ste. Marie, 2017). Smaller municipalities often feel constrained in their internal capacity and technical knowledge to apply to provincial funding programs. For instance, the Village of Burk's Falls considered forwarding an application to the Municipal GHG challenge fund; however, the municipal staff were lacking knowledge in the connection between savings in energy and greenhouse gas emissions to be able to proceed with the application to the program (Village of Burk's Falls, 2017).

There are a variety of sources of training offerings that are available to municipalities on the topic of sustainable energy. Training sources include: IESO and LAS.

Since 2013, 20 municipal organizations have received funding through the IESO's Training and Support initiatives to receive industry recognized training and accreditation, such as Building Operator Certification and Certified Energy Manager training. The Local Distribution Companies now offer funding for energy managers to support energy management activities.

Region of Durham: Leveraging Incentives through an Embedded Energy Manager from LDC

Over the last three years, the Region of Durham has had an embedded energy manager from their four local distribution utilities, who has been helpful in navigating opportunities and making the business case for sustainable energy projects (Region of Durham, 2017).

Exhibit 91: Sustainable Energy Incentive Program

Program name	Topic	Program Operator
LAS LED Streetlight Program	LED Streetlight	LAS
Fleet Management Program	Fleet Electrification	LAS
Recreation Facility LED Lighting Service	LED recreation facility	LAS

Exhibit 92: Sustainable Energy Tools and Resources

Program name	Topic	Resource Provider
LAS LED Streetlight Program	LED Streetlight	LAS

Exhibit 93: Sustainable Energy Training Offerings

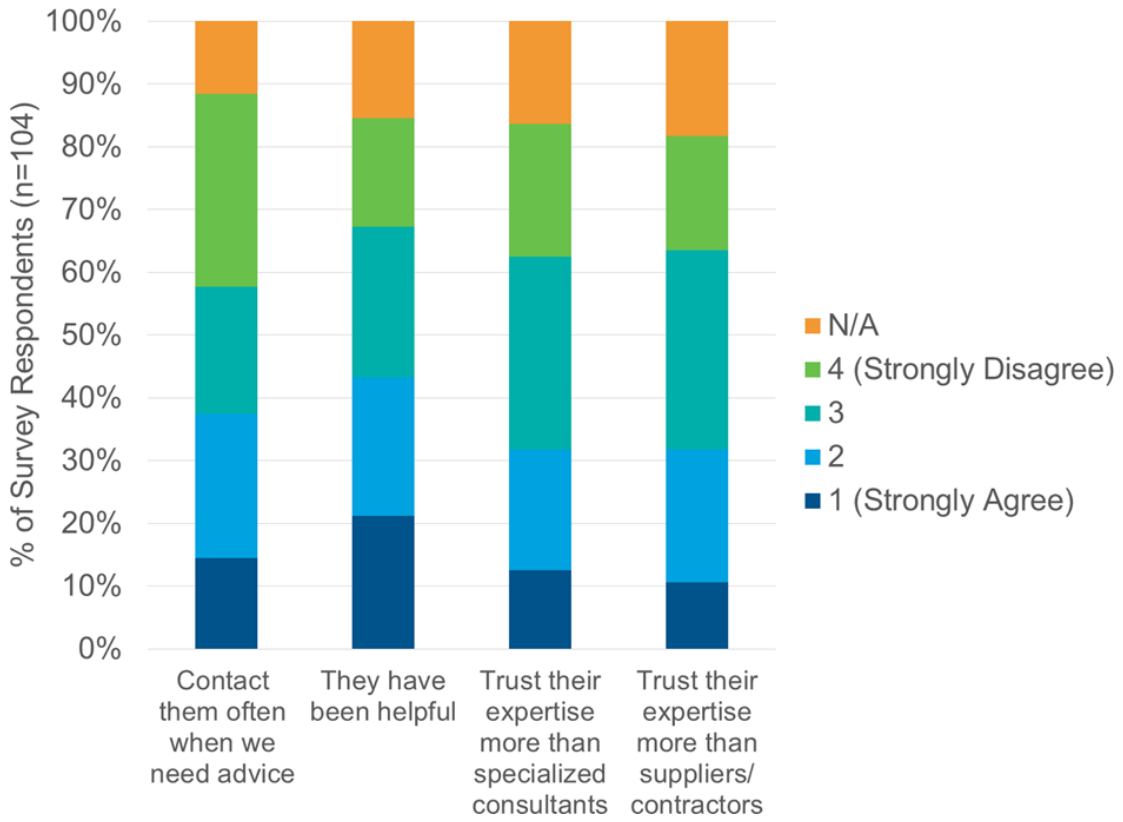
Program name	Topic	Training Provider
Energy Efficient Building Operations 101	Building Operations	LAS
Employee Engagement Workshop	Employee Engagement	LAS
Train-the-Trainer Engagement Workshop	Employee Engagement	LAS
In-House Dollars to $ense (D2$) Municipal Workshops	Various topics	LAS

9.4 Relationship with Local Distribution Companies

Under Ontario's Conservation First Framework, local distribution companies (LDCs) are responsible for planning cost effective ways to reach assigned electricity conservation targets. As such, they are often an excellent resource for customers who wish to pursue sustainable energy projects. Municipal survey respondents were asked to indicate to what extent they agree/disagree with a series of statements regarding their LDCs by rating on a scale of 1 (Strongly Agree) to 4 (Strongly Disagree). The results are presented in Exhibit 94: only 38% of respondents indicated that they go to their LDC often when they need advice regarding energy conservation and sustainable energy. A higher percentage (43%) agreed that in the past 5 years, LDCs have been helpful and forthcoming with regard to information and technical assistance on sustainable energy projects. 32% of respondents agreed that they trust the technical expertise from LDCs more than they trust the technical expertise of specialized consultants. The same proportion (32%) agreed that they trust the technical expertise of LDCs more than they trust the technical expertise of technology suppliers and contractors.

Between 12% and 18% of respondents stated "N/A" in response to the statements – this likely indicates that these municipalities have not hand enough experience with their local LDCs to be able to comment.

Exhibit 94: Municipal Relationship with their LDCs



LDCs and Save On Energy Incentives:

The Save On Energy incentives program has now become part of a “normal dialogue” when seeking funding opportunities for many municipalities including the Region of Durham, the City of London, the City of Hamilton, and more recently, Village of Burk’s Falls.

In 2014, the Village of Burk’s Falls was not aware of the Save on Energy program and did not apply for incentives from the program to fund their lighting retrofit project in the Armour Ryerson arena. Instead, they sought approval for the Ontario Trillium grant. Since then, the staff have been made more aware of savings and incentive opportunities including the Save on Energy program through their Local Distribution Company (LDC) with whom they have had an improved and a more engaging relationship. As a result of this effort, the town applied and was approved for Save on Energy incentives for their Street Lighting project in 2016. By the end of 2016, all of the streetlights in the Village of Burk’s Falls were converted into LEDs, and a higher than projected savings of 36% was realized in the last year. The town attributes the success of the project to the Save on Energy Incentives program as well as to a partnership with Realterm, a contractor that offered to fund the project through a capital lease program option, where the savings from the project would be paid back to Realterm for the first 10 years (Village of Burk's Falls, 2017).

