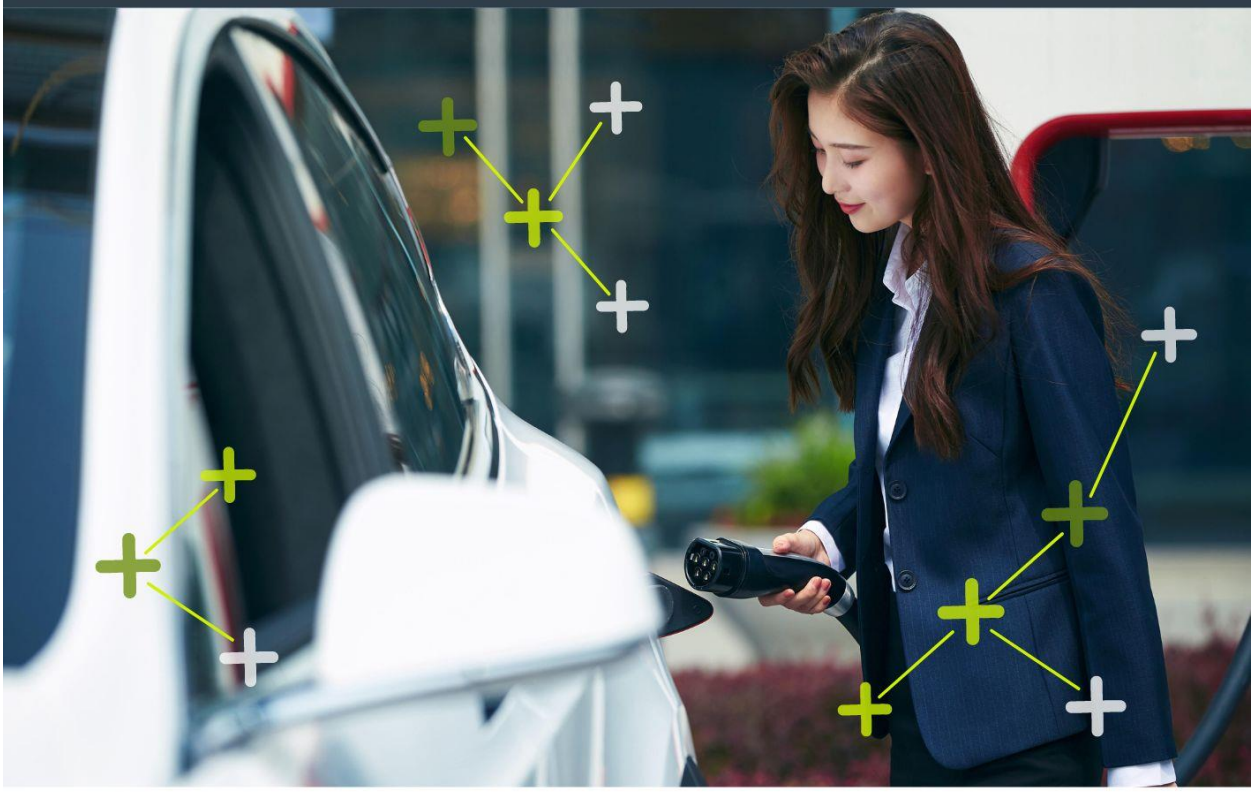
Final Project Report

AlectraDrive @WORK



Managed Electric Vehicle Charging Program for Workplaces

Project Partners

alectra GRE&T Centre

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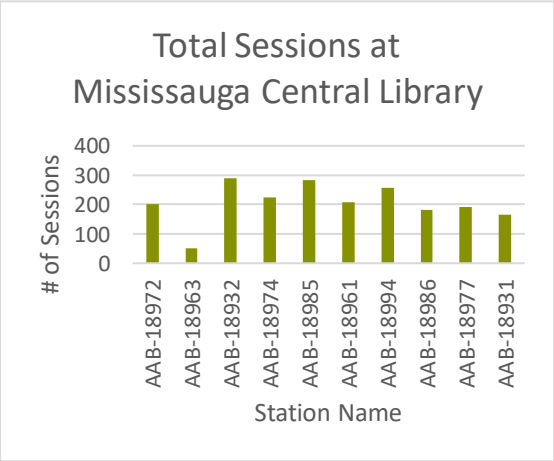
Executive Summary

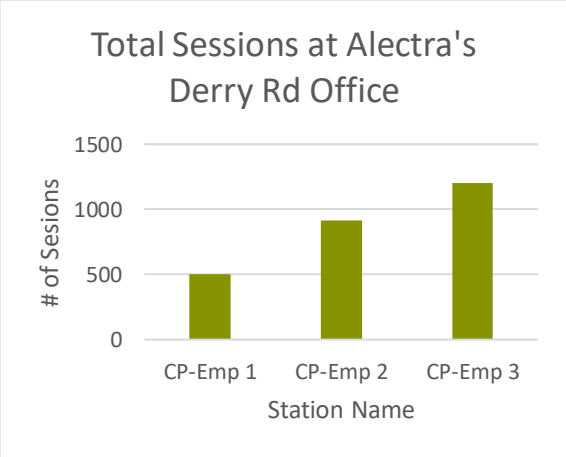
As the uptake of electric vehicles (EVs) began to accelerate, Alectra became interested in learning through a real-world implementation of a smart charging project, the best approaches, technologies, equipment, and platforms to manage and curtail charging.

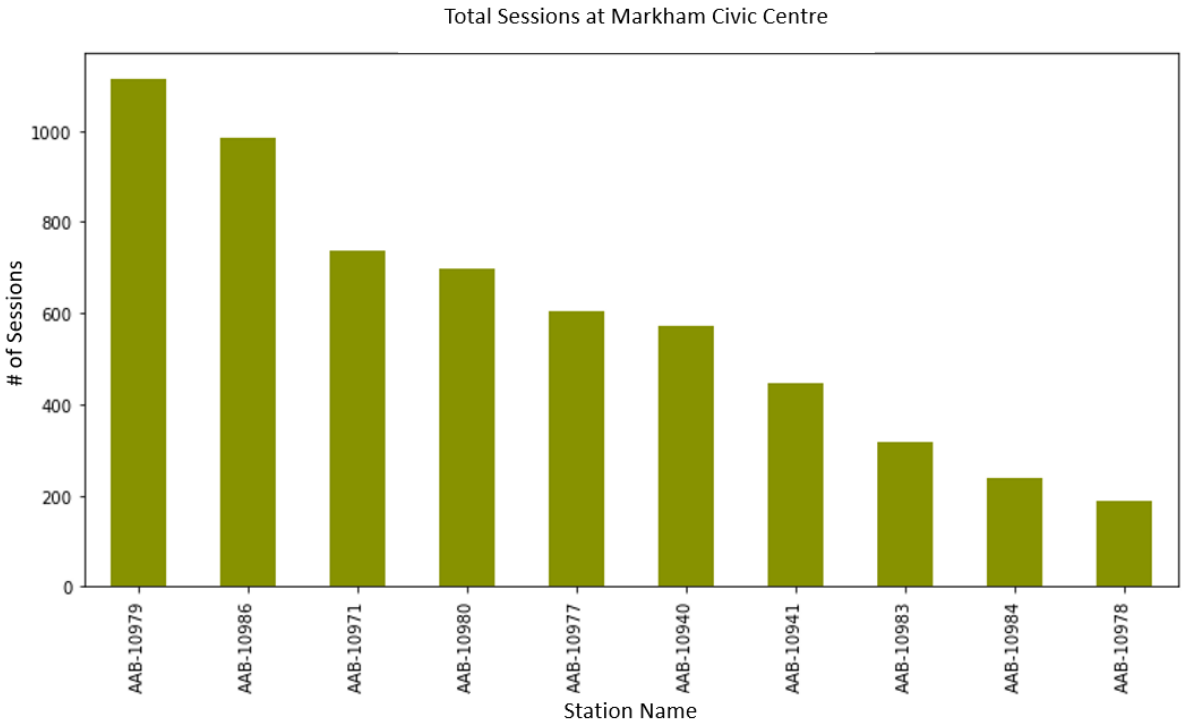
AlectraDrive @Work project was a big first step for Alectra to test some of the vendors and approaches to manage charging in commercial workplace settings, including the curtailment of EVs alone, as well as reducing dispatchable facility loads via building automation systems and batteries to provide a holistic, technology enabled, customer- and driver- friendly program. It directly informed the AlectraDrive @Home pilot program, and gave Alectra experience in installing and managing EV charging stations, which it has now deployed to all its 10 offices and service centres, and for public charging purposes, through its affiliated company, Alectra Energy Services.

The AlectraDrive @Work project saw more than 15,800 charging sessions, totalling more than 175,000+ kWh across all three sites during the pilot.

