Project Title: HIEV – A digital platform for Local Distribution Companies ("LDCs") to Manage Grid Reliability and Enable Smart EV ("EV") Charging

Organization: Elocity Technologies Inc.
Milestone: 5

Project ID #: 12401

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1. Project Introduction

Elocity along with its partners has demonstrated HIEV's solution for utility-driven, managed EV charging program. In collaboration with Toronto Hydro and Enova (Erstwhile Waterloo North Hydro) has recruited EV drivers to participate in the program.

The project has tested and validated HIEV's ability to solve interoperability and privacy issues for utility driven, managed EV charging.

The project simulates full-system deployment with component modelling, system interface optimization, and a business and user behavior modelling that demonstrates interaction between consumers, EVs and the grid. Project data will help LDC partners understand the impact of EV charging on grid reliability, power quality, customer demand flexibilities and the role of incentives for load shifting of EV charging to off peak period. The project will result in substantial technological advancement in managed EV charging and will provide Elocity with a referential use-case for other LDCs.

The proposed project has tested and validated technology to incent EV drivers to change charging behaviour and shift to off-peak charging. Program participants have used HIEV mobile app to schedule optimal charging (e.g., time/cost saving).

This project and Elocity's technology have helped LDC partners to understand, predict, and control demand. The cloud-based management platform has given LDCs visibility into actual energy usage, demand diversity and the effects of EV on micro-grids and the system. During the project LDC partners have data and reports to:

- Better understand/predict EV-owner behavior
- Develop demand-response strategies
- Manage consistent, quality power delivery
- Respond to the predicted increase in EV adoption
- Support infrastructure decision-making and budgeting
- Incent consumer changes needed to ensure quality and continuity of power delivery
- Actively engage customers in managing EV-related energy consumption
- Increase awareness of power-consumption and the benefits of participation in demand-response programs
- Enable customers for grid-supportive EV charging using smart scheduling

2. Project Technology

Because of our innovative HIEV-EVPlug technology we could allow any EV charger (make, model and type Level 1/ Level 2) and Electric Vehicle to be part of this project and participate in smart charging and EV demand response.

HIEV-EVPlug

HIEV-EVPlug with Level 1 and Level 2 chargers

Level 2 – SAEJ1772

Level 1 – TESLA

Testing and validation site at centennial college with four chargers

HIEV-Cloud

Elocity has developed an intuitive and grid-friendly electric vehicle (EV) charging system utilizing state-of-the-art technology known as HIEV™. This advanced platform captures essential data during each charging session, including power, energy, voltage, current, charging patterns, and user preferences, in fine detail. Subsequently, this data is meticulously analyzed to establish contextual information, which forms the basis for implementing demand response programs within the system.

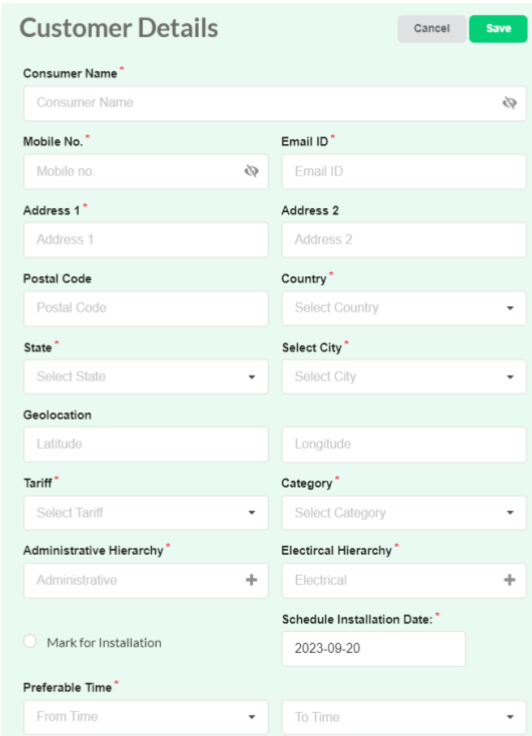
The HIEV™ EV charging network operates through a centralized control system that provides real-time monitoring and smart charging services. This intelligent charging infrastructure employs an Open charge Point Protocol (OCPP) -1.6 to communicate with a backend server, which facilitates charging services for end-users while also overseeing monitoring and control tasks for utility personnel. Users have the flexibility to adapt charging services according to their preferences, whether through local or remote charging algorithms. They can conveniently access these services through a mobile application, enabling them to log in, initiate or terminate EV charging, monitor the charging status, view the total energy supplied to their vehicle, and associated charging costs.

User Friendly HIEV Utility Charging Management Interface

Elocity thoroughly examined and explored the standard functionalities and operational needs of the Toronto Hydro and Enova Power Operations teams during the requirements gathering phase. Using this valuable input, user workflows, wireframes, and prototypes were developed, rigorously tested, and validated for the HIEV Utility cloud application.

The utility user can designate the EV users (customers) who will be involved in the program without revealing their personally identifiable information (PII) to the installation team (Elocity). Additionally, they can set the relevant tariff structures (such as Time of Use or Tiered rates) and establish and communicate a demand response event. Some screenshots are provided for reference.

Customer details: Utility user can enter the EV user details using this interface. Once saved, the information will be routed to Installation team (only with Address details, no name, mobile no information will be shared)



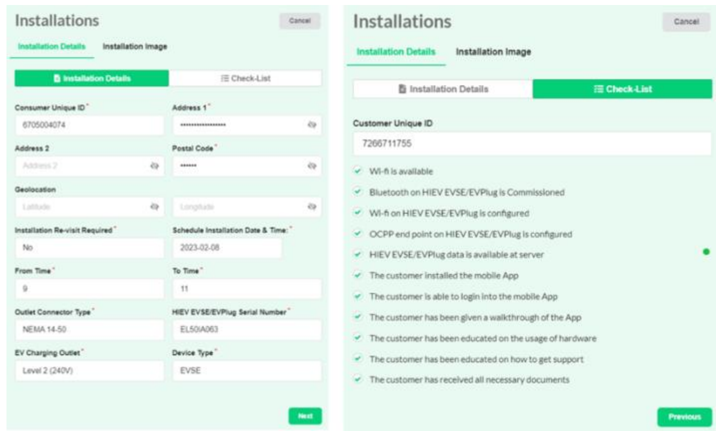


Fig 1: Installation Planning and Management Interface

Fig 2: Tariff details: Utility user can enter the tariff details like TOU tariff and Tiered tariff and their applicable dates. This information is later used for estimated charging cost calculation.

