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Evaluation of Grid Innovation Fund Program

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TABLE OF CONTENTS

Table 1: Terms and Abbreviations

The following terms and abbreviations are used in this report.

Ameresco	Ameresco Canada
BESS	Battery Energy Storage System
BEIS	Department for Business, Energy, and Industrial Strategy
BRL	Business Readiness Level
BTM	Behind the Meter
CUI	Canadian Urban Institute
DER	Distributed Energy Resources
DERMS	Distributed Energy Resource Management Software
DLMP	Distributed Locational Marginal Pricing
DR	Demand Response
EUI	Energy Use Intensity
FCM	Federation of Canadian Municipalities
FTM	Front of the Meter
GH	Guidehouse
GHG	Green House Gases
GIF	Grid Innovation Fund
IESO	Independent System Operator
IRL	Innovation Readiness Level
Intangible Benefits	Benefits of projects which cannot be tangibly measured or quantified such as development of new concepts or learnings shared amongst an audience.
LDC	Local Distribution Company
LDCSB	London District Catholic School Board
LH	London Hydro
OCWA	Ontario Clean Water Agency
OEB	Ontario Energy Board
ROI	Return on Investment
RWDI	Rowan Williams Davies and Irwin (name of engineering consulting firm)
SMR	Small Modular Reactor
TAF	The Atmospheric Fund
Tangible Benefits	Benefits of projects which can be measured or calculated such as GHG reductions or measured kW/kWh savings.
TE	Transactive Energy
TRL	Technology Readiness Level
THESL	Toronto Hydro
TMU	Toronto Metropolitan University
URL	User Readiness Level
VPP	Virtual Power Plant

TABLES

FIGURES

1 Executive Summary

1.1 Purpose and Objectives

Guidehouse was commissioned to conduct an independent evaluation of the Grid Innovation Fund (GIF) investment. This included undertaking a detailed evaluation of eight completed projects funded by the GIF in 2017 and 2018, focusing on their alignment with the Independent Electricity System Operator (IESO)'s corporate strategy, particularly in terms of driving and guiding the future of the energy sector. This comprehensive evaluation involves reviewing and assessing the impact of these projects, with a specific emphasis on understanding the trends and challenges faced by Ontario's electricity sector since 2017.

As part of this assignment, Guidehouse is responsible for developing and submitting an Evaluation Report to IESO, adhering to the Accessibility for Ontarians with Disabilities Act (AODA) standards. This report will encompass an executive summary, the evaluation plan and methodology, a summary of results including the impacts on the Ontario energy sector and the funded organizations, and an analysis of the Return on Investment. Additionally, the report will analyze each project's contribution towards the sector's future and provide recommendations for enhancing their impact on regulatory, policy discussions, and the adoption of innovative technologies in Ontario. Supporting appendices and data are also included. Alongside the report, Guidehouse will deliver a presentation to IESO, summarizing the key findings and recommendations.

Table 2: Goals and Objectives of IESO GIF Evaluation

Goals and Objectives of Evaluation Report	Related Deliverable from RFS	Location in Document
An executive summary;	N/A	1 Executive Summary
The evaluation plan and methodology used for the evaluations;	1.5.1	2 Evaluation plan and methodologies
A summary of the results from the evaluation for the suite of projects including: (1) impacts to the Ontario energy sector; (2) impacts to the funded organization & market effects and (3) analysis of Return on Investment	(1) 1.5.2.1 (2) 1.5.2.2 (3) 1.5.2.3	3 Results
An analysis of (1) how each project has contributed towards driving and guiding the sector's future (rating of high, moderate, low); and (2) how the suite of projects has contributed towards driving and guiding the sector's future (rating of high, moderate, low);	1.5.3.1, item D	4 Evaluation and Assessment of Projects: Analysis of Driving the Sector's Future
For each GIF project, provide recommendations on how the project can further contribute to regulatory and policy discussions and/or enhance the broader uptake of the innovative technology and solutions in Ontario;	1.5.3.1, item E	5 Project Specific Recommendations
Provide recommendations on how the GIF can improve its activities to enhance the impact of future GIF investments on driving regulatory and policy evolution and enhance their contribution to the IESO's core strategy to "Drive & Guide the Sector's Future".	1.5.3.1, item F	6 GIF Recommendations
Appendices and data to support the report.	1.5.3.1, item G	7 Appendices

1.2 Profile of GIF Projects

The Grid Innovation Fund, administered by the Independent Electricity System Operator (IESO), is a funding program designed to support innovative projects in Ontario, Canada, which have the potential to achieve significant electricity savings for Ontario ratepayers, either by enabling greater competition in Ontario's electricity markets or by helping customer better manage their energy consumption. The projects that were selected recipients of the GIF in 2017 and 2018 included projects that promoted innovation in the electricity sector, supported the integration of renewable energy, improved grid reliability and flexibility, facilitated the adoption of emerging technologies, reduced energy costs and increased efficiency, engaged stakeholders, and helped in addressing environmental and social goals. Below is a profile of the eight projects which have been analyzed by Guidehouse as part of the GIF Evaluation.

Table 3: Profile of GIF Projects included in Evaluation.

Proponent	Project Title	Summary
Canadian Urban Institute	Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario	As water and wastewater treatment and delivery becomes the single largest energy use for Ontario municipalities, this project provided small-medium municipalities with a tool to enhance visibility into energy consumption in water distributions systems and identify energy efficiency and peak demand reduction opportunities.
NRStor	Local Distributed Energy Resource (DER) Integration and Rental Program Pilot	This pilot demonstrated a rental model for deploying behind-the-meter energy storage in an electrically constrained urban neighborhood. The project explored how this model can make energy storage affordable for homeowners while providing valuable services to the local and provincial bulk electricity system.
Ameresco Canada	John Paul (JP) II Secondary School Carbon Free Microgrid Energy System	Ameresco designed, built, owned, operated, and maintained a carbon-free microgrid at JP II Secondary School in London Ontario. Along with the ratepayer benefits of annual electricity savings and improved electrical resiliency through controlled islanding and ride-through generation during outage conditions, there are also several research questions this project addressed for the IESO related to DERs, telemetry and real-time feeder data.
RWDI	COMPASS: A Benchmarking Tool for Energy Models	This project created a streamlined energy benchmarking and reporting tool for new construction projects at the design stage. By providing market-wide benchmarking analytics, this tool enhanced the quality of modelled energy performance, improved the energy literacy of the design and construction community, improved conservation program delivery and ultimately reduced electricity consumption, energy use and greenhouse gas emissions from every proposed building development.

Proponent	Project Title	Summary
The Atmospheric Fund	Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy	This project evaluated the performance of heat pumps within the context of deep energy retrofits and developed best practice metrics to advance their adoption across the electrically heated multi-unit residential building (EMURB) sector in Ontario. The strategies taken to transform the market for heat pumps included increasing market confidence; verifying performance in real-world environments; identifying and showcasing financing options; and developing a scale-up strategy that identifies and addresses the remaining market barriers.
Toronto Metropolitan University (formerly Ryerson University)	IESO Distinguished Research Fellows	The Centre for Urban Energy (CUE) at Ryerson University established two research fellowships focusing on Energy Storage and Transactive Energy respectively to advance IESO and industry knowledge in these fields.
York University	Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid	York University developed modelling, simulation, and optimization tools to study the integration of battery electric transit and school buses within existing electricity infrastructure and provide recommendations for local electric utilities and bus fleet owners/operators.
GE Digital (formerly Opus One Solutions)	Transactive Energy Network	This project, in collaboration with three Local Distribution Companies, developed and demonstrated the ability to generate locational price signals at the distribution system level to facilitate the economically efficient integration of energy storage, micro grids, smart EV supply equipment, and other resources into the electricity system while protecting local grid reliability.

1.3 Results

The results of the evaluation of the GIF program can be disaggregated into three components: the project's ability to "Drive and Guide the Sector's Future", the program's impact to its proponents, and Their Return on Investment (ROI). The summaries of these three components are as follows:

Table 4: Projects' overall rating towards "Drive & Guide the Sector's Future."

Project	Proponent	Rating	Location in Document
Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario	Canadian Urban Institute	Low (31%)	Table 32
Local Distributed Energy Resource (DER) Integration and Rental Program Pilot	NRStor	High (88%)	Table 33
JP II Secondary School Carbon Free Microgrid Energy System	Ameresco Canada	High (100%)	Table 34
COMPASS: A Benchmarking Tool for Energy Models	RWDI	Moderate (69%)	Table 35
Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy	The Atmospheric Fund	High (97%)	Table 36
IESO Distinguished Research Fellows	Toronto Metropolitan University (formerly Ryerson University)	High (93%)	Table 37

Project	Proponent	Rating	Location in Document
Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid	York University	Moderate (60%)	Table 38
Transactive Energy Network	GE Digital (formerly Opus One Solutions)	Moderate (69%)	Table 39
Suite of Projects	**All Proponents**	**Moderate (76%)**	**Table 40**

Table 5: Impact to the Proponent Matrix Results

Project	To what extent have the GIF projects impacted the growth and financial success of the funded organization?	To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?	To what extent would the GIF project have been affected without securing IESO funding?	Most Likely Scenario Score
Canadian Urban Institute	Low	Moderate	High	**81** (Moderate Impact)
NRStor	Moderate-High	High	Moderate-High	**90** (High Impact)
Ameresco Canada	High	High	Moderate	**85** (Moderate Impact)
RWDI	Moderate-High	High	Moderate	**83** (Moderate Impact)
The Atmospheric Fund	High	High	High	**95** (High Impact)
TMU	Moderate	High	High	**93** (High Impact)
York University	Moderate	Low	Moderate-Low	**70** (Low Impact)

Project	To what extent have the GIF projects impacted the growth and financial success of the funded organization?	To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?	To what extent would the GIF project have been affected without securing IESO funding?	Most Likely Scenario Score
GE Digital	High	Moderate	Moderate	**86** (Moderate Impact)
Suite of Projects (Average Score)	**Moderate**	**Moderate-High**	**Moderate**	**85** (Moderate Impact)

Table 6: Projects' ROI

Project	Proponent	Rating
Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario	Canadian Urban Institute	NA*
Local Distributed Energy Resource (DER) Integration and Rental Program Pilot	NRStor	16%
JP II Secondary School Carbon Free Microgrid Energy System	Ameresco Canada	29%
COMPASS: A Benchmarking Tool for Energy Models	RWDI	28%
Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy	The Atmospheric Fund	51%
IESO Distinguished Research Fellows	Toronto Metropolitan University (formerly Ryerson University)	NA*
Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid	York University	NA*
Transactive Energy Network	GE Digital (formerly Opus One Solutions)	28%

*Please note that three projects generated intangible benefits (as defined in Table 1: Terms and Abbreviations) such as promotion of research. As these types of benefits are not able to be tangibly quantified, they were omitted from the ROI analysis.

1.4 Key Findings and Recommendations

During the evaluation of the GIF program, key findings were found that resulted in recommendations to inform the improvement of the GIF and GIF funded projects.

Table 7: Key Findings and Recommendations.

Key Finding	Recommendation
Demand to further support proponents dealing with policy issues regulatory barriers	Projects were able to contribute to a growing body of research and knowledge to inform the Ontario Energy Sector, and projects' learnings may inform future regulatory and policy decisions, representing a key benefit of the GIF program. To further enable the projects' ability to inform these decisions, IESO may consider providing additional support services to help proponents in dealing with policy and regulatory hurdles such a guidance or training to help navigate nuances.
Need to define and utilize consistent forms of monitoring and evaluating progress	Proponents should define and deliver data on achievement of Key Performance Indicators (KPIs), with clear communication with the IESO on metrics and quantifications of project success. Guidehouse recommends utilizing logical frameworks to define, agree upon, and monitor KPIs and progress. The KPIs created by proponents should be vetted by IESO and expectations regarding their review and measurement of KPIs throughout the project should be clearly communicated to the proponents in the funding agreement or contract.
Many proponents presented output-level data (products and services delivered by their project) but would benefit from extending their scope to demonstrate outcomes (changes in use, attitude, behaviour, or knowledge) because of their projects.	There should be guidance to proponents on what specific metrics the IESO is interested in measure to ensure that the projects can demonstrate tangible outcome-level benefits in practice. Guidehouse also stressed the importance of capturing not only outputs (products, services, and deliverables), but also outcomes (changes in attitude, knowledge, use and/or behaviour) and impacts (system-level, encompassing changes) within logical frameworks.

2 Evaluation plan and methodologies

The following section describes the evaluation plan for Guidehouse's Evaluation of IESO's GIF program. This includes the description of how key areas of analysis were analyzed, outlines which research questions were associated with which section, and provides a description of the methodologies employed to conduct the analysis.

2.1 Impacts to the Ontario Energy Sector & Market Effects

To conduct a comprehensive evaluation of the impact of the eight GIF projects on the Ontario Energy Sector, Guidehouse designed a methodology that encompasses both qualitative and quantitative approaches. This assesses the projects' contributions to addressing energy sector challenges, supporting innovation, influencing discussions on energy transition, and their potential market performance. This part of the evaluation is focused on whether and to what degree the projects contribute towards IESO's "Guide and Drive the Sector's Future" strategy.

Guidehouse's methodology included a mixed methods approach, starting with desk research to understand the specific needs and gaps in the Ontario Energy Sector. This involved reviewing project materials, conducting research to respond to IESO's questions, and developing an Energy Sector Impact Matrix. This matrix used a standardized scoring system to compare different projects, categorizing their contributions based on criteria like technological advancement and regulatory impact. Each project was scored against this index to provide quantitative, evidence-based findings, supplemented by narrative descriptions to rationalize the ratings. Additionally, Guidehouse conducted stakeholder interviews to gather more data, fill information gaps, and add detail to these case studies, especially for projects showcasing significant innovations.

The deliverables from this evaluation included an analysis related to the research questions, findings from the Energy Sector Impact Matrix, a summary of key learnings for sector innovation and advancement, and a series of recommendations on enhancing future projects' contributions to regulatory and policy discussions and the broader uptake of innovative technologies in Ontario.

Table 8 summarizes the different research questions or levels of analyses and identifies a location in the document where the methodology is further explained.

Table 8: Evaluation Methodology Regarding Impacts to the Ontario Energy Sector & Market Effects Research Questions

Research Question/ Level of Analysis	Location in document
What trends and challenges has Ontario's electricity sector faced since 2017? What are the current trends and challenges faced in Ontario's electricity sector today?	2.1.1.1
For each GIF project, identify and describe key learnings that were derived from each of the projects, including technical, regulatory, policy, or other. How are these learnings relevant to the Ontario sector trends and how do they support sector innovation and advancement?	2.1.1.2 and 2.1.1.2.1
For each GIF project, to what extent have project learnings and outcomes informed sector discussions around the energy transition, efficient electrification, enabling resources, regulatory and policy discussions, value of non-wires alternatives, roles of consumers and utilities, and other relevant electricity sector topics?	2.1.1.2.2

Research Question/ Level of Analysis	Location in document
An analysis of (1) how each project has contributed towards driving and guiding the sector's future (rating of high, moderate, low); and (2) how the suite of projects has contributed towards driving and guiding the sector's future (rating of high, moderate, low);	2.1.1.2.3
Identify and describe additional market effects that each of the GIF projects achieved beyond the completion of the project itself. (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.).	2.1.3
For each GIF project, provide recommendations on how the project can further contribute to regulatory and policy discussions and/or enhance the broader uptake of the innovative technology and solutions in Ontario.	2.1.4
Provide recommendations on how the GIF can improve its activities to enhance the impact of future GIF investments on driving regulatory and policy evolution and enhance their contribution to the IESO's core strategy to "Drive & Guide the Sector's Future".	2.1.4

2.1.1.1 Trends and Challenges in Ontario's Electricity Sector

Guidehouse aimed to address the research questions *What trends and challenges has Ontario's electricity sector faced since 2017? What are the current trends and challenges faced in Ontario's electricity sector today?*

To do so, Guidehouse developed sub-questions to address various aspects of these questions, such as the historical analysis of the political, economic, social, environmental challenges; as well as the forward-looking analysis of how these affect us today. The questions were answered through a desk review of relevant literature and resources. Results and findings are shared in section 3.1.1 of this report.

