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SME ENERGY MANAGEMENT CONSORTIUM PROJECT

Report for IESO

A program of:

Toronto and Region Conservation Authority

Disclaimer: This project is supported by the financial contribution of the Independent Electricity System Operator (IESO), through its Grid Innovation Fund. However, the views, opinions and learnings expressed in this report are solely those of Toronto and Region Conservation Authority.

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EXECUTIVE SUMMARY

This project facilitated the initial stages of adoption of Strategic Energy Management (SEM) practices by Small-to-Medium (SME) manufacturers in the Greater Toronto Area. The project consisted of three key elements of support:

1. A forum for participants to meet guest experts and share best practices
2. Direct support from project coordinators
3. Financial support to install energy monitoring equipment

The objective was to trial a set of services that provide a segment of Class B customers to embed energy management and ensure sustained energy savings over the long-term.

Outcomes

Energy monitoring was found to greatly support the implementation of SEM best practices. When paired with educational resources and a forum to share experiences with other peer businesses, the level of engagement was found to be very high. Key metrics included:

- 100% engagement in implementing at least some elements of SEM with promising indicators that the SEM program will be continued by each participant
- An average of 2.25 operational efficiency implemented projects per participant in 4-5 months from completing the installation of energy monitoring equipment
- 95% attendance of consortium sessions, across 11 sessions delivered in a 10-month period

Non-Energy Benefits (NEBs) were found to be a key success outcome for participants. Every member of the group found at least one non-energy benefit to installing the energy monitoring equipment, including: optimizing equipment operation, improving process outcomes, employee comfort, power factor monitoring and more. A key driver for implementing SEM was customer demand for information on energy and emissions performance.

The COVID-19 pandemic likely had a negative impact on engagement, as unforeseen workloads were required from the members to respond to health and safety requirements. However, there were a few “silver-linings” discovered, including the ability to easily attend virtual events and the experience undertaking educational campaigns, in this case related to new health and safety protocols.

Key Learnings

Recruitment remains a key challenge:

During the recruitment phase it was found that there was a lack of stories that could be shared that showed how SME manufacturers had successfully reduced energy costs. Lack of education on costs and strategies of energy monitoring presented further barriers for SMEs to get engaged.

SEM implementation occurs irregularly:

SMEs are highly resources-strapped and are only able to make time to tackle SEM practices when regular business operations allow. Energy management programs need to be long-term to allow for irregular schedules. Encouraging adoption of best practices in SEM will ensure the changes made whenever possible are permanently embedded in day-to-day operations.

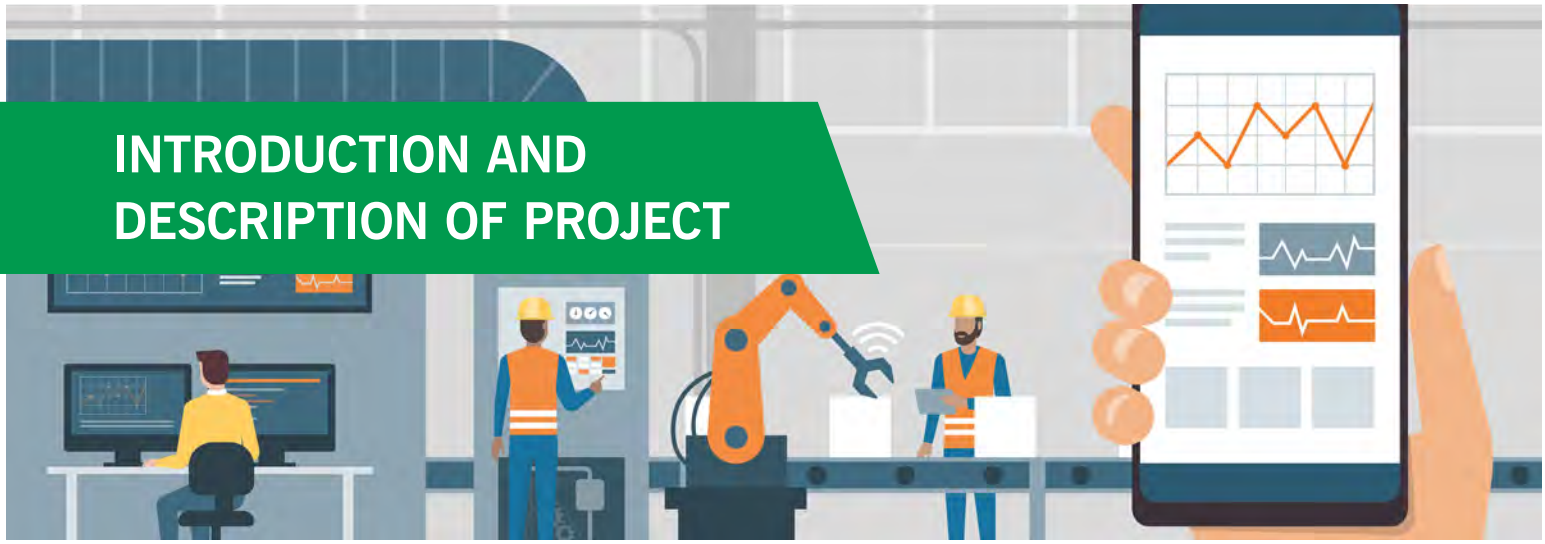
Measurement and Verification (M&V) is not a high priority for SMEs initially:

The members of the group preferred to act quickly when they saw an operational adjustment that would save energy and work from broad estimates of the savings. It could be helpful if M&V were more easily automated through advanced software in the monitoring platforms. Encouraging M&V best practices will help ensure the SEM initiative within company and achieved savings are sustained over time.

Next Steps and Recommendations

Partners in Project Green (PPG) aims to sustain the Consortium group as an ongoing program that reflects the broader industry needs within target communities. The participants of this initial project will be able to retain membership for one additional year at no further costs to participants of this program. PPG will continue to recruit SMEs to participate in the forum, with program fees respective to company size. This will enable the consortium to grow and maintain a self-sustained business model. Further activities for the group may include Collective Projects, a term used by PPG to describe initiatives taken on by two or more members, leveraging such advantages as group purchasing, grant funding or shared learnings.

Eight recommendations are made at the end of this report, focusing on promoting NEBs of energy monitoring, strategies for providing access to energy data, creating resources for implementing SEM and helping the market improve energy data technologies.