Site	Total # of Sessions	Accumulated kWh	Timeframe
Markham Civic Centre	11,150	94,675 kWh	Nov 2017-Mar 2023
Mississauga Central Library	2,056	41,881 kWh	Mar 2022-Mar 2023
Alectra Derry Rd Office	2,638	38,435 kWh	Aug 2019-Mar 2023







The top 5 major successes for the AlectraDrive @Work project were:

Participant experience: Signed up 20 unique drivers and were able to demonstrate the impact of electric vehicle charging stations (EVSE) charging infrastructure on adoption, both among staff and new fleet vehicles at Markham after install, and the rapid rise in utilization at Mississauga. The Alectra team gained valuable experience and insights in improving customer experience and understanding drivers' needs and desires related to charging.

Business model refinement, technology testing and proof of concept: Technology testing was successful, and the project team demonstrated that use cases could be deployed effectively, and that they can have an appreciable impact on demand at one site and more broadly when done at scale. Distributed Energy Resource Management Systems (DERMS) were successfully deployed, and batteries were used to avoid EV curtailment. The costs and benefits of the program were further understood through real-world testing over multiple years, which has provided insight into where it could be used effectively as a conservation measure.

Implementation: Selecting multiple vendors and comparing them and working with 3 facilities was a major accomplishment. The team learned an incredible amount about different technologies, deployment and operational processes and considerations, and challenges regarding opportunities to scale up. By the end of the project, we had one DERMS controlling EVSE at 3 sites and were able to execute concurrent demand response events at all of them. By working with three EVSE Original Equipment Manufacturer (OEMs), we were able to understand the real world issues and considerations that their hardware and software were intended to address, and to understand the value of their contrasting approaches.

Developing subject matter expertise: Both internal staff and vendors through relationships. As a result of the experience, Alectra was able to deploy additional stations more effectively, scope out future

demonstration projects, develop advocacy, build relationships with vendors, etc. This is serving Alectra well as it needs to effectively support the transformation brought about by electrification of transport. Customers have approached Alectra with their charging challenges, and we were able to leverage the AlectraDrive @Work experience to provide them with recommendations, and in one case, offer them a simplified version of the solution developed for AlectraDrive @Work.

EV charger installations and customer impacts: The team coordinated the installation of 33 stations at 3 separate facilities. One of the most positive legacies of the project is that this significantly accelerated the utilization of workplace charging built on the foundation of these charging stations, and we recognized an 'if you build it, they will come' trend. Experience deploying EV assets at the 3 sites also helped to build knowledge that enabled Alectra to deploy charging stations at its other facilities for workplace, fleet and public charging purposes, and developed relationships with EVSE OEMs and contractors.

Lessons learned from AlectraDrive @Work will be used to inform Alectra's other EV projects and its strategy moving forward, to focus resources where it is more needed, minimize effort and costs. In its final evaluation report, our evaluator Guidehouse provided recommendations/best practices with respect to the design of future pilots, which are applicable to other organizations:

1) **Simplifying pilot design and use case testing and controls**: define and carry out use cases one step at a time to clearly isolate impacts and confirm what's working and not. Ensure that the project team has a solid understanding of the controls objectives, architecture and data management. The pilot started off with more complicated controls and use cases at the first site, and simplified things to the benefit of the pilot and evaluation at the 2nd and 3rd sites.

2) **Establish agreements early**: Establish agreements sooner and consider conducting a workshop early on. The workshop would begin to identify areas of concern where executive-level decisions may be required. For example, insurance and liability standards can vary from partner to partner. If not resolved, these provisions can derail a project.

3) **Conduct a site needs assessment**: DERMS are a nascent technology that will require on-going development and staff availability. Appropriate development time and resources need to be provided. It is important to conduct full site assessment/ needs at the onset to determine, alignment with existing technology options. This will help in technology integration and limit complexity, which will help projects stay on budget and on time. Using established integrations between vendors would have simplified matters.

4) **Develop a participant engagement plan**: Ensure there is a good participant experience plan that includes several touchpoints with participants (regular project updates, requirements, drop-in sessions, etc.). Participant feedback reflected that regular and on-going dialogue is important to participants, and that they valued having a key contact or champion at every site. This individual should be able to help resolve issues and answer questions in a timely manner.

5) **Identify site champions**: Ensure we have a champion at each site that can help in pushing forward legal agreements, installations, and any ongoing concerns.

6) **Pilot team resourcing and site engagement**: Careful project planning, assignment of tasks, and documentation of progress and modifications to the pilot design and communications with

facility site hosts will help ensure smooth transitions of project staff and continuity of project tasks. The Alectra team felt that while documentation was conducted, it was not comprehensive and engagement with site hosts could have been more frequent and effective.

7) Legal resources: A key learning by pilot staff was to build sufficient time and budget to develop the legal agreements required to implement the pilot – particularly when employing new technologies and use cases that the participants' legal teams are unfamiliar with. The legal agreement with the City of Mississauga took 2.5 years+ to negotiate and finalize.

8) **Telematics:** Data loggers and the EMA portal are no longer supported by FleetCarma and we would have instead relied more on telematics from the vehicles themselves – Alectra is currently looking at opportunities to test the functionality of telematics to provide useful data monitoring and participant behaviour. There was value in using the vehicle data loggers, e.g., having vehicle side data for curtailment, leveraging existing integrations and getting more vehicle data.

9) **Confirm vendor capabilities and management**: At the outset, Flo could only deliver curtailment through a 3rd party DERMS provider. For future projects, having a DERMS may not be necessary, and so a direct DR capability would greatly simplify processes and the need for multiple integrations/interfaces between software/cloud systems and result in fewer failures.

10) **Consider post-pilot carefully**: Further work would have been helpful with vendors to confirm longer term license fees and number of assets to better manage ongoing costs.

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Part 1: Introduction

Purpose

Alectra's goal for this project was to assess the role that smart electric vehicle charging could play in Ontario's electricity system, informed by data from a real-world implementation and analysis of the business and technical considerations for success. This project enabled Alectra to explore opportunities to deploy electric vehicle charging systems, operationalize load curtailment technology, and establish a managed charging program with commercial customers.

Introduction

As the uptake of EVs began to accelerate, Alectra became interested in learning through a real-world implementation of a smart charging project, the best approaches, technologies, equipment, and platforms to manage and curtail charging for different types of customers.

AlectraDrive @Work project was a big first step for Alectra to test some of the vendors and approaches to manage charging in commercial workplace settings, including the curtailment of EVs alone, as well as reducing dispatchable facility loads via building automation systems and batteries to provide a holistic, technology enabled, customer- and driver- friendly program.

This final report summarizes the lessons learned regarding technology procurement and integration, customer recruitment, and the challenges and successes of developing, implementing, and evaluating use cases for managed EV charging. The report also comments on the business and technical considerations that would make this an economical service for utilities and/or service providers to offer as a future grid service in Ontario.

Project Overview

Alectra Utilities was interested in assessing the role that smart electric vehicle charging at workplaces can play in Ontario's electricity system. It did so by conducting a real-world implementation of a smart charging solution and analyzing the business and technical considerations that would make this an economical service for utilities and service providers to offer in the Ontario market.

AlectraDrive @Work was launched at three workplace charging sites – the Markham Civic Centre (MCC), Alectra's corporate head office on Derry Road in Mississauga, and the City of Mississauga's Central Library[1], located in its civic precinct. Alectra worked with its partners and vendors to deploy EVSEs, test, and manage the functionality of charging stations and related infrastructure through a Distributed Energy Resource Management System (DERMS) software & hardware platform.

Participants have been using smart EV charging stations at all three workplaces. Charging behaviour at the sites picked up noticeably since employees have returned to work with improving pandemic conditions and lifting of health restrictions.

[1] City of Mississauga was an optional third site that was not included in the Gird Innovation Fund project scope, but is being reported on for completeness as Alectra carried out the project in a similar manner as the other 2 sites.