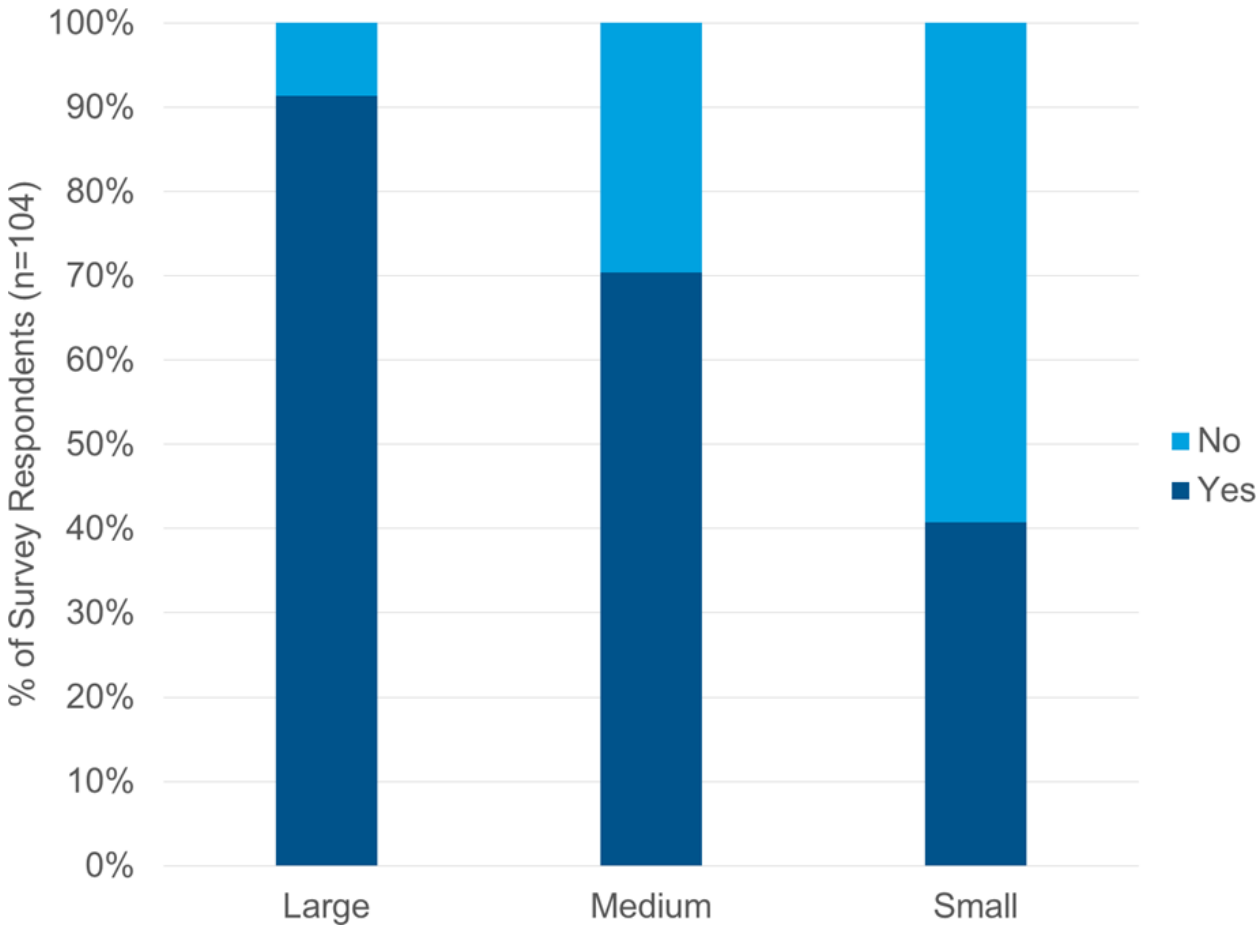
The Region of Durham has also indicated a higher level of cooperation and general level of involvement between the municipality and their LDC, primarily driven by a mutual interest of meeting CDM targets. An embedded energy manager from the LDC has been instrumental in coordination of sustainable energy projects and finding matching provincial incentives (Region of Durham, 2017).

To foster a more trusting relationship between utilities and municipalities, the City of Guelph recommended standardization of LDC operations across the board and streamlining of processes. The local distribution companies (LDCs) in Ontario differ in rigour-level when providing incentives, which leads to inconsistencies.

9.5 Relationship with Energy Service Companies

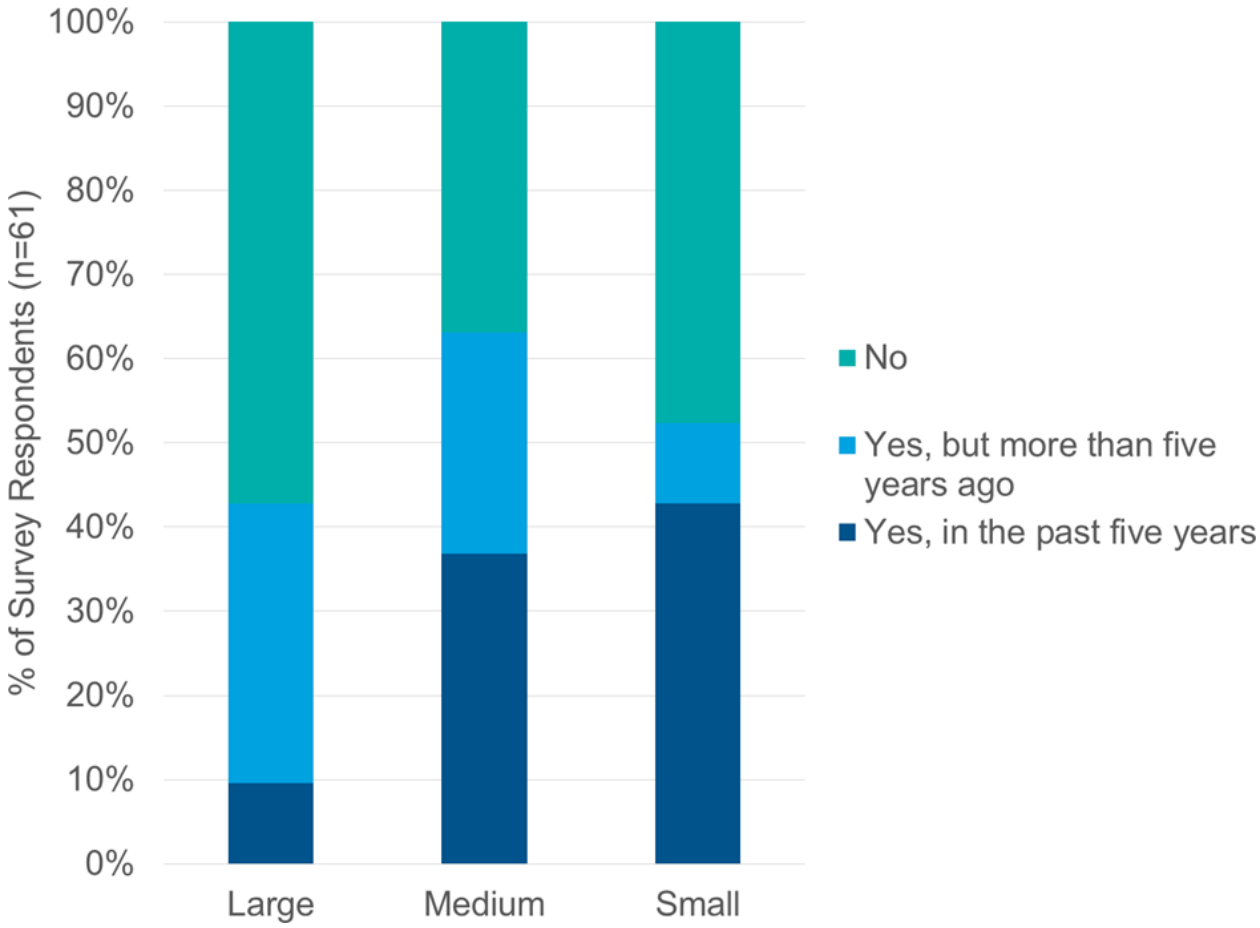
Energy service companies (ESCOs) are firms that offer turn-key energy projects that include technical expertise, project management, equipment and installation. They may, in certain cases, offer financing and/or offer a performance guarantee in the form of energy performance contracts. Municipal survey respondents were asked if they were aware of what energy service companies and energy performance contracts are. As shown in Exhibit 95, 91% of Large municipal survey respondents and 70% of Medium respondents were familiar with ESCOs, whereas only 41% of Small municipalities were familiar with ESCOs.