INTRODUCTION AND DESCRIPTION OF PROJECT

The Small-to-Medium (SME) Energy Management Consortium Project was partially funded through the IESO's Grid Innovation Fund from the summer of 2019 to June 30, 2021. This project guided Small-to-Medium Enterprise (SME) manufacturers through a process to embed Strategic Energy Management (SEM) best practices into their day-to-day operations.

The project was led by Partners in Project Green (PPG) – an initiative of Toronto and Region Conservation Authority (TRCA) – in collaboration with Excellence in Manufacturing Consortium (EMC). Project design, oversight and support was provided through an Advisory Group. The Advisory Group consisted of local utilities, municipal economic development departments and government energy management program representatives.

Project Components

The project offered three elements of support to help move participants towards business practices where sustained energy savings will be achieved:

1. Peer group knowledge exchange
2. Direct advisory services
3. Financial assistance for energy monitoring equipment and services

Eligible Businesses

The targeted group of utility customers for the project were Class B SME manufacturers. Specifically, eligible businesses were required to be: (A) Manufacturers with a facility located within Peel, York, Durham or Toronto, (B) Less than 500 employees total (including other Canadian and international employees), and (C) Class B electricity rate customers.

Project Costs and Incentives

The costs for each participant was $3,000 to cover two years of participation in the SME Consortium. This included access to the Consortium's sessions, one-on-one support from project coordinators and access to resources. Each participant received $15,000 in financial assistance towards energy monitoring equipment and any associated consultative services.

Community of Practice

The project fell under the Community of Practice category within the Grid Innovation Fund program. While the IESO-funded portion of the project ended as of June 30, 2021, the Community of Practice is being maintained on an ongoing basis, as part of the PPG initiative. The participants will continue to be members of PPG's SME Consortium for an additional year at no cost.

PROJECT OBJECTIVES

The project objectives are to trial a program model which engages the SME manufacturing sector and create a lasting Community of Practice amongst the project participants. The participant businesses were introduced to SEM concepts and the language of energy management, and were made aware of energy management incentive programs. The financial support to install energy monitoring equipment was meant to help accelerate the adoption of SEM practices by the participants.

Project objectives included:

- Introducing and implementing SEM practices
- Creating a lasting Community of Practice
- Evaluating the impact of a low-cost energy monitoring incentive for SME manufacturers

OBJECTIVE 1:
Introduce and implement SEM practices

An opportunity often noted within the energy management industry is scaling up engagement with SMEs. Energy management skills and knowledge are not the core business of the companies and therefore need to be acquired at a cost of time and money – which is often not readily available to many SMEs. The project aimed to introduce participant businesses to the basics of SEM, including the language and concepts of energy management more generally. An SEM 101 document was developed, a series of sessions were held to educate on best practices and one-on-one meetings were held with the project coordinators (PPG and EMC) to streamline the implementation of various components of SEM.

OBJECTIVE 2:
Create a lasting Community of Practice

Both PPG and EMC have experience delivering services that provide forums for businesses to come together and share with each other what works and what does not, across a variety of subject matter. PPG's Energy Leaders Consortium has been very successful for larger energy-consumers – many of which have budget allowance to hire dedicated energy management staff, which SMEs typically do not. This project trailed the effectiveness of a Community of Practice in engaging those within organizations who are tackling energy management as only a minor part of their role.

OBJECTIVE 3:
Evaluate the impact of a low-cost energy monitoring incentive for SME Manufacturers

PPG has found that energy monitoring prices that are quoted to businesses are often higher than initially expected and become difficult to justify because of the uncertainty of the savings simply from being able to see energy data. As plant digitization becomes increasingly more important to manufacturers, it is expected that innovations in sensors and software to track energy use will make energy data more ubiquitous. At this point, however, incentives are required to fill this essential gap in implementing energy management. This project provides a low-level of incentive to these businesses to discover what kind of ROIs can be achieved and what can be learned about their facilities from access to this data.

The Market Challenges Addressed

The focus of the Community of Practice stream of the Grid Innovation Fund is focused on engagement, rather than energy savings exclusively. Success was measured through an evaluation of metrics associated with participant engagement with the Consortium and SEM practices, including:

- Consortium session participation
- Use of resources provided
- Adoption of SEM practices
- Energy monitoring equipment installed
- New projects identified throughout the course of the project
- Additional learnings

How Success Was Measured

The project was designed to address challenges unique to smaller manufacturers. Engaging SME businesses has been a long-standing challenge for government-funded energy management programs, despite SMEs making up a large portion of the province's energy consumption and a large portion of employment in Ontario. The top market challenges identified through this project include:

- Sustained engagement by the SME manufacturing community
- Overcoming a lack of capacity to dedicate personnel exclusively to energy management
- A perceived risk in achieving an ROI from investing in energy monitoring
- Incentive programs for SEM have historically focused on larger manufacturers
- No forums for SME manufacturers to discuss energy management issues with peers

APPROACH TAKEN TO ACHIEVE OBJECTIVES

The project offered support to participants in three elements: Peer group knowledge exchange, advisory services and financial support for an energy monitoring project. The intended effect was that the participants make progress adopting components of SEM.

Formation of Advisory Group

An Advisory Group was formed to provide feedback on project design and support outreach and recruitment activities. Members included municipal economic development officers and managers, utility conservation team representatives, government energy management representatives, as well as PPG and EMC. Two meetings were held prior to public launch of the recruitment campaign and three more were held throughout the project, including a final meeting to determine how the learnings of the project could be used to influence the industry as a whole.

Recruitment

Recruitment and outreach strategies included stakeholder outreach, a newsletter and a webinar on the topic of the value of energy monitoring featuring a representative from the Save on Energy Program. A significant amount outreach was done through direct communication by the Advisory Committee. Members of this group had extensive experience deploying energy management programs and the networks developed across GTA businesses who were interested in reducing energy costs are at this point likely quite comprehensive. Since eligibility requirements limited who could sign-up to participate (SME manufacturer, Class B customer, within the GTA), the most effective outreach was by members of the Advisory Group directly contacting businesses in their networks deemed eligible and interested in signing up.

Development of Resources

An SEM 101 Guide was created to introduce participants to the concepts of Strategic Energy Management. The objective was to create one-page overviews of each element (listed below), including links to more detailed resources available at no cost.