Part 2: Use Cases, Business Model & Analysis

AlectraDrive @Work involved operation of EVSEs and ancillary equipment among 3 discrete sites with equipment deployed as described in the following table:

	Markham	**Derry**	**Mississauga**
EVSE Vendor	Flo & Schneider EVSE	ChargePoint	Flo
Battery Storage	Eguana battery storage	Sonnen battery storage	N/A
Scope of Curtailment	EV chargers, battery & building HVAC loads	EV chargers, battery & building HVAC loads	EV chargers
Building Systems	HVAC loads	HVAC loads	N/A
Solar generation	N/A	18 kW carport	N/A

The evaluation plans identified a set of impacts of interest:

- **Coincident Peak Demand Impacts.** The average demand impact during the "CP5" hours of the year. These are the Ontario system peak demand hours observed on five peak days of each 12-month Global Adjustment base period. Rationale for evaluating coincident demand was to reduce impacts on the distribution and bulk system.
- **Monthly Non-Coincident Peak Demand Impacts.** The difference (by month) between the average peak baseline demand and the average observed peak demand.[2] Rationale is for evaluating monthly non-coincident peak demand was impact on customer facility peak and monthly demand charges. This can affect future infrastructure requirements as well (i.e., avoiding system upgrades)
- **Time-of-Day Impacts.** The average demand impact in each of the 8-part avoided cost periods used by the IESO for CDM cost-effectiveness testing. Rationale for evaluating time of day impacts was to limit customer costs with the assumption they see price signals based on time of use.

To these a fourth impact was added in the table below: **DR Event-Based Impacts**. These were the estimated impacts associated with each DR event. The estimated impact of that resource in response to DR events can provide an understanding of the capability of that resource to provide capacity at times of system coincident peak, even if (for various operational reasons) no DR events were scheduled to coincide with the system peak.

Limitations of the data meant that not all these impacts could be estimated. Resource-impacts are identified in the table below.

	Markham	**Derry**	**Mississauga**
Non-Coincident Peak Demand	Building loads & Eguana battery storage	Building loads & ChargePoint EVSE	Flo EVSE
Coincident Peak Demand	Flo EVSE	ChargePoint EVSE, Building loads & Sonnen battery storage (simulated)	N/A

[2] The nature of non-coincident peak demand is such that if baseline peak demand is 150 kW, and the second-highest demand hour is 140 kW, even if DR curtailment of 50 kW is applied to the peak hour, the new peak hour (140 kW) is only 10 kW less than the previous peak, meaning the impact is 10 kW.

Time of Day	Eguana battery storage	Building loads & ChargePoint EVSE	N/A
DR Event-Based Impacts	Flo EVSE	ChargePoint EVSE	Flo EVSE

High Level Summary of Evaluation Results

There have been more than 15,800 charging sessions, totalling more than 175,000+ kWh across all three sites during the pilot. The monthly number of sessions at each facility are shown in graphs below. The Derry Rd. graph clearly shows both the impact of covid as well as the increase in EV charging demand in the intervening years after the pandemic abated. The Mississauga Library site graph shows the growing utilization that comes as users become more aware of new EVSE and charging needs increase with both adoption and returning to commute/travel post-covid. The Markham graph shows the impact of covid as well as the growing use of fleet vehicles using charging stations.

It is also worth noting that all the EVSE installed as part of the project continue to be used, and usage is increasing continuously.

Additional graphs showing usage is included in appendices to this report.

Site	Total # of Sessions	Accumulated kWh	Timeframe
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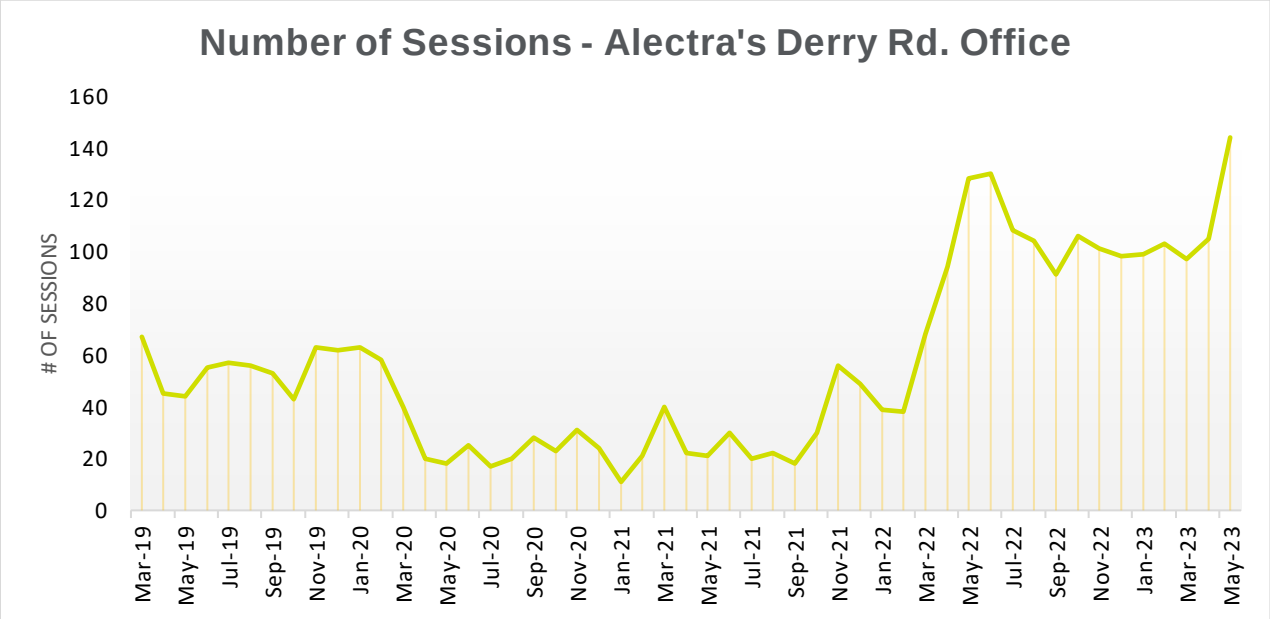
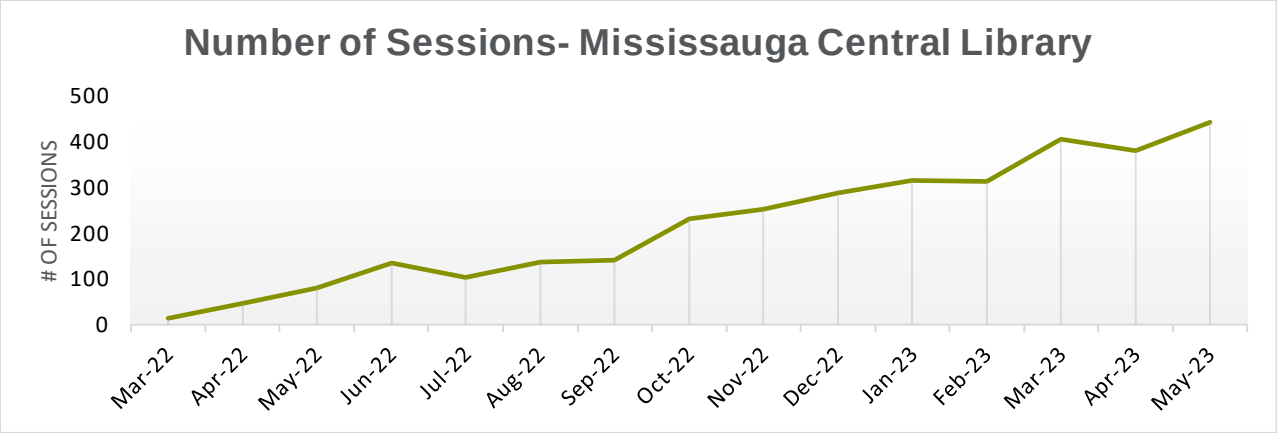
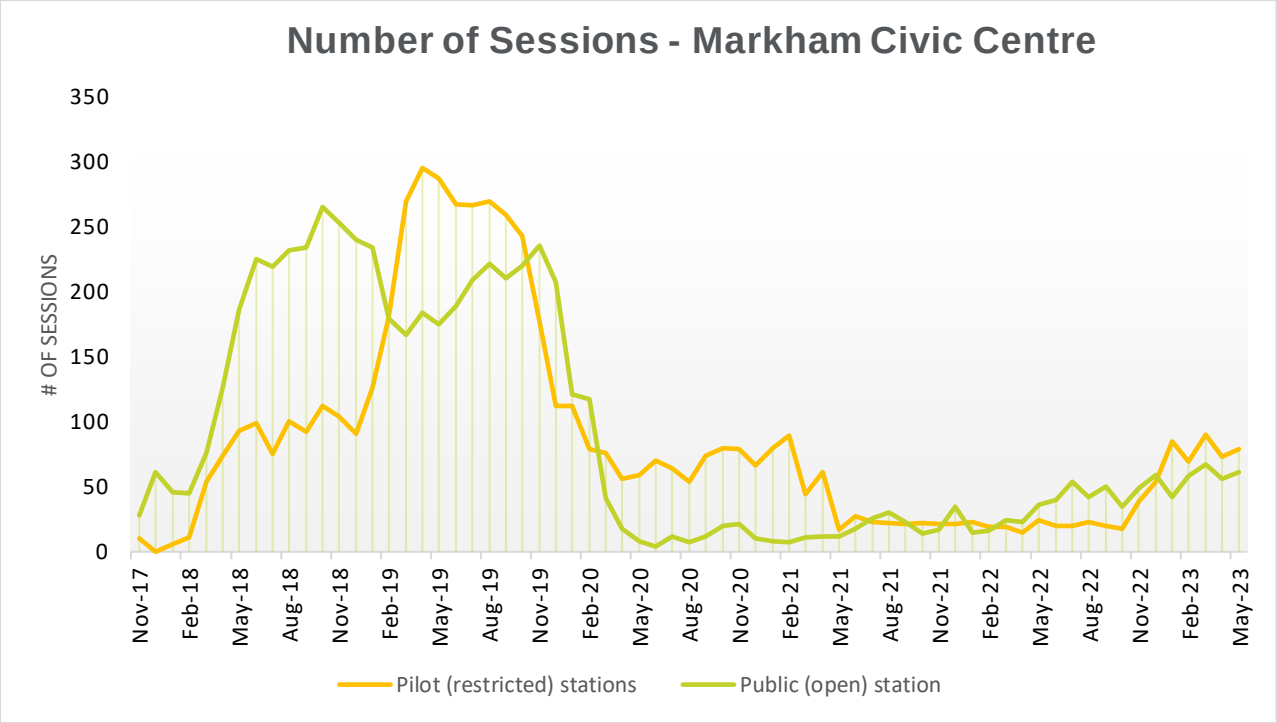