2.1.1.2 Key Learnings for Sector Innovation and Advancement

To distill key learnings, outcomes, and impacts of the projects, Guidehouse developed a couple of tools to probe deeper analysis in the form of an Interview Guide, as well as an Energy Sector Impact Matrix, both explained below.

Interview Guide

To further probe and determine the various accomplishments that were generated because of these projects, Guidehouse developed an Interview Guide which expands on the research questions provided by IESO. One objective of the interview guide was to identify specific outputs (i.e., products, services, and deliverables of the projects such as generating a report or presenting a workshop) as well as the tangible outcomes because of these outputs (changes in skills, attitude, knowledge, or behavior because of the project, such as informing a policy or increasing use of a new technology). The full list of questions included in the interview guide can be seen in 7.4 Interview Guide.

Energy Sector Impact Matrix

The Energy Sector Impact Matrix was developed to implement a standardized scoring system to compare the contributions of different projects. It uses data that was generated through responses from the Interview Guide and has six main criteria (see Table 9). Criteria 1-3 from our matrix directly relate to IESO's corporate strategy *Drive & Guide the Sector's Future*, per the RFS. Criteria 4-6 were added to the Sector Matrix to address additional IESO strategies which were relevant such as *Ensuring System Reliability* by measuring resilience and adaptability of the proponent, considering the evolving needs of the sector (Criteria 4); as well as *Drive Business Transformation* additional market effects that each of the GIF projects achieved beyond the completion of the project itself (Criteria 5) and ability to drive innovation through R&D and cutting-edge technology (Criteria 6).

Table 9: Energy Sector Impact Matrix

Focus	Criteria	Description	Percentage weight of total score
Alignment with "Drive and Guide the Sector's Future"	1. Stakeholder and Indigenous Communities Engagement	Quality and depth of engagement with stakeholders and indigenous communities.	12.50%
	2. Responsiveness to Customer Choice and Policy Changes	2a. Ability to identify and adapt to evolving customer preferences.	6.25%
		2b. Ability to identify and adapt to evolving Policy and Regulatory landscape.	6.25%
	3. Participation and in Sustainable Energy Dialogue	Contribution to discussions and actions shaping the future-state sustainable energy system.	25.00%
Project Impact to the Ontario Energy Sector and Market Advancement	4. Resilience and Adaptability	Ability to cope with changing environments and future threats.	12.50%
	5. Market Effects	Ability to support positive effects to market and sustain project into the future.	25.00%
	6. Innovation and Technology Adoption	Capacity to embrace and utilize new technology.	12.50%
		Total	**100%**

A scoring matrix to categorize contributions was completed to rate each of the projects along six criteria of the matrix, assigning each with a characterization of *high, moderate, low,* or *not applicable*. Each characterization was given the commensurate number of points: Not

Applicable (Points not given)[1]; Low (1); Moderate (3); High (5). Each of the criteria is given a weight (as seen in Table 9) according to its relative importance in the overall assessment.

Guidehouse determined weights to prioritize *Participation and in Sustainable Energy Dialogue* (criteria 3 on attached Energy Sector Impact Matrix, Table 9) and *Market Effects* (criteria 5 on Energy Sector Impact Matrix, Table 9).

The final ratings determined by Guidehouse are based on performance and are complemented with a narrative description of rationale for scoring. A given project can receive between 0-100%. This matrix will be used to provide an assessment of each project, as well as for the suite of projects. The entire matrix including characteristics of Low, Moderate, or High ranking can be seen in Table 41 and Table 42.

2.1.1.2.1 Key Learnings and their Relevance to Sector Trends

After analyzing the trends and challenges in Ontario's Electricity Sector since 2017 (see 2.1.1.1), Guidehouse took findings and applied them to analysis for each of the GIF projects. This was done through a thorough review of questions in the Interview Guide (see 7.4). Through this analysis, Guidehouse distilled key technical, regulatory, policy or other types of learning from each project. Then we reflected on how these learnings could be relevant to the Ontario Electricity sector trends and suggested ways in which they could support the sector's innovation and advancement.

2.1.1.2.2 Key Learning Outcomes and their Ability to Inform Energy Discussions

To determine to what extent the project learnings and outcomes informed sector discussions around the energy transition, efficient electrification, etc. Guidehouse developed questions (see Figure 1) to further probe our analysis and uncover findings about the outcomes of key learnings.

Figure 1: Guiding Questions to Understand Project's Ability to Inform Energy Discussions

Has your GIF project contributed to, been referenced/cited in, or participated in any of the following engagements:

- Referenced or cited in energy policy discussions or documents?
- Highlighted or featured in any news articles or media outlets?
- Presented or discussed at any conferences, seminars, or workshops?
- Have any stakeholders, such as other utilities, regulators, or industry groups, reached out to you directly because of your GIF project?

When possible, Guidehouse researched details of the accomplishments, the ramifications of the engagement in informing energy discussions, etc.

[1] The model did not penalize a characterization of "Not Applicable". When this choice was selected, our model adjusted scores to summarize values against the responses which were validated (i.e. those characterized as Low, Moderate or High which were accompanied by explanations).

2.1.1.2.3 Ability of Projects to Drive and Guide the Sector's Future

To determine how each project has contributed towards driving and guiding the sector's future (rating of high, moderate, low), Guidehouse developed questions (see below) to further probe our analysis and uncover findings about the outcomes of key learnings.

Figure 2: Questions to Determine Projects' Contribution towards Driving and Guiding the Sector's Future

1. Quality and depth of engagement with stakeholders and indigenous communities.
2a. Ability to identify and adapt to evolving *customer preferences*.
2b. Ability to identify and adapt to evolving *Policy and Regulatory landscape*.
3. Contribution to discussions and actions shaping the future-state sustainable energy system.
4. Ability to cope with changing environments and future threats.
5. Ability to support positive effects to market and sustain project into the future.
6. Capacity to embrace and utilize new technology.

When possible, Guidehouse researched details of the accomplishments and their ramifications. Explanations are provided to determine the rating of high, moderate, or low. This was also conducted for the suite of projects.

2.1.1.3 Market Effects

To understand the market effects that each of the GIF projects achieved beyond the completion of the project itself, Guidehouse developed a series of specific yes-or-no questions which we analyzed against each project. These questions were designed to assess several types of market impacts, including:

1. Ability to obtain seed funding or alternative funding sources.
2. Development or use of commercial technology.
3. Creation of job opportunities.
4. Attraction of investment to Ontario.
5. Increase in revenue.
6. Improvement in profit margins.
7. Expansion in the number of customers.
8. Enhancement in brand recognition or reputation.
9. Formation of strategic partnerships or collaborations.
10. Receipt of awards or recognition.

The responses to these questions served as key indicators of each project's influence on the market. Projects that yielded more affirmative answers were interpreted as having a greater market effect. This methodology allowed for a nuanced analysis of how each GIF project contributed to market dynamics, ranging from financial growth to reputational enhancement. The approach was designed to provide a comprehensive understanding of the market impact of each project, thereby enabling a thorough evaluation of their overall effectiveness in the market.

This was complemented by a section that captures any quantitative responses to these various market effects and is highlighted in the results in the section regarding Impacts to the Funded Organization & Additional Market Effects.

2.1.2 Recommendations for Further Contribution to the Sector and Uptake of Innovative Technology

Guidehouse approached the task of providing recommendations for each GIF project with a comprehensive methodology. This approach involved an analysis of project materials, a desk review, and an in-depth analysis of trends in the Ontario Electricity and Energy Sector since 2017. Additionally, where feasible, Guidehouse conducted interviews with proponents to gather more nuanced insights. This multi-faceted approach aimed to provide tailored recommendations to the specific needs and contexts of each project.

For the first inquiry, Guidehouse focused on how each GIF project could further contribute to regulatory and policy discussions in Ontario, as well as enhance the broader uptake of innovative technologies and solutions. The recommendations were grounded in the current state and potential future trajectories of the energy sector in Ontario. By analyzing project materials and sector trends, and supplementing this with insights from stakeholder interviews, Guidehouse identified key areas where each project could have a more significant impact. Many of the recommendations generated focus on how the projects can align more closely with ongoing policy discussions and identified opportunities for projects to serve as exemplars or catalysts for broader technological adoption within the sector.

Further, Guidehouse provided strategic recommendations on how the GIF could enhance the impact of its future investments. These recommendations were aimed at driving regulatory and policy evolution in line with the Independent Electricity System Operator's (IESO) core strategy to "Drive & Guide the Sector's Future." Guidehouse's analysis considered the performance of the entire suite of GIF projects, their outcomes, and the challenges they faced. This helped in identifying patterns and lessons that could inform future investment strategies. The focus for this level of analysis was reflecting on the challenges faced by many or all projects in the portfolio to present actionable recommendations for IESO.

2.2 Impacts to the Funded Organization

The purpose of this analysis is to understand the likelihood of expanding from pilot to scale, or, whether the projects have successfully scaled/made tangible plans to scale. Guidehouse focused on evaluating whether each of the GIF projects' activities has driven new business models or has implementation of novel approaches to technologies.

Key research questions that analyze the projects' financial successes, ability to drive new business models or technologies, and the likelihood of success were analyzed using the Impact to the Proponent Matrix. Guidehouse employed Scenario Analysis Modelling to determine possible scenarios.

2.2.1 Scenario Analysis Modelling

To allow consistent and thorough analysis of the question *"To what extent would the GIF project have been affected without securing IESO funding? Quantify, where possible."*, Guidehouse employed the following methodology:

Standardized Scoring System: Guidehouse created a scoring matrix with criteria like "Financial Success" and "Driving New Business Models" in the Impact to Proponent Matrix (see 7.3). The projects were ranked on three main criteria:

1.1. To what extent have each of the proponents impacted the growth and financial success of the funded organization including the perceived ability that the project will be sustained into the future, and ability to secure achievements beyond the completion of the project itself.

1.2. To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?

1.3. To what extent would the GIF project have been affected without securing IESO funding and in what degree of instances was the GIF project was able to accomplish following benefits:

- 1.3.1. Obtain seed funding.
- 1.3.2. Commercialize technology.
- 1.3.3. Create jobs.
- 1.3.4. Attract investment to Ontario.
- 1.3.5. Increase revenue.
- 1.3.6. Improve profit margins.
- 1.3.7. Increase number of customers.
- 1.3.8. Gain brand recognition or reputation.
- 1.3.9. Lead to strategic partnership or collaboration.
- 1.3.10. Receive awards or recognition.

A description of how the eight proponents' projects were scored, their rating, and the rationale for weighting are described in Table 12.

Scenario Construction and Analysis: For each project, Guidehouse tested multiple future scenarios based on the data collected and insights from the ex-post interviews. Scenarios include Best Case, Average Case, and Worst Case to develop a final Most Likely scenario. This model is based off a multi-scenario analysis tool developed by Damodaran. [2]

First, the model considers the ratings under three different criteria based on the industry and context. The model Guidehouse employed uses the three criteria explained above, based around the requested areas of analysis from IESO.

Table 43 explains the criteria and possible characterizations (either High, Medium, or Low degree of change/impact).[3]

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[2] (Damodaran, 2007)

[3] Note that one sub criterion is not based on a High, Medium or Low characterization, but instead considers the number of tangible and intangible benefits generated by the project, reflected as the share of benefits observed over all possible benefits. For this score, the numerator of benefits observed, denominator all possible benefits. While the model accounted for 10 possible benefits, if the realization of a given benefit for a project was unknown, it did not negatively impact the score.

Table 10: Scenario Probability for Impact to the Proponent Matrix

Scenario	Probability	Final Score (Probability x Score)
Best Case Scenario	25%	Best Case Probability x Score
Average Case Scenario	50%	Average Case Probability x Score
Worst Case Scenario	25%	Worst Case Probability x Score
Most Likely Case	**100% (sum of all scenarios)**	**Sum of Best, Averages, and Worst-Case Scenario probabilities multiplied by their scores**

Weighting and Aggregation: The model assigned weights to the criteria based on their importance to the project's success and the goals of the GIF program (seen in Table 9). These weights are standardized across all projects. Scores were aggregated for each criterion to produce a total score for each scenario based on their probabilities (seen in Table 10). This total score represents the project's overall performance or impact in the most likely scenario, and therefore the model allows for values ranging from zero to 100 points. Table 11 explains the different thresholds that determine the final scores, based on a bell-curve rating across projects.

Table 12 also explains how many points could be allotted to each characterization, the weight of their final score, and the rationales for their weighting. Please note that a given project could include any combination of characterizations across the three different criteria, depending on their characterizations on the interview guide.

Secondly, the model considers the probability that each of those scenarios would be actualized, which are described in Table 10 and based on the multi-scenario analysis used by Damodaran.[4] That model offers a 25% probability of the best case, 50% probability of the average case, and 25% probability of the worst case, adding to 100%. The score from Table 12 is multiplied by each scenario probability, and the output (the most likely scenario) is the sum of the three cases.

Table 11: Threshold to Determine Degree of Impact from Proponent Impact Matrix

Degree of impact	Lower Threshold	Upper Threshold
High Impact	90 points	100 points
Moderate Impact	80 points	90 points
Low Impact	0 points	80 points

Comparative Analysis and Ranking: The scores are compared across the projects to rank them relative to each other. This comparison, which is explained in greater detail in the results section of the report (Impacts to the Funded Organization & Additional Market Effects) compares the projects' results in the most likely scenario.

[4] (Damodaran, 2007)

Table 12: Possible points allotted to each criterion on Impact to the Proponent Matrix

Criterion	To what extent have the GIF projects impacted the growth and financial success of the funded organization and its what is the project's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself?	To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?	To what extent would the GIF project have been affected without securing IESO funding, and in what degree of instances was the GIF project was able to accomplish benefits? [5]	Total Weight/ Total Score
Weight → Description ↓	30%	15%	55%	100%
Description of how scoring is conducted and rationale for weight.	Guidehouse rated each project as either High, Moderate or Low degree of change or impact in (1) their ability to drive new business model (question 5.12 in Interview Guide) given 10% of weight, and (2) perceived ability to sustain funding and benefits in future (question 5.16 in Interview Guide), given 20% of weight. Combined, these contribute to 30% weight of total score.	Guidehouse rated each project as either High, Moderate or Low degree of change or impact in their ability to drive new business models or implementation of novel approaches to technologies (question 6.2 in Interview Guide) given 15% of weight of total score. This was given less weight than the other criteria as the next criteria also partially addresses new business models as possible benefit.	This section was given the highest weight in share of points because it covers a variety of tangible (quantifiable) and intangible (important, but unquantifiable) benefits. This criterion is based on: (1) whether the project would have been affected without securing IESO funding, characterized as High, Moderate or Low degree of change/impact (question 5.15 in the Interview Guide) and was given 30% of score and (2) how many types of benefits the project was able to secure (question 5.1-5.10 in the Interview Guide), which was given 25% weight. In total, this section comprised 55% of the total score.	**N/A**
Range of possible points for *High Change*	22.5 - 30	11.25 - 15	41.25 - 55	**75 - 100**
Range of possible points for *Moderate Change*	15 - 22.5	7.5 - 11.25	27.5 – 41.25	**50 - 75**

[5] The 10 tangible or intangible benefits considered in our model include: obtain seed funding/alternative funding; commercialize technology; create jobs; attract investment to Ontario; increase revenue; improve profit margin; increase number of customers; gain brand recognition or reputation; lead to strategic partnerships or collaboration; receive awards or recognition. They were characterized as Yes (the benefit was realized), No (the benefit was not realized) or Unknown (unable to determine whether the project was able to realize the given benefit).

Range of possible points for *Low to No Change*	0 - 15	0 – 7.5	0 – 27.5	**0 - 50**

2.3 Return on Investment

Guidehouse's approach to measuring the benefits of GIF projects for ROI analysis was tailored to the unique aspects of each project. Recognizing the challenge in quantifying tangible benefits in financial terms, Guidehouse developed a robust methodology to address this.

Firstly, Guidehouse conducted an extensive analysis of the types of benefits represented by each GIF project. This step was crucial in understanding the diverse range of benefits, such as greenhouse gas (GHG) emissions reduction, deferral of grid infrastructure investments, and avoided costs. Each of these benefits, while not directly financial, has significant implications for the financial performance and value of the projects. Guidehouse refers to these types of benefits as tangible benefits.