RESOURCE: SEM 101 COMPONENTS

STEP 1: Draft Letter of Commitment to Strategic Energy Management

STEP 2: Key Performance Indicators (KPIs) and Measurement and Verification (M&V)

STEP 3: Energy mapping

STEP 4: Metering gap analysis

STEP 5: Tips for procurement of energy monitoring equipment

STEP 6: Energy dashboarding and reporting

STEP 7: Identifying and capitalizing on energy savings

STEP 8: Engaging employees

APPENDIX: Additional links to Energy Management Guides and Resources.

In addition, lists of local energy monitoring vendors and local university/college programs that could provide students to support SEM implementation were developed and provided to members.

Executive Sign-Off

As a part of recruitment, each participant was required to provide a letter of executive support for the project. This was to ensure that each member had secured awareness and support from the top levels of their organizations before beginning the process of pursuing SEM.

Peer Group Sessions

A key component of the project was allowing participants access to an exclusive forum to share experiences in implementing SEM with other businesses of similar type and size. Originally planned for in-person meetings, the impact of COVID-19 required a pivot to all-virtual sessions. The sessions commenced from the time of project launch and are continuing beyond the end of the IESO-funded portion of the project.

Subject Matter Experts were invited to present on specific areas, based on expressed interest of the participants and the equipment running within their facilities.

CONSORTIUM SESSION TOPICS

- Strategic Energy Management 101
- Sustainability Reporting
- Energy Monitoring Basics
- Corporate Sustainability Strategy
- Energy Monitoring Success Case Study
- Organizational Engagement
- Sustainability Data Management
- Electricity Incentives Update
- Finding Low/No Cost Savings
- Energy Market Update
- Air Compressor Systems Efficiency
- Gas System Efficiency
- Going Carbon Neutral
- Member Presentations of Energy Monitoring Projects
- Decarbonization in the F&B Sector
- Energy Efficiency Financing
- AI and Energy Efficiency
- Solar PV and Travel Emissions

Funding for Energy Monitoring

The energy monitoring funding was provided to participants in the form of reimbursement following completion and payment of projects. Eligible expenses including those related to the purchase and installation of energy monitoring equipment or consulting hours toward onboarding employees onto software platforms or managing energy data such that key data points could be analyzed going forward. The maximum amount available to participants was $15,000, with coverage of expenses required on their behalf. Any costs above the maximum were required from the participants.

The intention of this funding for energy monitoring was to give participants a sample of what insights can be had from energy data. Many energy monitoring systems are easily scaled up over time, meaning that to start the participants are not required to apply sensors to every circuit, but can start small and scale up. The amount of funding was working from an assumption (based on discussions with industry stakeholders) that the average cost for energy monitoring equipment was $500 per data point. This would allow for 30 data points to be added to the facility, which was assumed to be more than adequate to give interesting insights, based on a typical Class B facility.

Implementation of SEM Components

The project coordinators at PPG and EMC provided direct support to participants in the form of virtual meetings. Four meetings per participant were held throughout the 10-month course of the project.

Guidance included:

- Energy data analysis
- Project identification
- Funding program identification
- Measurement and verification

An additional important element was encouraging accountability. As members of the Consortium, the participants want to be able to showcase their progress on SEM to the project coordinators and other members. Regular check-ins were important to instate a timeline that the participants could work toward (e.g. completing a task prior to the next check-in meeting). In a similar fashion, the Round-table sessions at consortium meetings provided timelines for the members to provide updates on their projects.

PROJECT FINDINGS

Key project findings outlined below focus primarily on participant engagement. Projects identified and implemented are also captured. The focus of implemented projects are operational – meaning low/no-cost changes that are often the first to be identified from installing energy monitoring equipment.

Consortium Session Engagement

Metrics directly connecting engagement with action can be difficult to track as participants may connect outside of the consortium sessions or leverage learnings from the sessions without knowledge of project coordinators. The success of building a Community of Practice is best measured by longevity of the program and stated value of the participants. The project has only been fully active for less than a year and enthusiasm from the participants remains strong. The following metrics proposed are suggested for tracking engagement:

95%

Consortium session attendance rate

4

Recorded incidents of participants following up with each other to share experiences on specific projects

5

Connections to solution providers made

100%

Stated commitment to continuing to participate in consortium sessions

Adopted SEM Practices

Strategic Energy Management practices are captured in categories highlighted in Figure 1 and tracked by how many of the four participants completed the components. While all elements of SEM were encouraged and assisted by coordinators, it was left to the participants to determine which order they were implemented. With many pressing priorities (especially during the COVID-19 period), the participant businesses had limited capacity and often had to choose which SEM component is most valuable at that time.

FIGURE 1:
SEM COMPONENTS IMPLEMENTED

	1	2	3	4
Executive Buy-in	●	●	●	●
Installation of Energy Monitoring System	●	●	●	●
Goals / Targets Set	●	●	○	○
Establish a Green Team	●	●	●	✓
Identify Energy-saving Projects	●	●	●	●
Establish M&V Methodology	●	●	○	○
Implemented Projects	●	●	○	○
Regular Reporting on EM Performance	●	●	○	○

● Completed ✓ In Progress ○ Not Started

Projects Identified and Implemented

The types of projects pursued by the participants is captured in an anonymized form in Figure 2. This kind of tracking allows us to see which types of projects are most of interest and which are most often completed. It also allows participants to see (when not anonymized) who in the group is pursuing similar projects and who they can connect with the inquire about common experiences.

FIGURE 2:
TYPES OF PROJECTS

	1	2	3	4
Energy Monitoring	✓	✓	✓	✓
Lighting	●	✓	✓	✓
Air Compressor	●		●	●
HVAC			●	
Water Efficiency				●
High Speed Doors		●	✓	
High Velocity Low Speed Fans			✓	
Boiler				●
Equipment Scheduling Optimization	●	●		
Equipment Shut-off Program	●	●		
Power Quality			●	●
Equipment Operation Correction	●	●	●	

● Completed ✓ In Progress

Below are a few metrics summarizing the implementation of the group, as averages per participant. The New Projects Identified differs from the chart above in it excludes projects that were conceived prior to joining the Consortium. Operational Savings Measures were the prioritized type of project here, so it comes as no surprise that capital expenditure projects have not yet been completed by participants. As per SEM methodology, energy monitoring unlocks the capacity to save energy through low/no-cost projects prior to requiring investments in equipment retrofits and upgrades.