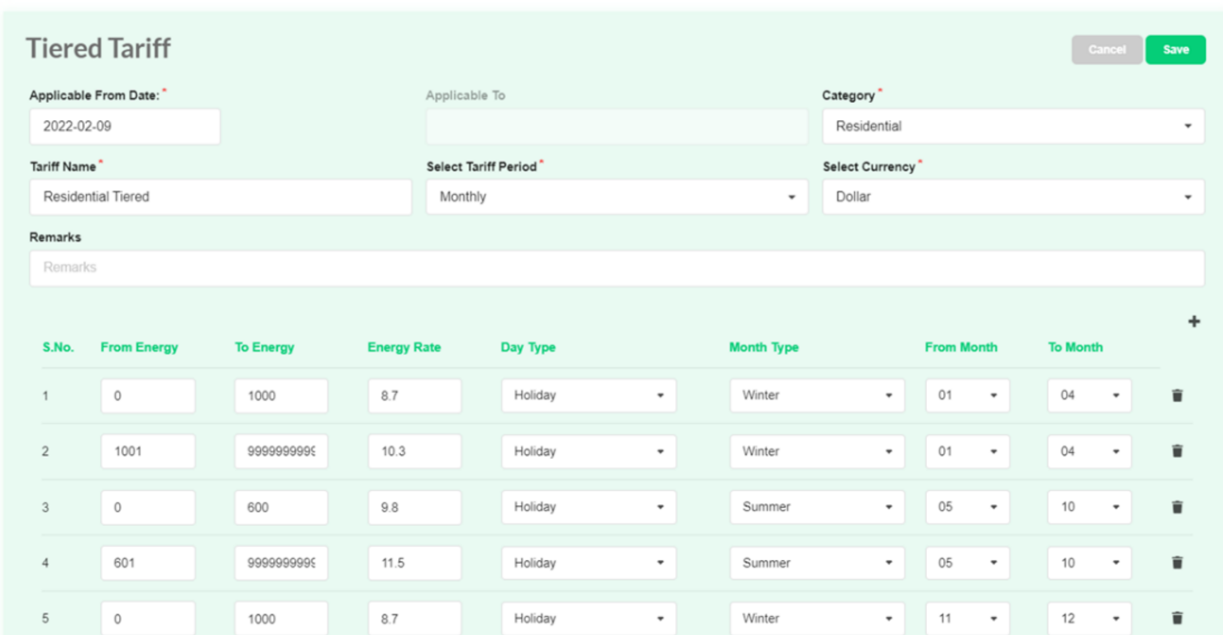
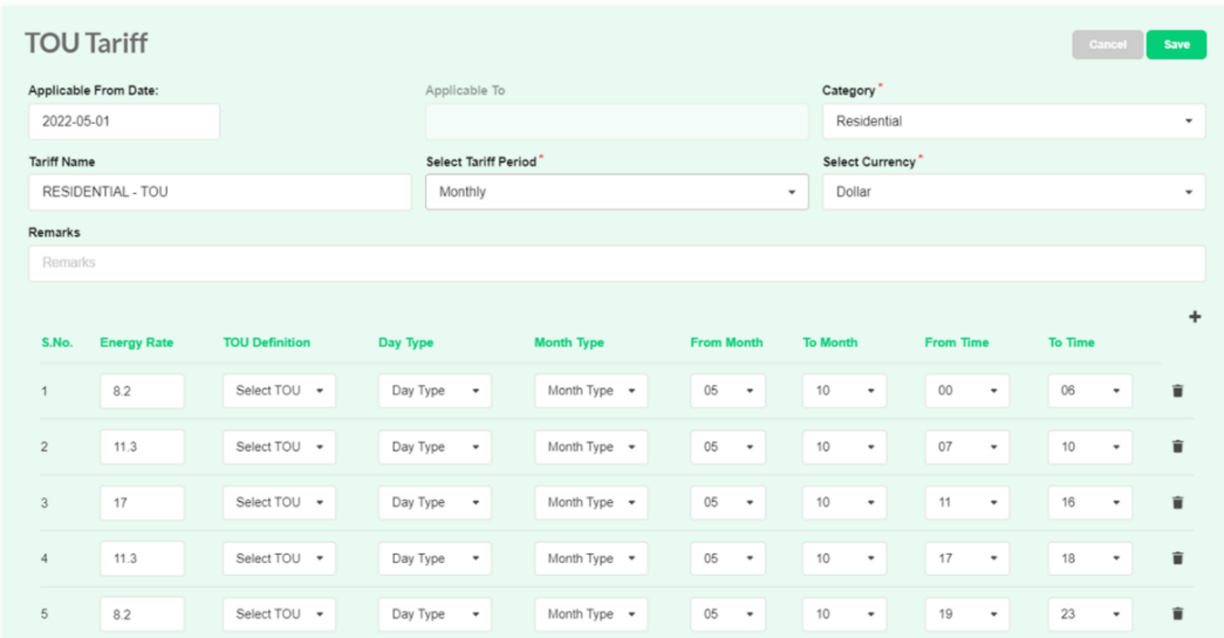
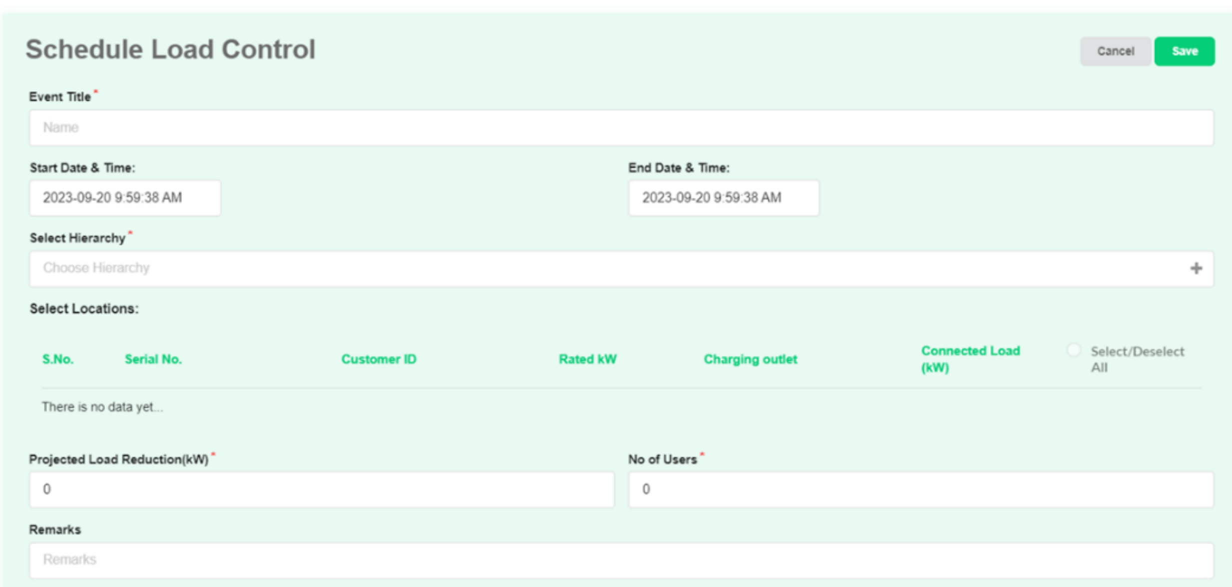


Fig 3: Scheduled Load Control interface: This is the interface where Utility user can design and publish demand response events





HIEV Utility Monitoring Interface

Furthermore, the utility user has access to visual representations of the charging behaviors and patterns of all the EV users through a set of four distinct dashboards. These dashboards were developed following in-depth discussions with the operations teams of Toronto Hydro and Enova Power. Details regarding these dashboards are provided below.