Once the types of benefits were identified, Guidehouse selected a subset of methodologies that could effectively translate these tangible benefits into quantifiable financial measures. This selection process was critical to ensure that the methodologies applied were appropriate and relevant to the specific benefits of each project. For instance, for benefits like GHG emissions reduced, Guidehouse employed Social Cost of Carbon to measure the societal benefits related to the GHG emissions attributed to the project.

Guidehouse then applied these methodologies to each project to calculate an ROI. This involved a detailed process of assigning monetary values to the identified benefits. Depending on the data that was available and the scope of benefits, this sometimes resulted in stacking different categories of benefits. In each case, Guidehouse provided a detailed description of the metrics used, explaining why these metrics were relevant and how they related to the intended outcomes of the projects.

Intangible benefits, which Guidehouse has defined as benefits from the project which cannot be translated into a financial value such as contribution to research, were also considered in the analysis. Other sections of this report account for some of these intangible benefits (such as market effects which are captured in ratings in Impacts to the Funded Organization & Additional Market Effects . When relevant, these intangible benefits are also listed in Detailed Explanation of ROI Findings for GIF projects.

2.3.1 ROI Formula and Scaled Variable for Innovation

ROI was conducted for all projects that could measure tangible benefits. The equation below represents the general formula that was used to capture the different types of tangible benefits for each of the GIF projects.

Equation 1: Return on Investment for Tangible Benefits

$$\frac{\left(Tangible\ Benefits + (Scaled\ Variable \times Tangible\ Benefits)\right) - IESO\ Investment}{IESO\ Investment}$$

Equation 1: Return on Investment for Tangible Benefits is an adjusted formula and adds the value of the ripple effects of innovation (as a proportion of the tangible benefits) to the original ROI calculation. The value labeled **IESO Investment** represents the amount of funding provided by the IESO to a given GIF project. The **scaled variable** represents the ratio of the ripple effects of innovation caused by the projects to the **tangible benefits**.

The **scaled variable** is determined by an Innovation Readiness Level (IRL), a model which was developed by Carl-Magnus Lunner and Emelie Worrmann.[6] Their model is an extension of the Technology Readiness Model developed by NASA in 1990. Lunner and Worrmann's model expands on the technological readiness of NASA's model to include business and user readiness respectively. IRL is calculated by taking an average of the three scores for Technology Readiness Level (TRL), Business Readiness Level (BRL) and User Readiness Level (URL). Table 13 explains how the levels (1 through 9) apply to each TRL, BRL, and URL. Guidehouse has used IR to measure the ripple effects of innovation caused by the projects as the final **scaled variable** in Equation 1.

Table 13: Innovation Readiness Levels Model

Readiness Level	Technology Readiness Level (TRL)	Business Readiness Level (BRL)	User Readiness Level (URL)
1	Basic principles observed and reported – Scientific research has indicated an opportunity to develop a new technology. This has evolved to applied research and development.	Business Opportunity Identified	Opportunity Identified
2	Technology concept and/or application formulated	Strategic Fit Verified	User Segment Identified
3	Analytical and experimental critical functions and/or characteristic proof-of-concept – The most critical functions of the new technology have been validated through simulation and concept development.	Ideas Generated and Selected	User Needs Observed
4	Component and/or breadboard validation in a laboratory environment – The concept has been tested to assure that the technical elements can be integrated together and achieve the desired performance, at a component and/or breadboard level. A product specification is formulated.	Business Case Development and Testing	Ideas Generated
5	Component and/or breadboard validation in relevant environment – The components making up the concept have been identified and are tested individually in a realistic environment.	Supply Chain Established	User Desirability Verified Using Low-Fidelity Prototypes
6	System/sub-system model or prototype demonstration in a relevant environment – A complete model or prototype of the concept, is tested in a relevant environment to validate system functionality.	Value Chain Established	Promising Concepts Identified Through User Tests
7	System prototype demonstration in the planned operational environment – A prototype is tested in the environment in which the final product will operate.	Sales Method Determined	User Desirability Verified Using High-Fidelity Prototypes in Planned Environment

[6] (Worrmann, 2018)

Readiness Level	Technology Readiness Level (TRL)	Business Readiness Level (BRL)	User Readiness Level (URL)
8	Actual system completed and "qualified" through test and demonstration in operational environment – The technology is built to the specifications of the final product and is tested in the operational environment alongside all systems it will interact with. All questions surrounding production, logistics, and sales have been resolved.	Business Case Verified	User Desirability Verified through Large Scale Testing
9	Actual system proven through successful system and/or mission operations – At this level all technology development has been completed. The product is sold through the intended channels and performing as intended in the real-world environment.	Business Case Proven through Successful Product Launch	User Desirability Proven through Successful Product Launch

Tangible benefits are summarized with a dollar value using the methodologies (see Table 14) and **scaled variables**. Guidehouse has calculated the benefits of the entire project (rather than the fraction of the project that was supported by IESO).

2.3.2 Assumptions

Due to the nature of the projects and the availability of data, it was necessary to employ a couple of important assumptions which underpin the ROI model for this evaluation. These assumptions were taken into consideration and applied across the suite of projects to conduct ROI of these tangible benefits in a consistent manner.

1. **Net Benefits:** Traditional ROI methodologies consider the net benefits after costs of investment, such as capital and operational costs, amongst other factors. The methodology employed in this model uses the IESO's investment in each of the projects as the measure of the cost. This approach was utilized in lieu of more traditional cost data (such as capital and operational costs), to analyze across the suite of projects.
2. **Timeframe:** In this analysis, Guidehouse has uniformly assumed a timeframe of four years for each project unless otherwise stated (i.e., if there was proof that suggested benefits were realized in a shorter period). The four-year duration was selected based on the traditional length observed in similar types of projects and average length of contracts for GIF projects. This approach was adopted to maintain consistency in the evaluation considering the varying timeframes of pilots, demonstrations, or trials where benefits were measured, as well as the limited data available for measuring the generation of benefits across different projects.
3. **Scaled Variable:** As described above, a scaled variable was added to the ROI formula to capture the ripple effects of innovation of each project. Guidehouse employed the Innovation Readiness Level model to discern a scaled variable for each project.

2.3.3 Methodologies to Measure Tangible Benefits

Please see table below which elaborates on the methodologies employed to measure ROI for the Suite of Projects. Appropriate methodologies were applied on a project-by-project basis, depending on the nature of the given project and the data available to support the relevant formula.

Table 14: Methodologies for Measuring Tangible Benefits of GIF Projects

Tangible Benefit	Methodology and Formula	Description	Variable Letter	Variable Name/Description	Unit of Measure
GHG Reductions	Social Cost of Carbon (SCC)[7] = $\int_{t=0}^{T} \frac{D_t E_t}{(1+r)^t} dt$	Uses 2023 constant dollars and provides (for illustrative purposes) a comparison of the cost of carbon, the federal backstop price of carbon, and the avoided cost of gas, all in common units ($/m3).	$D_t(E_t)$	Represents the function of avoided damages (due to decreased emissions) at the time t, which calculates the economic damage caused by an additional ton of CO2 emitted at time t. This damage is a function of the Emissions level Et	#
			r[8]	Discount Rate: Reflects the present value of future damages	2%
			T[9]	The time horizon over which the damages are calculated.	#
Uptake of New Tool or Technology	**Revenue Generation** (Total Energy Savings) = ((A-B) *C)*D	Calculation of expected revenue from new technology by calculating the net revenue considering different streams, and forecast using historical data,	A	Energy Cost Before Implementation[10]	CAD
			B	Energy Cost After Implementation (or expected cost)[11]	CAD
			C	Total number of units (or expected number of units)	#

[7] This formula is highly simplified, the actual calculation of SCC involves additional complex models and numerous variables such as projected economic growth, population growth, etc. Due to lack of resources in this project (time, data) we will be conducting a simplified version demonstrated here.

[8] r is a decimal value representing the real discount rate (i.e., 2% would equate to 0.02 in the formula; Guidehouse will apply 2% Near-term Ramsey discount rate).

[9] The integral sums of these discounted damages are over the chose time horizon.

[10] Unless stated in proponents' documents, energy costs were based off figures from IESO.

[11] Unless stated in proponents' documents, energy costs were based off figures from IESO.

Tangible Benefit	Methodology and Formula	Description	Variable Letter	Variable Name/Description	Unit of Measure
		market analysis, or customer feedback. Adjust to the given timeframe of the project.	D	Time Period	# years
Deferral of Grid Infrastructure / Improved DER Integration	**Levelized Cost of Avoided Capacity** = (A)/(B)	Estimate the costs that would have been incurred if the grid infrastructure had to be upgraded or expanded.	A	Total Deferred Capacity Costs (total costs associated with the capacity that would have been added to the grid)	CAD
			B	Total Capacity Avoided (the amount of capacity [in kWh] that the grid did not need to add due to the DER integration)	kWh
	Net Present Value (NPV) of Deferred Infrastructure Costs= $\sum_{t=1}^{n} \frac{Defferred\ Cost_t}{(1+r)^t}$	Financial metric used to assess the value of postponing investments in infrastructure projects. It calculates the present value of cost savings achieved by delaying these expenditures, considering the time value of money through a discount rate.	Deferred Cost	Deferred Capacity Costs (total costs associated with the capacity that would have been added to the grid)	CAD
			t	Year in which the cost would have been incurred	#
			n	Number of years over which the deferral is considered	#
			r	Discount rate, reflecting the time value of money	2%[12]
	Cost-Benefit Analysis (CBA) of DER Integration = A - B	Projects the benefit of the DER integration/ deferral of grid infrastructure from a cost basis.	A	Total Benefits (reduced energy costs, avoided grid infrastructure costs, and any other financial benefits from DER integration)	CAD[13]
			B	Total Costs	CAD
			A	Peak Demand Reduction	kWh

[12] r is a decimal value representing the real discount rate (i.e., 2% would equate to 0.02 in the formula; Guidehouse will apply 2% Near-term Ramsey discount rate).
[13] Unless stated in proponents' documents, energy costs were based off figures from IESO.

Tangible Benefit	Methodology and Formula	Description	Variable Letter	Variable Name/Description	Unit of Measure
Reduced Energy Consumption and Reduced Emissions	**Emission Reduction from Peak Demand Reduction** = (A*B) *C	Expresses the monetary value of money saved by reducing emissions during peak demand.	B	Emissions Factor	Tonnes of CO^2 equivalent emissions/kWh
			C	Cost per Tonne of CO2-equivalent	CAD[14]
	Avoided Energy Costs= (A)*(B)	Estimate the costs that would have been incurred if status quo was used, and what was actually incurred by the technology or tools utilized by the project.	A	Avoided Energy Generation	kWh[15]
			B	Cost of Energy Generation	CAD[16]

[14] Based on values from Government of Canada.
[15] Estimated based on the capacity of the tools/technology relevant to the proponent's project, and their utilization rate according to Ontario Energy Board.
[16] Includes fuel costs, operation, maintenance, capital costs, and any other variable or fixed costs associated with energy production; Unless stated in proponents' documents, energy costs were based off figures from IESO.

3 Results

In this section of this evaluation report, we present a thorough analysis addressing key questions related to the suite of projects funded under the initiative. This analysis is structured to provide a clear overview and is tailored to meet the needs of IESO.

First, section 3.1 summarizes the impacts these projects have had on the Ontario energy sector. This part of the analysis focuses on how the projects have influenced sector dynamics, contributed to its growth, and addressed specific challenges within the energy landscape of Ontario.

Secondly, in section 3.2 we examine the impacts on the organizations that received funding. Here, we assess how the funding has influenced their operational capacities, project outcomes, and overall organizational development, as well as market effects of the projects. This section aims to provide insights into the effectiveness of the funding in achieving its intended goals within these organizations. This also provides a ranking of High, Moderate, or Low degree of impact.

Lastly in section 3.3 we delve into an analysis of the Return on Investment (ROI). This crucial aspect evaluates the tangible benefits generated by the projects relative to the investments made. The ROI analysis is designed to offer a comprehensive understanding of the efficiency and value generated by the funded projects, which provides insight into their financial viability and long-term sustainability.

3.1 Impacts to the Ontario Energy Sector

In this section, we answer the research questions (see Table 15) based off section 1.5.2.1 of the RFS.

Table 15: Evaluation Results for Impacts to the Ontario Energy Sector Research Questions

Research Question	Location in document
a) What trends and challenges has Ontario's electricity sector faced since 2017? What are the current trends and challenges faced in Ontario's electricity sector today?	3.1.1 and sub-questions listed in Table 16
b) For each GIF project, identify and describe key learnings that were derived from each of the projects, including technical, regulatory, policy, or other. How are these learnings relevant to the Ontario sector trends and how do they support sector innovation and advancement?	3.1.2
c) For each GIF project, to what extent have project learnings and outcomes informed sector discussions around the energy transition, efficient electrification, enabling resources, regulatory and policy discussions, value of non-wires alternatives, roles of consumers and utilities, and other relevant electricity sector topics?	3.1.2
d) Identify and describe additional market effects that each of the GIF projects achieved beyond the completion of the project itself. (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.).	3.2

3.1.1 Trends and Challenges in Ontario's Electricity Sector

To answer the research questions *What trends and challenges has Ontario's electricity sector faced since 2017? What are the current trends and challenges faced in Ontario's electricity* *sector today?* Guidehouse has broken down the questions into themes and sub-questions illustrated in Table 16.

Table 16: Impacts on Ontario Energy Sector Themes and Sub-Questions

Theme	Sub-Questions
Historical Analysis	How have the production sources in Ontario's electricity sector evolved since 2017?
Infrastructure and Technological Trends	How has the condition and capacity of Ontario's electrical infrastructure changed since 2017, and what factors have driven these changes?
Economic Analysis	What have been the economic impacts of shifts in Ontario's electricity production and consumption?
	How have electricity prices in Ontario changed since 2017, and what factors have contributed to these changes?
Environmental Impact	What role has environmental policy played in shaping Ontario's electricity sector since 2017?
	How have changes in the electricity sector impacted Ontario's environmental goals and carbon footprint?
Regulatory and Political Challenges	What regulatory challenges has Ontario's electricity sector faced since 2017, and how have these challenges been addressed?
Social Considerations	How have changes in the electricity sector affected different communities in Ontario, particularly marginalized or rural communities?
	What initiatives have been taken to ensure equitable access to electricity across Ontario?
Future Outlook	Considering current trends, what are the potential future challenges for Ontario's electricity sector?
	What strategies are being implemented to ensure the sustainability and reliability of Ontario's electricity supply in the face of these challenges?

3.1.1.1 Historical Analysis

How have the production sources in Ontario's electricity sector evolved since 2017?

Since 2017, there have been varied changes across the board in production sources of Ontario's electricity sector. While some sources have remained largely stable, other have witnessed notable changes. Hydro has maintained approximately 26% of the energy mix from 2017 to 2022, going from 26% in 2017 to 25.9%, approximately 38 TWh (see Table 17).

Table 17: Change in the Energy Mix of Ontario's Electricity Grid

	2017		2022		
Source	TWh	Share of energy Mix	TWh	Share of energy Mix	Percentage Change in TWh
Nuclear	90.6	63%	78.8	53.7%	-13%
Hydro	37.7	26%	38	25.9%	~0%
Gas/Oil	12.7	9%	15.2	10.4%	+20%
Wind	9.2	6%	13.8	9.4%	+50%
Biofuel	0.4	<1%	0.3	<1%	-25%
Solar	0.5	<1%	0.75	<1%	+25%

The energy mix in Ontario's grid has seen varied changes from 2017 to 2022. Biofuel's contribution decreased from 0.4 TWh to 0.3 TWh, a 25% reduction, while solar energy increased from 0.5 TWh to 0.75 TWh, a 50% rise. Both biofuel and solar continue to constitute less than 1% of the energy mix. Wind energy experienced a significant increase, rising from 6% (9.2 TWh) in 2017 to 9.4% (13.8 TWh) in 2022, marking a roughly 50% increase. Nuclear energy, the largest source for electricity generation in Ontario, saw a decrease from 63% (90.4 TWh) in 2017 to 53.7% (78.8 TWh) in 2022.[17] Gas and oil usage rose from 4% (5.9 TWh) in 2017 to 10.4% (15.2 TWh) in 2022, approximately a 250% increase, though it should be noted that 2017 was an atypical year. Compared to 2016, when gas and oil made up 9% (12.7 TWh) of the energy mix, their share increased by nearly 20% by 2022.