Average New Projects Identified	**4.75**
Average Operational Savings Measures Implemented	**2.25**
Average Capital Measures Implemented	**0**

Energy Monitoring Equipment Installed

The average spend on energy monitoring equipment and services by participants averaged very close to $15,000. However, at least three participants indicated the interest in continuing to invest in energy monitoring in the near future. Increasing understanding of equipment and systems on site through energy monitoring data appears to have the effect of creating the desire for more – and once initial systems are installed, the incremental cost of installing energy monitoring for new portions of the facility is relatively small.

Lowest Installed
Energy Monitoring Cost

$333.00 / data point

There are a variety of types of energy monitoring equipment. The most common consists of current transformers (CTs) installed around wires at the electrical panel. These CTs can be wired or wireless and communicate with a gateway that either links to a local network or has its own independent network connection through cellular data. At lower, single-phase voltages, these systems can be easily installed and set up. They are easy install and allow the flexibility to move to other circuits if desired.

The participant who achieved the lowest cost project was able to install the system using their own onsite certified electrician. Costs can increase for those interested in monitoring the main feed, three-phase circuits or alternative sensors to monitor non-electricity data points. Non-electricity data (e.g. compressed air, water) is very useful in informing SEM strategies, such as airflow or water.

Strategies to reduce costs by using virtual monitoring – for example using equipment PLC/SCADA data for runtime information along with estimates of equipment power draw – were not utilized by participants to monitor electricity in this study. However, one participant was able to use this technique to monitor natural gas consumption. Natural gas meters were found to be prohibitively expensive and in one case during recruitment was actually a stated reason that a potential participant ended up not joining.

Another way to reduce monitoring costs could be integrating API data from the utility meter into the energy monitoring system platform to avoid installing a meter on main feeds. This applies both to all utility meters (electricity, gas, water). Some participants did explore this with their utility using their energy monitoring vendor but none were successful in securing interval utility meter data, let alone integrating it into their energy monitoring platforms.

Additional Learnings

Common Motivation to Pursuing Energy Management: Customer Demand

All four participants cited customer interest in energy management and carbon emissions as a reason they participated. This was often a B2B relationship, meaning important business customers had requested some form of information from their suppliers (the participants) on energy and climate mitigation strategies. But in the cases of participants who sold directly to consumers, there was an appeal to being able to showcase sustainability practices.

In some cases, the trigger to act on energy management was initiated merely from a simple email inquiry from an important customer – this was enough for these SMEs to see the need to prepare for potential future reporting requests coming from their customers. Large corporations that follow protocols like the Carbon Disclosure Project (CDP) are required to initiate a level of reporting on Scope 3 emissions – including emissions produced in their supply chains. This can entail submitting energy and emissions data to the customer. It may in the future even require that the SMEs will collect data from their suppliers – continuing down the supply chain.

It is expected that as investor-driven reporting requirements (CDP, SASB, TCFD, etc) increase for large publicly traded companies, more and more pressure will be put SME manufacturers to engage in energy and emissions management, thereby increasing the demand for SEM Community of Practice programs.

Non-Energy Benefits

Participants identified that side benefits to their energy monitoring project were often greater than the value of utility cost savings. That is to say, reduction of utility bills in many cases was only a small part of the reason why the participants saw this project as successful. For some, the value of the NEB was part of the original intent. In other cases, the benefits of having the extra insight into their operations was not fully understood until the energy monitoring data was laid out in front of them.

Some of the Non-Energy Benefits included:

Identification of equipment malfunctions:
3 out 4 participants noted that there were issues with how equipment was operating, that was discovered through the energy monitoring data and would otherwise have gone unnoticed. Minor operational errors can run without impacting operations, however, may continue to consume additional energy or lead to early equipment failure.

Additional insight into equipment operations:
Participants were able to have an extra layer of data to monitor operations, allowing them to double-check data coming in from other software on site or to get new data on equipment runtimes.

Behaviour change:
Once the energy monitoring project was shared with employees, many were more responsive to shutting off equipment that was not in use.

Insight into production rates:
One participant identified that the data collected from the energy monitoring equipment would allow the company to better track production rates in more detail than they were previously able.

Power quality submetering:
Many in the group noted the desired to improve power quality on site, to protect equipment wear and tear and reduce downtime.

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Employee comfort:
Those that decided to focus on HVAC and heat management within the facility noted that the benefit of improving the working environment was a significant success story for them.

Efficiency equipment:
Insights into the energy consumption of equipment allowed better analysis of lifecycle costing of machinery on site. Purchasing low-cost refurbished equipment can appear cheaper if energy efficiency of newer models are not taken into account. In many cases, the benefit to maintenance managers can be significant if the newer equipment is more reliable.

These discoveries are closely in-line with the IESO's recently released Non-Energy Benefits Study that found: "In many cases, the value of the NEBs within a given sector exceed the value of the participant energy savings." The NEB study focuses on the benefits of all types of energy management funded by the IESO from 2017-19. It may be interesting to commission a study on NEBs related specifically to energy monitoring, since data is so dynamic in the ways it can be used. In the future, as digitization increases in manufacturing facilities, data points will be of even greater use.

Energy Savings M&V

While the project timeline was quite short in terms of fully embedding SEM into an organization's DNA, it may be significant to note that measurement and verification (M&V) was not noted as a high priority by participants. With the encouragement of the project coordinator, one participant followed up with their vendor to secure an M&V report for a project. Others were starting to identify how they would implement a strategy to verify energy savings – for example, comparing energy use with monthly reports on equipment runtimes. Often the priority fell to identifying and then making operational changes as quickly as possible. The energy savings project was more often understood by everyone involved to be inherent and good, without necessarily needing to quantify them. Because the SME organizational structure is relatively small, the executive levels are often able to understand the benefit of energy savings in operations without requiring quantitative data.

That said, it could be that in the future, the SEM program's success at the company will need to be evaluated and hard data will be useful to justify continuation. One finding was that there seemed to be limited capability in the energy monitoring software to easily automate M&V. Exploring automated M&V software could be an interesting avenue of further study for the IESO.

Impact of COVID-19

The COVID-19 pandemic disrupted business across the world, in Canada the major impacts commencing in March 2020. While the manufacturing industry remained operational more or less constantly throughout the pandemic, each member of the group was impacted in some way, whether it was through customer orders, supply chain or having to take on new EH&S protocols The pandemic effected the project in three key ways: recruitment, engagement and "silver-linings."

Recruitment

At this time, the project had just wrapped up the initial recruitment campaign and had received eight applications. Since there was a maximum allocation of 10 businesses, it was determined to continue to pursue recruitment throughout the summer. Over that duration no more businesses were recruited and 4 dropped out. Of these, two stated that COVID-19 was the reason.