Fig 4: Real time dashboards

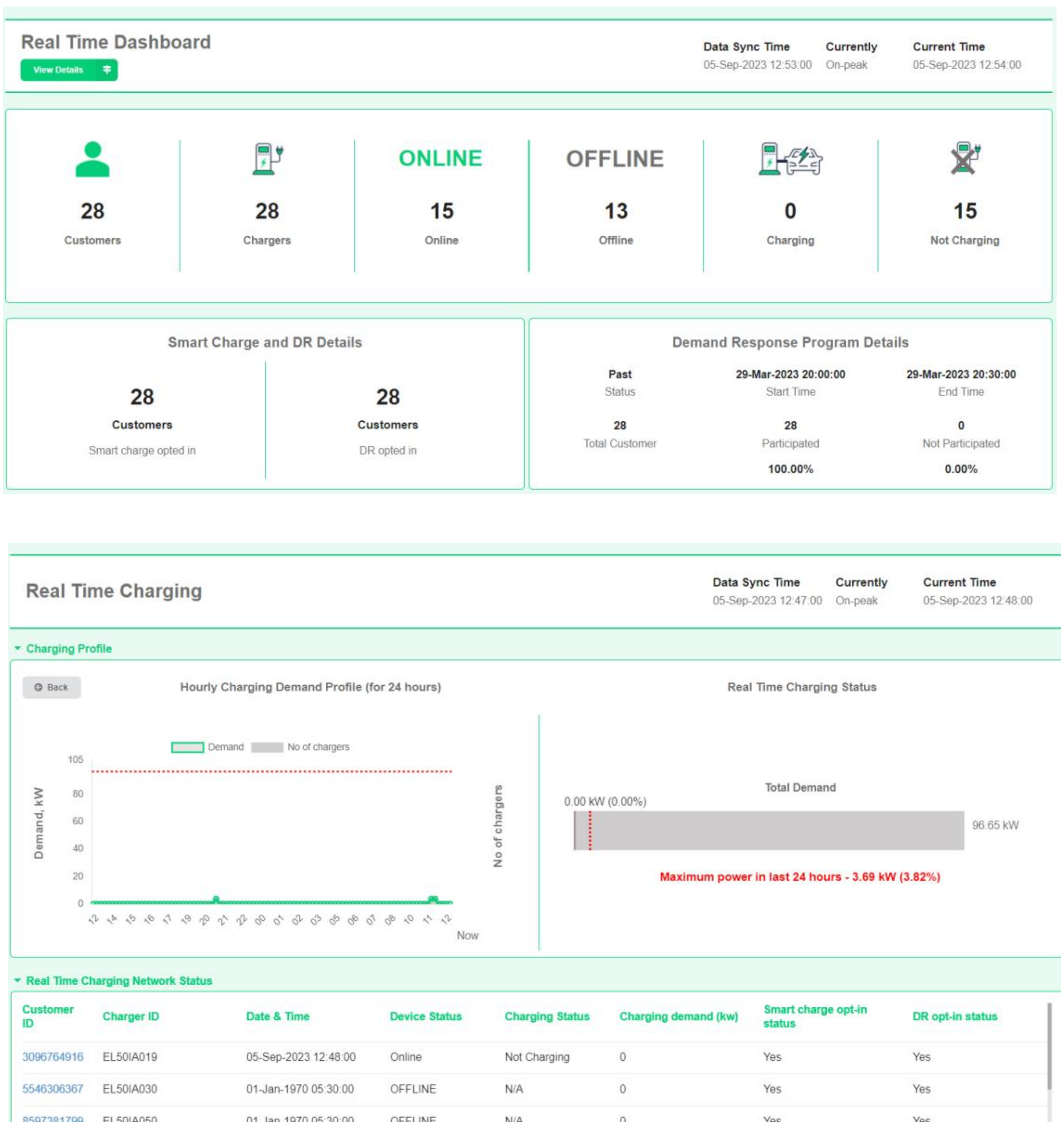


Fig 5: Consumer Dashboards

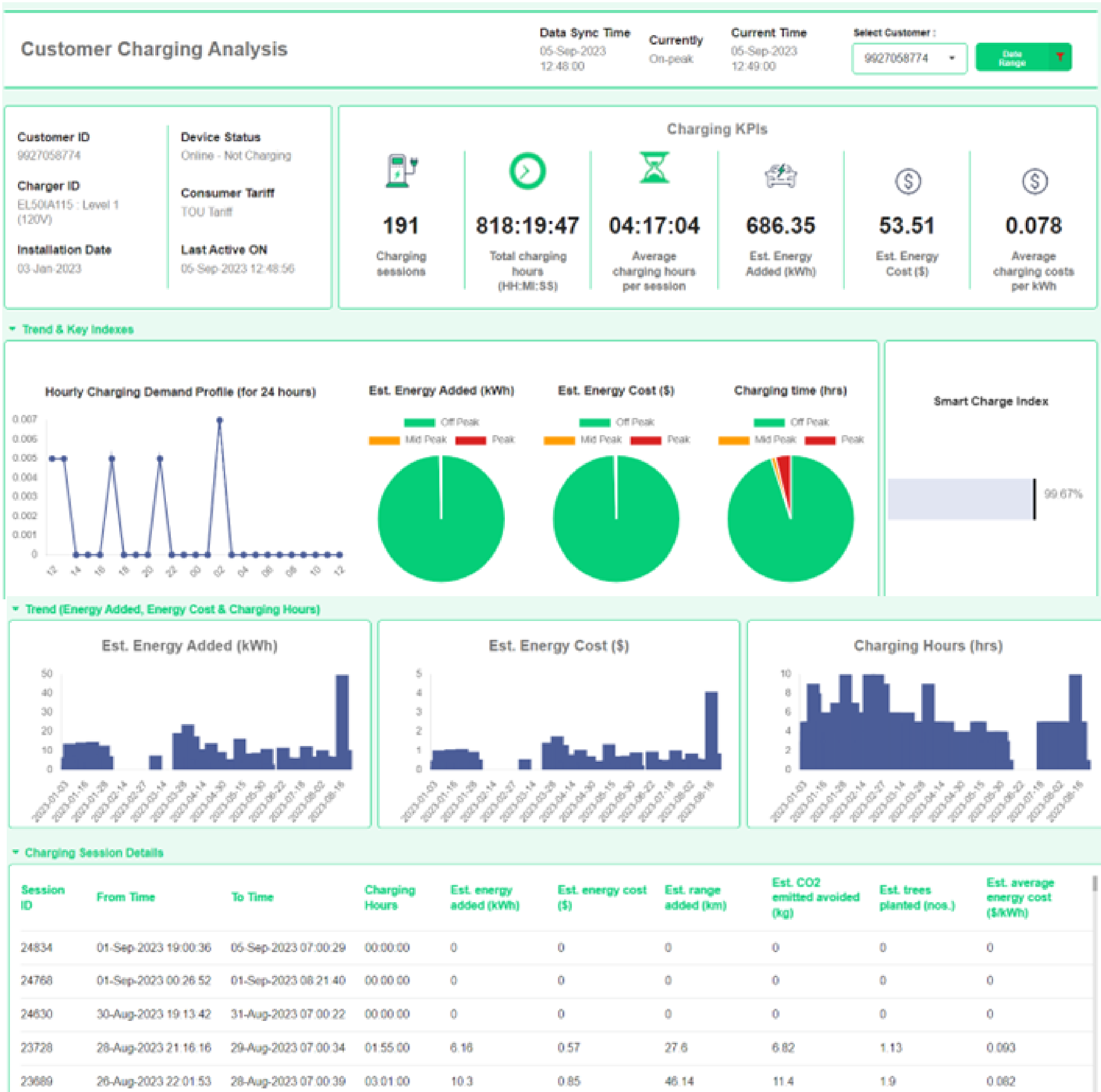
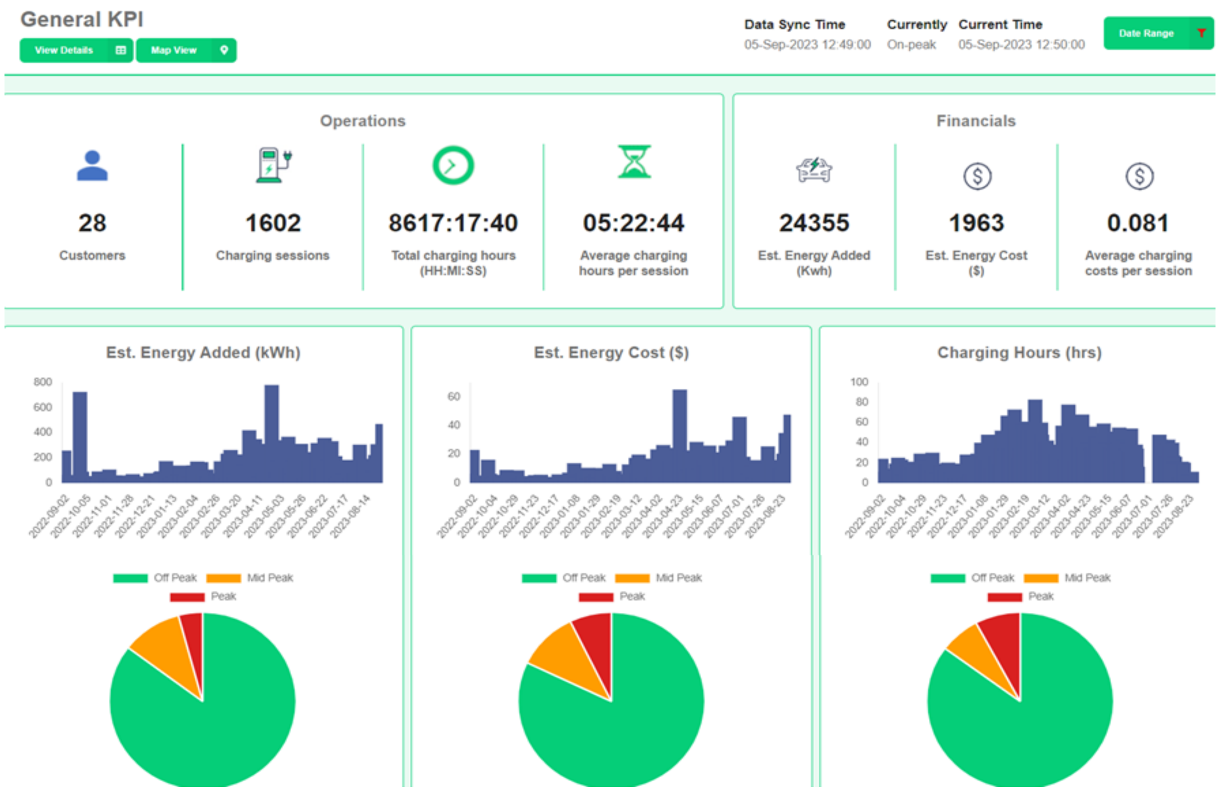


Fig 6: General KPI Dashboards



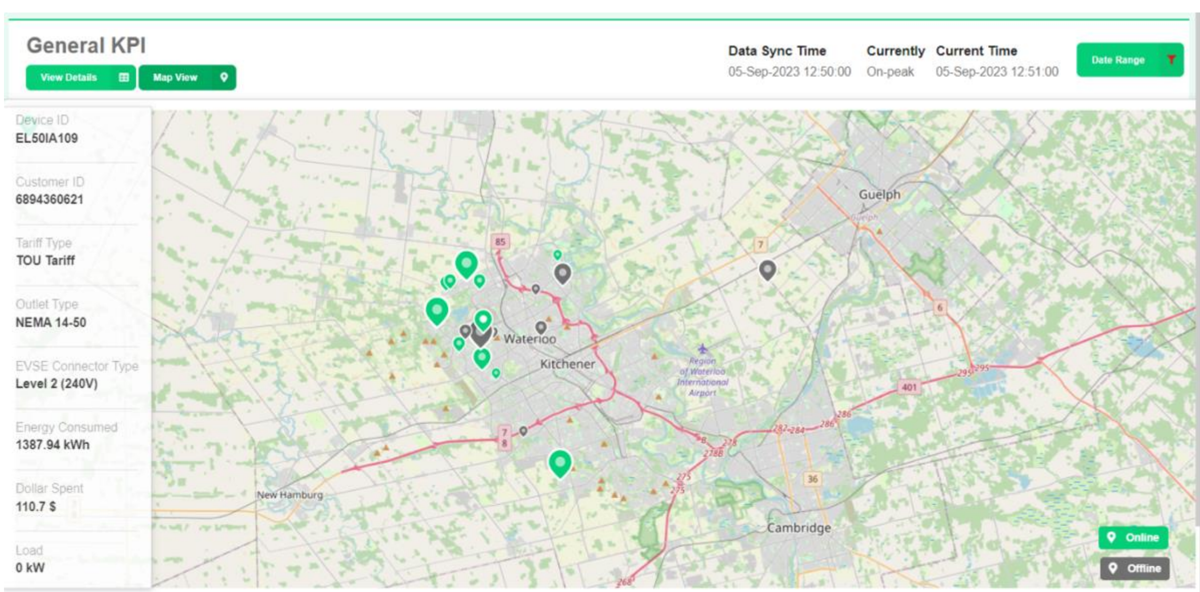
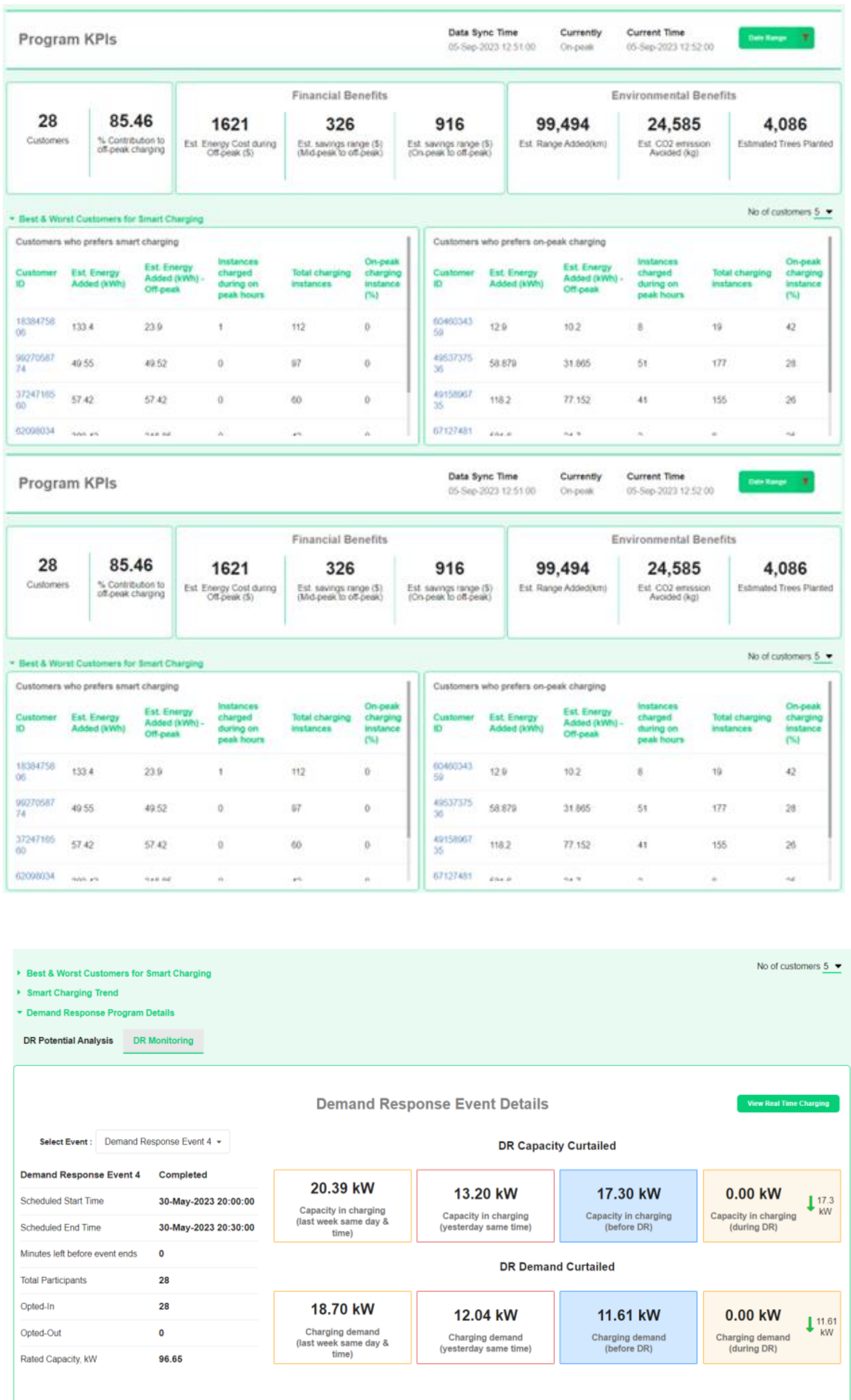