3.1.1.2 Infrastructure and Technological Trends

How has the condition and capacity of Ontario's electrical infrastructure changed since 2017, and what factors have driven these changes?

Ontario has put together a Hydrogen Strategy Working Group in 2022 to explore the possibilities of a low-carbon, hydrogen-based economy for the province’s future. The working group has identified hydrogen hub communities in the province, where low-carbon hydrogen demand can be matched with low-carbon hydrogen production by leveraging existing electricity infrastructure. Another key result of this working group’s is the development of a Hydrogen Interruptible Electricity Rate pilot that would offer large consumers reduced rates for reduced consumption during local or system reliability events. The recently announced IESO second long-term procurement (LT2) is focused on non-emitting generation. Over the next 4-6 years, the IESO expects to run a regular cadence of procurements, with LT2 looking to add approximately 2000 MW of energy-producing resources. That LT2 is supported by the same government which repealed the Green Energy Act is emblematic of a significant change in policy and a clear, bipartisan path forward in Ontario for renewables.[18] The Zero Emission Vehicle Infrastructure Program (ZEVIP) is a $680 million initiative by NRCan to provide funding towards deployment of electric vehicle (EV) chargers and hydrogen refueling stations across Canada.[19] Initialized in 2019 with $280 million and recapitalized with an additional $400 million in 2022, this program promises to address a key barrier in zero-emission vehicle (ZEV) adoption in Canada, a lack of refueling stations, and lead to an increase the electricity demand in the province.[20]

There have also been key technological developments that have helped push the needle on the energy transition in Ontario. These have particularly focused on the increased adoption of Distributed Energy Resources (DER). Software companies developing integrated DER Management Software (DERMS) have helped provide more control to operators to integrate and optimize various DERs in their system for maximum environmental and economic benefit. The growing popularity of Energy Storage as a Service (EaaS) has allowed facilities to enter into a service agreement for energy storage and energy management systems without needing to purchase the entire system upfront. This has increased uptake of energy storage, which

[17] IESO (2023) *Supply Overview, Transmission-Connected Generation* website: https://www.ieso.ca/en/Power-Data/Supply-Overview/Transmission-Connected-Generation

[18] (IESO, 2023)

[19] (Natural Resources Canada, 2023)

[20] (Natural Resources Canada, 2023)

helps stabilize the electricity grid and reduce its carbon intensity. Finally, the growing adoption of EVs, as well as electrification in general, is notable for increasing customer demand. This trend has been caused by both customer choices as well as government promotion and will continue to impact the amount of generation capacity needed. Finally, the growing adoption of EVs, as well as electrification in general, is notable for increasing customer demand. This trend has been caused by both customer choices as well as government promotion and will continue to impact the amount of generation capacity needed.

These factors have been reflected in Ontario's long-term demand forecasts. Since 2017, these forecasts have started to show needs arising in terms of capacity and energy, with the IESO's 2022 annual acquisition report showing a need for more than 8000 MW of capacity in 2029 to handle increased demand (IESO, 2022). The IESO has made several infrastructure acquisitions to acquire this capacity, issuing an RFP to secure medium term commitments, with more long-term RFPs to forthcoming. The RFPs underway or recently completed include: the medium-term RFP, the long-term 1 RFP and LT1 expedited process (the latter which successful projects were announced in 2023). As an additional measure, the IESO has planned for growth of the capacity auction from 1200 MW to 1800 MWs of target capacity in the summer and 750 MW to 1400 MW in the winter.

3.1.1.3 *Economic Analysis*

How have electricity prices in Ontario changed since 2017, and what factors have contributed to these changes?

Table 18: Change in Electricity Prices in Ontario[21, 22]

Electricity Rate	2017	2023
HOEP	1.58 ¢/kWh	2.95 ¢/kWh
GA	9.97 ¢/kWh	7.17 ¢/kWh
TOU On-Peak[23]	15.7 ¢/kWh	18.2 ¢/kWh
TOU Mid-Peak	11.3 ¢/kWh	12.2 ¢/kWh
TOU Off-Peak	7.7 ¢/kWh	8.7 ¢/kWh
Ultra-Low Overnight Night	N/A	2.8 ¢/kWh
Ultra-Low Overnight On-Peak	N/A	28.6 ¢/kWh
Ultra-Low Overnight Mid-Peak	N/A	12.2 ¢/kWh
Ultra-Low Overnight Weekend Off Peak	N/A	8.7 ¢/kWh

The total annual Ontario energy demand has gone from 137.4 TWh to 137.6 TWh[24] from 2017 to 2022, staying mostly stable over the 5-year period, notwithstanding dips in demand from 2019 to 2021 due to the COVID pandemic. This increase in demand has been a factor in the

21 (Independent Electricity System Operator (ieso.ca), 2023)
22 (Ontario Energy Board, 2023)
23 (Ontario Energy Board, 2023)
24 (IESO, 2023)

increasing HOEP and time of use rates, while the ICI rate freeze[25] that was put into place in 2020 partially explains the decrease in the Global Adjustment charges facing larger customers.

Time of use rates were held to the rate of inflation by the Fair Hydro Act of 2017 until 2019 when the Ontario Electricity Rebate program was instituted instead. The provincial government then raised prices for both residential and industrial customers in 2019, before slashing and freezing them in 2020 in response to the pandemic. From 2020-2017 TOU rates were intermittently raised and fixed in response to various COVID-19 policies as well as provincial legislation. Post COVID the TOU rates settled at a higher price in response to the rising cost of generation. Finally in 2023 the Ontario Government established the Ultra-Low Overnight electricity price which provides a lower overnight rate in exchange for a higher peak rate. This price was aimed at customers that use more electricity at night such as shift workers.

The HOEP has also risen in parallel with the cost of generation. Ontario's prime source of energy is Nuclear and as plants get shut down due to reaching end of life, higher cost sources of generation will be forced to fill the gap.

3.1.1.4 Environmental Impact

What role has environmental policy played in shaping Ontario's electricity sector since 2017?

The Greenhouse Gas Pollution Pricing Act, as its name implies, allowed the national government to set a price on greenhouse gas emissions. This act shall help stimulate investments and innovation in the novel clean technologies as financiers and private corporations have an economic incentive to cut down on their greenhouse gas emissions. The Clean Fuel Standard (CFS), passed in 2022, is a forward-looking federal legislation that aims to reduce greenhouse gas emissions by 30 million tonnes by 2030. This is aimed to be achieved by requiring suppliers of various hydrocarbons in the Canadian market (refiners, importers, etc.) to reduce the overall lifecycle carbon intensity of those fuels. The costs to the oil and gas industry because of CFS are estimated to be approximately $1-2 billion annually, which, when passed down the customer, further incentivizes switching to clean energy fuels to power the province's electric grid.

Other important policy initiatives include Ontario's Clean Energy Credit Registry as well as the Hydrogen Innovation fund. The Clean Credit Registry is a program administered by the IESO to issue certificates for corporations and other entities in recognition of their ability to source clean energy generation. These certificates help entities reach corporate sustainability goals, and incentivize them to look for clean energy alternatives, such as wind and solar. The Hydrogen Innovation Fund was implemented by the IESO to fund the exploration of emerging technology to determine if and how hydrogen resources can support reliability in the sector. It has invested in several different types of short-term projects including production of hydrogen from electricity, electricity generation from hydrogen, and support for the hydrogen economy. The Hydrogen Innovation Fund was implemented by the IESO to fund the exploration of emerging technology to determine if and how hydrogen resources can support reliability in the sector. It has invested

[25] (Ontario, 2020)

in several different types of short-term projects including production of hydrogen from electricity, electricity generation from hydrogen, and support for the hydrogen economy.

How have changes in the electricity sector impacted Ontario's environmental goals and carbon footprint?

As policymakers look at alternative, low-carbon fuels such as hydrogen, as evidenced through the various provincial and national hydrogen strategy groups, gas utilities are considering the adoption of such alternative technologies themselves. The production of green hydrogen could be an opportunity for these utilities as it could provide an alternative fuel source to gas, consequently requiring a drastic change in the use of natural gas pipeline infrastructure to serve different types of customers.

Given the low carbon profile of Ontario's electricity system, which is already 95% carbon free, near-term opportunities to drive down GHG emissions are most likely to come from transportation and building electrification.

3.1.1.5 Regulatory and Policy Challenges

What regulatory challenges has Ontario's electricity sector faced since 2017, and how have these challenges been addressed?

Since 2017, the Ontario electricity sector has faced several regulatory and policy challenges, including:

1. **Market Reform and Modernization:** Efforts to modernize the electricity market to improve efficiency and integrate renewable energy sources have been ongoing, with demand set to rise by 62% by 2035 to support province-wide electrification.[26] This includes addressing the challenges of managing a grid with a growing proportion of intermittent renewable energy sources. As per a report by the Canadian Climate Institute, the electricity system will need to increase its capacity by two or three times by 2050, approximately 75% of which would need to come from intermittent renewable sources of energy like solar and wind.[27, 28] Furthermore, more battery storage and peak demand management will also be necessary because of mass electrification.[29]
2. **Carbon Pricing and Climate Change Policies:** Ontario has grappled with how to integrate carbon pricing into its energy policy, particularly in the context of federal climate change initiatives. This has involved balancing environmental goals with economic impacts.
3. **Electricity Pricing and Affordability:** Managing electricity prices while ensuring the financial sustainability of the electricity sector has been a challenge. This includes addressing the high costs of electricity for consumers and businesses. With a growing demand for increased

[26] (Toronto Atmospheric Fund, 2022)
[27] (Canadian Climate Institute, 2022)
[28] (Canadian Broadcast Corporation (CBC), 2022)
[29] (Canadian Broadcast Corporation (CBC), 2022)

customer choice, the OEB's Regulated Price Plan, enacted as of November 1, 2020, proposed tiered energy pricing options for electricity and gas service in the province.[30] This change has helped provide the customer a greater feeling of autonomy in their energy decisions, which is integral to furthering the cause of energy equity.

4. **Infrastructure Investment and Grid Reliability**: Ensuring adequate investment in electricity infrastructure to maintain reliability while transitioning to more sustainable energy sources has been a key focus.
5. **Regulatory Adjustments for Technological Advancements:** Adapting regulations to keep pace with technological advancements in the energy sector, such as energy storage and smart grid technologies, has been necessary.

To address these challenges, the Ontario government and regulatory bodies have implemented various measures, including policy reforms, adjustments in market rules, investment in infrastructure, and initiatives to promote renewable energy and energy efficiency. However, the specifics of these measures and their effectiveness can vary and are subject to ongoing debate and adjustment.

The IESO'S Market Renewal Program is a great example of one such province-wide initiative. The purpose of MRP is to enhance the efficiency of Ontario's electricity markets. Through the MRP, the IESO has enforced some market changes. Firstly, the IESO will replace the two-schedule market with a single schedule market (SSM), thereby eliminating the out-of-market payments by removing misalignments between dispatch and prices.[31] MRP also introduced a day-ahead market (DAM) that ensures that only the resources required to meet system needs are committed, thus increasing the IESO's operational certainty as well as the market participants' financial certainty.[32] Finally, through the enhanced real-time unit commitment (ERUC) initiative, the MRP hopes to reduce costs of scheduling and dispatching resources by allowing market participants to do so in real-time.[33]

Another such Ontario-wide initiative is the OEB's Innovation Sandbox Challenge, which supports projects that advance the Ontario energy sector's understanding of how innovative technologies can benefit customers. Till date, they have provided $1.5 million to six such projects, along with regulatory guidance. The challenges posed to winners of the Innovation Sandbox's funding are focusing on how pilot projects can be scaled successful and helping customers grasp their role in the energy transition through innovative strategies. In 2021, the OEB Innovation Sandbox joined in a partnership with the IESO Grid Innovation Fund on a call with an eye towards new and innovative proposals in the DER space. Accepted projects were provided funding by the IESO while the OEB assistance in the regulatory space of their projects.[34] This partnership explored how DERs can help support the transmission of electricity, and what roles LDCs can take in the implementation of these resources.

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[30] (Environmental Registry of Ontario, 2020)

[31] (Independent Electricity System Operator (ieso.ca), 2023)

[32] (Independent Electricity System Operator (ieso.ca), 2023)

[33] (Independent Electricity System Operator (ieso.ca), 2023)

[34] (IESO, 2021)

3.1.1.6 *Social Considerations*

How have changes in the electricity sector affected different communities in Ontario, particularly marginalized or rural communities?

Quick communication with customers through digital platforms that provide real-time information has helped in increasing the customer's understanding of how their behaviors impact utility bills and, consequently, carbon footprint. In a similar vein, the ubiquity of ever-connectedness has led to development of more personalized customer experiences, allowing for customers to not only be able to voice their grievances but also know that they are being heard. This serves as an indispensable asset for communities to advocate for themselves and seek better services. This has been evidenced in a preferential shift from just energy prices and service reliability to sources of energy supply as well as reducing energy bills. Furthermore, there has been a greater interest in cleaner, resilient energy sources through increasing DER investment, higher choice in utility rate plans and customer program offerings. Higher DER investments have also led to the development of microgrids and Small Modular Nuclear Reactors (SMR) to help develop resiliency for marginalized communities by reducing their dependencies on external sources for their energy demands.

What initiatives have been taken to ensure equitable access to electricity across Ontario?

There has been a concerted effort across the province to provide more equitable access to electricity through several different initiatives. During COVID the Ontario government froze electricity rates on three separate occasions to support consumers who were paying time of use rates during the pandemic.[35] This is in addition to the Ontario Electricity Rebate[36], the program put in place to replace Fair Hydro in 2019. The Ontario Electricity Rebate offers rebates to customers that had their rates increase due to the abolishment of Fair Hydro.

Several more targeted initiatives also exist. The Ontario Electricity Support Program (OESP)[37] is one of several OEB run programs aimed at helping lower income customers cover their electricity bills. The OESP specifically provides ongoing monthly credits based on size of household for residents below certain income thresholds. The First Nations Equity Partnership[38] is one of many initiatives focused at ensuring Indigenous groups are consulted and included in the energy transition. The First Nations Equity Partnership initiative is an equity partnership model between Hydro One and First Nations on new capital transmission line projects with value above a threshold of $100 million. This partnership will offer First nations the ability to purchase 50% of equity of relevant projects. The Rural or Remote Rate Protection Program[39] is an initiative run by Hydro One that reduces the monthly deliver charge for residential ratepayers who are in rural or remote areas.

[35] (Ontario Energy Board, 2023)
[36] (Hydro One, 2023)
[37] (Ontario Energy Board, 2023)
[38] (Electricity Canada, 2022)
[39] (Hydro One, 2023)

3.1.1.7 Future Outlook

Considering current trends, what are the potential future challenges for Ontario's electricity sector?

Considering the current trends in these markets, some challenges remain. Perhaps most important is the upfront capital cost of renewable energy projects. This is not a new challenge by any means but is a challenge that still needs to be contended with. This challenge particularly affects marginalized and equity-seeking populations, preventing them from being able to participate in the energy transition.

As per a report by the Canadian Climate Institute, the electricity system will need to increase its capacity by two or three times by 2050, approximately 75% of which would need to come from intermittent renewable sources of energy like solar and wind.[40, 41] The IESO's Annual Planning Outlook further supports this demand forecast, stating that by 2043 Ontario will be running a Summer capacity deficit of 2000 MW to 1500 MW[42]., Furthermore, more battery storage and peak demand management will also be necessary because of mass electrification.[43]

Another obstacle that the Ontario's electricity sector must deal with is barriers for emerging technologies such as DERs to participate in wholesale power markets. To properly harness the potential of these emerging technologies to contribute to the energy transition, policies and regulations need to foster innovative ways to integrate these technologies into the province's electricity grid.