During the secondary outreach period, of the few businesses that responded to outreach a small number indicated that it was not the right time, due to the pandemic. This was also echoed by the members of the Advisory Committee from their out-reach. Taking on new projects had a higher perceived risk during the uncertain period of the pandemic.

Engagement

The engagement level for the project is considered to be good, at a rate of 2.25 projects implemented per participant over the 4-5 months following installation of the energy monitoring equipment. The project was conducted during the very challenging period of the COVID-19 pandemic, where new EH&S protocols and ebbs and flows in supply chain and customer demand created unique operating conditions. It is expected that, with the energy data in-hand, the implementation related to this program/project will continue to scale up post-pandemic.

Silver Linings

A few participants reported "silver-lining" – that is beneficial learnings – from the COVID-19 experience. This included an appreciation of virtual meetings. It was also noted that employee engagement efforts for new COVID-19 protocols, such as communications around new protocols that needed to be followed in the facility, could be replicated for energy management campaigns. Going forward, the consortium group hopes to further capitalize on these identified opportunities.

Participant Case Study

DISHON LTD.

Dishon Ltd. is a world class supplier of complex precision machine components and assemblies for North America, Europe and Asia, with experience in Aerospace, Nuclear, Medical, Sub-sea Oil & Gas Industries.

The Vaughan, Ontario facility operates 80,000 sq ft of manufacturing space, employs around 85 people and typically operates on a 5-day, 3-shift schedule.

Why they got involved

Dishon joined the SME consortium initially to manage and reduce our energy cost, thereby reducing overhead and add to profitability. Additionally, they wanted to see how energy data could be integrated into their ERP system.

At the outset, only a few limited energy projects were identified. Since Dishon's equipment consists mostly of machines that needed to run as much as possible to optimize production, the opportunity to reduce energy use was initially seen as only minimal.

What they did

45 wireless CTs were installed around the facility, giving them real-time insight to the bulk of their equipment. They noted how easy wireless technology was to install, you can even use your own on-staff electricians.

What they found

- Discovered that air compressors make up a significant portion of electricity use, looking at ways to improve compressor plant efficiency and reduce demand-side losses (checking for leaks and end-use).
- Looking to find ways to reduce consumption of machines when not in use. An opportunity identified was to shut off machines while the plant was not in operation. This project alone, which requires no upfront capital could save the company over $16,000/year, essentially paying back the cost of the energy monitoring system installed in a 1-year payback.
- Side benefit: The energy monitoring allows for an added layer of insight into equipment, allowing them to monitor machine run-times, identify faults and generally verify operations are running as intended.

"Being a part of the SME Consortium has been a great experience for Dishon. We have gained valuable insight into the energy consumption of our plants and now have excellent tools and resources to reduce our usage and save on energy costs."

– Nathan Silverman, Business Intelligence Manager

Participant Case Study

ALGOOD CASTERS INNOVATION

Algood Casters Innovation manufactures a wide variety of casters for office furniture, institutional and industrial applications, shopping carts, food service equipment, material handling equipment and many other applications.

At the 80,000 square foot Toronto facility, they currently employ around 75 employees.

Why they got involved

Algood joined the SME Consortium as a way of furthering the energy management program already underway. Taking advantage of provincial incentive programs, they had evaluated the air compressor system.

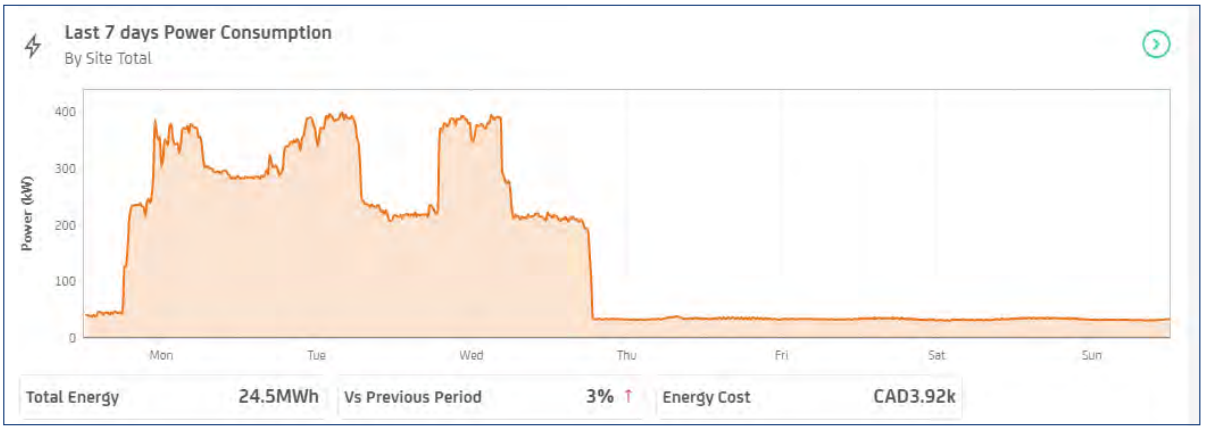
A key reason for joining the program was to work toward a detailed understanding of how energy was consumed compared to production rates in the facility.

What they did

Installed over 20 data wireless CTs throughout the plant, including airflow meters on the compressor plant and larger CTs in the main feed.

What they found

- One of the older pieces of equipment was found to consume significantly more energy than others in the facility. Simply by shifting production to machine capable of doing the same job while consuming less energy resulted in big cost savings for Algood.
- Immediate behaviour change was witnessed among employees who had access to the monitoring platform, taking their own initiative to shut off equipment when not in use.
- Side benefit: A large opportunity discovered during the program was the capability of leveraging the data provided by the energy monitoring equipment to get better insight into production rates provided by each machine.



Participant Case Study

AMTEX YARNS

Amtex are spinners of superfine Merino wool, Merino wool and merino wool blend yarns for the hosiery, suiting, weaving and sweater industry using the latest state of the art spinning equipment Amtex is one of the most modern plants for spinning wool in the world producing high end customized yarns for different textile markets.

They currently employ around 46 employees at their 48,000 square foot facility in Mississauga.

Why they got involved

Amtex joined the program to reduce energy bills and improve environmental sustainability. A key opportunity they saw in energy monitoring was to combine monitoring of energy consumption with monitoring of power quality, thereby improving their power factor and reducing wear and tear on the many motors operating within the facility.