Fig 7: Program KPI Dashboards

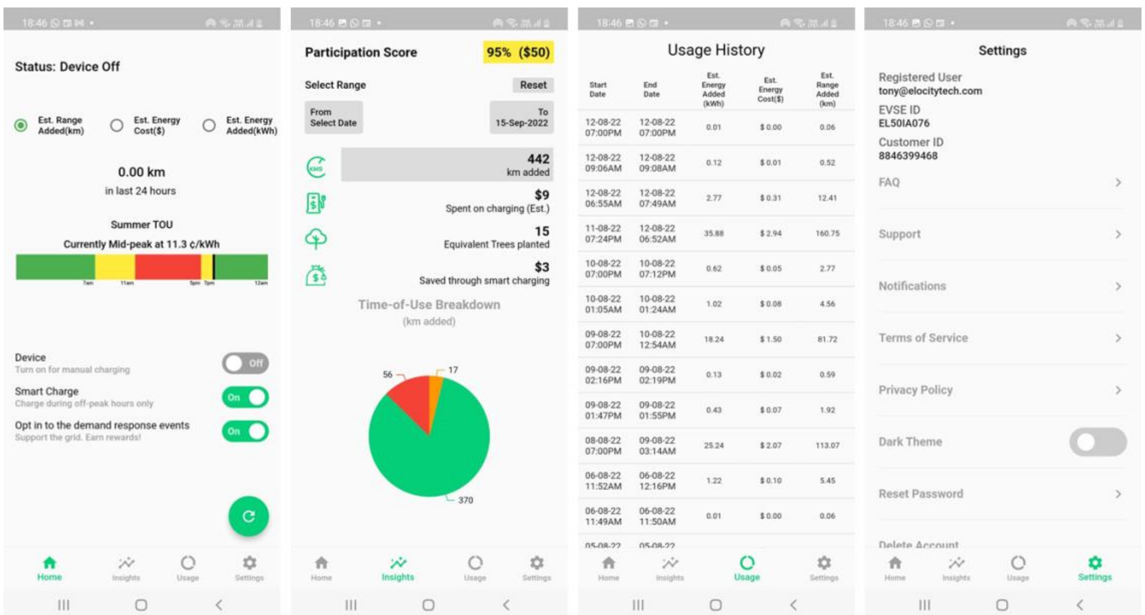


HIEV-Engage App

User friendly mobile app interface

To cater to a wider user base, two distinct mobile applications, namely 'HIEV – Utilities' and 'HIEV – WNH,' were implemented for Toronto Hydro and Enova Power respectively. These applications enable smart charging, discharging operations and option to opt-in or opt-out of the demand response event (as published by respective utilities) on both Android and iOS platforms. Through these applications, users have the capability to initiate or terminate charging, specify their preferences for intelligent charging, and access demand response programs that have been made available. Furthermore, they can conveniently review their charging history and records.

Fig 8: HIEV-Engage



3. Technology Intervention

The demonstration project has tested and validated technology to incent EV drivers change charging behaviour and shift to off-peak charging. Program participants have used HIEV mobile app to schedule optimal charging (e.g., time/cost saving).

EVPlug, which is a smart plug designed to bring non-networked and networked chargers on a unified platform based on industry standard open protocol (OCPP 1.6 J) and open automated demand response framework to design, dispatch, and settle EV demand response. Platform has validated an integrated technology for LDCs to rollout large scale EV demand response programs removing technical challenges of interoperability, standards-based demand response, data privacy concerns of EV drivers (by anonymizing the data of project participants).

1. The EVPlug is inserted between the charger and the electric vehicle, acting as an intermediary component. Moreover, it can seamlessly integrate with conventional, non-smart chargers, enhancing the entire system's intelligence.

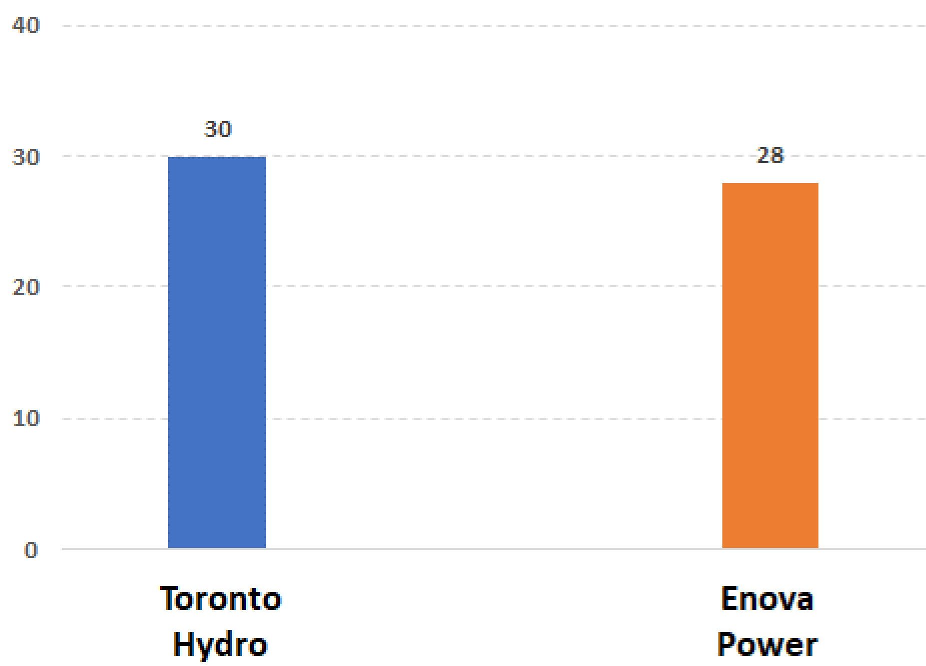
2. The EVPlug can be directly used by EV users in a straightforward manner. They can simply connect the charging connector of their electric vehicle to the EVPlug and then initiate the charging process. This user-friendly and intuitive process allows EV owners to easily start charging their vehicles by plugging into the EVPlug without the need for complex setup or configuration.

4.0 Key Guidelines Informed by Learnings for Production Deployment

Project Participation and Installation Summary

Participants Selection:

Following a series of initiatives and a rigorous selection process, both Toronto Hydro and Enova Power have identified a combined total of 58 qualified participants for the EV smart charging pilot program. These participants are geographically scattered and the distribution of these participants between the two utilities is depicted below.