Another large issue facing the sector is the decommissioning of the Pickering Nuclear generating station by 2026.[44] As one of the largest generators in Ontario, efforts will need to be made to secure additional electricity generation. This has been recognized as one of the major driving issues for the coming capacity deficit by the IESO's Annual Planning Outlook.[45] The IESO is actively planning for this, outlined in its Annual Acquisition Report and various procurement initiatives.

What strategies are being implemented to ensure the sustainability and reliability of Ontario's electricity supply in the face of these challenges?

There have been several strategies implemented across the provincial energy sector to ensure sustainability and reliability. To combat the high capital cost of renewable energy projects, several different companies have been seeking funding from government sources. The federal government has invested in some of these projects in various ways, including $7.8 million in investments to SWITCH Power to deploy BTM energy storage systems and operating DERs to enable Ontario's ongoing electrification. This investment also helps to combat the barriers facing DERs when participating in wholesale power markets.

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40 (Canadian Climate Institute, 2022)
41 (Canadian Broadcast Corporation (CBC), 2022)
42 (IESO, 2022)
43 (Canadian Broadcast Corporation (CBC), 2022)
44 (Ontario Newsroom, 2022)
45 (IESO, 2022)

Another federal source of funding is the Green Infrastructure Smart Grid Program[46], an NRCan led targeted program that invested over $100 million for utility led projects that deployed smart grid systems or smart grid technologies. In addition to combating the high capital cost of these programs, it also promotes the adoption of smart grid technologies which helps further ensure sustainability and reliability in the grid.

Many organizations are working to address the issue of increased demand and not enough electricity supply. OPG is specifically looking into refurbishing the Pickering Nuclear generating station[47] to maintain the largest source of affordable energy in the province.

The Government of Ontario has also listed several other concrete steps to acquire additional generation in their Power Ontario Growth report[48]. These steps include pre-development work on a new large-scale nuclear plant, three smaller modular reactors and new transmission lines in northeastern and eastern Ontario. The Government of Ontario has also done work on optimizing hydroelectric power to the province, planning for future energy efficiency programs, and invested in long term pumped hydroelectric storage. In addition, Ontario has directed the IESO to do additional rounds of procurement, launching a new round in 2025/2026 in addition to the round completing in 2024. Both the IESO and Ontario are continuing to invest in procuring resources to meet Ontario’s energy needs.

Other non-governmental sources are also stepping up to provide capital to green projects. The IESO has expanded eligibility for resource participation in existing procurement mechanisms. Third-party ownership of net-metered solar generation is becoming increasingly popular.[49] Furthermore, community net-metering models are also gaining traction, allowing renewable generation in community common spaces.[50] Another promising development is a financial instrument called solar bonds through SolarShare, which is a Canadian renewable energy co-op. SolarShare owns and operates solar energy installations across Ontario that any Ontario resident can invest in. They have generated investments of nearly $80 million, earning over $12 million in interest in the process.[51]

3.1.2 Key Learnings for Sector Innovation and Advancement

In the following section, we provide a detailed analysis focusing on the outcomes of the Energy Sector Impact Matrix as it relates to the Grid Innovation Fund (GIF) projects.

We begin by identifying and discussing the key learnings from each GIF project. These insights cover various areas, including technical advancements, regulatory and policy developments, and other significant aspects. Our goal is to clearly articulate how these findings are not only relevant but also beneficial to the current trends and future direction of Ontario's energy sector.

Additionally, Guidehouse assessed how the learnings and outcomes from each project have

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46 (NRCan, 2023)
47 (Ontario Newsroom, 2022)
48 (Government of Ontario, 2023)
49 (Environmental Registry of Ontario, 2022)
50 (Government of Ontario, 2021)
51 (SolarShare, 2023)

contributed to broader discussions in the energy sector. This includes their influence on critical issues such as the energy transition, the role of efficient electrification, the development of enabling resources, the evolving responsibilities of consumers and utilities, as well as policy and regulatory options regarding non-wire alternatives.

This section is designed to provide a clear and comprehensive overview of the GIF projects' impacts, highlighting their significance and value to the IESO and the broader Ontario energy sector.

Canadian Urban Institute

Key technical, regulatory, or policy learnings

CUI's project identified various site-specific options to improve energy efficiency in municipal water distribution systems. Through their simulations, it is evident that energy savings can be achieved through a very simple tool, thus making it a low-cost solution and accessible to a broad range of operators. Even though they were not able to take the tool to commercialization due to capacity restraints, they have set the path for another entity to build on their work in the future.

How project learnings informed sector discussions and outcomes

The following are outcomes of CUI's contributions on electricity sector discussions in Ontario:

1. Development of Energy Metrics Tool: A significant contribution from the project is the development of a tool for automatically calculating energy metrics of a water distribution system. This tool, based on an input EPANET hydraulic model file, enabled rapid calculation of energy efficiency and identification of key inefficiencies in the systems studied.
2. Energy Conservation and Efficiency Improvements: The application of this tool in the case studies led to insights on improving energy efficiency. For instance, in the LAWSS case study, adjustments in pump controls and Variable Frequency Drive (VFD) speed settings resulted in increased energy efficiency and a 6.5% reduction in energy consumption, amounting to about $102,000 in annual electricity cost savings.
3. Model for Identifying Conservation Opportunities: These case studies demonstrate a low-cost methodology for identifying electricity conservation opportunities in small to medium-sized systems. This approach can serve as a model for other municipal water systems in Ontario, offering a viable alternative to more complex energy use optimizers.
4. Guidance for Future Operations Adjustments: The findings from these studies provide actionable insights for future adjustments in operations, such as altering pump operations or installing VFDs, leading to significant reductions in energy use and improvements in energy efficiency.
5. Impact on Infrastructure Durability: The studies also highlighted how operational changes could lead to reduced wear and tear on pumps and pipes, thereby increasing infrastructure durability.
6. Support for Provincial Energy Conservation Goals: The learnings from these projects align with Ontario's broader goals for energy conservation and efficiency in municipal services, thereby informing policy and regulatory discussions in the sector.

7. Potential for Scalability and Replication: The successful implementation and outcomes of these projects indicate the potential for scalability and replication across other municipal water systems in Ontario, contributing to province-wide energy conservation efforts.

NRStor

Key technical, regulatory, or policy learnings

The project identified several key learnings that apply to future DER projects throughout the sector. Primarily, this pilot proves that there is customer demand for residential BTM storage. This project also proves that this kind of storage is possible and reliable. As the sector moves towards smaller, more modular, DERs, this project serves as a guidepost demonstrating the lower bound on size and modularity for these units.

How project learnings informed sector discussions and outcomes

The NRStor project has made significant contributions to the discussions and outcomes in Ontario's electricity sector, particularly in Distributed Energy Resources (DERs). Key learnings from the project that have informed the sector include:

1. Transformation of the Electricity Sector by DERs: The project underscored the transformative impact of DERs, like home batteries, on the traditional electricity sector framework. It highlighted how these resources can provide value to the Ontario energy grid via improvements in reliability, peak reduction, and infrastructure investment deferral.
2. Valuable Project Insights: Throughout the project, NRStor and its partners garnered valuable insights at various stages of development. These insights include market research on residential customer interest in BTM storage, research on the education stakeholders require to understand energy storage resources, and the type of actions LDCs can take to participate and activate value in DERS.
3. Challenges and Opportunities in Regulatory Engagement: The project's engagement with regulatory bodies like the IESO, OEB, and local distribution companies led to the identification and exploration of technical, commercial, and regulatory challenges for home batteries and DERs. These challenges included conversations with the Electrical Safety Authority with regards to battery warranties and installation, rules regarding sharing customer energy data, fire and building codes with regards to residential energy storage, and discussions with OEB regarding BTM ownership of energy storage.
4. Potential for Scalability and Replication: The project's success has sparked interest among several local distribution companies and federal agencies in replicating similar pilots. This interest demonstrates the potential for scalability and broader application of the project's learnings.
5. Contribution to Policy and Regulatory Development: The pilot served as a key enabler for regulatory discussions for home batteries and DERs in Ontario and Canada, specifically driving an OEB bulletin on BTM ownership of energy storage. This marks an important contribution as it remediated NRStor's engagement in various stakeholder working groups and initiatives has been instrumental in driving regulatory innovation.

6. Financial and Operational Insights: The project provided insights into commercial responses to challenges like COVID-19 and the importance of close partner coordination. NRstor weathered the disruption of COVID-19 by closely coordinating with its various partners and maintain customer engagement via digital channels. Commissioning and installation of the units was delayed due to the pandemic, nevertheless NRstor was able to ensure that customer relationships were maintained, and that commissioning went smoothly once it was allowed. This highlights the criticality of customer engagement in project success.
7. Efficiency and Cost-Savings: The pilot demonstrated that a fleet of home batteries, operated as a Virtual Power Plant, can offer savings to Ontario ratepayers, contributing to more efficient utilization of the province's generation assets.
8. Value of Energy Storage in Ontario: The project emphasized the economic valuation of energy storage in Ontario, projecting savings of up to $2.7 billion over the next decade for electricity customers.
9. Future Potential of DERs and Storage Resources: NRStor's experience with the project suggests a substantial market potential for DERs and storage resources in Ontario, with the possibility of significant environmental and economic benefits.
10. NRStor is already in talks with other utilities in the province to adopt similar projects to implement small scale BTM storage, and other entities looking to develop this type of project are looking at the Cecil Pilot Project as an example.

Ameresco Canada

Key technical, regulatory, or policy learnings

As the province looks to rapidly boost DER uptake in a bid to modernise the electric grid, enabling market participation from a greater, more diverse share of customers is a necessary step. Ameresco's JP II project serves as a successful exemplar of the need for communication and collaboration between developers, LDCs, the OEB and the IESO to support innovative projects that have the potential to support both the distribution network and the bulk electricity system.

How project learnings informed sector discussions and outcomes

Ameresco's JP II project has significantly contributed to the Ontario energy sector's discussions around the systemic changes needed to improve DER integration in the province's electric grid. Key learnings from the project include:

1. Complexities of Offering Ancillary Services: The deployment and operation of the project, despite delays due to COVID-19, went exceptionally well. The project highlighted the complexities involved in offering ancillary services to the market. These complexities include understanding new limitations and preparing for real-time market participation, insight which could be useful for other like-minded projects and their viability.
2. Collaboration Challenges: A significant aspect of learning came from interaction with London Hydro (for operational matters). The project revealed the need to re-examine current market rules (considering the rate misclassification issue), OEB rules and system protection requirements to facilitate greater penetration into the market for projects like this one.

3. Transfer Trip Technology and Feeder Issues: Ameresco installed Transfer Trip technology due to regulations and faced challenges due to the unilateral disconnection of the project by the utility required for safe operation of the distribution network. This highlights some limitations on distribution connected system to providing services to the IESO Administered Markets (IAMs) under current requirements and highlights the need for transmission-distribution coordination when DERs are providing services to the IAMs.
4. Rate Classification and Economic Implications: Midway through the project, a rate classification change was enforced upon the project by London Hydro. This initially seemed to negatively affect its economics as per Ameresco's calculations, but the utility was adamant on their decision despite Ameresco's qualms and did not offer any explanation when it was sought out. After a lot of dialogue, which also included Ameresco escalating the matter to the OEB, London Hydro finally explained how the tariff they put Ameresco's project on was the most economically viable option. This experience underscored the importance of special attention for new projects by utilities. This experience also reinforced the need for clear communication and transparency in rate class information from utilities by allowing project developers to harness utilities' knowledge to connect projects in a way that minimized utility resources and, ultimately, reduce costs.
5. Demand-side Management and Peak Energy Contribution: The project emphasized the importance of demand-side management in effective electrification of the system. It suggested that utilities should provide real-time information on demand at feeder connection points to proponents who can control their loads.

RWDI

Key technical, regulatory, or policy learnings

Compass is the first tool of its kind, without any current competitors in the market. However, they have not yet developed a commercially viable business case. They are considering developing an API for the tool instead of the existing service-based model, which might help with wider adoption and enabling a greater variety of applications. The adoption of this tool will help developers in Ontario create energy efficient buildings and sustainable infrastructure, furthering the energy transition and efficient electrification in the province.

How project learnings informed sector discussions and outcomes

RWDI's Compass project has made contributions to sector discussions and outcomes in the following ways:

1. Development of Energy Efficiency Tool: The Compass tool allows developers in to upload and browse hundreds of energy models of buildings to directly compare and model energy efficiency measures and their effects on buildings.
2. Research Into Effective Energy Efficiency Measures: As part of their inaugural pilot, RWDI used their initial stock of energy efficiency models to research commonly held beliefs on energy efficiency indicating metrics such as the Window to Wall ratio and its impact on energy usage.
3. Municipality Energy Evaluation: The tool was picked up and used by several municipalities as their first real way of evaluating developer proposals from an energy efficiency point of view.

4. Collaboration with Industry and Regulatory Bodies: Collaborations were established with entities like the Ontario Association of Architects, the Toronto 2030 District, the IESO, and various beta testing firms, enhancing the tool's relevance and applicability.
5. Challenges and Opportunities: The project faced challenges, such as data confidentiality concerns with the City of Toronto and the complexity of extracting data from proprietary software like IES-VE. These challenges highlighted the need for close collaboration and negotiation with various stakeholders.
6. Potential Impact on Energy Efficiency: By facilitating easier benchmarking and reporting, the tool has the potential to significantly impact energy efficiency in new construction buildings, contributing to greenhouse gas emission reductions.

The Atmospheric Fund

Key technical, regulatory, or policy learnings

Through this project, the lack of provincial incentives for heat pumps in Ontario in 2017 was underscored for TAF. Due to the low price of natural gas, in the absence of such an incentive, the business case for retrofitting gas-heated residential properties with heat pumps is challenging. To make deep retrofits more compelling, policymakers need to lead the charge on increasing incentives across the province, particularly in underserved areas. TAF found that projects such as community housing stood to benefit the most from these types of projects due to a lack of existing energy efficiency measures in these areas. Furthermore, cooling bylaws need to—and should—become more common, making the rules around air conditioning requirements for landlords transparent. This will also increase demand for heat pumps.

How project learnings informed sector discussions and outcomes

TAF's project have significantly contributed to discussions regarding deep retrofits of heat pumps in Ontario. Key learnings from these projects include:

1. Technical Feasibility of Heat Pumps in Cold Climates: There was a prevalent myth in the HVAC industry that heat pumps would not work in cold climates like that of Toronto's. TAF's successful project helped dispel that myth, leading to a marked shift in conversations among industry groups and paving the way for further adoption.
2. Project Expansion: Due to growing demand for TAF's retrofits and increased funding from various avenues, TAF was able to expand its retrofits to 11 buildings in the GTA, with plans and funding for rapid expansion.
3. Policy Advocacy and Discussions: TAF pushed the envelope on leading industry groups in discussions around what HVAC policy needs to be to ensure that deep retrofits can be pursued at scale in Canada. TAF has a dedicated policy team that focusses on such advocacy. TAF's efforts led to them authoring a letter of recommendation alongside HVAC industry leaders around incentives for deep retrofits in Ontario to combat energy poverty in the province and fulfill the government's Made-in-Ontario Environment Plan. Since 2017, there have been several heat pump incentives introduced at a federal, provincial, and municipal level. Notable programs are Canada Greener Homes Grant (CGHG) by NRCan, Home Efficiency Rebate Plus (HER+) by Enbridge, Save on Energy (SOE) by IESO, and Home Energy Loan Program (HELP) by the City of Toronto

TMU

Key technical, regulatory, or policy learnings

TMU's white papers included key learnings on revenue generation from energy storage assets, and transactive energy networks. Of these two concepts, energy storage assets have put into use across the Ontario energy sector with new DERs across the grid using some of the revenue generation principles mentioned in these papers. The transactive energy network whitepaper has driven discussion regarding similar models of operation such as Distribution System Operator models.