Part 3: Lessons Learned

There were many insights that developed over the course of the project, which have been summarized into a few broad themes, including lessons regarding both implementation of technology and engagement with host sites and drivers.

These lessons were identified through the direct experience of the project team, provided by site representative and drivers through interviews and surveys. Key lessons and themes from were also drawn from the process evaluation conducted by Alectra's selected measurement and verification firm, Guidehouse. The participant survey responses, facility interviews, and Guidehouse process evaluation are included as separate supporting attachments to this final report.

Challenges / Risks	Lessons Learned / Successes
Legal Agreements & Site Host Requirements • Many agreements took longer to finalize than anticipated. This was due to their novelty and the complexity of project details, as well as an attempt to provide standardization while agreements were negotiated concurrently with multiple counterparties who had different areas of concern. • Agreements required input from staff in Alectra's executive, business, facilities management, project management, IT and insurance and risk teams to reach final agreements. This required close collaboration between the legal and project management teams and clear communication of objectives and timelines on a regular and ongoing basis.	• Alectra used both legal internal and external legal counsel to develop agreements as expeditiously as possible. • Since host sites were municipalities, it was important to understand their motivation for participating in the pilot and ensure objectives were aligned. • Considerations went beyond commercial value, making decisions more complex, but also made participation in this pilot more attractive and provided greater host site support. • New technology entails risk, which requires more time for participants to understand and become familiar with/develop mitigation for.
DERMS Testing & Integration • DERMS were not one-size fits all or out-of-the-box solutions when these technologies were being deployed. In many cases, additional development work and customization was required. For example, the existing BAS and peak demand management system at Derry Rd did not support Enbala's DERMS, which required the team to develop custom graphic capabilities through their 'QuickServer' solution. • Integrating the hardware and software at each site was complex. There were many dependencies involved that took time and significant coordination effort. For example, the Eguana battery required extensive customization enabling integration with the Schneider DERMS. This was a specialized task and new relationships had to be developed to bring the right expertise to bear on the problem. • For example, the DERMS integration at the City of Markham involved four vendors (Enbala, Schneider, Flo, and Eguana) to engage use-cases on the FLO stations. When attempting to do validation testing in early 2020, we were unsuccessful multiple times. Given the complexity of the integration, it	• Attempt to simplify integration as much as possible to minimize effort and points of failure. • Going forward, it will be important to clarify capabilities and needs, only conducting new integration if necessary (e.g., battery and DERMS coming together as a package is preferred). • Despite being a standard protocol, OpenADR integration still requires substantial customization and requires familiarity on both sides of the integration to be effective. • Need to better document details of site install early in the project, e.g., site photos, well documented site descriptions, single line diagrams. This will enable more smooth transition when there is staff and contractor turnover. • Data from all sources of data should be downloaded regularly to ensure its quality matches the expectations of the evaluation, and to ensure that it is not lost from systems. • The pilot started off with more complicated controls and use cases at the first site, and simplified things to the

was very difficult to pinpoint the exact error as it the integration may have been broken with several vendors. Getting all parties involved to solution the problem was a time consuming task in itself. • DERMS technology needed to be updated and repaired over time. Given that they were a nascent technology, upgrade schedules and equipment lifespans were not predictable. Software updates introduced new issues and required follow up to ensure no new issues were introduced affecting functionality or integrations.	benefit of the pilot and evaluation at the 2nd and 3rd sites.
Battery / Storage • Batteries should be matched to their use case. Because of the difficulty integrating a new battery to the Schneider DERMS, the existing integration between Sonnen and Enbala was used for the Derry site. While this avoided additional integration work, the Sonnen battery was meant for residential applications and had difficulty downloading firmware updates through a corporate internet firewall. The Sonnen Battery located at the Derry Rd head office was inactive for most of 2020 due to ongoing software and network issues as Alectra's firewalls did not allow the residential battery to connect.	• For future battery installations, network issues can be minimized by choosing a battery designed for a commercial setting. It is also important to monitor communication of the battery regularly to ensure it doesn't run out of charge, as once fully depleted, requires to be brought online and configuration updated. • Consideration should be given to warranty and after-sale support provided by vendors. The Sonnen battery required a warranty call due to failure, but the vendor did not actually complete the work, while in contrast, the Eguana battery was under recall and this work was completed per the manufacturer.
DERMS & Building Automation System (BAS) integration • The level of technology and implementation maturity will need to increase for this project to scale beyond the pilot phase. • Facilities staff were generally reluctant to expose existing building automation systems to the solution and cooperate with site testing activities due to perceived loss of control, additional coordination efforts, and concerns about tenant comfort. • This had an impact on host/business customer experience and caused delays and additional costs during DERMS testing. • Construction and regular BAS system upgrades created challenges for testing activities and maintaining control of DER assets.	• DERMS are nascent technologies and require specific resources and expertise. • Host site staff acknowledged that if they had not had the expertise available, it would have been extremely difficult to continue with the project. • Alectra's partner had a BAS technology specialist on staff. However, this will likely not be the case for many potential partners. • Demonstrating that the DERMS technology is low risk/low pain will be important to being able to scale this type of initiative to control building loads. • The development of standards and providers' library of connections to OEMs' systems will make this process simpler as the technology and ecosystem evolve.

Vendor Management • The vendor experience was mixed – some were extremely responsive and were active in resolving issues, while others had difficulty engaging in the pilot on an ongoing, meaningful basis. This changed over time due to staff availability and competing vendor priorities. While vendors saw value in the pilot, they also were more focused on commercial solution development. • The Markham DERMS provider had an internationally based team, which led to time zone, language, and team cohesion issues (inter/intra organization). This created challenges for other partners in integrating and commissioning the battery and HVAC systems. • Alectra was alerted to an issue with ChargePoint sending multiple notifications per minute during curtailment events, which was introduced at some point through a software update. This did not impact operation, but was a nuisance impacting employee productivity, and caused multiple participant complaints. As a result, use cases for these chargers were turned off for several months while the system was fixed, to preserve the customer experience and enable them to continue charging.	• Understanding of the complex process of installing and operating these systems has informed Alectra's approach going forward. For example, for the Derry site, we required the DERMS provider have an established integration for the battery storage provider. However, this storage provider's product was meant for a residential setting, which created operational support issues. • Future work will require using a DERMS provider with local presence to simplify integration. Those without local presence relied on facilities staff to support troubleshooting and maintenance, which is not realistic for a commercial solution. • To hold vendors accountable and ensure ongoing validation of use cases, there needs to be robust documentation for all related aspects, including documentation for UAT, validation testing, vendor deliverables, timelines, solution architecture drawings for communication and data pipeline from local DERMs integrator, factor drawings and as-built drawings. • Fewer vendors would have required fewer agreements, which would have reduced workload and accelerated deployment. • Some vendors responded to identified issues after sufficient (sometimes extensive) escalation, while others did not. In a pilot setting, the leverage of future business opportunities may not be sufficiently compelling.
Driver Buy-in and Peer Impact • Potential participants were concerned about the telematics device (FleetCarma C2 equipment) that plugged into their vehicle to measure charging events. Alectra negotiated detailed privacy provisions into its vendor agreements and also with its host sites to allay concerns. However, some employees were dissatisfied and chose not to join the project, as the device installation was a requirement.	• Those involved in the various aspects of the project needed ample lead time to review and obtain approvals. In addition, projects that span over a year to plan need to factor in staff schedules. • Participant feedback revealed that having senior management EV ambassadors at each project site helped drive participant recruitment and successful project coordination.