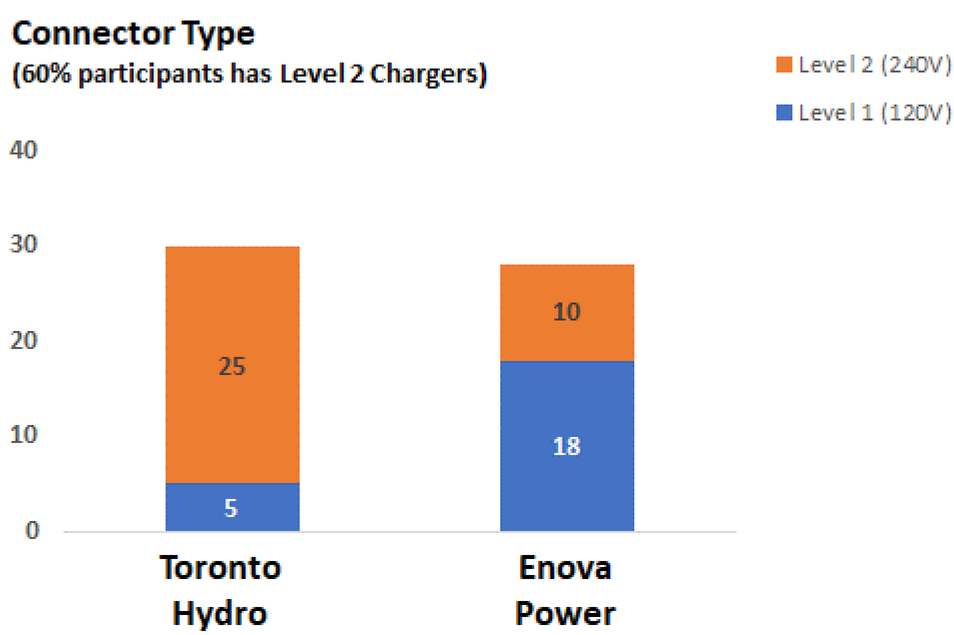
Project Participation Analysis

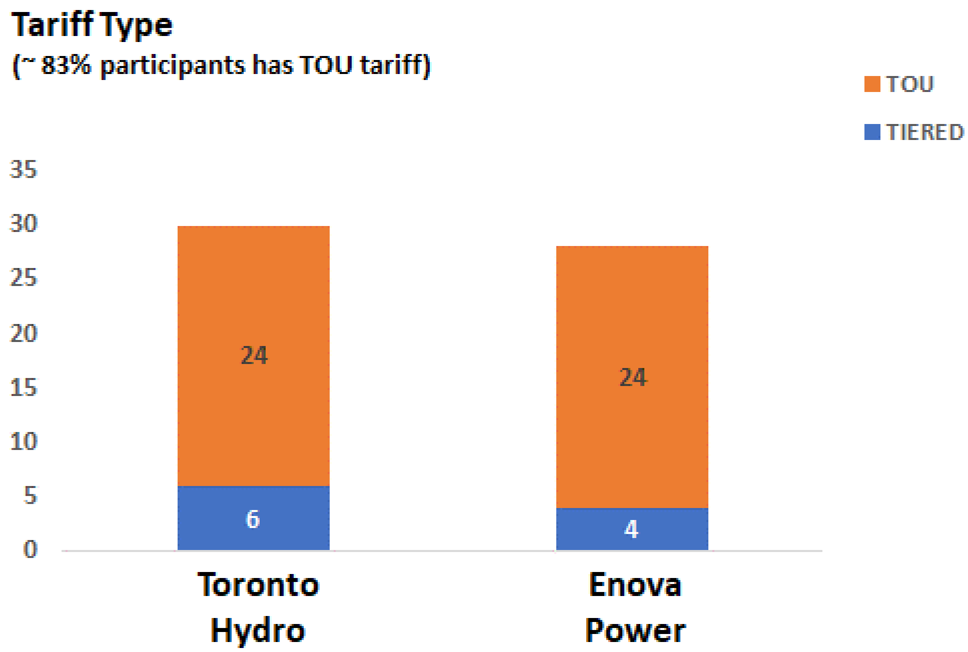
	Targetted as per IESO Application			Actual			Deviaiton	
LDCs	Number of Participants	Months*	Total Participants months	Number of Participants	Months*	Total Participants months	Total Participants months	%
Toronto Hydro	50	6	300	30	10	300	0	0.0%
Enova Power	30	6	180	28	10	280	100	55.6%

Total participants months are more than minimum target of the project.
Elocity is continuing engagement both with Toronto Hydro and Enova Power (Waterloo North Hydro) for another year which is not part of IESO project. We will gather more data during this period.

EVPlug Installation:

The installation schedule was thoughtfully prepared in consultation with the participants to ensure a seamless and trouble-free installation process. Following the schedule, Elocity installation team visited the participants' premises, where they expertly installed the chargers and configured them to connect to the home Wi-Fi network for seamless communication. Participants were also provided comprehensive training on how to effectively use the charger, the associated mobile app, and were made aware of the support channels available to assist them in case they encounter any challenges during the charging process. The distribution of these participants between the two utilities, categorized by connector type and tariff structure, is outlined below.





Smart Charging and Demand Response Methodology

Smart Charging:

The objective is to have an automated system that enables off-peak charging for all EVs, irrespective of their tariff plans (Time-of-Use or Tiered rates). In this system, the default state is designed to turn on all chargers during off-peak hours. If the vehicle is already plugged in, it will commence charging; otherwise, it will initiate charging as soon as it is connected. This approach optimizes grid asset utilization and minimizes costs, reflecting the commitment to sustainability and efficiency.

However, we also understand the importance of flexibility for our users. To that end, we offer an option for EV owners to override the default off-peak setting and charge their electric vehicles during on-peak hours if they so choose. It is important to note that, when users opt for on-peak charging, they are informed of two crucial aspects. Firstly, they will be subject to a higher rate that corresponds to the prevailing on-peak electricity prices. Secondly, we provide a transparent message to users, highlighting that charging during on-peak hours places added stress on the electricity grid. This information empowers our users to make informed decisions about their charging preferences while contributing to grid stability.

Furthermore, the option for users to override and charge during on-peak hours has offered enhanced convenience and choice, aligning with our commitment to customer-centric solutions.

While this choice comes with a higher tariff rate and awareness of grid stress, it empowers users to prioritize their individual charging needs while being environmentally conscious.

Throughout this developmental phase, process flows underwent iterative adjustments to enhance the user experience. Many test cases were jointly performed in multiple iterations for this task.

Demand Response:

The objective is to test the implementation of our demand response system, centered around smart EV charging station, for its ability to address the utility's published demand response event automatically.

This mechanism ensures that electric vehicle connected to our EV charging station promptly and seamlessly respond to demand response events published by the utility, primarily by temporarily discontinuing charging during the specified period. This proactive approach plays a crucial role in supporting grid stability and load management during times of peak electricity demand.

In this system, once the demand response event is initiated by the utility, our charging station automatically suspends charging operations across all connected vehicles without requiring any human intervention. This swift and coordinated response enhances the grid's capacity to handle peak loads efficiently. However, we recognize the importance of flexibility and choice for our users. Therefore, we provide an option for EV owners to override the default demand response setting and continue charging their electric vehicles during the event. It is important to note that users exercising this option are informed that they will not receive any demand response incentives, and we transparently communicate that charging during this period places additional stress on the electricity grid.

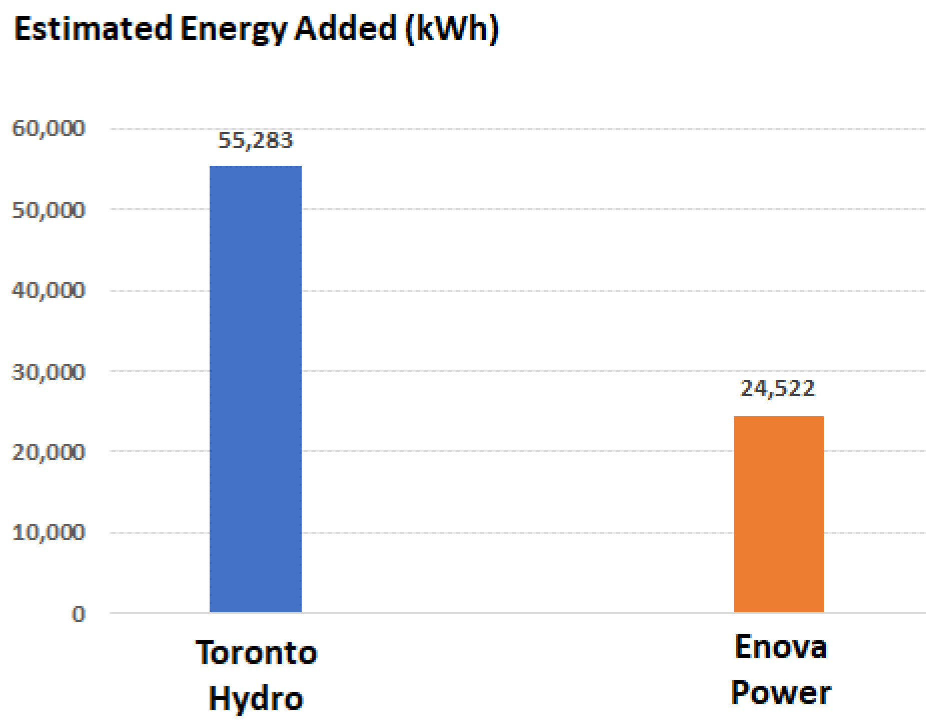
Throughout this developmental phase, process flows underwent iterative adjustments to enhance the user experience. Many test cases were jointly performed in multiple iterations for this task.