What they did

Installed CTs on panels throughout the plant, with the ability to monitor both energy and power quality.

What they found

- Identified key large consuming equipment in the plant, presenting new opportunities to recycle heat that would otherwise go to waste.
- Amtex is continuing to dive into how power quality if affected by different equipment in the plant and how it can be effectively improved over time.

Participant Case Study

NAHANNI STEEL PRODUCTS

Nahanni is a Tier II/Tier III automotive parts manufacturing company that specializes in supplying to the automotive industry through metal stamping , welded and mechanical assemblies.

They have operated in Brampton since 1968 and currently employs 64 people.

Why they got involved

The original key issue Nahanni wanted to address was thermal comfort for their employees on the shop floor. Industrial buildings can be tricky to maintain temperatures, especially in busy winter seasons when overhead doors are frequently opened and closed. They also wanted save energy costs.

They required an advanced monitoring and controls system for their existing HVAC equipment. An unexpected outcome of the project was that energy savings were so significant that the project would pay itself back in only a few years, all the while improving the work experience of employees.

What they did

Installed smart thermostat controls and integrated HVAC equipment into a cloud-based monitoring and controls platform.

What they found

- Increased employee thermal comfort on the shop floor, using the ability to immediately respond to any issues anywhere/anytime using cloud-based access to HVAC controls.
- Reduced energy consumption during unoccupied hours. Installed door sensors to turn off nearby heating units when exterior loading doors were opened. Furthermore, quick roll doors were installed to reduce the time outside air was allowed to infiltrate the shop floor.
- The project saves both heating gas and cooling electricity. To date, the Measurement and Verification (M&V) estimates close to $10,000 in annual savings – and that is only from heating costs.
- Side benefit: Found a rooftop heating unit was not operating correctly and was able to repair the problem before the unit failed.

"The program has added informative data and much needed support for Nahanni to make real-world decisions in a cost-effective manner. The team is well rounded and offers years of experience in a condensed timeline."

– Sebastijan Zupanec, General Manager

LESSONS LEARNED

The Timing must be Right for SMEs to Take on SEM

SME Manufacturers have very limited human resources to dedicate exclusively to SEM and priorities can quickly change as production demands shift. With larger organizations, often the task of engaging the executive level is a key challenge; it was found in the most effective cases that the champion's roles were often close to the top of these small organizations – President, GM, Director of Operations, etc. While this is great for ensuring top-level direction, it means that those who are champions have a broad scope of duties and often need to sideline SEM for more immediate matters related to business success. This can make SEM programs or projects with fixed deadlines difficult to recruit and apply for since the ebbs and flows of dedicated resources do not always line up with program timelines. Installation of energy monitoring equipment itself should allow for engagement of companies who invest the time and capital to implement and operationalize measures. It was seen from the project that enthusiasm for, and commitment to, implementing projects increased following installation of energy monitoring equipment. Offering a forum to report on progress ongoing along with the tools to track performance will keep the companies engaged. In order to better understand how feasible and how impactful programs that create these forums would be, more data on the number of companies in Ontario that would need to implement SEM in order to influence a tipping point in industry practices needs to be researched.

No participating companies leveraged the offered assistance to support the onboarding of students from local post-secondary institutions. Most companies identified that the scope of work required by implementing SEM would be a good use of a student placement, but that they wanted to establish the SEM program further bringing one on. There could be an opportunity to accelerate the student recruitment process by having the project coordinators or professors train students on specific tasks before bringing them to the companies.

Recruitment of Class B Customers Remains Challenging

Many SME manufacturers are still challenged to see the benefit of monitoring different equipment and systems within their facility. It is difficult to motivate businesses to take on these types of projects without strong set of stories to tell about how companies of their size and type were successful in undertaking SEM. There is also a poor understanding of the costs associated – both under and overestimating – for energy monitoring.

This project has generated some learning opportunities and success stories that can be leveraged for future promotional materials. Across the literature, there is evidence that energy monitoring and SEM practices can save around 5%-20% through operational improvements. Scaled across all facilities of this type, the savings could be impactful. Focusing on how energy monitoring data can be used to improve business operations as a whole will be most impactful. Averages of the time needed to implement SEM, the costs of energy monitoring and savings would help provide more clarity for interested businesses.

Restrictions from the project's eligibility requirements made recruitment difficult. It turned out that Class B customers often actually fall much closer to the "small" end of the "small-to-medium" spectrum. SMEs are commonly defined as 500+ employees, while the larger companies who participated in this program were around 200 employees. Those on the Advisory Committee found it difficult to do targeted recruitment because there was no way to know before contacting a company if they were Class A or B – and even after contacting them, the company itself did not know. The ability to directly target the desired customers through data of Class A/B would help overcome the barrier of first determining a company's eligibility.

Another stated challenge by potential participants was that the structure of the program costs were perceived as unfair because it was paying for access – i.e. the cost to join the consortium was a requirement to receive the incentive funding. The intention of this cost structure was to trial breaking apart the two-line items of the support services and the incentive for the monitoring project, so that they were perceived as separate and future costs for support services would be more likely to continue. If done again, it would be more straightforward to simply reimburse the participants for 80% of energy monitoring project costs and fund the Consortium management costs in addition – the required budget for the funder being the same in the end.

Resources and Guides Need to be Extremely Straightforward

There was a low reported usage of the SEM 101 Guide produced by the project coordinators. This category of participating companies reported being time-strapped and found it much easier to have the project coordinator explain requirements for each component of SEM in a meeting rather than diving into the details of a document.

While originally intended to be easy-to-digest for participants – each element of SEM was only a single page – there was still lower engagement than initially hoped for. This SEM 101 document can be used as a template for the development of short videos, checklists or brochures designed by professional technical communications specialists that may prove more useful for companies and can be deployed on a province-wide scale.

There is Room for Improvement in the Current Energy Monitoring Technologies Market

Overall, the installation of energy monitoring equipment, commissioning and calibration, training on software and software customization for the needs of the participant proceeded more or less without issues. However, there were a few learnings that could direct where further R&D could be supported in future programs.