• Covid certainly made recruiting participants difficult, especially during periods of lockdown when there was little to no workplace charging.	• Peer impact also played a key role, as we had registration continue throughout the year through word of mouth, etc. • Some program participants even served as champions for engaging their circles in Alectra's other EV initiatives (e.g., Alectra Drive @Home). We saw evidence that peer impacts can have positive spill-over and snowball effects. • Participant interest and uptake in the pilots grew over time, as awareness of the availability of participation and the greater number of EV drivers increased. Later in the program, the availability of charging infrastructure enabled the City of Markham to purchase several EVs for bylaw enforcement purposes. During COVID, these fleet vehicles became the main users of the EVSE. • Adoption increased once EVSEs were installed (e.g., Markham staff and bylaw vehicles)
Communications & Customer Engagement • Covid was a real challenge and participation was impacted a result of limited access to the workplace. • It was possible to testing use cases, but it was more of a lab-setting than a real-world demonstration because covid sometimes prevented participants from driving and charging at work. • Hybrid work arrangements further complicated access to charging on a consistent basis and skewed the data as some days they were in use and other days were not.	• Due to delays, it was important to keep participants informed of the latest developments. In fact, ongoing communication was highly valued by the participants. • Facilities managers articulated that on-going feedback loops were important so participants had opportunities to ask questions and raise issues such as a process for flagging issues or concerns (who to file a complaint with and a means to resolve those issues). • Alectra was able to demonstrate its commitment when, for example, maintenance issues with an EV charger required service. • Building communications networks/tools enabled informing EV drivers about new installs, changes to rates, charging policies, etc. • There was value in building and facilitating community among the drivers, so that they could raise and discuss issues among themselves and highlight their

	needs/suggestions back to facilities and the Alectra team.
Program Administration • Many of the teams involved in this project were lean and finding back up during vacation or other busy periods was difficult and created delays. • There was staff turnover for Alectra and for several partners. This necessitated re-training and invariably some inefficiencies were introduced.	• Support from staff and executive management at each project site was critical to the program's success. • Documentation is an important tool to enable continuity.
Policy & Regulatory Barriers or Opportunities • The inability to include pilots or fully build out programs where investments are rate based creates a barrier to scaling up workplace EV charging programs.	• There is a trade-off between higher commercial demand rates which encourage peak shifting through price tools, and lower demand charges, which can allow for more resources to run during peak times, and thus are available for demand response. Currently, the incentives between these two tool are not equivalent (and in fact, the opportunity to use either is quite limited in the current market construct) • A DER framework report (OEB Framework for Energy Innovation) was released recently, and there is an opportunity to further leverage working groups for advocacy purposes. • There is a need for DER management and non-wires alternatives to be recognized and valued as a useful asset with a return to incent utility investments. This is an issue that the industry is grappling with. Once there is clarity, businesses can adjust and plan future activities accordingly.

Highlighting Major Accomplishments

This section summarizes the top 5 major successes for the AlectraDrive @Work project.

Technology testing and proof of concept: Testing was successful, and the project team demonstrated that use cases could be deployed effectively, and that they can have an appreciable impact on demand at one site and more broadly when done at scale. DERMS were successfully deployed, and batteries were used to avoid EV curtailment.

Participant experience: Signed up 20 unique drivers and were able to demonstrate the impact of EVSE charging infrastructure on adoption, both among staff and new fleet vehicles at Markham after install,

and the rapid rise in utilization at Mississauga. The Alectra team gained valuable experience and insights in improving customer experience.

Vendor development: Selecting multiple vendors and comparing them and working with 3 facilities was a major accomplishment. The team learned an incredible amount about different technologies, deployment, and challenges regarding requirement to scale up. We had one DERMS controlling EVSE at 3 sites and were able to execute concurrent demand response events at all of them.

Developing subject matter expertise: Both internal staff and vendors through relationships. As a result of the experience, Alectra was able to deploy additional stations more effectively, scope out future demonstration projects, develop advocacy, build relationships with vendors, etc. This is serving Alectra well as it needs to effectively support the transformation brought about by electrification of transport. Customers have approached Alectra with their charging challenges, and we were able to leverage the @work experience to offer them a solution.

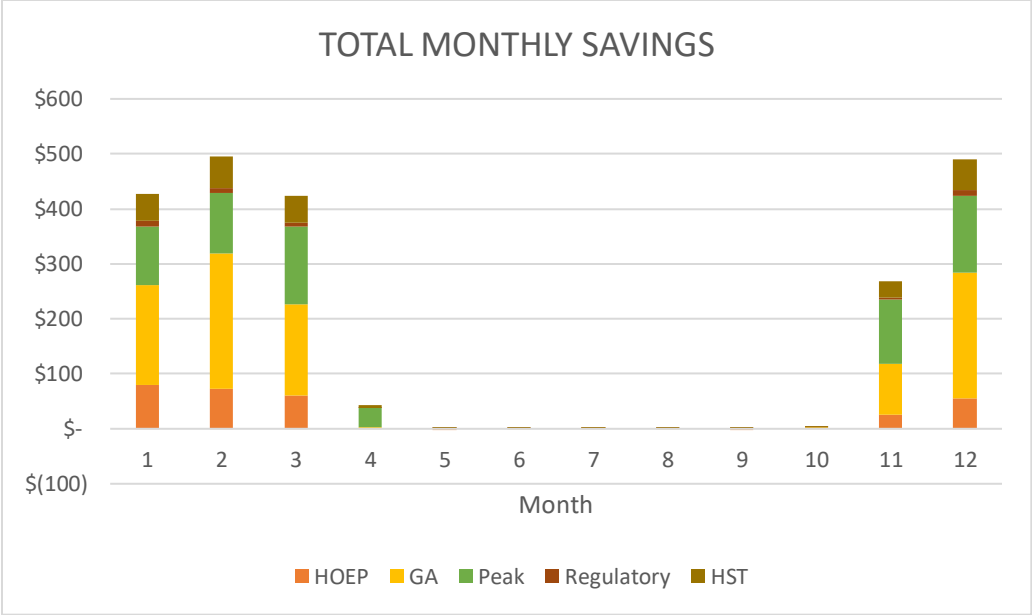
EV charger installations and market activity: The team coordinated the installation of 33 stations at 3 separate facilities. One of the most positive legacies of the project is that this significantly accelerated the utilization of workplace charging built on the foundation of these charging stations. Experience deploying EV assets at the 3 sites also helped to build knowledge that enabled Alectra to deploy charging stations at its other facilities for workplace, fleet and public charging purposes, and developed relationships with EVSE OEMs and contractors.

Highlights from Financial Modeling

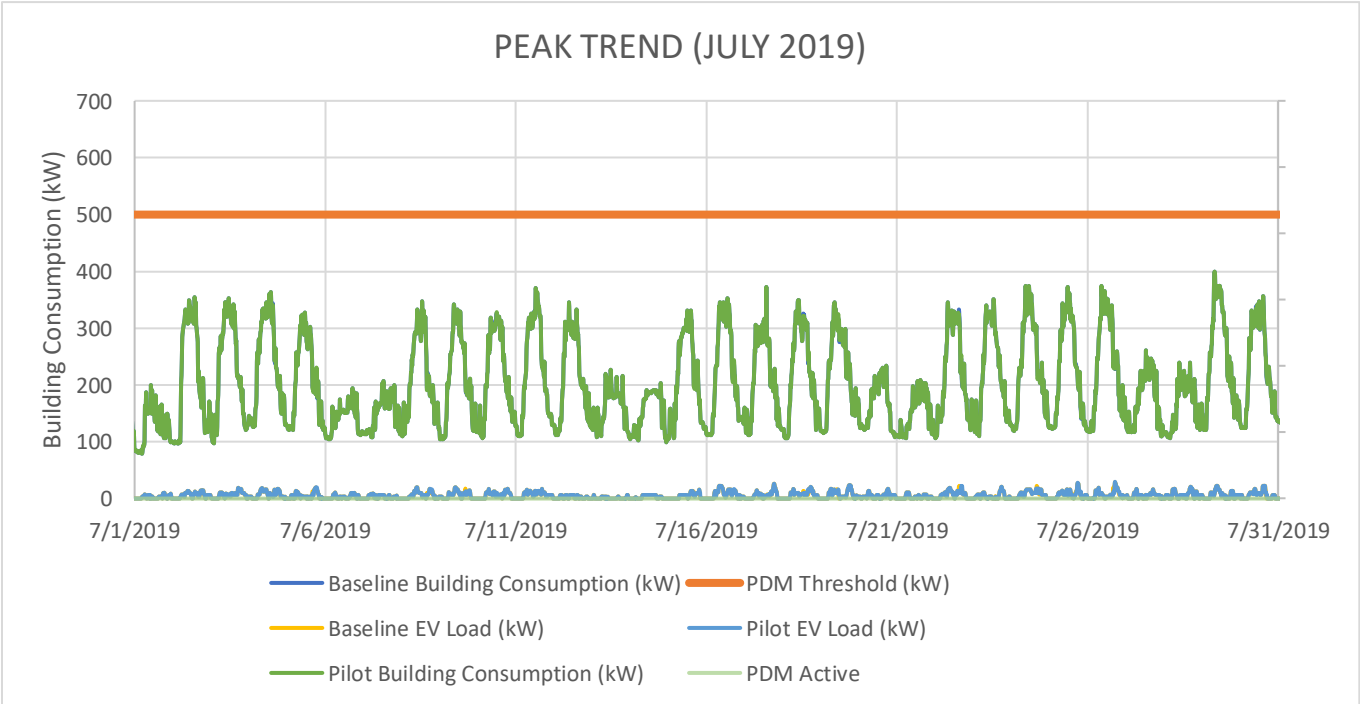
Alectra's GRE&T Centre developed and refined a financial model to analyze and quantify the financial implications of implementing smart charging at the workplace. The financial model simulates scenarios where various combinations of three load management use cases are utilized at a workplace. Below, some of the key findings of this analysis are included; the full report detailing the methodology and findings can be found as an appendix to this report.