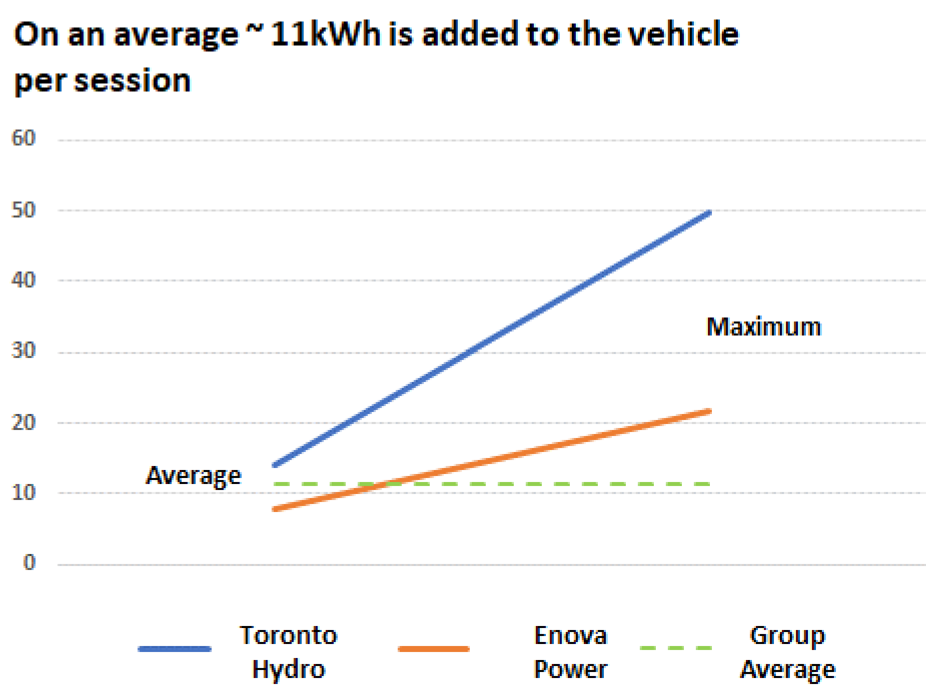
Project Outcomes

Utilizing the charging patterns and data gathered from the chargers installed at the premises of EV users, we have generated the following findings both from smart charging and demand response perspective. In essence, it can be observed that all engaged EV drivers express their willingness to partake in smart charging and demand response by deferring their charging sessions.

General observations

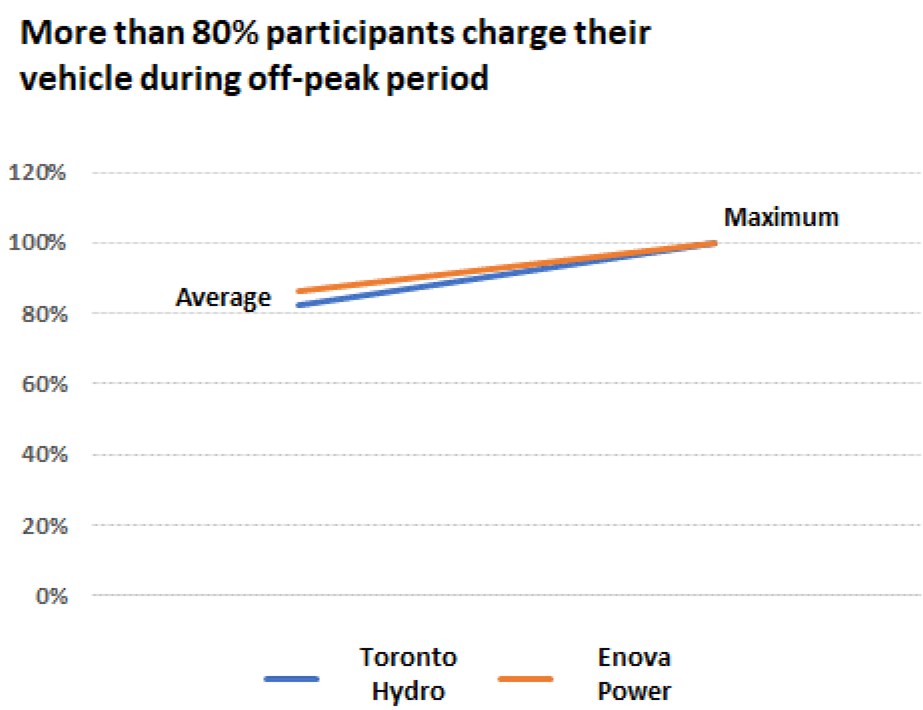
The participants have conducted a collective sum of 7,566 charging sessions, contributing a total energy consumption of 79,805 kWh, equating to an average of approximately 11 kWh per session. The distribution of these for each utility is shown below.



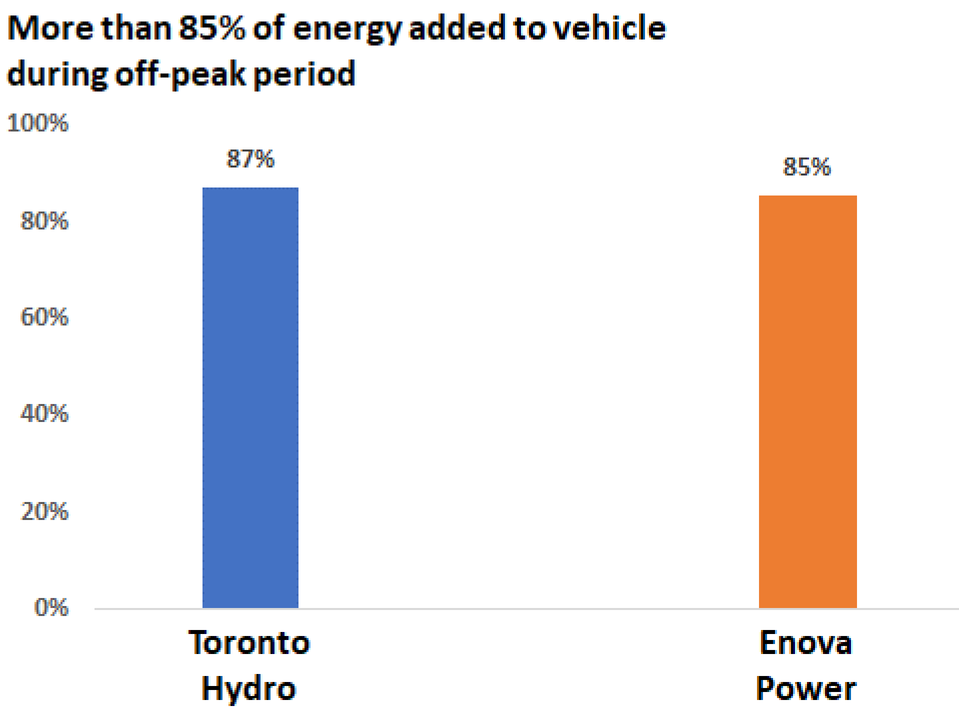


Smart Charging

This section delves into the perspective of EV users with regard to smart charging, aiming to achieve the automated activation of EV chargers at the commencement of off-peak hours. The chargers are designed to remain operational throughout the entire off-peak duration, and without any user intervention, they automatically deactivate as on-peak hours commence. This automated process is particularly advantageous due to the cost-effectiveness of energy during off-peak periods, resulting in a mutually beneficial situation for both EV users (who can save on charging costs by avoiding expensive on-peak rates) and the utility (which can leverage existing infrastructure to accommodate the EV load without straining the grid, ultimately contributing to grid stability). The outcomes related to smart charging is detailed below.



As indicated in the preceding figure, an impressive average of approximately 95% of participants actively embrace smart charging protocols, demonstrating a highly positive response to this program among participants. A few participants, who possess EVs with smaller battery capacities, may, on occasion, choose on-peak charging to ensure a seamless and convenient travel experience. As depicted in the chart below, the smart charging index, calculated as Off-peak kWh compared to Total kWh, stands at an impressive approximate value of 85% for both Toronto Hydro and Enova Power. This indicates that approximately 85% of energy added to the vehicle during the off-peak period which is significant.



Demand Response

This analysis exclusively focuses on one specific demand response (DR) type: Pure DR. Under the pure DR, the power supply from the charger to the vehicle is completely halted, reducing it to zero.

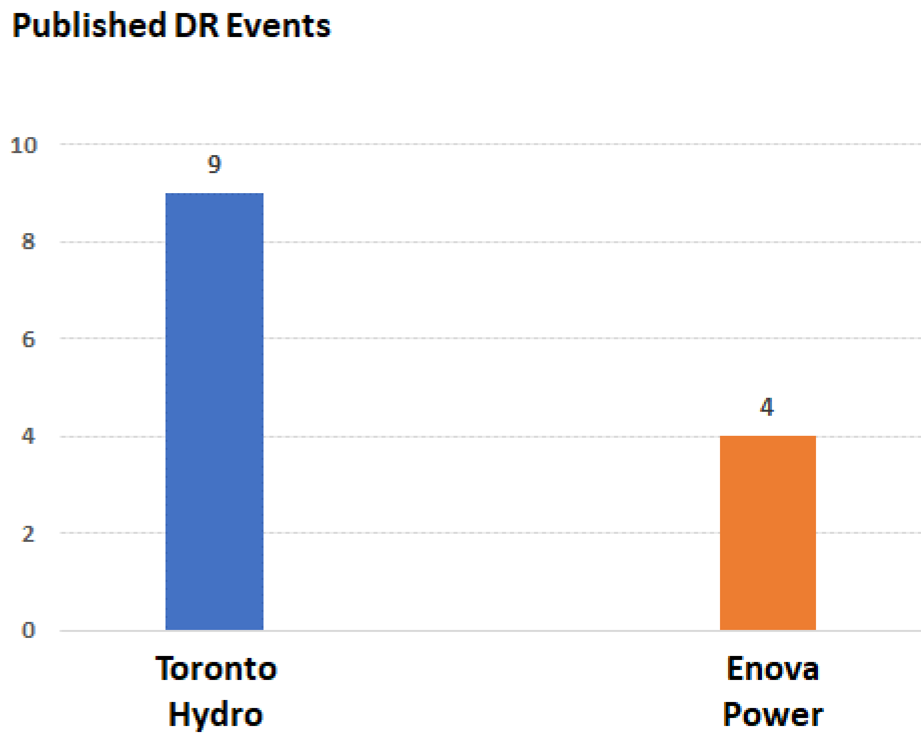
The details for each demand response event is shown below.