How project learnings informed sector discussions and outcomes

TMU's White Papers have significantly contributed to discussions regarding Transactive Energy and Energy storage in Ontario. Key learnings from these projects include:

1. Findings on Transactive Energy: The white paper produced by TMU helped showcase the viability and benefits of Transactive energy and its use case when it comes to the Ontario Grid. It highlighted the need for Transactive Energy to be one of the many tools that needed to be used to keep up with the surge in demand that the Ontario energy grid will deal with in the coming years.
2. Findings on Energy Storage: The project developed a white paper on revenue generation in Energy Storage projects. DERs utilizing BTM energy storage have proven to become a key piece of the Ontario Energy Grid, and TMU's research has directly impacted how those projects can generate revenue.
3. New Collaborations: These whitepapers led to direct partnerships with private entities that are using TMU's new IESO funded lab to implement solutions based on these research papers. These include Toronto Hydro's exploration of BTM storage as well as Demand Response Benefit stacking, Toronto Community Housing FTM storage pilot, and Hydro One's forays into Transactive Energy.
4. Direct Policy Discussions: The Transactive Energy white paper led to direct engagements between TMU and the Ministry of Energy. These engagements included input from TMU on how to determine the implications of the growth in demand across the province and how Transactive Energy could potentially solve some of these coming issues.
5. Discussions on Deep Electrification: The project was invited to present their work to the Electrification and Energy Transition Panel of the government of Ontario on how the city of Toronto's policies needed to change to support the energy transition to keep up with growing demand in the city.

York University

Key technical, regulatory, or policy learnings

York University's research demonstrated the strong technical potential that electrification of bus fleets could have in the GTA as well as across the province. At the same time, their work also highlighted the shortcomings in the status quo that would impede the uptake of battery-based electric buses (BEB). The first such learning was that the high initial capital investment significantly hinders the economic feasibility of such projects.

How project learnings informed sector discussions and outcomes

A few key areas where the Optimization Toolbox's learnings and outcomes have informed discussions include the following:

1. Modeling and Simulation for Grid-Scale Power Flow: The project developed a modeling and simulation toolbox that allows for the analysis of power flow at grid-scale, including the inclusion of charger loads at desired Battery-based Electric Bus (BEB) operating schedules. This has implications for understanding how large-scale electrification of transit systems can impact the power grid, an essential consideration in energy transition discussions.
2. Technical Advancements and Challenges: The project highlighted the need for further development in BEB technology, particularly in reducing capital expenditures and ensuring compatibility with existing transit and power systems. These insights are crucial for ongoing technical discussions and advancements in the field of electric transportation.
3. Impact on Power Distribution Systems: The study identified challenges related to power distribution systems, such as potential undervoltage violations under heavy power loading conditions caused by BEB charging. This finding is significant for discussions around infrastructure readiness and upgrades necessary for supporting large-scale electrification.
4. Collaborative Efforts and Training: The project emphasized the importance of collaboration between different stakeholders, including utilities, research institutions, and transit authorities. It also highlighted the role of training highly qualified personnel in the field, contributing to workforce development discussions in the sector.
5. Economic and Environmental Analysis Tools: The toolbox includes modules for economic and environmental analysis, providing a framework for assessing the cost-effectiveness and environmental impact of electrifying public transit buses. This is relevant for policy and regulatory discussions focused on sustainable transportation and climate change mitigation.
6. Operational, Economic, and Environmental Impacts: The simulations and observations from the project have operational, economic, and environmental implications, contributing to a broader understanding of the impacts of transit system electrification. This includes considerations for both transit and power grids in the design of electrified bus fleets.
7. Informing Policy and Regulatory Frameworks: The insights from the project can inform policy and regulatory frameworks by providing data and analysis on the implications of transit electrification. This includes understanding the demands on power systems and the environmental benefits of transitioning to electric buses.

GE Digital

Key technical, regulatory, or policy learnings

These pilot deployments demonstrated the feasibility of a Distribution Location Marginal Pricing (DLMP)-based Transactive Energy Market taking into account specific capabilities from asset managers and LDCs. The project also showed the lack of regulatory and policy support for projects of this kind. Transactive Energy can provide value and help address some of the challenges the sector is facing by optimization utilization of DERs, increasing reliability, and reducing peak load.This project promotes looking into the regulatory challenges that are holding a Transactive Energy Market back.

How project learnings informed sector discussions and outcomes

GE Digital has informed sector discussions and outcomes in the following ways:

1. Modeling and Simulation for Transactive Energy Network: The project implemented a DLMP based transactive energy network simulation on their already existing simulation software platform. These simulations were one of the first ways to see the viability and benefits of Transactive energy using real world data.
2. Real World Limitations for Transactive Energy: As part of this project LDCs provided different feedback from asset owners about the real-world requirements that would need to be in place for them to participate in Transactive Energy, such as specific dispatch bounds.
3. International Modeling Comparisons: GE Digital was approached by ComED to also create a pilot of a DLMP transactive energy market system in Illinois. In addition, they implemented a simulation model in the UK for the comparison between transactive energy and economic costing. These other simulations bring value by comparing transactive energy possibilities in Ontario with those internationally.
4. Cross-Border Knowledge Transfer: GE Digital published a whitepaper on DLMP optimization methodology and shared the data from their simulations as part of a cross-border knowledge exchange with UK utilities facilitated by NRCan and Department for Business, Energy, and Industrial Strategy (BEIS).
5. Informing Policy and Regulatory Frameworks: This project showed that the current regulatory and policy frameworks are not in place for commercialization of Transactive Energy, but it can be used to push forward similar concepts that fit more readily within the regulatory framework of Ontario, such as the Distribution System Operator model.
6. Enterprise Scaling: The core capabilities created in this project are a roadmap to facilitate an enterprise level Distributed Energy Resource Management Software that enables Transactive Energy.

SUITE OF PROJECTS

Key technical, regulatory, or policy learnings

This suite of GIF projects addressed a variety of topics, geographic scopes, and types of tangible or intangible benefits. Further, they have delivered many promising technological solutions that have the potential of modernizing the grid, increasing energy efficiency, and helping Ontario move towards a climate-friendly future.

However, the various projects also demonstrated similar challenges, hindering them from harnessing the true potential of their respective interventions. In most cases, the technology was ready to be deployed and had proven to be successful in simulations and pilots. However, an adaptive regulatory and policy environment is required to capture the full potential and benefits of the technology. TAF is a great example of this: While the market displayed an appetite for their product in terms of customer demand, at the time that TAF's deep retrofit programs began in 2017, there was a lack of attractive government incentives for heat pumps and other retrofits that are necessary for heat pump installations (like air sealing, ductwork, etc.). According to TAF, while there was demand for these services, the lack of incentives resulted in a sense of adversity towards deep retrofits which negatively affected the business case for deep retrofits in the face of affordable natural gas.[52] This lead TAF to advocate for regulatory and policy changes while it also highlights need for supports, resources, and

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[52] Please note: While more recently, incentives have been developed such as federal Greener Homes and the City of Toronto's Home Energy program which would likely help create enabling environment for projects such TAF's, these programs were only available after TAF's project began.

guidance to understand how to navigate these environments more nimbly. Another example is Ameresco, whose project served as a successful demonstration of the need for communication and collaboration between developers, LDCs, the OEB and the IESO to support innovative projects that have the potential to support both the distrubution network and the bulk electricity system, and highlighted the evolving role of the LDC. This project attracted much interest from potential customers across industries and secured funding to continue growing their project. However, the lack of regulatory clarity on the tariff structures significantly affected the project economics. GE Digital/Opus One's pilot determined that the regulatory landscape needed to successfully commercialise their innovative DLMP-based TE market technology did not exist at the time.

Therefore, in order to accelerate the energy transition and modernize the grid in Ontario, the provincial and federal governments—and their respective agencies—need to be proactive in designing transparent and supportive policies and regulations that help incentivize the large-scale deployment of innovative climate technologies. Greater involvement of industry and the scientific community in these decisionmaking processes will also go a long way in ensuring that policies and regulations are reflective of not only the current state of the market, but also of its future potential.

Over the past several years, the IESO, OEB and the Ministry of Energy have been working on enabling DERs to support the grid at the distribution and the transmission levels. This work, in close collaboration with industry and stakeholders, will inform and enable the modernization of the grid and support a smooth energy transition. Everyone has a role to play in ensuring a reliable and cost-effective future electricity grid.

How project learnings informed sector discussions and outcomes
The projects that were part of this suite of GIF funding all contributed to discussions and actions to shape the future-state of the sustainable energy system in Ontario. All projects presented their work at workshops, conferences, and webinars to important stakeholders such as industry groups, governments, financiers, and potential customers, not just in Ontario, but across Canada and even the world. Their work was recognized in industry-leading journals as well as renowned media outlets. The novelty of their projects meant that they often spurred important conversations in the industry, such as the evolving role of LDCs (Ameresco), the possibilities of incorporating a DLMP-based model for Transactive Energy (GE Digital), or the opportunities and challenges with electrifying the transit systems across the province (York University).

Some projects went above and beyond in their contributions to this dialogue by having dedicated efforts to engage with policymakers as well. TAF not only changed discourse around the feasibility of deep retrofits for heat pumps in Canada but also wrote a letter of recommendation to the federal government to enact policies to improve the business case for deep retrofits. TMU's scholarship led the project to be invited to participate in the Energy Transition Panel by the Ministry of Energy, to help inform the province's electrification policy.The NRstor project was directly involved in discussions that led to the OEB bulletin on behind the meter storage assets.

3.2 Impacts to the Funded Organization & Additional Market Effects

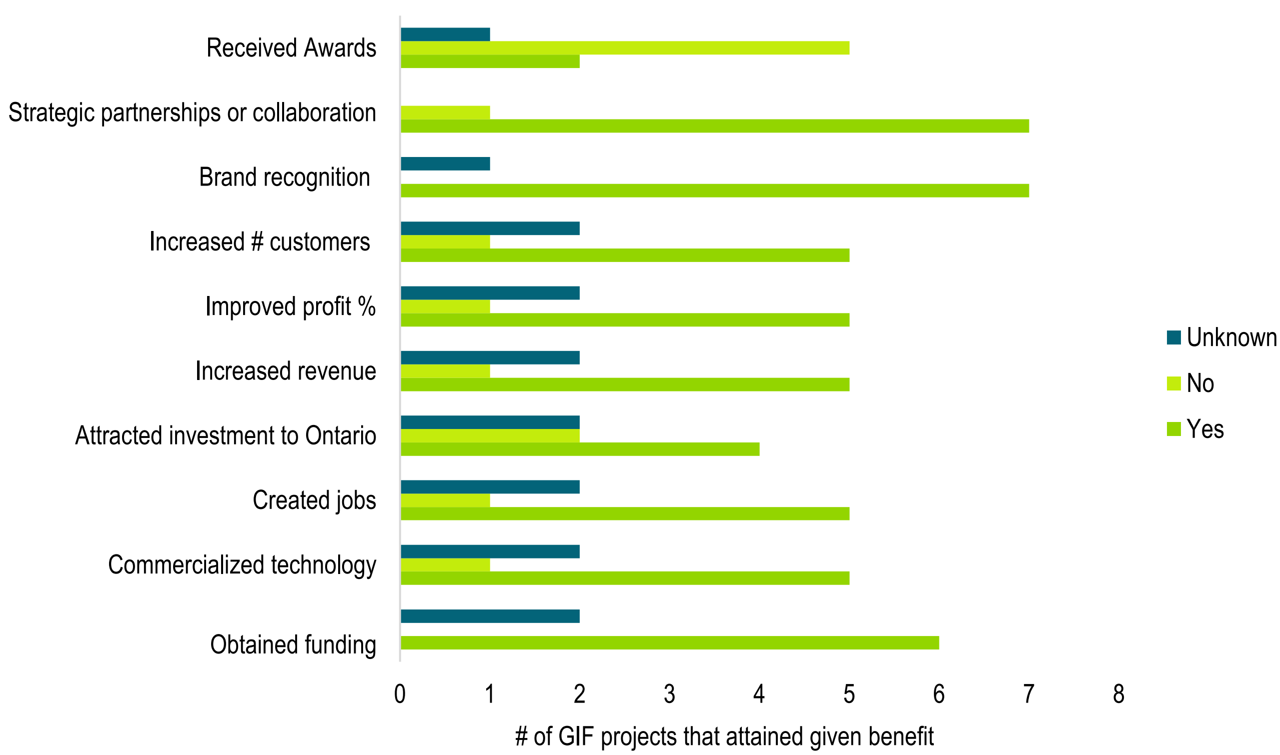
This section is dedicated to explaining the additional market effects that each of the GIF projects achieved beyond the completion of the project itself (such as job creation, acquisition of seed funding, attracting investment to Ontario, amongst others). It responds to several research questions and presents findings from the Impact to the Proponent Matrix and scores.

Table 19: Impacts to the Funded Organization Research Questions

Research Question	Location in document
To what extent has the GIF program impacted the growth and financial success of the funded organization? Quantify, where possible.	3.2.1
To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies? Quantify, where possible.	3.2.2
To what extent would the GIF project have been affected without securing IESO funding? Quantify, where possible.	3.2.3
Overall Ratings and Scenarios	3.2.4

Specific market effects of the projects were analyzed through a desk review and interviews with proponents. The findings in Figure 3 show that the most significant areas of achievement for the projects included: creating strategic partnership or collaboration, brand recognition, and obtaining seed funding.

Figure 3: Market Effects Across Suite of Projects



3.2.1 Impact on Growth and Financial Success of Funded Organization

This section responds to the question: *To what extent has the GIF program impacted the growth and financial success of the funded organization? Quantify, where possible.* In Table 21, Guidehouse presents the findings for each GIF project, its rating, and the rationale for that rating.

Table 20: To what extent has the GIF program impacted the growth and financial success of the funded organization?

Project	Rating	Rationale
Canadian Urban Institute	Low	CUI was able to create a partnership with OCWA and the three municipalities that they conducted pilot studies on. However, based on available information, they decided to terminate the project after IESO funding and any further development of a commercially viable version of their tool due to capacity constraints.
NRStor	Moderate-High	NRStor was able to reach out to new partners and utilities who were interested in implementing similar projects because of this pilot. This was one of many successful storage projects that NRStor had piloted. NRStor has received interest from many new partners, including utilities.
Ameresco Canada	High	Amongst the many contributions this project has made, Ameresco has: Created a successful business model using commercially viable technology; Generated more jobs as they move to operational models from contract-based models; Led to rapid business growth in terms of revenue, profit margins, and customers, thereby increasing its brand recognition amongst LDCs; and has been awarded "Project of the Year" by Energy Storage Canada. After the successful demonstration of JP II, Ameresco secured substantial funding from Canada Infrastructure Bank (CIB) for more projects like JP II all around Canada. CIB's funding necessitates that projects reduce energy by 30%, and now they can demonstrate as the JP II facility became carbon neutral. The Possibility of taking these types of projects further is Canada-wide. The new funding from CIB opens a host of possibilities for Ameresco to aggressively expand its project portfolio. Debt funding also helps incentivize potential customers. Ameresco has met with great success on this project and are committed to taking this project--along with many others like it--into the future. They also have demonstrated interest from both investors as well as prospective customers.
RWDI	Moderate-High	RWDI has a tool that the market has shown demand for, and their design processes are resilient in keeping up with the demands of the future. RWDI has presented this tool internationally and it has made them more known in the industry. This includes work with a large architectural firm from the US using Compass, which brought in a lot of revenue. Greater awareness and demand for their tool has helped them determine this is something they want to invest more time and resources into this project. However, they have not been aggressive to pursue this as a business opportunity, which might hinder their growth in the absence of funding like IESO's.