Scenario 1: Static PDM vs Dynamic Peak Demand Management (PDM)

In the financial model, by employing the Static Peak Demand Management (PDM) use case with a 500-kW threshold, the Markham Civic Centre could potentially save $2,369.04 on its annual electricity bill when combining all three use cases. PDM would be the most frequently occurring use case, accounting for 29% of the time between 8 AM and 5 PM on workdays, followed by ECM at 8% and DR at just 1%. The PDM use case would result in the largest energy reduction at the Markham Civic Centre, a total of 13,370.43 kWh. In comparison, the contribution of DR events and ECM events was relatively minimal in reducing energy consumption.



Total monthly savings when employing static PDM

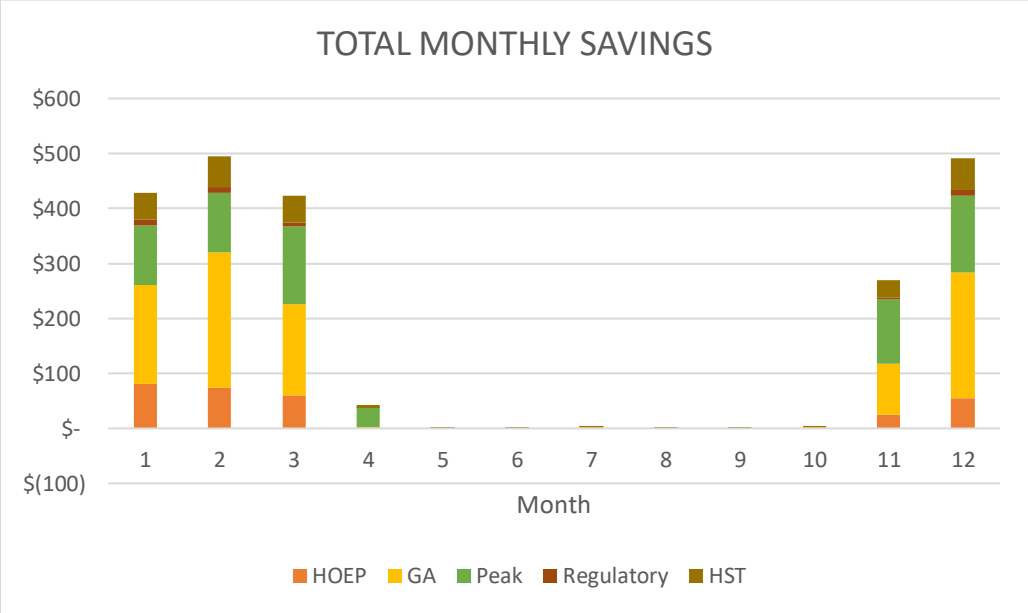


Monthly building load trend with static peak threshold (July 2019)

During the summer months, no PDM events are observed because the building load at the Markham Civic Centre never surpasses the Static Peak threshold of 500 kW. Consequently, there are no peak savings achieved during this period.

In this scenario, the dynamic PDM use case occurs less frequently compared to the static PDM use case, but it still leads to the highest load reduction among all three use cases. The decrease in the occurrence

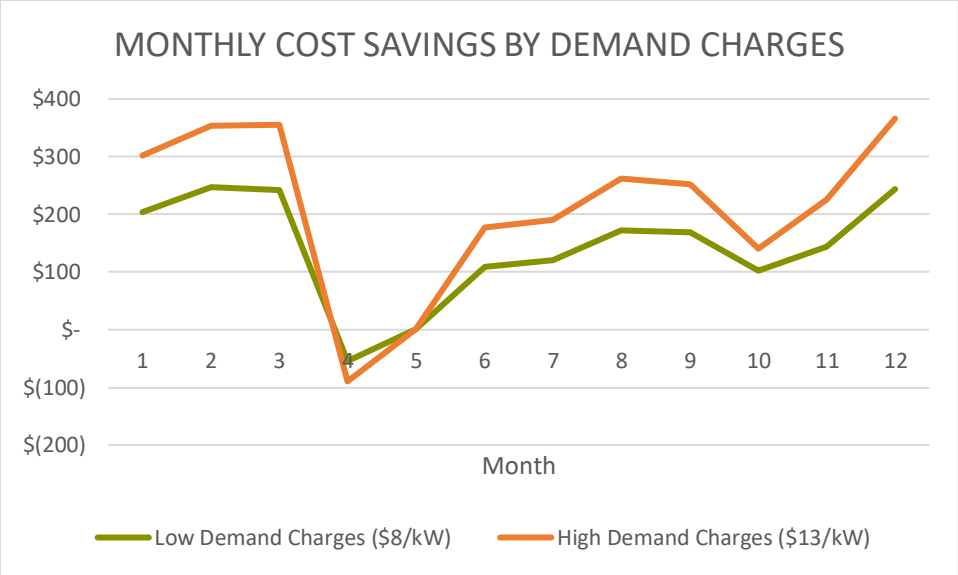
of PDM events is attributed to the fact that the building's historical peak demand in 2019 was much higher than the actual building load, resulting in fewer triggers for PDM events.



Total monthly savings when employing static PDM

Scenario 2: Demand Charges (Low Vs High)

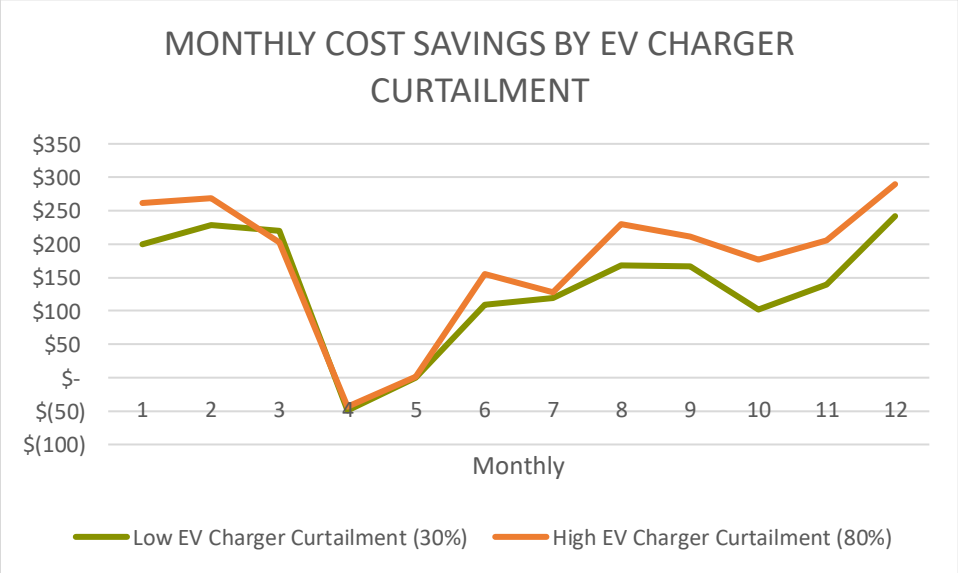
The financial costs at the Markham Civic Centre were examined in two scenarios, considering different monthly demand charges. The first scenario assumed demand charges of $8/kW, while the second scenario considered a higher rate of $13/kW. In the low demand charge scenario, the total cost savings amounted to $1,369.41, while in the high demand charge scenario, the savings increased to $2,037.30. The higher demand charges resulted in greater cost savings, as the building load was shifted significantly through PDM events, particularly during the winter months when peak loads at the Civic Centre were more pronounced. This highlights the importance of PDM events to manage demand charges at workplaces.