Exhibit 95: Percentage of Municipalities Familiar with ESCOs



Municipal survey respondents that were aware of what ESCOs and energy performance contracts were asked if they have worked with an ESCO in the past, and 52% of them have. Their responses are presented based on municipal size in Exhibit 96.

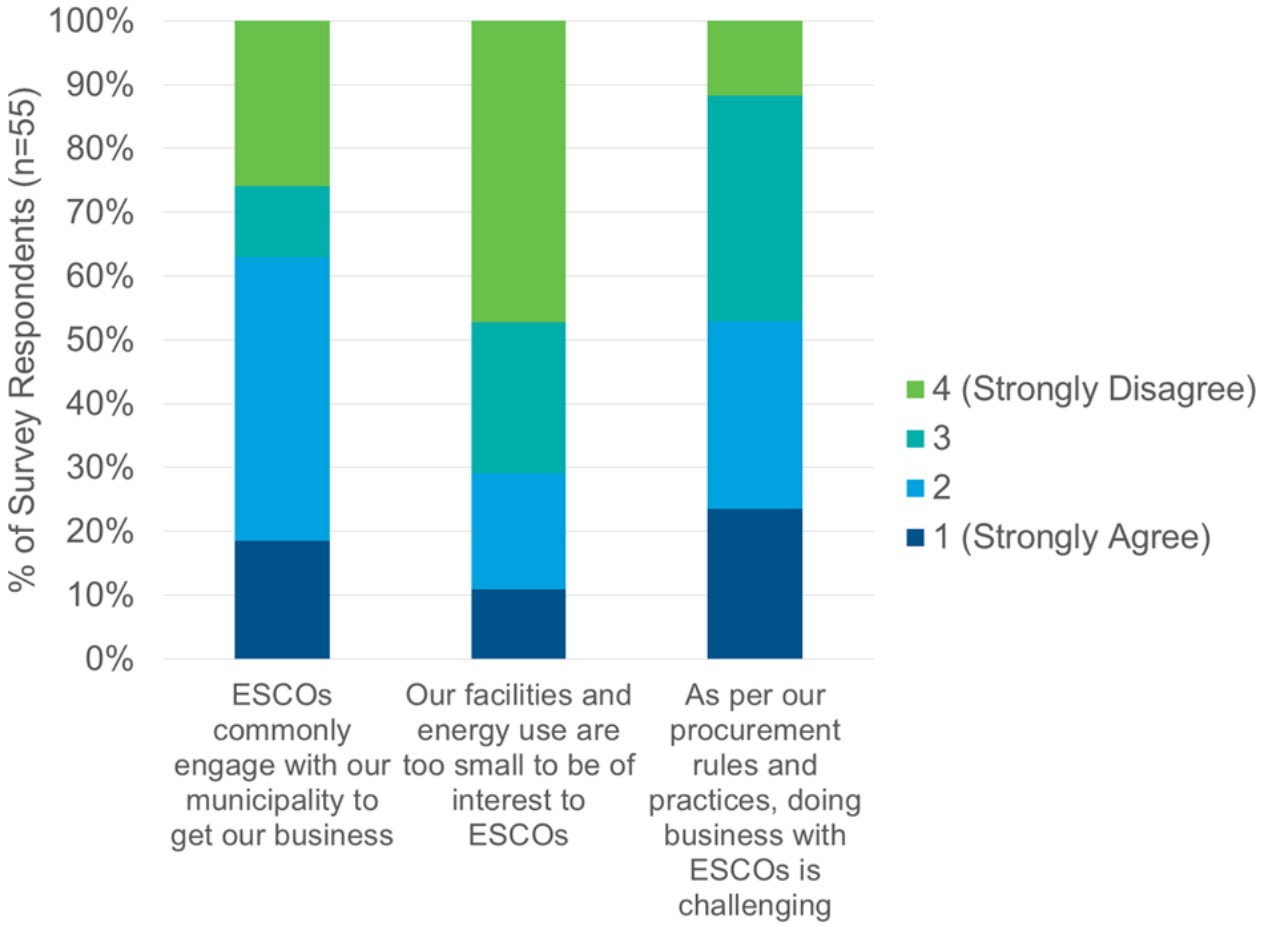
Exhibit 96: Percentage of Respondents Who Have Worked with an ESCO



Large municipalities such as the Region of York have the internal capacity to manage sustainable energy projects while also having the benefit of their municipalities in their best interest (Region of York, 2017). Smaller municipalities such as the Town of Fort Frances find relying on ESCOs to manage their sustainable energy projects more convenient given their internal capacity constraints (Town of Fort Frances, 2017).