Project	Rating	Rationale
The Atmospheric Fund	High	TAF's project has served 306 households to date, without any complaints from them, and continues to expand its customer base through additional funding for the project. This has given TAF the confidence and evidence that heat pumps were viable in cold climatic regions like Toronto. There has been a marked shift in tone where people are more accepting of using heat pumps in cold climates. TAF has also raised millions in additional funding from federal and municipal government agencies as well as private family foundations for their retrofit accelerator because of this project, which could be considered as revenue gain. However, since they are a non-profit, all the additional funding was poured back into project expansion. Their work was recognized at conferences, which also led to important brand recognition and key partnerships with institutions like NRCan and the Greater Montreal Climate Fund. The funding that TAF received shall help them expand their project far beyond their initially proposed scale. Their presence at various conferences and other such platforms has increased awareness of their program, which has helped with technology adoption. TAF has demonstrated the effectiveness of their product to their customers. They have a well-structured business model that works at scale. They have also secured a lot of funding to actively pursue this rapid expansion. TAF is also cognisant of all the challenges they face and are actively participating in policy and industry discussions to bring about change in this regard. TAF's project has successfully commercialised the technology by serving as a case study for deep retrofits for heat pumps in cold climates, paving the way for increased adoption of this technology. TAF has also attracted millions in additional investments from federal and municipal government agencies as well as private family foundations to help scale and rapidly expand their project far beyond the initial scope. The project has already created jobs for the province and promises to continue doing so as it pursues its expansion.
TMU	Moderate	This pilot allowed TMU to make a lab that employs seven new positions in the form of post-doctoral fellows and grad students. This lab has helped them reach out to new partners based on the research performed for the IESO. TMU has demonstrated the ability to find new partnerships to implement technologies and products based on these white papers. It has already started working with both Toronto Hydro and Toronto Community Housing on projects that have been commissioned and sponsored. This pilot was able to create seven new, part-time jobs for post-doctoral fellows and grad students, as well as expandeding research within its lab to explore potential new technologies that are already implemnting solutions for resiliency and sustainability issues in the province.

Project	Rating	Rationale
York University	Moderate	A major accomplishment achieved in relation to this project was a NSERC discovery grant offered to the Smart Grid Research Lab. However, it is worth noting that this grant was given to the lab writ-large, not just specifically to this project, and, consequently, the funding was used for various projects across the lab. While the additional funding received by York University was helpful in supporting additional research that this specific lab was pursuing, the funding received was a small portion of the total funding that the university receives and did not significantly change anything for either the university or the lab with regards to their progress. The project was never commercialised and the project leads have no intentions of pursuing it commercialy in the future either. That said, their research has been published in industry-leading journals, which could perhaps lead to future uptake, even if by a different entity.
GE Digital	High	GE Digital has shown that they have the ability to attract new partners and customers who are interested in the implementation of this technology. This pilot helped increase brand recognition of Opus One Solutions (contributing to them being acquired by GE Digital). It led to being part of a cross-border knowledge exchange with US utilities facilitated by NRCan and BEIS. However, the implementation of any transactive energy project at scale relies on changes in policy to support the endeavour. This may be an important consideration for GE Digital as well as the IESO in the feasibility of scaling GIF projects and the types of supports which proponents may need.
All projects (Average Score)	**Moderate Impact (84%)**	**The overall score for extent to which the suite of GIF projects impacted the growth and financial success of the funded organization is overall considered moderate. Projects were mostly able to demonstrate new technology or business models. Their readiness and ability to generate financial success in a practice varied substantially.**

3.2.2 Ability to Drive New Business Models

This section responds to the question: *To what extent have each of the GIF project activities* *driven new business models or implementation of novel approaches to technologies?* Quantify, where possible. In Table 22, Guidehouse presents the findings for each GIF project, their rating, and the rationale for that rating.

Table 21: To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?

Project	Rating	Rationale
Canadian Urban Institute	Moderate	CUI's technology was an energy efficiency tool for water distribution systems. CUI's project identified the possibilities of achieving energy efficiency in municipal water distribution systems. Through their simulations, it is evident that these savings can be achieved through a very simple tool, thus making it low hanging fruit. Even though they were not able to take the tool to commercialization due to capacity restraints, they have set the path for another entity to build on their work in the future.
NRStor	High	NRStor's project was the installation of Tesla Power wall units in several residential homes in order to turn them into a Virtual Power Plant (VPP) capable of working as Behind the Meter Storage. This VPP was tested for its ability to provide energy arbitrage as well as Demand Response. VPPs and in-home energy storage are already taking off across Ontario and this project only further pushes this concept into viability. NRStor is a proven player in this space and has commissioned a great deal of research to show the benefits of large-scale adoption of residential VPPs.
Ameresco Canada	High	Ameresco's project involved the implementation of microgrid technology at JP II Secondary School in London, Ontario as it set out to demonstrate Energy as a Service (EaaS). It is Ameresco's execution and maintenance of the microgrid technology, and its communication with the local distribution utility, which is remarkable and has made it an exemplar in the province. There has been considerable demonstrated interest shown in the project from private companies as well as institutions to set up projects like JP II. This is evidence for increasing adoption for this novel technology. Ameresco is helping mass adoption of this novel technology, which shall help alleviate the load on the grid and significantly increase the efficiency of DER integration into the province's as well as the nation's grid. While Ameresco's demonstration of EaaS faced challenges, particularly in terms of rate classification and market rules, these were eventually resolved, leading to operational success and economic benefits. The project was successful in demonstrating the viability and potential of EaaS, contributing valuable insights and learnings for future market participation.
RWDI	High	Their technology, Compass, obtained 138 users by the end of the IESO funding period (July 2020). As it continued to scale, the project grew to a total of 194 (November 2023). RWDI's tool is novel in the industry and industry has shown an appetite for this technology as well. With increasing needs for improving energy efficiency in the built environment, their tool could lead to the widespread implementation of this new technology.

Project	Rating	Rationale
The Atmospheric Fund	High	TAF's project involved the implementation of deep retrofits of heat pumps to promote energy efficiency and, consequently, emissions reductions in residential buildings. What is particularly new about their project is that there was a lot of skepticism about the effectiveness of such deep retrofits in cold climates like that of Ontario. TAF's project helped dispel this myth, hopefully paving the way for increased adoption of this technology. TAF has served as a case study for deep retrofits in colder climates. Through their successful implementation, active engagement in policy and industry discussions about the matter, as well as ability to secure funding for expansion, they have paved the way for rapid utilization of this new technology at a provincial level.
TMU	High	TMU worked with Toronto Hydro to develop a software to determine how much BTM storage to procure on their feeders (determining the economic case and size the storage with metrics like power and energy capacity). TMU also delivered software for Toronto Community Housing for controlling their Front-of-the-Meter (FTM) storage. Both projects were based on research done in their IESO funded white papers. This pilot project has resulted in the creation of a lab where other entities can sponsor studies and the implementation of new technologies in the sector. TMU is directly translating cutting edge research into products that are working to transform the grid.
York University	Low	York University would like to develop their tool into a full business model. They are discussing with parties. This project promotes the adoption of a novel technology that would lead to significant GHG emission reductions within the province's transit bus fleets. However, high capital investment costs along with no intentions or plan to continue commercializing the ideas means that it is unlikely that this technology will ever be used.
GE Digital	Moderate	GE Electric (formerly Opus one) is implementing a Distribution Locational Marginal Pricing (DLMP) based transactive energy market management software. GE Digital has used this project to springboard the discussion when it comes to the implementation of Transactive Energy Networks. They've paved the way for other projects in this area to be implemented and worked directly with LDCs to be able to determine exactly how to best implement this technology.
All projects (Average Score)	**Moderate -High Impact (88%)**	**The rating for the extent to which the suite of GIF project activities has driven new business models or implementation of novel approaches to technologies is considered high. All projects were able to develop some degree of a business model or spoke to the generation of new ideas or technology.**

3.2.3 Effects of IESO Funding

This section responds to the question: *To what extent would the GIF project have been affected without securing IESO funding? Quantify, where possible.* In Table 23, Guidehouse presents the findings for each GIF project, their rating, and the rationale for that rating.

Table 22: To what extent would the GIF project have been affected without securing IESO funding?

Project	Rating	Rationale
Canadian Urban Institute	High	IESO funding made up a considerable portion of the funding (75%). It is hard to foresee a situation where they would have been able to implement the project without it.
NRStor	Moderate-High	IESO provided close 43% of the planned project funding, however the project ran over budget such that IESO's funding was only ~22%. Without the IESO's funding, it is unclear whether NRStor would have been able to test out the Virtual Power Plant model in Ontario, including gaining experience with Tesla's aggregation software and demonstrating their capability to leverage DERs for energy arbitrage and demand response.
Ameresco Canada	Moderate	While 48% of the project's funding was from IESO and was considered an integral investment for the project, there were other competing sources of funding that could have substituted for IESO's support. Federal NRCan funding was a substantial driver of this project. Ameresco has met with great success on this project and are committed to taking this project--along with many others like it--into the future. They also have demonstrated interest from both investors as well as prospective customers.
RWDI	Moderate	Initial funding was already in place from The Atmospheric Fund, but the IESO funding was crucial. GIF funding was significantly larger than TAF (TAF was 10-20% of IESO GIF). TAF helped produce a minimum viable product, but no users were acquired before the IESO GIF funding was secured.
The Atmospheric Fund	High	While TAF received external funding, TAF would not be eligible for the NRCan funds they were able to procure because of their GIF project if it hadn't been for IESO funding. This project expanded the work they do. TAF has demonstrated the effectiveness of their product to their customers. They have a well-structured business model that works at scale. They have also secured a lot of funding to actively pursue this rapid expansion. TAF is also cognizant of all the challenges they face and are actively participating in policy and industry discussions to bring about change in this regard. TAF's project has successfully commercialized the technology by serving as a case study for deep retrofits for heat pumps in cold climates, paving the path for increased adoption of this technology. TAF has also attracted $13.5 million in additional investments to help scale and rapidly expand their project at a provincial level, far beyond the initial scope of the project. The project has already created jobs for the province and promises to continue doing so as it pursues its expansion.
TMU	High	TMU has demonstrated the ability to find new partnerships to implement technologies and products based on these white papers. They had already started working with both THESL and Toronto Community Housing on projects that have been commissioned and sponsored with no IESO help. This pilot was able to create seven new, part-time jobs for post-doctoral fellows and Grad Students, as well as expanding research within its lab to address problems facing the energy grid.

York University	Moderate-Low	York University and the lab at which this research was undertaken have raised funding since the project, although not specifically for this project. The project was never commercialized, and the project leads have no intentions of pursuing it commercially in the future either. That said, their research has been published in industry-leading journals, which could perhaps lead to future uptake, even if by a different entity.
GE Digital	Moderate	Despite the other internal partners and sources of funding, the IESO provided a significant amount of funding also with other critical contributions that were needed to properly implement the pilot. Further, the funding provided GE Digital with the opportunity to work with Ontario LDCs and better understand LDC tools and systems, which provided their business a great deal of value. GE Digital has shown that they can attract new partners and customers who are interested in the implementation of this technology.
All projects (Average Score)	**Moderate Impact (84%)**	**The rating for the extent to which the suite of GIF projects would have been affected without securing IESO funding is considered moderate. While IESO funding proved crucial for all projects, the degree to which the projects were able to generate different market effects independently of IESO ranged substantially. Accordingly, it was calculated to have had moderate impact.**

3.2.4 Overall Project Ratings and Scenarios

This section considers the overall score for each project and the suite of projects under three scenarios: a best case, a worst case, and the most likely (the status quo). Please refer to Table 11 which identifies the thresholds of impact from Proponent Impact Matrix.

The table below demonstrates the overall results of all projects and is colour-coded for High, Moderate, and Low Impact.

Table 23: Impact to the Proponent Matrix Results

Project	To what extent have the GIF projects impacted the growth and financial success of the funded organization?	To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?	To what extent would the GIF project have been affected without securing IESO funding?	Most Likely Scenario Score
Canadian Urban Institute	Low	Moderate	High	**81** (Moderate Impact)
NRStor	Moderate-High	High	Moderate-High	**90** (High Impact)
Ameresco Canada	High	High	Moderate	**85** (Moderate Impact)

Project	To what extent have the GIF projects impacted the growth and financial success of the funded organization?	To what extent have each of the GIF project activities driven new business models or implementation of novel approaches to technologies?	To what extent would the GIF project have been affected without securing IESO funding?	Most Likely Scenario Score
RWDI	Moderate-High	High	Moderate	**83** (Moderate Impact)
The Atmospheric Fund	High	High	High	**95** (High Impact)
TMU	Moderate	High	High	**93** (High Impact)
York University	Moderate	Low	Moderate-Low	**70** (Low Impact)
GE Digital	High	Moderate	Moderate	**86** (Moderate Impact)
Suite of Projects (Average Score)	Moderate	Moderate-High	Moderate	**85** (Moderate Impact)

These findings demonstrate that GIF funding can drive impact/has driven impact for the proponent organization. This was especially the case for projects which demonstrated a high degree of innovation readiness and that their business models or technologies were ready to be scaled and had a demonstrated potential to drive new business, attract investment, and generate impact.

3.3 Return on Investment

Results of the ROI calculations across the suite of projects were varied. In practice several different methodologies were employed to the projects due to their unique contexts and tangible benefits.

As the intention of the GIF program was to spur innovation in the Ontario energy sector, the ROI methodologies had focused on tangible benefits such as energy savings, greenhouse gas emission reduction, etc. Three of the GIF projects focused solely on research and either did not develop a firm business case and/or did not conduct technology demonstrations, which we considered to be *intangible* benefits. While these studies provided important contributions to the body of research in the sector, the efficacy of their business model or solution was not able to be measured. Accordingly, the GIF projects from CUI, TMU and York University were omitted from ROI analysis.

A summary of the ROI analysis is as follows:

Table 24: Projects' ROI

Project	Proponent	Rating
Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario	Canadian Urban Institute	NA*
Local Distributed Energy Resource (DER) Integration and Rental Program Pilot	NRStor (Table 26)	16%
JP II Secondary School Carbon Free Microgrid Energy System	Ameresco Canada (Table 27)	29%
COMPASS: A Benchmarking Tool for Energy Models	RWDI (Table 28)	28%
Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy	The Atmospheric Fund (Table 29)	51%
IESO Distinguished Research Fellows	Toronto Metropolitan University (formerly Ryerson University)	NA*
Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid	York University	NA*
Transactive Energy Network	GE Digital (formerly Opus One Solutions) (Table 30)	28%

*Please note that three projects generated intangible benefits (as defined in Table 1: Terms and Abbreviations) such as promotion of research. As these types of benefits are not able to be tangibly quantified, they were omitted from the ROI analysis.

To visualize more details of the ROI calculations, please refer to Table 44: Calculation of Scaled Variable for Projects and additional details in section 7.5 of this report.

NRStor's Local Distributed Energy Resource (DER) Integration and Rental Program Pilot – ROI 16%

Description of Tangible Benefits and Methodologies:
NRStor's Local Distributed Energy Resource Integration and Rental Program Pilot was the installation of several BTM Tesla battery units in residential homes and one commercial setting in the effort to implement a Virtual Power Plant. The financial benefits measured from this project were the following: Avoided cost of peak energy and reduction in TOU costs for customers, due to the energy arbitrage exhibited by the DER. Avoided capacity costs, due to the VPP's ability to participate in the IESO's capacity auction. Avoided carbon emissions costs, due to the reduction in GHG caused by the project. Finally, deferral in investments in transmission and distribution investments were included due to the VPP's ability to reduce customer interruptions and lessen the load on infrastructure.

Assumptions and Limitation:

NRStor commissioned a data driven study from Power Advisory to calculate the value of this pilot if scaled across Ontario in over the course of eight years by assuming installation of 50,000 units across the province. Guidehouse took the benefits calculated by Power Advisory and instead scaled them to the actual number of units installed, 13. Guidehouse then used that data to calculate the total benefits generated by the pilot units over the course of four years to remain in line with the rest of the ROI calculations. Readers should recognize that this data was extrapolated based on a pilot program in 2022, and that the revenue generated is only compared to the IESO investment ignoring investments and expenditures from other sources, and therefore the ROI measured should be considered an estimation.

Table 25: ROI methodologies employed for NRStor's Local Distributed Energy Resource (DER) Integration and Rental Program Pilot *

Type of Benefit	Methodology Used	Findings
Reduced Energy Consumption	Analysis of Power Advisory Report on Energy Arbitrage	**$1,261** Value of savings caused by decreasing peak demand
Avoided Energy Cost	Analysis of Power Advisory Report on reduction in Customer TOU costs and outages	**$13,312** Value of reduced TOU costs and outage costs for customers
Uptake of New Tool or Technology	Analysis of Power Advisory Report on Capacity Response capabilities	**$50,596** Value of revenue generated from Capacity Auction
Deferral of Utility Transmission and Distribution Investments	Analysis of Power Advisory Report on Utility T&D deferral	**$14,859** Value of revenue generated from reliability benefits of the VPP with regards to infrastructure
Improved DER Integration	Analysis of Power Advisory Report on Reduction of Customer Outages and Utility Reliability	**$390** Value of revenue generated from reliability benefits of the VPP with regards to reductions in outages
Project's Total Net Benefits		**$80,418**

** A full breakdown of the calculations can be seen in Appendix 7.5.*

Relevant Findings:

Guidehouse's analysis of the project highlighted the potential for significant savings from several revenue streams because of new technology. This created several benefits that were found to potentially have large values to both customers and utilities that participated in the pilot.