Monthly cost savings by demand charges

Scenario 3: EV Charge Reduction (Low Vs High)

Two scenarios were examined to assess the impact of different EV charging curtailment levels on cost savings. In the first scenario, the dynamic PDM use case was employed with a low charge reduction of 30% for all three use cases, resulting in total savings of $1,357.95. During this scenario, the charge delivered to EV chargers on-site while a use case was in effect amounted to 4.368 kW. Conversely, in the second scenario, the EV charge reduction was set to a high level of 80% for all three use cases, leading to greater savings totaling $1,698.13. In this case the charge delivered to EV chargers while a use case was in effect was reduced to 1.248 kW.



Monthly cost savings by EV charger curtailment rates

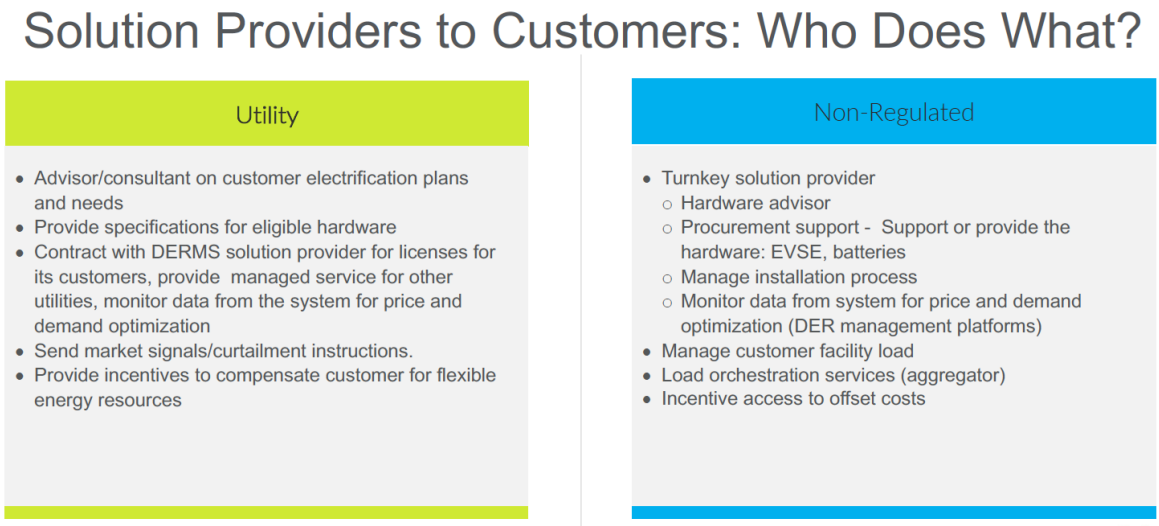
The findings demonstrate that setting a higher EV charging curtailment percentage (80%) results in increased cost savings, as expected. It is important to note that if a workplace predominantly has plug-in hybrid electric vehicles (PHEVs) charging at their facilities, the maximum charge delivered by stations on site is 3.6 kW. Consequently, only the ECM use case would curtail charging for PHEVs, and even then, the impact on electric vehicle charging costs would be minimal. PDM and DR use case events would have negligible effects on PHEV charging, and no EV load would be shifted.

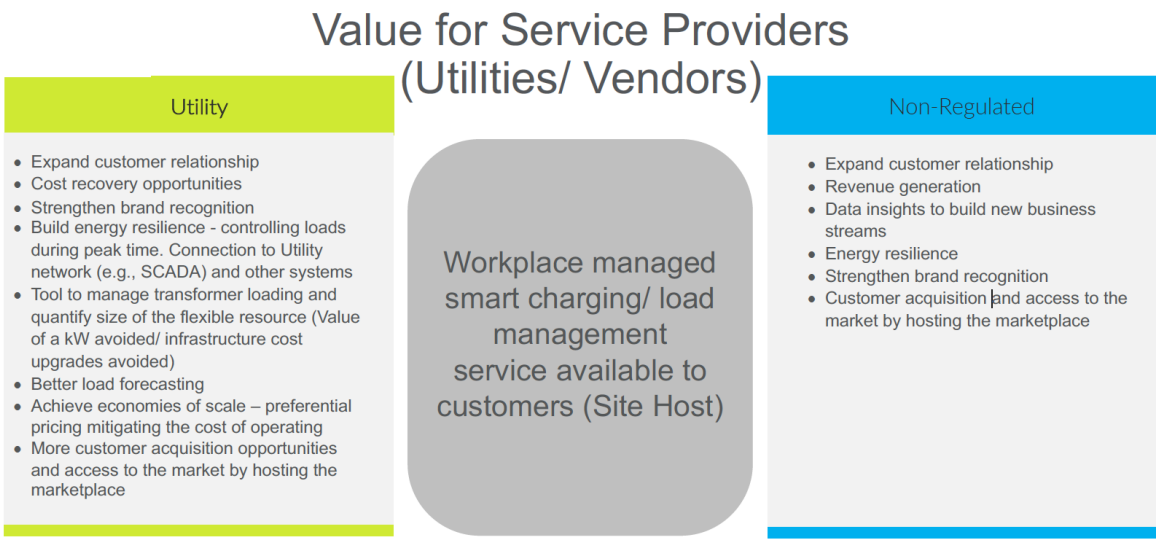
However, for workplaces with a high proportion of battery electric vehicles (BEVs) compared to PHEVs, greater EV charging curtailment savings can be achieved. By setting the EV charging curtailment to 80% (1.248 kW), workplaces can effectively reduce the EV load at their facilities and shift the load to periods when the demand is lower. This highlights the potential for significant savings through EV charging curtailment, particularly in workplaces with a higher concentration of BEVs.

Highlights from Commercialization Roadmap

Alectra staff developed a commercialization roadmap that highlights the workplace charging problem from the utility perspective and addresses how a managed smart charging solution combined with load management through the integration of DERMS, provides grid benefits while simultaneously meeting customer needs by addressing their barriers to workplace charging.

The roadmap identifies how the results of this pilot could be scaled up to become a program, with insights into what the considerations and requirements of such a program would be. It shows the differences in the unique roles that Utilities vs non-regulated companies can play in bringing a commercial solution to Ontarians while showcasing the gained value streams for the respective parties.





The roadmap also gives insight into the key DERMS vendors in the market, that utilities or non-regulated companies can partner with, as well as calling to attentions the cost considerations for each party including the customer.

Optimizing charging behaviour to achieve specific quantifiable goals enables the measurement of success and provides opportunities to adjust certain components of the managed charging program as needed. Reaching scale is critical to creating value from managed charging. Both from a grid benefit and customer energy bill perspectives. Focusing on capacity-constrained customers first can put utilities in a better position to recover an ROI earlier and grow enrollment over time as the need for managed charging increases and customers become more comfortable with the concept.

The commercialization report concludes by noting that currently, there is not a source of funding that would support a managed charging program such as AlectraDrive @Work. Managed EV charging or other load control is not within the scope of current CDM programs, despite the opportunity to shift load from peak to off-peak times. While there is a potential for managed EV charging to participate in provincial capacity markets (as they do in jurisdictions like California) by providing demand response, there is not sufficient scale in Ontario to provide the minimum 1MW of dispatchable load that these programs require, and this resource will not likely be competitive against more established technologies (e.g., air conditioning) for several years.

A CDM framework that included managed EV charging would provide a mechanism within the existing regulatory structure to incentive customers to shift their consumption to off-peak periods, creating a flexible dispatchable resource. Such programs could target specific areas of concern to provide local system benefits, for example to provide relief to an individual transformer, feeder or substation. Currently, Alectra does not have a source of funding to pay for non-wires solutions such as this. A program such as this could be likely be implemented in 1-2 years of being authorized in a new CDM framework, which would be within the time frame of being able to address capacity issues before the problems emerging from load growth from EVs has grown to substantial levels.

Other options to fund managed charging programs would be through utility cost of service applications. The disadvantage of this approach would be that each utility would have to separately apply for its own program, which would result in a longer term for rollout (since utilities typically only make such

applications every 5 years, and the timelines are staggered among utilities) and inconsistency between utility programs, since each application would necessarily be unique.

A third option would be for revenues to operate a managed charging program to come through a Distribution System Operator model; discussions about the potential for this model to be made available in Ontario are ongoing.