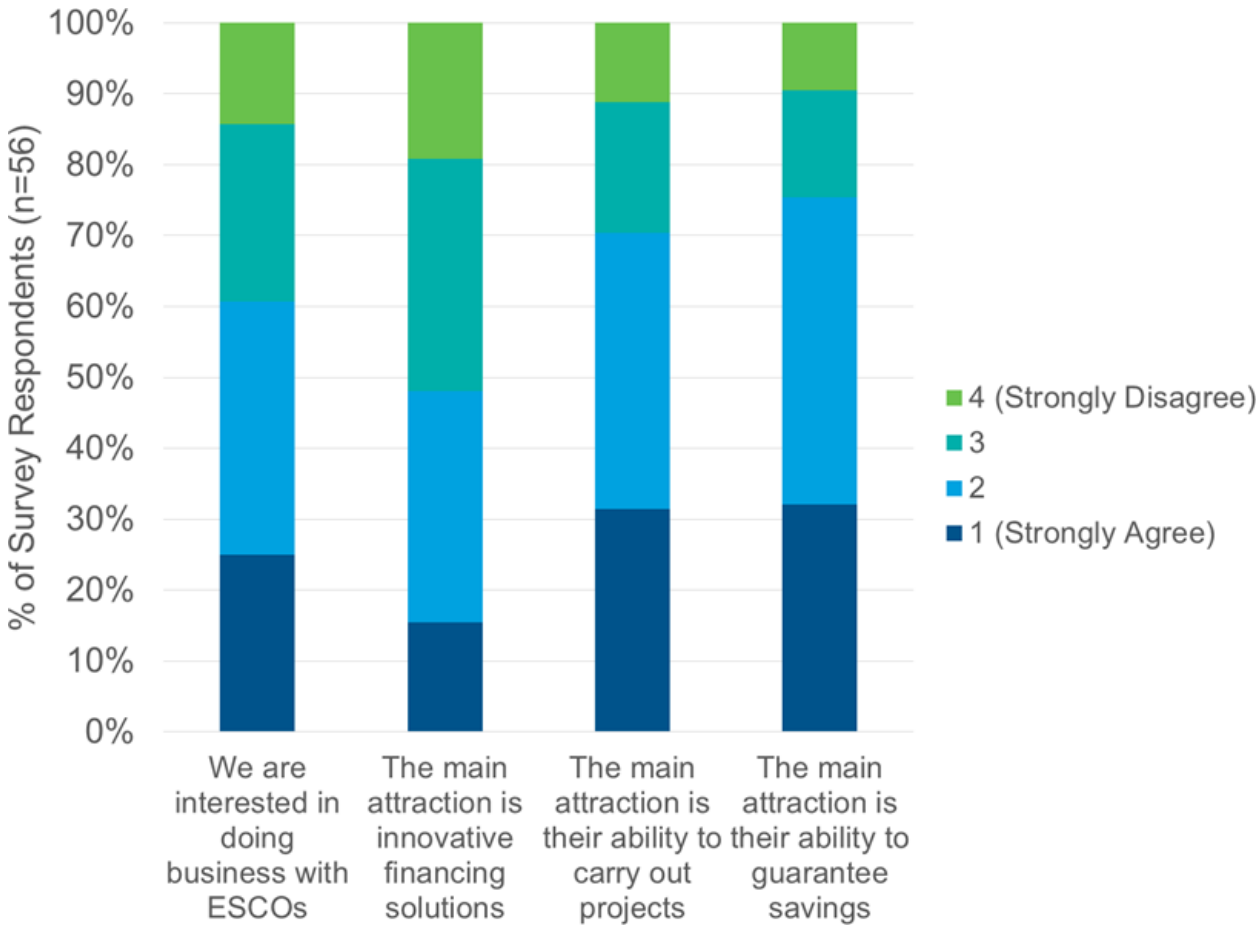
Survey respondents were asked to indicate to what extent they agree/disagree with statements regarding the accessibility of energy service companies and energy performance contracts by rating on a scale of 1 (Strongly Agree) to 4 (Strongly Disagree). The results are shown in Exhibit 97. 63% of respondents agreed that ESCOs commonly engage with their municipality to get their business; 29% agreed that their facilities and energy use are too small to be of interest to ESCOs; and 53% agreed that as per their municipal procurement rules and accepted practices, doing business with ESCOs is challenging.

Exhibit 97: Accessibility of ESCOs



Survey respondents' level of interest in ESCOs as a means to implement projects is illustrated in Exhibit 98. A majority of survey respondents (60%) indicated they are or would be interested in doing business with ESCOs, assuming hurdles were removed and their concerns were mitigated. The two main appealing features of ESCOs for survey respondents are their ability to guarantee the savings from projects and their ability to carry out projects that their staff does not have time or knowledge to. Less than half of respondents agree that the main appealing feature of ESCOs is the innovative financing solutions they offer.

Exhibit 98: Level of Interest in ESCOs



Town of Fort Frances

The “Honeywell Energy Project” – Large Scale Energy Retrofit Dubbed internally as the “Honeywell Energy Project,” the project started with an audit of the Town of Fort Frances’s 13 main facilities identified as its largest energy consumers. The audit generated a report that listed recommended projects with total cost of over $3M. Through an energy performance contracting agreement with the town, Honeywell led of all aspects of the project development from start to end. The town managed to reduce the payback period to 12 years and make the business case to town Council by bundling high-cost projects with projects of very short payback periods. With the success of the “Honeywell Energy Project,” the Town of Fort Frances is interested to find out more about what other types services are offered by ESCOs and how it can leverage opportunities to work with ESCOs more in the future. (Town of Fort Frances, 2017).

10. Summary of OBP Survey Results

Exhibit 99 below illustrates the 75th percentile Organizational Best Practice (OBP) scores to each survey question in all seven categories by size and region. The highest scores are highlighted in blue and lowest scores in red. Data for Exhibit 99 was derived from self-reported responses to the Organizational Best Practices questions of the online survey. The “existent community energy plan” scoring included data from the complete working list of Municipal Energy Plans received from the Ministry of Energy (Kirschbaum, 2018), in addition to survey responses.

This exhibit serves two main purposes including identifying the indicators for adoption of OBP at the corporate level and a reference point for municipalities as next steps in the adoption of specific best practices in each of the seven OBP categories.

Indicators for Best Practices: The results suggest that the best indicator for adoption of best practices is the size of the municipality. In general, Large municipalities tend to have the highest 75th percentile scores followed by Medium and Small municipalities. The next best indicator is the geographic region, with municipalities in the GTA/Central and Southwestern regions scoring the highest, followed by Eastern and then Northeastern and Northwestern regions. Also apparent from the exhibit is the high 75th percentile scores in the Policy and Planning categories as well as the low 75th percentile scores in the Training category, confirming the findings from other exhibits in this section.

Reference for Specific Best Practices: This exhibit could serve as a reference point for specific best practices that municipalities could work on depending on their size and region. Three examples are given below:

- **Energy strategy (Small, Southwestern):** Small municipalities in the Southwestern region scored low in including in the scope of their Energy Strategy (including their 2014 CDM plans) a clause on high performance standards for new building construction. These municipalities have the option of working either with other Small municipalities from the GTA or Medium and Large municipalities in their own region (Southwestern) to incorporate the clause in the upcoming 2019 CDM cycle.
- **Senior staff training (Small, Northern):** Senior staff in Small municipalities in the Northeastern region receive training in business case development but are not trained in conducting energy conservation planning processes. Still, Small municipalities in the Northwestern region would benefit from connecting with Small municipalities in the Northeastern region to implement energy management related training for their senior staff.
- **Staff participation (Medium, Southwestern):** All Medium municipalities would benefit from connecting with the Medium municipalities in the Southwestern region to understand how to better encourage and support staff awareness and participation in energy management at all organizational levels.