Utility	Event Name	Date	Start Time (HH:MM)	End Time (HH:MM)	Duration (HH:MM)	Total # Participants	# Opted-in	# Opted-out	Connected demand	Demand during DR (kW)	Net curtailment achieved (kW)
Enova Power	Demand Response Event 1	31-Jan-23	20:00	20:30	0:30	28	28	0	97.62	0	98
Enova Power	Demand Response Event 2	28-Feb-23	20:00	20:30	0:30	28	28	0	97.62	0	98
Enova Power	Demand Response Event 3	29-Mar-23	20:00	20:30	0:30	28	28	0	97.62	0	98
Enova Power	Demand Response Event 4	30-May-23	20:00	20:30	0:30	28	28	0	96.65	0	97
Toronto Hydro	DR Event 1	06-Dec-22	19:30	20:00	0:30	27	27	0	159.80	0	160
Toronto Hydro	DR Event 2	25-Jan-23	19:30	20:00	0:30	27	27	0	159.80	0	160
Toronto Hydro	DR Event 3	16-Feb-23	19:30	20:00	0:30	29	29	0	173.80	0	174
Toronto Hydro	DR Event 4	24-Mar-23	20:00	20:30	0:30	30	30	0	173.70	0	174
Toronto Hydro	DR Event 5	24-Apr-23	20:00	20:30	0:30	30	30	0	173.70	0	174
Toronto Hydro	DR Event 6	24-May-23	20:00	20:30	0:30	30	30	0	173.70	0	174
Toronto Hydro	DR Event 7	23-Jun-23	20:00	20:30	0:30	30	30	0	173.70	0	174
Toronto Hydro	DR EVent 8	26-Jul-23	20:00	20:30	0:30	30	30	0	173.70	0	174
Toronto Hydro	DR Event 9 Part 1	24-Aug-23	20:00	20:30	0:30	10	10	0	48.3	0	48
Toronto Hydro	DR Event 9 Part 2	24-Aug-23	20:15	20:45	0:30	10	10	0	64.9	0	65
Toronto Hydro	DR Event 9 Part 3	24-Aug-23	20:30	21:00	0:30	10	10	0	60.5	0	61

Observations:

Consistent Participation: Both Enova Power and Toronto Hydro have experienced consistent participation from their respective EV users in the demand response (DR) events, with all participants opting to take part in the events. As shown above, throughout the study, a total of

13 nos. of demand response events were published, and it's noteworthy that all EV users responded affirmatively to each event.

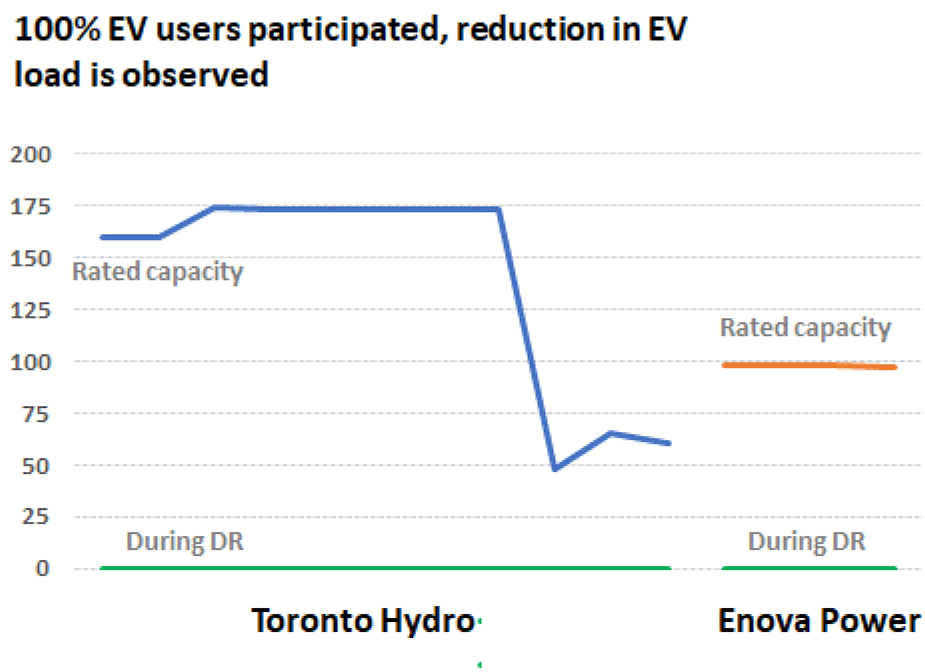


It's important to highlight that the event duration is consistently set at 30 minutes to ensure minimal inconvenience to EV users.

Typically, the system experiences its highest load levels during on-peak hours. Consequently, it is strategically preferable to schedule demand response events exclusively during these peak periods. Given that the chargers are inherently equipped with smart charging capabilities, they automatically activate during off-peak hours as a default setting. Therefore, it's worth noting that demand response events were deliberately scheduled during off-peak periods, primarily since most charging activities occur during this time frame. This decision aimed to evaluate the participation behavior of EV users in response to events during off-peak hours.

A variation is introduced in the time of event occurrence in Toronto Hydro to see the impact of EV user participation. It is observed that there is hardly any impact on the participation level.

During the DR events, the charging demand significantly decreases compared to the demand before the events. This indicates that EV users are responsive to the demand response signals and reduce their charging activities during the specified periods.



It is observed that the charging demand prior to a demand response (DR) event is typically lower than the total charging capacity of the chargers, indicating that only a subset of chargers is actively in use at that time. Consequently, when no DR event is in effect, there exists a possibility that these EV users might opt to initiate charging during that period. However, it's important to highlight that the program effectively manages and reduces the load of all chargers that are part of the system but are not actively charging prior to the event. In essence, the DR program successfully optimizes charger usage and mitigates potential load spikes during peak periods.

Toronto Hydro implemented a distinctive approach with "DR Event 9," dividing it into three equal parts to create a staggered event. This design aimed to simulate a scenario where multiple events are published with a staggered timing, as if the participants under each event are connected to separate distribution transformers. Notably, participants in each of these individual events exhibited a positive response to the demand response event.

All these capabilities have been made feasible through the implementation of the automatic opt-in principle for each EV participant in the demand response (DR) event. This means that the charging status in place before the DR event will persist once the event concludes. During the DR event, charging will automatically cease without any requirement for user intervention. However, users retain the flexibility to override this operation. They can opt-out of the DR event before its commencement or even during the active DR event period, allowing them to initiate charging manually through the mobile app.

Overall, the data suggests that the demand response programs have been successful in influencing EV users to reduce their charging demand during the specified event periods, contributing to grid management and stability.

Explanation of participant rewards

Toronto Hydro rewards and incentive mechanism and methodology

Toronto Hydro has chosen to reward participants based on both DR participation and smart charge. Below is detailed model and an example for easy understanding.

Maximum Rewards per participant - A	**$50**

	Unit	Planned	Actuals
# Program days	Days	182.5	182.5
# Daily smart charge events	Smart charge events	182.5	182.5
Total Events (DR Changes)	Numbers	10	10
Calculated values and indices			
Smart Charge participation rate - B	%		100%
DR participation rate (%) - C	%		100%
Weighted contribution of Smart Charge participation rate - D	**1**		
Weighted contribution of DR participation Rate - E	**2**		
Participation score - F	**(B*D+C*E)/(D+E)**		
Rewards in $ - G = as per table H	**Consider slabs as per table (H)**		

Example

	Unit	Planned	Actuals
# Program days	Days	182.5	120
# Daily smart charge events	Smart charge events	182.5	120
Total Events (DR Changes)	Numbers	10	5

Calculated values and indices			
Smart Charge participation rate - B	%		66%
DR participation rate (%) - C	%		50%
Weighted contribution of Smart Charge participation rate -D	**1**		
Weighted contribution of DR participation Rate - E	**2**		
Participation score - F	**55%**		
Rewards in $ - G as per table H	**30$**		

Table H - Slabs for rewards

<25%	0
>25%	$20
>50%	$30
>75%	$50

Enova Power (Waterloo North Hydro) rewards and incentive mechanism and methodology

Enova Power has chosen to reward participants based on DR participation only, smart charge is an add on benefit for EV drivers as they save cost on charging. Below is detailed model and an example for easy understanding.