Wireless solutions tended to be the most cost effective and easiest to install. In some cases, the CTs themselves are self-powered by the current they are monitoring, so neither communication nor powered wiring is required. On-staff electricians can easily set up and activate the systems, saving on technician hours. If electrical distribution systems in the plant are being maintained or upgraded, the CTs can easily be removed and re-installed without having to call a technician to the site. Wireless systems work well in small plants because distances between various panels and communications bridges are not too great, but they are large enough for the benefit of avoiding costs to run wires. The only drawback is in plants with a great deal of electrical "noise" – e.g. with lots of motors. Cost-effective solutions to overcome this wireless communications barrier could provide more wireless solutions to more facilities. Software packages included were in some cases found to be quite accessible and visually appealing. An area of improvement noted would be customization of the interface. If the customer requires programmer support from the software vendor to customize how or what the data is presented, this can cause delays, headaches or even result in additional calculations to done by the customer. In some cases, it was difficult for the participants to have a simple pie chart of main loads by category displayed on their interface. Plug-and-play software can sound appealing. The option of highly flexible customization to optimize visual display and interpretation would be even better.

An additional software feature that would have been extremely beneficial for the participants would have been automated M&V capability. While M&V was not a identified as a high priority by any of the participants, being able to easily track and communicate operational savings would be a large benefit to justifying continued work in SEM. Software that was able to easily integrate data from production, outside air temperature, equipment runtimes and run regression analysis against energy consumption datasets would help enlighten on cost savings associated with smaller initiatives without requiring employee time costs that offset those savings.

Natural gas monitoring was another challenge. In-line gas monitoring is not cost-effective for the smaller loads in these facilities and the one potential participant who was most interested in gas monitoring decided not to pursue the project based on the costs. Other strategies, including virtual monitoring or low-cost non-invasive sensor technologies are potential solutions.

RECOMMENDATIONS

Promote Success Stories of SMEs Leveraging Non-Energy Benefits of Energy Monitoring Projects

Energy efficiency projects are often intimidating to SEMs because of high investment costs, long (2+ years) payback times and unfamiliarity with the strategies required to maintain the savings. This can be especially off-putting in energy monitoring projects, where savings happen only when additional actions after the project are complete. For businesses that spend $100,000-$400,000 on utilities per year, the annual investment to reduce energy by 5% per annum (a common SEM target) must be below $10,000-$40,000 to achieve a 2-year payback – including employee hours, energy monitoring investments and any capital investment projects. This is the kind of "back-of-the-envelope" calculation that many SMEs use to evaluate whether to pursue SEM and, crucially, it relies on the perception by the SME that that level of savings can be reliably achieved.

In every case for this project, the participants noted a higher perceived value in Non-Energy Benefits (NEBs) than the energy savings themselves, including: Optimizing equipment operation, process improvements, employee comfort, power quality monitoring and more. In most cases these NEBs were the reason the project was pursued in the first place. Improving the core business outcomes is perceived as far more beneficial than re-training employees in SEM to shave $5,000-$20,000 from the utility bill.

That said, if all SME manufacturers in the province where able to reduce energy consumption by 5% per year and retain energy efficiency reductions around 20%-30%, this would be highly beneficial to the energy system and improve output productivity of Ontario's businesses. Energy monitoring in manufacturing facilities is the best way to ensure energy savings are being maintained in an environment where equipment use changes frequently. Creating SEM programs that include energy monitoring should be a prioritized area of work for government programs.

Once these programs are created, recruitment can be a key challenge: In order to communicate the benefits of SEM, it is essential to tell the stories of companies who have benefited from the NEBs. The narratives should not be simplified to simple payback, but rather the benefits achieved on top of investment in a project that pays itself back through the energy savings. The energy savings are the break-even on the investment, but then the company achieves a whole extra set of benefits to improve their operations – essentially for free.

The IESO has already started this process by studying NEBs. A recent report titled Non-Energy Benefits Study: Phase II comes to the similar conclusion that the NEBs are often the key driver to energy management projects. It also recommends the IESO further study the industrial sector. We recommend this as well and would encourage differentiating between different types of energy management projects. It is likely that energy data projects have higher NEB impacts, because of the cross-functional nature of data insight. Plant digitalization is a growing trend and more data within a plant enables AI and automation projects.

> As noted by one of the members of the advisory committee **"45% of automation projects fail because pre-requisite information/ data systems are lacking."**

Energy monitoring data can contribute the required data points to enable advanced manufacturing and AI projects. This trend is set to be an area of constant growth for manufacturers in the coming decades.

Research the Energy Impacts on Supply Chains from Widespread Adoption of Scope 3 Reporting

A strong current trend in the sustainability industry is investor- and government-driven requirements for large publicly-owned companies to undertake Scope 3 reporting. As we saw in this project, engagement from large customers with the SMEs that supply their products is a strong motivator to take on energy management in a serious way. Protocols like TCFC, CDP, SASB, SBT all provide guidance on requiring data from suppliers on energy and emissions. At the moment Scope 3 reporting is largely voluntary. While the IESO is not an advocacy organization, it would be interesting to study the potential impacts of wide-spread Scope 3 reporting on the energy system in the province.

Create Programs Specifically Targeting Class B Manufacturers

Programs specifically targeting Class B customers should be developed to engage this demographic of businesses. It is important to differentiate between SMEs (less than 500 employees) and Class B customers (under 500kW). There is a large portion of SMEs that are able to opt-in to the Class A category and take advantage of the ICI program.

Programming developed for Class B customers should be made to lucrative, since they are unable to participate in the ICI program. Feedback from the members indicated that the DR programs they have explored have not provided the incentives needed to participate. Demand-based programs will be best-suited as local programs, in partnership with LDCs, since the size of these companies individually makes them unlikely to have a big impact on the provincial-wide grid. Working with LDCs is advantageous because it enables recruitment through energy bills and targeted recruitment based on Class A/B status. Municipalities will support such programs as they enable system reliability and development in their regions and help meet climate targets.

Implementing SEM on a widespread basis will enable uptake in demand-based programs. A thorough understanding of energy use on site – especially in the manufacturer context – by installation of energy monitoring will allow participants to better evaluate what systems can provide response resources to the grid. Programs enabling SEM should be deployed broadly, while targeted grid resource programs should be deployed in specific key regions.

Break Down Barriers to Accessing Energy Data

The most important first step in getting engagement on SEM is putting data in the hands of customers. Following the traditional adage "you can't manage what you can't measure," this is well-known in the manufacturing sector, while not widely applied to energy management yet. As shown in the project, new initiatives were developed by each participant as soon as they could see how systems and equipment were consuming energy. Energy monitoring equipment is more valuable in SME manufacturing settings, because of the variable nature of equipment used in manufacturing and because SMEs often have older equipment that does not provide a lot of data already.