When extrapolating opportunities from this exhibit, it is important to remember that the scoring is based on self-reported data from the 2017 Municipal Energy Profile survey and also to note the sample size (refer to the last row "# of respondents") for each segment.

Exhibit 99: 75th Percentile OBP Score

Best Practices		L*				M					S				
		GTA	SW	E	NW	GTA	SW	E	NE	NW	GTA	SW	E	NE	NW
Existent sustainable energy policies + plans		100%	100%	100%	50%	100%	63%	100%	50%	100%	75%	75%	100%	50%	100%
Energy Strategy:	* long-term goals	100%	100%	88%	50%	100%	100%	100%	100%	100%	75%	100%	100%	100%	100%
	* targets	100%	100%	50%	50%	100%	100%	100%	50%	50%	75%	50%	75%	100%	100%
	* conservation + demand	100%	100%	50%	50%	50%	100%	100%	50%	50%	75%	50%	75%	100%	100%
	* new construction	100%	100%	50%	50%	100%	75%	63%	0%	50%	75%	25%	50%	50%	50%
	* procurement	100%	75%	88%	50%	50%	75%	63%	0%	50%	75%	50%	75%	100%	50%
Existent CDM plan		100%	100%	50%	50%	100%	88%	100%	100%	0%	75%	100%	100%	100%	100%
CDM:	* benchmarking	100%	100%	38%	100%	75%	50%	88%	50%	0%	75%	50%	50%	100%	100%
	* performance	100%	100%	88%	100%	100%	50%	50%	50%	0%	75%	50%	100%	100%	100%
	* energy targets	100%	100%	38%	50%	75%	50%	50%	0%	0%	75%	50%	100%	100%	50%
	* measures + actions	100%	100%	38%	100%	100%	100%	88%	100%	0%	75%	50%	50%	100%	50%
Existent Community Energy Plan		0%	100%	25%	0%	100%	88%	100%	100%	50%	0%	100%	100%	100%	38%
Financing:	* funding procedure	100%	75%	0%	0%	88%	50%	38%	0%	0%	38%	75%	50%	50%	0%
	* material	100%	75%	38%	50%	100%	100%	50%	50%	100%	75%	100%	100%	100%	63%
	* business case	100%	100%	88%	0%	100%	50%	50%	50%	50%	38%	63%	50%	50%	50%
	* life-cycle	88%	100%	88%	50%	50%	100%	100%	50%	50%	75%	63%	100%	75%	50%
Accountability:	* senior manager oversight	100%	100%	50%	100%	50%	100%	100%	50%	#####	38%	88%	25%	88%	100%
	* shared responsibility	100%	50%	75%	100%	50%	63%	100%	100%	100%	75%	100%	100%	50%	50%
	* EM&V	50%	50%	38%	0%	50%	50%	50%	0%	#####	75%	0%	25%	13%	0%
	* sufficient resources	100%	100%	38%	0%	88%	0%	75%	50%	#####	75%	88%	75%	50%	0%
Monitoring:	* metrics tracking	100%	100%	0%	100%	50%	0%	63%	50%	0%	75%	38%	100%	0%	0%
	* data gathering	100%	100%	75%	100%	50%	100%	100%	0%	50%	75%	100%	75%	100%	50%
	* data quality	100%	75%	38%	50%	50%	0%	50%	0%	0%	75%	38%	100%	50%	50%
	* staff communication	50%	75%	75%	50%	50%	0%	63%	0%	0%	0%	38%	0%	50%	50%
Communication:	* policy on website	100%	100%	88%	100%	100%	100%	100%	100%	0%	75%	100%	100%	100%	100%
	* consistent reporting	100%	100%	75%	50%	88%	50%	50%	100%	0%	88%	50%	100%	100%	50%
	* staff participation	100%	75%	50%	50%	50%	100%	50%	50%	0%	88%	50%	75%	100%	63%
	* ideas from employees	100%	75%	38%	50%	50%	50%	50%	50%	0%	75%	50%	75%	100%	50%
Training:	* budget	50%	25%	0%	50%	50%	0%	50%	50%	0%	0%	0%	0%	0%	0%
Senior staff are trained on:	* conservation planning	50%	50%	38%	50%	50%	0%	63%	50%	50%	0%	0%	0%	0%	0%
	* business case	50%	50%	0%	50%	50%	50%	50%	0%	0%	0%	0%	0%	50%	0%
	* vendors management	50%	50%	0%	50%	75%	50%	50%	100%	0%	0%	50%	50%	50%	0%
# of respondents		20	3	3	1	12	10	12	1	1	2	12	9	32	17

*Large, NE not applicable

75th percentile Score
No data available

11. Broader Policy Context

Ontario released the 2017 Long-Term Energy Plan in October 2017, which sets the future direction for Ontario's energy for the next 20 years. The following bullets were taken directly from the Executive Summary of the Long-Term Energy Plan, and highlight elements of the Plan which are particularly relevant to municipalities:

- The government will continue to work with its agencies to implement the Conservation First policy in regional and local energy planning processes.
- With the first round cycle of regional planning completed, the government is directing the IESO to review the regional planning process and report back with options and recommendations that address the challenges and opportunities that have emerged.
- Ontario's Climate Change Action Plan has reinforced the importance of community energy plans, and indicated the government's continued support for them.
- The government will encourage the construction of near net zero and net zero energy and carbon emission homes and buildings to reduce emissions in the building sector.
- The government is proposing to expand the options for net metering to give building owners more opportunities to access renewable energy generation and energy storage technologies.
- The government will continue to work with industry partners to introduce renewable natural gas into the province's natural gas supply and expand the use of lower-carbon fuels for transportation.
- Ontario's cap and trade program, as well as programs and initiatives in the Climate Change Action Plan will support efforts to decarbonize the fuels sector.
- The net metering framework will continue to be enhanced to give customers new ways to participate in clean, renewable energy generation and to reduce their electricity bills.
- Barriers to the deployment of cost-effective energy storage will be reduced.
- The government will build on its success and renew and enhance the Smart Grid Fund. This will continue the Province's support of Ontario's innovation sector and help overcome other barriers to grid modernization.

V. Conclusions and Recommendations

This section summarizes the findings of the study, presents conclusions on the progress made since 2006, and provides recommendations for improving energy efficiency in the municipal sector going forward.

1. Ontario Municipalities Have Come a Long Way

Between 2006 and 2014, municipalities in Ontario have decreased their electricity and natural gas consumption and achieved energy and cost savings as a result of actively pursuing energy savings opportunities and participating in electricity and gas energy efficiency incentive programs.