Maximum Rewards per participant - A	**$50**

-

	Unit	Planned	Actuals
# Program days	Days	182.5	182.5
Total Events (DR Changes)	Numbers	10	10
Calculated values and indices			
DR participation rate (%) - B	%		100%
Rewards - C	**A*B**		

Example

	Unit	Planned	Actuals
# Program days	Days	182.5	120
Total Events (DR Changes)	Numbers	10	5

Calculated values and indices			
DR participation rate (%) - B	%		50%
Rewards - C	**$25.00**		

Summary of Targeted Vs Actual Outcomes

Metrics	Target vs Actual	Section Referenced in Written Proposal	Lower Bound	Upper Bound	Expected Result	Units
Energy Savings						kWh
Peak Load Reduction						KW*
Peak Load Shifting	Target	1.6.F.	172	1080	500	KW*
	Actual		271			
Bill Savings	Target	1.6.F.	0-20.5	34.3	20.5	CAD$ per Bill
	Actual		CAD$ 73**	CAD$ 205**		**Total for all customer per month
Reliability Improvement SAIFI						hours
Reliability Improvement SAIDI						hours
Jobs Supported	Target	4.B.	5	10		Jobs
	Actual		5			
Jobs Created	Target	4.B.	5	10		Jobs
	Actual		5			
Additional Available Capacity / Energy						kW / kWh
Active Participants	Target	1.6F.	80	150		Participants
	Actual		58			
Policy Change			N/A	N/A		N/A
International partnerships	Target	1.5	3	7		
	Actual		5			
International investment	Target	1.5	2.0	5.0		Million CAD
	Actual		2.0			

5.0 Timelines

Date	DESCRIPTION
Apr, 2021	Agreement with IESO
Aug, 2021	Agreement with LDC partners - Enova
Oct, 2021	Agreement with LDC partners - Toronto Hydro
Nov, 2021	MS#1 Completed Key Activities Organize key directives and resources to solidify partnerships and initiate the pilot project, ensures that LDC team members are briefed on product specifics and engaged in a process to develop a rollout plan for end users, and solidifies alignment of pilot delivery responsibilities and expectations, and kicks off end-user outreach.
April 19, 2022	MS#2 Completed Key Activities Lifecycle of the HIEV hardware manufacturing and testing stages, and includes deployment, testing, and beta release of units to end-users via LDC partners.
Aug, 2022	MS#3 Completed Key Activities Cloud setup necessary to begin integrating the EVPlugs with the LDC back-end systems for data collection and demand response control purposes and includes initial stages of data collection to inform fixes needed to refine the software, as well as developing participant agreements and contracts based on LDC and end-user feedback.
Jul, 2023	MS#4 Completed Key Activities Mass-installation stage for the EVPlug, complete with end-user training, and as the data collection stage that will ultimately inform the final proof-of-concept report.
Sep, 2023	MS#5 Completed Key Activities Final submission of discoveries and learnings to the IESO after project completion.

6.0 Learnings and discoveries to IESO, project partner, policymakers, and project participants, and to the industry and research forums

Learnings and discoveries to IESO

Grid Management and Optimization: Project data might be useful for IESO to learn how to better manage and optimize the electricity grid by incorporating managed EV charging into their strategies. This includes understanding the impact of EV charging patterns on grid load and implementing measures to mitigate grid congestion during peak times.

Load Shifting Strategies: Project provide insights into load shifting strategies. IESOs can use these strategies to encourage EV drivers to charge during off-peak hours, which can reduce the need for grid upgrades and enhance grid reliability.

Demand Response Integration: IESO can leverage the project findings as part of their demand response programs. This allows them to balance electricity supply and demand more effectively, especially during periods of high demand or supply fluctuations.

Grid Resilience: IESO can enhance grid resilience by integrating managed EV charging. This involves the ability to curtail or modify EV charging patterns in response to grid emergencies or stress conditions, ensuring grid stability.

Data Analytics: The project has generated valuable data that IESO can use for grid forecasting and planning. Insights into EV charging behavior help IESO anticipate future grid needs and make informed decisions about infrastructure investments.

Communication and Collaboration: IESO can use project for devising effective communication and collaboration with stakeholders, including utilities, electric vehicle service providers, and regulators.

Customer Engagement: Engaging with EV drivers and educating them about the benefits of managed charging is essential. IESO can play a role in promoting customer awareness and incentivizing behavior that benefits grid reliability.

Environmental Considerations: IESO can integrate environmental considerations into their grid management strategies. The project findings can be used to encourage EV drivers to charge when renewable energy sources are abundant, reducing greenhouse gas emissions.

Scalability: As the adoption of electric vehicles grows, IESO can use the project findings to learn about the scalability of managed charging programs.

Technology Integration: Project has demonstrated integrating advanced technologies, such as EV Chargers, Protocols, EV drivers, and data analytics. IESO can gain insights into the challenges and benefits of adopting these technologies.

Overall, managed EV charging projects provide valuable insights and opportunities for ISOs to enhance grid management, improve grid resilience, and facilitate the integration of electric vehicles into the broader energy ecosystem. These learnings are crucial for adapting to the evolving energy landscape and ensuring a sustainable and reliable electricity grid.

Learnings and discoveries to Policymakers

Public Policy Advocacy: Policy makers can use project findings to advocate for supportive public policies that encourage sustainable transportation and grid-friendly EV charging practices. They can work with policymakers to shape regulations that promote clean energy and grid stability.

Environmental Considerations: Policy makers can integrate environmental considerations into their grid management strategies. The project findings can be used to encourage EV drivers to charge when renewable energy sources are abundant, reducing greenhouse gas emissions.

Regulatory Frameworks: This project highlights the need for adaptable regulatory frameworks that accommodate emerging technologies and new demand patterns. Policy makers can work with regulators to create policies that support grid-friendly EV charging practices.

Learnings and discoveries to LDC partners

Lesson 1: Customer Recruitment Process

- Diversify recruitment channels to maximize participant enrollment.
- Consider inclusivity for customers with hardwired chargers through open-source protocols (OCCP etc.).
- Consider various incentive models to increase customer enrollment.

Lesson 2: Plug-and-Play Hardware

- Provide easy-to-use hardware solutions to maximize accessibility.
- Address Wi-Fi range issues for reliable connectivity.

Lesson 3: Customer Mobile Application Offer a user-friendly mobile app for monitoring and control.

- Ensure privacy protection through masked IDs.

Lesson 4: Customers prefer automated TOU (time of use) charging and options to opt out of DR events.

Gaps and improvement

Building upon the success of the pilot program and incorporating the lessons learned, the following steps are recommended for scaling up of the EV Smart Charging initiative:

Step 1: Program Expansion
Expand the program to cover a larger residential area within the Toronto Hydro service area.
Implement diversified recruitment strategies, including hardwired chargers.
Explore integrating EV charging management with THESL energy centre.
Explore additional partnerships with EV Charger manufacturers and EV OEMS to identify potential participation through open protocols such as OCCP and OADR.

Step 2: Enhanced Hardware Solutions
Evaluate and incorporate Wi-Fi extenders or integrated cellular service to address connectivity issues.

Step 3: Mobile Application Improvements
Continue enhancing the customer mobile application with additional features and real-time controls.

Step 4: Demand Response Optimization
Collaborate with various EV charging vendors to fine-tune demand response capabilities.
Develop and implement incentive models to encourage customer participation in demand response events.

Learnings and discoveries for Project participants

Grid Optimization Benefits: EV drivers have learned that managed charging can help optimize grid usage. By charging during off-peak hours or based on grid conditions, they contribute to grid stability and potentially reduce the need for costly grid upgrades.

Cost Savings: Participants have discovered that by shifting their charging demand to off-peak time results in 30% to 50% cost savings.

Environmental Impact: Our Mobile App in real-time displays CO2 savings, number of trees saved which has given EV drivers better understanding of the environmental benefits of managed charging.

User Flexibility: We have offered Smart Scheduling which in turn offers flexibility in charging schedules. EV drivers were adjusting their preferences and priorities based on their specific needs.

Incentives and Rewards: We have offered incentives for smart charging and demand response rewards for participating EV drivers.

Data Insights: Participants got access to charging patterns and their charging habits. This information helped them make informed decisions about when and how to charge their EVs efficiently.

Future of EV Charging: The project has generated substantial data on EV charging behavior of EV drivers which will help in rolling out large scale managed charging projects to actively contribute to shaping the future of EV charging infrastructure and sustainable energy practices.

Technological Awareness: Participants have become more aware of advancements in charging technology and software solutions that enable managed charging.

Learnings and discoveries for Elocity

- Establish Elocity as a reputable brand in the managed EV charging space
- Inform LDC partners with data and project learnings to aid in design of large-scale rollout
- Enhance and mature HIEV's technological features and provide path for scalability
- Capture near-shore large managed charging market in the US
- Position Elocity as a preferred partner of LDCs within Ontario and Canada to promote faster EV adoption and decarbonization
- Inform LDC partners and lay groundwork for a large-scale program roll out

Progress made by Elocity during the Project

- Launched one of the largest residential EV charging projects of the world with Adani Electricity, Mumbai- India
- Signed technology supply and service contract with TotalEnergies, Singapore for launching their EV charging network in UAE, Cambodia, Fiji, Thailand, Singapore, and Vietnam
- Signed a partnership with Samsung to launch EV charger along with Samsung displays for commercial and industrial customers.
- Signed partnership with Alfanar (Largest Electrical Equipment manufacturer from Saudi Arabia) to launch EV charging network in Middle East and Europe.
- Signed partnership with Meralco (Largest Electrical Utility in Philippines) to launch EV charging network.

All the above partnerships and contract have put Elocity on the forefront of technology providers for smart EV charging. These will help Ontario to generate export-based revenues and jobs in Canada.

Elocity's customer base in North America

Elocity's customer base rest of the world