The components of Strategic Energy Management provide a good baseline for businesses to effectively embed sustained energy management. Eventually, the businesses will be capable of scaling up their SEM practices to meet standards such as ISO50001 or SEP. Programs should support businesses in each of the initial steps of implementing SEM – getting started is the most difficult part. An ideal program would provide resources along each step of the SEM pathway. It would best be offered in tandem with a program to fund the installation of energy monitoring equipment (see Recommendation #7).

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A program offering of temporary use of a diagnostics toolkit could be useful to engage businesses. Energy monitoring, air compressor leak detection, ultrasonic water flow sensors, harmonics sensors and other monitoring tools could be lent out to businesses to assess their utility use and get them interested in identifying reduction projects. The US DOE's Better Plants Program has a good example of this - betterbuildingssolutioncenter.energy.gov/better-plants/diagnostic-tools.

Leveraging post-secondary institutions to undertake an "SEM Gap Analysis Assessments" could be a great way to get students real-world experience while also providing essential services to SMEs who are interested in taking the first steps toward energy management. This could include energy mapping, metering gap analysis and an overall charting of the pathway to implementing SEM. The US DOE's Industrial Assessment Centre is an example of a partnership with post-secondaries, although it is limited only to identifying energy efficiency projects - energy.gov/eere/amo/industrial-assessment-centers-iacs.

Fund Digital SEM Educational Resources

The number of SMEs in Ontario is far greater than the number of larger businesses, therefore digital engagement resources and tools will make it far easier to engage with this wide audience. A variety of educational resources could be funded and, where necessary, online facilitation by energy management personnel could help accelerate adoption of SEM.

An easy way to walk businesses through SEM is through a simple checklist that outlines the purpose and details requirements of each stage of SEM. An example of this is the US DOE's ISO 50001 Ready Navigator Playbook. While ISO 50001 is far more intensive than the SEM Minimum Requirements, the idea of providing a checklist accompanied by templates for any necessary documentation that needs to be created could be easily applied to SEM best practices - navigator.lbl.gov/playbook.

Short, explanatory pathway guides addressing specific common energy management systems – lighting, air compressors, boilers, VFDs – that walk businesses step-by-step through the process of upgrading equipment to the most energy efficient would be useful. These short guides could point to deeper dives in the form of recorded webinars, that walk the project managers responsible for implementing upgrades through the specific considerations to be taken into account in order to follow best practices of energy management. The US DOE's Better Plants Program has a series of Virtual In-Plant Trainings that are already available at no cost - bptraining.ornl.gov.

In order to promote NEBs, resources and guidance materials likely need to be sector-specific. Mark Jewell's Selling Energy product offers a good example of sector-based marketing - sellingenergy.com/products/segment-guides.

Fund Forums to Foster a Community of Practice of SEM

Forums for businesses to share best practices can be excellent tools to accelerate uptake in any area of best management practices. Other businesses are virtually the only other party who has no direct benefit in another business implementing SEM (assuming they are not in partnership or competition). Even program facilitators of SEM programs are subject to evaluation based on action taken by the business. Advice from peers is the best way for many to learn and the best way to facilitate this is to create spaces to meet and connect.

These forums should be based in every region, to allow for in-person meetings where possible. Virtual meetings are great for efficiency and attendance, but community-building happens during networking breaks and following the end of the session. Community-building leads to offline conversations between members of the forum and supports accountability and friendly competition between them. While the benefits of these forums are not always easy to quantify, they can be relatively low-cost and help foster a Community of Practice around SEM.

The forums could focus on not just electricity, but gas and water efficiency and be deployed in partnership with Enbridge and municipal water departments, some of which have water efficiency mandates. Municipalities who have Climate Change Action Plans are also seeking ways to engage their IC&I sectors on emissions reduction, so would be supportive of the program. Local organizations like TRCA (PPG) and EMC would be able to facilitate these programs.

An additional benefit is that these forums provide a space for ongoing stakeholder engagement for the IESO. As it is often difficult for a province-wide organization to reach smaller businesses, this would be a constant touchpoint for businesses who have already indicated their interest in energy management. On top of this, it would allow for a place to retrieve success stories, to showcase to the broader business community pathways to getting involved in similar initiatives.

Fund Programs Focused on Getting Energy Data into the Hands of SMEs

In order to prepare Class B customers to engage in demand-focused programs, energy monitoring equipment will be essential for understanding what types of loads can be curtailed and what types can ride out a peak event. This is on top of the potential for granular energy data to drive energy management through SEM practices. Contributions of $5,000-$15,000, dependent on the size of the Class B customer, should be adequate for an initial monitoring project of key systems and equipment. Restrictions around eligibility should not be too strict around savings performance or what is being monitored. Being able to monitor, for example, compressed air, water, harmonics, will allow for improved capabilities to manage energy consumption as well as the NEBs referred to above. The program should also include initial setup costs associated with the software, to allow for any customization necessary to display data to the customer in the most effective manner.

Enabling access to interval utility meter data (both natural gas and electric) is a useful tool to engage a business form the initial stages. Funding utility programs that make it easier to access to API data that can integrate with energy monitoring software platforms will save businesses from installing their own equipment on main feeds. There is also potential to drive engagement by simply putting interval datasets into the hands of customers.

Support Emerging Energy Monitoring Technologies

Improvements and cost-efficiencies in energy monitoring technologies will greatly support deployment across all sectors and accelerate the adoption of SEM. The first step to fully understanding barriers to bringing down costs in both hardware and software would be to commission a study to better understand what emerging technologies are on the horizon. As referred to above, examples could be improved wireless communications, affordable non-intrusive gas monitoring, data integration software and automated M&V.

Funding R&D of Ontario-based start-ups or established vendors seeking to lead in this area could raise attention to the gaps here. Collaboration with college/university research institutions or agencies that regularly fund R&D (OCE, SDTC, etc) could prove fruitful. Many companies exist that are attempting to address residential and large industrial IoT opportunities. There remains a gap in effective technologies available to address the needs of SME manufacturers.

Contact Us

Partners in Project Green
Toronto and Region Conservation Authority (TRCA)
101 Exchange Avenue, Vaughan, ON L4K 5R6
416.661.6600

partnersinprojectgreen.com

In collaboration with:

Region of Peel working with you

Toronto

York Region

ieso
Independent Electricity System Operator

Toronto and Region Conservation Authority