Over the past decade (2007-2017), municipalities also improved their performance in the implementation of organizational best practices at the corporate energy management level. They have pursued higher engagement opportunities with facility staff and their local distribution companies (LDCs) through various programs such as the Town of Caledon's Corporate Energy Awards program and embedded energy manager programs from their local LDCs, all of which have enabled municipalities to gain a better understanding of their internal competencies and streamline their processes at the corporate level.

Municipalities are now at the forefront of adopting innovative, next-generation technologies such as net-zero buildings and net-zero or energy-plus wastewater treatment plants. They have taken the initiative to develop new and creative ways of funding their sustainable energy projects, a notable example of which is the green revolving fund.

Provincial regulations have helped create the enabling environment for driving action at the municipal level. In fact, municipalities have identified the Ministry of Energy's O.Reg. 397/11 – Energy Conservation and Demand Management Plans as the most significant contributor to a higher level of interest in sustainable energy development.

1.1 Municipal Energy Use

- **Consumption and Costs:** In 2014, the primary source of energy for municipal operations (facilities, social housing, and street lighting) in Ontario was electricity (63%) and natural gas (35%), with minor use of other fuels including hot water and steam from district heating, chilled water from district cooling, propane, and fuel oils. Municipalities spent an estimated $917 million on electricity and $105 million on natural gas in 2014.
- **Comparison with 2006 Baseline:** Electricity consumption in 2014 was 6% less than the baseline municipal electricity consumption of 6,653 GWh estimated in 2006. Natural gas consumption was 12% lower in 2014 compared to 2011 as reported to the Ministry of Energy under O.Reg. 397/11.

1.2 Energy Efficiency

Comparison with 2006 Baseline: The 2008 Power Application Group Inc. report estimated an energy efficiency potential of 780 GWh based on 2006 consumption data. To date, 42% of this estimated potential (330 GWh of annual savings) has been achieved through the municipal energy efficiency projects completed through the Save On Energy Retrofit Program alone. Municipalities in Southwestern Ontario have exceeded the estimated potential savings by 5%, whereas municipalities in Central/GTA have achieved 31% of the estimated potential.

IESO's Save On Energy: Between 2010 and 2017, approximately 74% of municipalities and municipal service boards have completed at least one project through the IESO's Save On Energy programs, receiving approximately $44 million in incentives and achieving annual electricity savings of 330 GWh. The majority of these incentive dollars (91%) were delivered through the Save On Energy Retrofit Program. The Save On Energy incentives program has now become part of a "normal dialogue" when seeking funding opportunities for many municipalities including the Region of Durham, the City of London, the City of Hamilton, and more recently, Village of Burk's Falls.

IESO's Energy Procurement Programs and Contracts: Municipalities that have participated in IESO's Energy Procurement Programs and Contracts have a total cumulative of 21.6 MW of generation capacity that is currently operational, and another 16.6 MW that is contracted (but not yet operational) with an average installation capacity of 4.6 MW per year since 2013. A majority of these projects are solar (predominantly rooftop), followed by combined heat and power (aka cogeneration). Over the next 5 years, municipalities are predominantly interested in pursuing projects in solar photovoltaics (PV), followed by renewable natural gas, and combined heat and power. Given the high levels of risk with these projects, less than 30% of survey respondents expect that on-site electricity and renewable generation projects will be easier to schedule in their capital budget.

IESO's ICI: To date, a total of 72 municipal facilities from 22 municipalities and 1 municipal service board are participating in IESO's Industrial Conservation Initiative (ICI) program, a program which allows participants to save on their Global Adjustment costs if they are able to reduce their demand during the top 5 hours of peak demand in the year. The majority of these municipalities have large populations and are from Central/GTA and Southwestern municipalities. 67% of municipal facilities participating in the ICI program are sewage treatment and water treatment facilities.

IESO's DR Auction: Of the 102 municipalities that provided a response to the DR Auction questions in the 2017 Municipal Energy Profile survey, only 10 indicated that they have participated in an IESO DR Auction, a competitive process through which resources are selected to be available to reduce their electricity demand, as needed during certain peak periods of the year.

Street lighting: Over the last decade, Ontario municipalities have successfully achieved significant electricity savings opportunities in street lighting while benefitting from other non-energy benefits such as reduced light pollution and better visibility. As of 2016, municipalities have achieved a 27% reduction in energy consumption from street lighting compared to 2006. Approximately 54% of municipalities have conducted retrofit projects and have retrofitted an estimated 49% of street light fixtures. Municipalities in Northeastern and Northwestern Ontario have retrofitted over 85% and 75% of their street lighting fixtures, respectively, surpassing progress made in other parts of the province.

Gas Programs Participation: Between 2011 and 2015, municipalities have achieved estimated cumulative natural gas cost savings of $4.0 million, receiving $2.3 million in incentives and achieving annual savings of 16.1 million m3. Over 65% of the municipal projects completed through natural gas incentive programs were space heating projects.

1.3 Organizational Best Practices

Overall Organizational Best Practices: Between 2010 and 2017, municipalities across Ontario have improved their median performance in Organizational Best Practices (OBP) by 20%. OBP is a qualitative assessment of corporate-level organizational practices related to strategic energy management performance.

Examining OBP performance by category: The highest increases in their median scores occurred in the following categories: Policy (41%), followed by Planning (32%), and Financing and Communication (25% each). The lowest increases in median scores occurred in the Accountability (8%) and Training (10%) categories.

Revolving Funds: Several municipalities including the Town of Caledon, the City of Pickering, the City of Guelph, and the York Region have developed revolving funds for sustainable energy projects, where the revenues are “recycled” back into a reserve fund to finance additional sustainability projects.

1.4 Impact of Policy

Driver to Sustainable Energy Projects: Most municipalities jointly ranked Ontario Regulation 397/11 compliance and bill savings and fiscal responsibility as the most influential drivers to pursuing sustainable energy projects in their municipality. O.Reg.397/11 has helped to equip municipalities with the data needed to make the business case to Council for approval of sustainable energy projects.

Better knowledge of internal competencies and capacity constraints: The previous 2014-2019 CDM planning cycle provided municipalities with an opportunity to better understand their own competencies as well as resource and capacity constraints. Municipalities also viewed the process of preparation for their 2014 CDM plans as an opportunity for staff from other departments to learn about facility management challenges. A mutual interest in meeting CDM

targets has also led to a higher level of cooperation and general level of involvement between municipalities and their stakeholders, as was seen by municipalities like the Region of Durham and their Local Distribution Companies. As a consequence, municipalities now feel more confident in setting achievable targets and goals and defining the scope of projects for the upcoming 2019-2024 CDM plan.

Energy efficiency and climate change: Many municipalities would like to see better integration of energy efficiency and climate change in provincial policies and regulations. A few municipalities suggested incorporation of GHG emissions reporting in O.Reg 397/11. Other municipalities would like to see more funding support for fuel switching opportunities such as fleet transitioning and electrification of space heating.