Part 4: Conclusion

Recommendations for Alectra and other Utilities

Lessons learned from AlectraDrive @Work will be used to inform Alectra's other EV projects and its strategy moving forward, to focus resources where it is more needed, minimize effort and cost elsewhere. For example, Alectra leveraged existing vendor relationships and avoided complex integrations (e.g., BAS, battery, solar) for our residential EV project, AlectraDrive @Home. Alectra is now exploring options to develop flexible loads from electric vehicle charging through managed charging solutions for fleet vehicles, and exploring alternate commercial rate options that could incentive peak shifting, as the Ultra-Low Overnight rate does for residential customers.

The recommendations for Alectra and other utilities considering offering EV charging programs:

1) **Simplifying pilot design and use case testing and controls**: define and carry out use cases one step at a time to clearly isolate impacts and confirm what's working and not. Ensure that the project team has a solid understanding of the controls objectives, architecture and data management. The pilot started off with more complicated controls and use cases at the first site, and simplified things to the benefit of the pilot and evaluation at the 2nd and 3rd sites.

2) **Establish agreements early**: Establish agreements sooner and consider conducting a workshop early on. The workshop would begin to identify areas of concern where executive level decisions may be required. For example, insurance and liability standards can vary from partner to partner. If not resolved, these provisions can derail a project.

3) **Conduct a site needs assessment**: DERMS are a nascent technology that will require on-going development and staff availability. Appropriate development time and resources need to be provided. It is important to conduct full site assessment/ needs at the onset to determine, alignment with existing technology options. This will help in technology integration and limit complexity, which will help projects stay on budget and on time. Using established integrations between vendors would have simplified matters.

4) **Develop a participant engagement plan**: Ensure there is a good participant experience plan that includes several touchpoints with participants (regular project updates, requirements, drop-in sessions, etc.). Participant feedback reflected that regular and on-going dialogue is important to participants, and that they valued having a key contact or champion at every site. This individual should be able to help resolve issues and answer questions in a timely manner.

5) **Identify site champions**: Ensure we have a champion at each site that can help in pushing forward legal agreements, installations, and any ongoing concerns.

6) **Pilot team resourcing and site engagement**: Careful project planning, assignment of tasks, and documentation of progress and modifications to the pilot design and communications with facility site hosts will help ensure smooth transitions of project staff and continuity of project tasks. The Alectra team felt that while documentation was conducted, it was not comprehensive and engagement with site hosts could have been more frequent and effective.

7) **Legal resources**: A key learning by pilot staff was to build sufficient time and budget to develop the legal agreements required to implement the pilot – particularly when employing new technologies and use cases that the participants' legal teams are unfamiliar with. The legal agreement with the City of Mississauga took 2.5 years to finalize.

8) **Telematics:** Data loggers and the EMA portal are no longer supported by FleetCarma and we would have instead relied more on telematics from the vehicles themselves – Alectra is currently looking at opportunities to test the functionality of telematics to provide useful data monitoring and participant behaviour. There was value in using the vehicle data loggers, e.g., having vehicle side data for curtailment, leveraging existing integrations and getting more vehicle data.

9) **Confirm vendor capabilities and management**: Alectra is still exploring the extent to which Flo can deliver curtailment directly without the need of a 3rd party DERMS provider. This would greatly simplify processes and the need for multiple integrations/interfaces between software/cloud systems and result in fewer failures, for example when Flo added the Cityview L3 to Alectra's account portal and load management was removed for all stations.

10) **Consider post-pilot carefully**: Further work would have been helpful with vendors to confirm longer term license fees and number of assets to better manage ongoing costs.

Next Steps

Building on the valuable insights gained from the AlectraDrive @Work project, Alectra is poised to embark on several strategic next steps to enhance its EV initiatives and contribute to the broader landscape of utility-driven EV programs. These new initiatives directly leverage the learnings from the AlectraDrive @Work project. Alectra is moving forward with new EV related pilots and programs. Next steps are integral to refining Alectra's approach and ensuring the success of future projects:

Transition to post-pilot business model: The charging stations that were deployed as part of this project continue to be used, with utilization growing consistently over time. At Markham, new vehicles have been added to the fleet, and the chargers primarily serve this customer type, as most employees are currently working mainly from home. The Mississauga Central Library has become a popular site for charging in the Civic Precinct, with both government services, civic events and entertainment activities popular in the area. The charging stations deployed at Alectra's corporate head office continue to be used by staff, and additional stations have since been added to serve guests and the public. Meanwhile, access to the control technology has ceased, given that there is no budget to pay for the annual software licenses. However, the networks supporting these deployed EVSE continue to offer integration,

and thus these assets could be used again in the future, should there be an opportunity to provide capacity or flexibility services to electricity markets.

Continued work on services offering: Alectra's commitment to refining its EV and related services offerings reflects a dynamic approach to meeting the evolving needs of customers and strategic partners. The ongoing AlectraDrive @Home project, currently in its crucial data collection and reporting phase, serves as a living testament to the organization's dedication to continuous improvement. By incorporating the valuable insights garnered from the AlectraDrive @Work project, Alectra is strategically positioning itself to provide more tailored and efficient solutions. As customers express increasing interest in managed charging services, Alectra remains responsive to these demands, leveraging the project's learnings to enhance customer experience and satisfaction. This iterative approach ensures that Alectra's services align with the latest industry trends, placing the organization at the forefront of the rapidly advancing EV landscape.

Options for future pilots: Alectra is actively exploring opportunities for technology testing, commercialization, and scaling up initiatives . Targeting specific market segments, such as fleets, presents a promising avenue for expanding the impact of Alectra's EV programs. This forward-looking approach aligns with the organization's commitment to innovation and sustainable growth. As of November 2023, Alectra has been invited to submit a proposal to the NRCan On-Road Decarbonization Fund for a managed charging program for fleets, which is strongly influenced by our experience with AlectraDrive @Work. Alectra is also interested in testing out commercial fleet customers' responses to alternative rate plans that are in the process of being stakeholdered by the OEB through its Electric Vehicle Integration initiative.

Technology and service vendors refresh: Alectra's unwavering commitment to remaining at the forefront of EV technology and controls manifests in its proactive stance towards continuous monitoring and adaptation. The organization vigilantly tracks innovations in EV controls, DERMS, and related technologies. Regular evaluations of service vendors are not merely a routine exercise but a strategic effort to align with industry best practices, ensuring that Alectra's operations are efficient, cutting-edge, and future-ready.

Advocacy: Alectra recognizes the crucial role of funding in driving innovation within the utility sector. Continued advocacy for funding, particularly for projects like AlectraDrive @Work, is essential to keep Ontario's utilities at the forefront of EV initiatives. Alectra emphasizes the importance of creating avenues for new initiatives to secure funding for scaling up, leveraging the success and insights gained from pilot programs.

Knowledge dissemination: Alectra's commitment to knowledge dissemination underscores its role as a thought leader in the electric mobility domain. Through its communications plan, Alectra aims to share its knowledge and insights with stakeholders, fostering a collaborative and informed community. The dissemination strategy includes leveraging Alectra's website as a central hub for information, releasing the full report and participating in external and internal presentations with a diverse audience. By actively participating in the broader discourse on EV program design, implementation, and cost-effectiveness, Alectra contributes to the collective wisdom of the industry. This proactive sharing of knowledge not only solidifies Alectra's position as an innovator but also empowers other utilities and stakeholders to make informed decisions, fostering a culture of collaboration and advancement within the electric mobility ecosystem.

In conclusion, Alectra Utilities has not only successfully achieved the objectives outlined for AlectraDrive @Work, but has also paved the way for a transformative future in electric mobility. By designing and delivering a networked infrastructure solution for commercial/institutional customers, Alectra has demonstrated its commitment to providing a simple and efficient charging solution that not only reduces energy costs but also ensures customer satisfaction.

The implementation of a DERMs, utilizing real-time data to optimize EV and building loads, reflects Alectra's dedication to operational excellence and responsiveness to site and provincial system requirements. The successful deployment of this initiative at the Markham Civic Centre and Alectra Utilities' Derry Rd. office, and the City of Mississauga Central Library, showcases the scalability and adaptability of Alectra's solutions.

The strategic next steps outlined, including continued refinement of services, technology and service vendors refresh, exploration of future opportunities, advocacy for funding, consideration of post-pilot implications, and knowledge dissemination, align seamlessly with the initial project objectives. These steps ensure a sustained commitment to innovation, sustainability, and the continued evolution of Alectra Utilities as a leader in utility-driven EV programs.

As Alectra embarks on the next phase of its EV initiatives, it stands poised to further shape the future of smart EV charging, leaving an enduring impact on energy efficiency, customer satisfaction, and the broader landscape of sustainable transportation.