2. Looking Forward – What's next for Municipalities?

Despite the progress that has been made since 2006, municipalities still have significant opportunities remaining to reduce utility spending, cut greenhouse gas emissions, and upgrade infrastructure. Municipalities will also face new challenges and opportunities such as the electrification of space heating and transportation which is being driven by new regulations and climate change mitigation targets. The following section addresses the savings potential, identifies the major focus areas for municipalities, and highlights existing data gaps that will need to be addressed if significant progress is to be achieved.

2.1 Energy Efficiency Savings Potential

2.1.1 Electricity Savings Potential

ICF estimated the electricity savings potential for each of the end uses, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 1,176 and 2,620 GWh per year, representing a reduction of between 19% and 42% compared to 2014 consumption. The largest opportunities for electricity savings lie in water and wastewater treatment and pumping, building lighting, and street lighting.

2.1.2 Natural Gas Savings Potential

ICF estimated the natural gas savings potential for each of the end uses, assuming a lower and higher achievable potential for implementing cost effective energy efficiency measures. The potential savings range between 75.1 million m3 and 156.7 million m3 per year, representing a reduction of between 18% and 37% compared to 2014 consumption. The largest opportunities for natural gas savings lie in space heating.

2.2 Specific Focus Areas

2.2.1 Social Housing

Local Housing Corporations are owned and managed by municipal or district Service Managers and operate over half of the social and affordable housing units in Ontario. In 2014, consumption from these units accounted for 20% of total municipal electricity use and 37% of total municipal gas use.

The electricity consumption represents a 15% increase from the 2006 estimated consumption of 1,093 GWh. Virtually no new social housing has been built in 20 years (Housing Services Corporation, 2018). No gas data was collected in 2006, but gas use has been trending higher in recent years according to data provided by the Housing Services Corporation. The rise in utility consumption can largely be attributed to aging building stock, old and inefficient equipment, as well as greater plug loads. Specific opportunities for energy savings are noted in Section III.1.6.

2.2.2 Water and Wastewater Pumping

In 2014, water and wastewater treatment and pumping continued to make up roughly 33% of municipal electricity consumption, collectively representing the largest electricity end use. In wastewater treatment plants, sludge aeration is a major energy user, typically accounting for over 50% of electrical energy consumption. Specific opportunities for energy savings are noted in Section III.1.6.

Modern wastewater treatment plants are capable of using 85% less energy than the existing portfolio, and have been designed to be net zero or energy surplus facilities. One prime example in the province is the City of Guelph's plan to move toward a net zero or surplus energy scenario for their wastewater treatment facility – the City's largest energy consuming asset. The City seeks to achieve a net zero energy consumption in its operations by installing variable frequency drives on aeration blowers, harnessing the chemical energy stored in treated waste, and deploying on-site solar panels and battery storage to eliminate the treatment plant's use of energy during peak demand. (City of Guelph, 2017).

2.2.3 Street Lighting

Although municipalities have made significant progress over the last 5 years, there is still an opportunity for further savings. This study suggests that as many of 51% of the municipally owned streetlights in Ontario remain to be retrofitted. ICF estimates that the savings potential of retrofitting the remaining streetlights is between 243 and 287 GWh. Nexant's 2016 Achievable Potential Study identified a potential savings from street lighting of 258 GWh, based on all technically feasible retrofits between 2015 and 2020 (Nexant, 2016). Specific opportunities for energy savings are noted in Section III.1.6.

2.3 Data Gaps

2.3.1 Social Housing

Municipalities are not required to report their energy consumption from housing under O.Reg. 397/11. Since social housing represents the largest use of both electricity and natural gas for municipalities, this is a significant data gap which acts as a barrier to implementing energy efficiency. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including social housing in the regulation would be a good way to reduce this gap. Collaborating with other entities such as the Housing Services Corporation who have energy use statistics for over 42,000 social housing units would provide a starting point for municipalities that do not already have tracking systems in place.

2.3.2 Water and Wastewater Pumping

Municipalities are not required to report electricity consumption from water and wastewater pumping under O.Reg. 397/11. It was originally a requirement, but was removed by the time 2013 data was to be reported. Considering that pumping is one of the largest electricity end uses, and given the importance of water quality to municipalities, this is a significant data gap. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including social housing in the regulation would be a good way to reduce this gap.

2.3.3 Street Lighting

Municipalities are not required to report electricity consumption from street lighting under O.Reg. 397/11. In addition, there are significant gaps in information about Ontario's municipal street lighting system including which municipalities operate street lights, and how many fixtures there are in total. Since municipalities report that O.Reg. 397/11 is the most influential driver for implementing sustainability projects, including street lighting in the regulation would be a good way to reduce this gap. In addition, there is no central repository for information related to street lighting retrofit projects. As many municipalities are likely to seek Save On Energy funding for retrofits, tracking street lighting projects explicitly in the Save On Energy program database would provide more insight on street lighting retrofits going forward.

2.4 Capacity Building and Training

Of all the Organizational Best Practice categories, municipalities scored the lowest in Training, where their median Training scores increased by a mere 10% since 2010 and their 25th percentile scores remained stagnant at 0%. Put differently, a quarter of municipalities scored 0% in the Training category in 2017. When prompted on the training material and format that they would like to see offered in the market, municipalities suggested the following:

- **Incentive Offerings and Applications:** Municipalities of all sizes expressed interest in informational sessions on provincial incentive programs and funding offerings. Larger

municipalities such as the Region of York recommended capacity building training for municipalities to establish internal structures dedicated to provincial grant applications (Region of York, 2017). Medium municipalities such as the Town of Caledon and the City of Sault Ste. Marie want to know how to effectively find matching provincial incentives and make successful business cases to Council for more complex projects (Town of Caledon, 2017), (City of Sault Ste. Marie, 2017). Smaller municipalities often feel constrained in their internal capacity and technical knowledge to apply to provincial funding programs.

- **Knowledge Sharing:** The highest spread between 25th and 75th percentile Organizational Best Practice scores (a difference of ~50%) occurred in the Planning and Financing categories, suggesting knowledge sharing opportunities for municipalities in those two categories. Knowledge sharing could be done remotely through an online platform, an idea that was brought up by several municipalities including the Town of Richmond Hill.
- **Northern Ontario:** Municipalities in Northern Ontario find it exceptionally challenging to get their staff trained on energy management practices because of huge gaps in the resource availability from utilities and the ally network including consultants, distributors, and contractors. What is more is that many of the training courses are typically offered in-person in Southern Ontario. Staff will receive approval for training expenses but not travel expenses, so will be unable to attend as a consequence.
- **Content-Specific Training:** When it comes to training content, municipalities felt that they have general knowledge of energy conservation opportunities but lack specific in- house knowledge to identify, design, plan, and make the business case for more complex sustainable energy projects. For instance, behavioral programs have started to gain momentum in several municipalities such as the Town of Caledon and the City of Guelph; however, more support from the provincial government or other entities in launching these programs will make them more widespread and common among other municipalities.
- **Operational Training for Facility Staff:** Efficient operation of electrical and mechanical systems presents an otherwise missed opportunity not only in energy savings but also cost savings. Local training can be provided to facility operators on load shedding, scheduling, proper start-up and shutdown, troubleshooting, and preventative and predictive maintenance of electrical and mechanical equipment, particularly in arenas.

3. Recommendations

The following section includes specific recommendations to improve energy efficiency in the municipal sector.

3.1 Achieving Further Energy Savings

Approaches to energy savings and generation opportunities need to take a holistic approach to the present and future needs of the municipality, and need to be imbedded into other long term, strategic decision making processes such as capital replacement. Without an overall strategy,

capital replacement decisions tend to be made at or near end of life, without adequate time or budget to implement energy efficiency or consider longer term goals. As a consequence, significant energy savings opportunities are often missed. Similarly, energy generation opportunities need to take into account longer term objectives due to the long lifetimes of the measures, and the capital costs involved. To facilitate this decision making, accurate and up to date information on energy consumption is essential. This study has identified that despite the progress made in recent years in energy data tracking and reporting, there are still significant gaps. With so many competing priorities for municipalities, identifying the focus areas for energy conservation can be challenging. Some strategies are listed below:

- **Improve data tracking and use:** Accurate and up to date information on utility consumption and costs is required in order to identify and prioritize opportunities. This needs to be achieved in a variety of ways, including investing in tracking systems such as utility meters and databases, providing increased funding and staff to facility operations, and empowering facility staff to act on identified opportunities. In order to contribute effectively to energy savings, the data cannot simply be tracked, but needs to be acted upon.
- **Take a portfolio approach:** Prioritize facilities that have high energy consumption compared to the rest of the stock, either because they are large or are poor performers compared to their peers. Water and wastewater treatment, social housing, and street lighting are the biggest electricity consumers, while social housing, multi-purpose buildings, and arenas are the biggest users of natural gas. Barriers to implementation should also be considered. For example, although social housing is one of the largest energy users, it consists of multiple smaller buildings and often includes additional stakeholders and decision makers.
- **Prioritize new construction and natural capital replacement:** Energy efficiency is much more cost effective when only the incremental cost compared to standard efficiency equipment has to be funded. Incremental costs for many measures are often negligible. Planning for energy efficiency should be undertaken when designing new facilities and planning for major capital replacement.
- **Establish priorities in reduction targets:** Due to the nature of Ontario's electricity generation mix and market factors, electricity has significantly lower GHG emissions compared to natural gas, while natural gas costs about 20% of electricity on a purchased unit energy basis. Therefore, electricity measures should be favored when seeking to maximize utility cost reductions, and natural gas savings measures should be prioritized when the objective is to maximize GHG emission reductions.
- **Focus on significant end uses:** Similar to the portfolio approach, the largest energy end uses should be prioritized. Wastewater treatment process loads, street lighting, and water and wastewater pumping are the largest end uses outside of the building portfolio. Within the building portfolio (multipurpose, municipal buildings, arenas, and housing), lighting, ventilation, and arena process loads such as ice rink cooling are the largest end uses. Space heating is by far the largest end use for natural gas, followed by domestic hot water

heating and wastewater treatment.

- **Focus on reduction, efficiency, and then generation:** The most cost effective way to save energy is not to consume it in the first place, so measures that reduce waste, such as turning lights off in unoccupied spaces, should be prioritized. These savings can be accomplished through awareness campaigns or the use of technologies such as occupancy sensors. After waste reduction, the use of energy efficient equipment such as LED lighting should be implemented. Without implementing waste reduction strategies first, or in parallel, the benefits of equipment upgrades are not maximized as they may simply be wasting energy more efficiently, such as illuminating unoccupied spaces. Generation is the last option to consider due to high capital costs and complexity of implementation. Holistic retrofits will minimize energy use through waste reduction and energy efficiency prior to the implementation of generation. This allows for smaller generating systems or a larger proportion of facility energy use to be produced than would have occurred without these retrofits.
- **Include non-energy benefits in decision making:** Energy efficiency can have important non-energy benefits such as improved light levels, better indoor air quality, and improved equipment reliability. This can have an impact on diverse area such as occupant comfort, health and safety, and potable water quality. Factoring in non-energy benefits can be crucial to getting buy in from decision makers and stakeholders, as well as making the business case for efficiency more compelling.

Specific measures of particular benefit to municipalities are discussed in more detail in Section III.1.6. This list is by no means exhaustive, but includes cost effective savings opportunities for each of the major end uses within the municipal sector, and can be used to inform sustainability planning in conjunction with the guidelines provided above.

3.2 Addressing Data Gaps

Despite the progress made in recent years in energy data tracking and reporting, there are still significant data gaps particularly in social housing, street lighting, and water and sewage treatment. ICF proposes that either the mandatory requirement for municipalities to report on energy data from social housing, street lighting, water and sewage pumping is introduced under O.Reg 397/11 or that inventory studies are routinely conducted to fill in the critical data gap and provide accurate and up to date information on energy consumption in these sectors.

3.3 Capacity Building and Training

The following recommendations are proposed to address the low scores in Training identified during the Organizational Best Practices survey.

- **Webinar on Incentive Offerings:** ICF proposes developing a webinar on all provincial incentive offerings available for gas and electricity savings and emissions reduction opportunities, targeting municipalities as the audience.

- **Targeted Support on Incentives and Grant Applications:** In addition to the webinar noted above, ICF recommends working with municipalities of different population groups to offer the following targeted support:
    - **Large Municipalities:** Provide training for larger municipalities on how to establish internal structures dedicated to provincial energy and climate change-related grant applications;
    - **Medium Municipalities:** Provide training for medium municipalities on how to make the business case to get their Council buy-ins for more complex projects such as behavioral programs;
    - **Small Municipalities:** Include supplementary material with grant applications that explain the technical terminology and offer smaller municipalities the opportunity to call-in and inquire about applicability of their project ideas to obtain specific grants.
- **Special Attention to Northern Ontario:** Given the gap in resource availability in the Northern Ontario region, ICF recommends the following:
    - **Online Training:** Offer more online training courses to reduce the cost of traveling and training and allow more staff to be trained in matters related to energy management.
    - **Localized Support:** ICF also recommends that the IESO, MOE, AMO/LAS, and utilities work in partnership to offer more localized and readily available support specifically dedicated to this region. Focus areas to include: arena technological upgrades, operational and maintenance support for facility staff, and training on procurement of energy efficiency products and services to help small and rural municipalities expand the scope of their energy conservation projects.
    - **Pairing of Municipalities:** Findings from the Organizational Best Practice survey questions indicate that for Northern Ontario specifically, the lowest 25% scoring municipalities could use the support of the highest 25% scoring municipalities in improving their energy-related organizational practices. ICF proposes pairing of high performing municipalities with municipalities that are lagging behind to allow for knowledge sharing of best practices and help boost the performance of the lowest scoring municipalities in Northern Ontario.
- **Content-Specific Training:** In line with the Long-Term Energy Plan, ICF proposes offering training on the following content: Net-Zero attributes, beneficial electrification, fleet transitioning, integration of life cycle costing in asset management, behavioral programs, and developing community energy plans.

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