Considering the large increase in demand projected to occur in Ontario, reductions in peak energy usage shown in Guidehouse's analysis are important to maintain the health of grid infrastructure. Should VPPs like the NRStor be employed across Ontario in other residential areas, we could expect to see large scale benefits to be realized. This case study shows the importance of enabling policies and initiatives to fund integrated DER projects like this one.

Ameresco's JP II Secondary School Carbon Free Microgrid Energy System – ROI 29% Plus[53]

Description of tangible Benefits and Methodologies:
Ameresco's project at JP II was an embedded carbon free microgrid energy system that featured both real time grid islanding and capabilities including the demonstration of transmission grid support as well as additional support services to local distribution companies. Using an 825 kW DC solar Photovoltaic (PV) carport array firmed and supported by a 1.1 MW/2.2MWh Battery Energy Storage System (BESS), this system supplied energy to loads at the school and evaluated the provision of energy and ancillary services to the grid. Aligned with its primary objectives, JP II excelled in reducing GHG emissions as well as reducing energy costs. To measure the reduction in greenhouse gases with a financial metric, Guidehouse employed the Social Cost of Carbon (SCC) methodology. This provides a useful proxy to measure the tangible benefits of GHG emissions for this project to conduct an ROI analysis.

Assumptions and Limitation:
The data used to measure tangible benefits for this project were based on data provided by Ameresco on the project's realized GHG reductions. The respective SCC values were used for each year, discounting them from 2020, which was used as the base year. Readers should note that Guidehouse was given access to data from demonstration tests conducted by Ameresco for IESO. Therefore, the ROI measured should be considered an estimation.

Table 26: ROI methodologies employed for Ameresco's JP II Secondary School Carbon Free Microgrid Energy System*

Type of Benefit	Methodology Used	Findings
GHG Reductions	Social Cost of Carbon	**$176,206** Value of the estimated cost of damages caused by the avoided carbon emissions of this project through electrification.
Sectoral and Regulatory Learnings around efficient DER Integration	Proponent Interview	Intangible Benefit: Learnings around need for communication with LDCs during coordination of BTM assets and the benefits of clearer regulatory guidelines for efficient DER integration.
Project's Total Net Benefits		**$176,206**

** A full breakdown of the calculations can be seen in Appendix 7.5.*

Relevant Findings: This project was able to demonstrate significant reductions in GHG emissions through electrification and DER integration, amounting to a 67% reduction in GHG compared to the baseline values. This proves to be an important finding for the efficacy of this tool and a model. Furthermore, through efficient demand-side load management, the project was able to generate significant energy savings as well. Ameresco's project had several key learnings for the industry. Firstly, the need for communication with LDCs during coordination of BTM assets was underscored. Secondly, clearer regulatory guidelines on matters such as tariffs and rate structures are necessary for efficient DER integration.

[53] Additional intangible benefits that were unable to be quantified can be observed in this project, see Table 27 for example.

Considering the large increase in electricity demand projected to occur in Ontario, the ability to manage demand-side load by deploying behind-the-meter assets through LDCs is paramount to maintaining the resiliency of Ontario's electric grid. As DER uptake increases, the learnings from this project with regards to DER integration shall be crucial in rapid and successful DER integration into the grid.

RWDI's COMPASS: A Benchmarking Tool – ROI 28%

Description of Tangible Benefits and Methodologies:
COMPASS was an energy model benchmarking tool that could be used by developers and architectural firms to upload an analyze the energy profiles of proposed buildings. RWDI stated that proposed models on COMPASS had a 25% reduction in Energy use Intensity (measured as kWh/m^2). To measure this reduction in energy, Guidehouse took the total amount of buildings proposed in the tool and employed a Reduced Energy Consumption calculation to estimate avoided costs and conduct an ROI Analysis. This benefit was calculated over the course of four years to remain in line with the other ROI calculations.

Assumptions and Limitation:
The data used to measure this reduction in energy usage was based on data in a research report RWDI presented on the performance of COMPASS. It makes a conservative assumption that 15% of the buildings in the model are built as specified and experience the reductions calculated in the tools constantly across the four years of analysis. Given the timeframe of the project, energy pricing was based on 2022 values and not extrapolated forward due to a lack of forward-looking pricing data. Due to the nature of this project and its data, this ROI figure should be seen as an estimation to be used to assist decision making.

Table 27: ROI methodologies employed for RWDI's COMPASS: A Benchmarking Tool *

Type of Benefit	Methodology Used	Findings
Reduced Energy Consumption	Avoided Energy Generation	**$104,989** Value of Reduced Energy Consumption over four years
Project's Total Net Benefits		**$104,989**

** A full breakdown of the calculations can be seen in Appendix 7.5.*

Relevant Findings:
This project was able to demonstrate significant theoretical savings of energy consumptions by allowing developers to properly analyze energy efficiency features in their building models.

This project serves as an important case study regarding analysis of energy efficiency measures in buildings in Ontario. Various initiatives have gone forward to emphasize the importance of energy efficiency measures in developments in the sector, and this tool can be used to properly analyze what measures are effective. The COMPASS project underlines the importance of policy makers understanding how certain energy efficiency measures and metrics influence energy consumption.

TAF's Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy– ROI 51%

Description of Tangible Benefits and Methodologies:
TAF designed, implemented, and monitored heat pump retrofits in 11 buildings in the Greater Toronto Area (GTA) pilots to increase their energy efficiency, thus leading to energy savings and GHG reductions. To measure the reduction in Green House Gases with a financial metric, Guidehouse employed the Social Cost of Carbon methodology. This provides a useful proxy to measure the tangible benefits of GHG emissions for this project to conduct an ROI analysis. To calculate reduced energy consumption, the avoided energy generation, as provided by TAF, was multiplied by the average TOU price for residential customers in Toronto.

Assumptions and Limitation: The data used for these calculations assumes that TAF had four years of consistent operations. Furthermore, normal energy pricing (average pricing without disruptions) is also assumed when calculating reduced energy consumption, which is the average TOU price for residential customers, not accounting for any unexpected price fluctuations due to extraneous circumstances such as natural calamities, supply chain issues, or regulatory changes. Therefore, the ROI measured should be considered an estimation.

Table 28: ROI methodologies employed for TAF's Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy*

Type of Benefit	Methodology Used	Findings
GHG Reductions	Social Cost of Carbon	**$33,456** Value of the estimated cost of damages caused by the avoided carbon emissions of this project through energy efficiency.
Reduced Energy Consumption	Avoided Costs	**$141,010** Value of avoided energy costs across all buildings within a 2-year period
Project's Total Net Benefits		**$174,466**

** A full breakdown of the calculations can be seen in Appendix 7.5.*

Relevant Findings: This project was able to demonstrate significant energy efficiency because of the deep retrofits, amounting to a 40% reduction in energy consumption compared to the baseline values. Furthermore, it led to significant GHG reductions, reducing 68 tonnes of CO_2-equivalent annually.

Considering the skepticism around the feasibility of heat pump retrofits in cold climates like Toronto's, TAF's project serves as an important case study to dispel that myth and change the discourse in industry. TAF is rapidly expanding their project portfolio in Toronto, and should similar models be employed across Ontario, we could expect similar benefits to be realized and scaled. This also underscores the importance of enabling policies like incentives for heat pumps, particularly at the provincial level, to improve the scope and reach of deep retrofits of heat pumps.

GE Digital's Transactive Energy Network – ROI 28%

Description of Tangible Benefits and Methodologies

GE Digital's Transactive Energy network project implemented several pilot simulation tests to showcase the value of its DLMP based transactive energy network using real world LDC data. To measure financial benefits of this network, Guidehouse took the financial benefit data from different simulation scenarios, and then extrapolated over the course of four years at the three different LDCs that GE worked with. This provided a useful benchmark to compare the ROI with other projects.

Assumptions and Limitation:
The data used to measure the benefits for this project were based off simulation data that only featured a 24-hour time frame. Guidehouse extrapolated the data over the course of a year by fitting a normal curve to the different loading scenarios exhibited in the simulation and then summing the daily value generated. Guidehouse was not able to measure the other benefits that the project generated such as deferral of infrastructure or reduction of outages due to a lack of data as the project was only a pilot. Therefore, readers should recognize that this ROI is an estimation that can be used for decision making.

Table 29: ROI methodologies employed for GE Digital's Transactive Energy Network*

Type of Benefit	Methodology Used	Findings
Avoided Energy Costs	Analysis of GE Digital Simulation Data	**$295,463** Value of reduced costs in electricity due to DLMP algorithm managing dispatch of assets
Project's Total Net Benefits		**$295,463**

** A full breakdown of the calculations can be seen in Appendix 7.5.*

Relevant Findings:

This project is high value in terms of both scaled ROI as well as benefits to the sector. Although only a simulation, this pilot provided a better understanding of what a distribution market could look like in the future, which is an increasingly important conversation for the energy transition. This project shows that transactive energy is feasible and can be quantified in terms of financial revenue. Given Ontario's interest in the integration of DERs as well as decreasing peak demand, this case study lends credence to the strategy of using transactive energy as a method to achieve these goals. This project serves as a case study for transactive energy to be applied across the province and underlines the importance of changing the policy landscape to allow projects like these to be implemented in jurisdictions across the province.

4 Evaluation and Assessment of Projects: Analysis of Driving the Sector's Future

This section presents the assessment of how the projects were able to contribute to IESO's core strategy to "Drive & Guide the Sector's Future". Using the Energy Sector Impact Matrix, Guidehouse analyzed each project (or suite of projects) against six key criteria, characterizing the criteria as one of the following: high, moderate, low, or not applicable (N/A) – in regard to their overall contribution to the IESO's strategy. This resulted in a final overall rating which is expressed as a High, Moderate, or Low alongside a score of 0-100. For more details about the characteristics that distinguish each rating (from high, moderate, or low on any criteria), please see the Energy Sector Impact Matrix.

Table 31 contains an overview of the project and suite of project ratings, while the subsequent subsections from 4.1 to 4.9 contain detail breakdowns along each impact category selected.

Table 30: Projects' overall rating towards "Drive & Guide the Sector's Future."

Project	Proponent	Rating	Location in Document
Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario	Canadian Urban Institute	Low (31%)	Table 32
Local Distributed Energy Resource (DER) Integration and Rental Program Pilot	NRStor	High (88%)	Table 33
JP II Secondary School Carbon Free Microgrid Energy System	Ameresco Canada	High (100%)	Table 34
COMPASS: A Benchmarking Tool for Energy Models	RWDI	Moderate (69%)	Table 35
Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy	The Atmospheric Fund	High (97%)	Table 36
IESO Distinguished Research Fellows	Toronto Metropolitan University (formerly Ryerson University)	High (93%)	Table 37
Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid	York University	Moderate (60%)	Table 38
Transactive Energy Network	GE Digital (formerly Opus One Solutions)	Moderate (69%)	Table 39
Suite of Projects	All Proponents	Moderate (76%)	Table 40

4.1 Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario

Canadian Urban Institute's Rating: Low (31%)

Table 31: CUI's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of Canadian Urban Institute's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Low	CUI established a partnership with the Ontario Clean Water Agency (OCWA), the University of Toronto, through which they were able to receive funding. However, based on available information, there were no tailored strategies to engage with the larger communities CUI was working in.
Canadian Urban Institute's ability to identify and adapt to evolving customer preferences.	High	CUI took the initiative to conduct workshops with water distribution system operators in three municipalities to show them the results of CUI's simulations and train them on how to use CUI's tool. They also incorporated feedback from them to modify the tool to make it easier for their customers to use the tool.
Canadian Urban Institute's ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	CUI's work was not affected by any policies or regulations.
Canadian Urban Institute's contribution to discussions and actions shaping the future-state sustainable energy system.	Low	CUI's project opened the dialogue on the possibility of increasing energy efficiency in water distribution systems using simple tools. They also lay the foundation for the eventual development of a commercially available tool for this function. That said, due to their capacity constraints, they could not take this project past the pilot phase.
Canadian Urban Institute's ability to cope with changing environments and future threats.	Low	CUI was unable to deal with identified capacity constraints to develop their tool into a commercially viable version. CUI identified it would need to either reorganize internally to make it feasible to continue development, hire more resources to do so, outsource the development of the tool to an external organization, or partnering with an industry partner with the capacity and resources to build on CUI's work. Ultimately, none of these avenues were deemed appropriate for CUI at this point.
Canadian Urban Institute's ability to sustain the project into the future, and to secure achievements beyond the completion of the project itself. [54]	Low	CUI was able to create a partnership with OCWA and conduct workshops about their tool through Zoom conferencing with managers and operators of the following water systems, along with representatives of the local utilities and Ward councillors: 1. Saugeen Shores 2. Lambton Area Water Supply System 3. Tri-county Water Supply System

[54] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
Canadian Urban Institute's capacity to embrace and utilize new technology.	Moderate	Even though CUI were not able to take the tool to commercialization due to capacity restraints, they have helped develop a new technology which can be built upon and widely utilized.

4.2 Local Distributed Energy Resource (DER) Integration and Rental Program Pilot

NRStor's Rating: High (88%)

Table 32: NRStor's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of NRStor's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Low	Based on the information in their report, NRStor did not sufficiently engage with their stakeholders and develop their relationships for future projects. THESL was only engaged to help determine customers. Enbridge and Union were not solicited for feedback. Tesla was only involved insomuch as their battery was the one being installed by Mpower. This was very much an NRStor project, on which they only utilized their own expertise and knowledge with little input from stakeholders.
NRStor's ability to identify and adapt to evolving customer preferences.	High	NRStor commissioned and acted according to a full and comprehensive market research report that surveyed over 2000 people across the province. They also continued to integrate customer feedback into their product offering while doing research on the average consumer's level of knowledge and enthusiasm towards residential energy storage.
NRStor's ability to identify and adapt to evolving Policy and Regulatory landscape.	High	NRStor successfully navigated many different changing codes and policies that had to do with the installation and operation of their battery installations. They also actively worked to guide policy within the sector to their benefit by contacting regulatory bodies.
NRStor's contribution to discussions and actions shaping the future-state sustainable energy system.	High	Several utilities have already reached out to replicate this pilot. It has informed policy regarding the way distributors can utilize BTM storage. This project is expanding and reaching out to new partners and is expected to be in use in new regions in the future.
NRStor's ability to cope with changing environments and future threats.	Moderate	NRStor was able to educate and sell to a customer base that had very limited knowledge of energy storage. They were able to acquire more customers than expected and install and operate units easily and effectively. However, there were issues involving regulations and utilities which they have attributed to "red tape" and regulatory bodies not properly understanding DERs.

Description	Rating	Explanation
NRStor's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [55]	High	NRStor has received interest from many new partners and due to the project running over budget, it has already proven that it and its existing partners have the funds necessary to run the project.
NRStor's capacity to embrace and utilize new technology.	High	VPPs and in-home energy storage are already taking off across Ontario and this project only further pushes this concept into viability. NRStor is a proven player in this space and has commissioned a great deal of research to show the benefits of large-scale adoption of residential VPPs.

4.3 JP II Secondary School Carbon Free Microgrid Energy System

Ameresco Canada's Rating: High (100%)

Table 33: Ameresco's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of Ameresco Canada's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	High	Ameresco has displayed persistence, understanding, and commitment to their goals in their stakeholder engagement. They have used this project as an opportunity to develop new relationships with key partners as well as strengthen pre-existing relationships. These relationships are going to be crucial as they seek to aggressively expand their project portfolio. Even when they have had disagreements with London Hydro, they have carried out conflict resolution in a respectful manner, whilst holding their ground and making their case. Furthermore, Ameresco has also helped set up the school as a resiliency centre for the larger London community, thus benefiting the public in the region through their project as well.
Ameresco Canada's ability to identify and adapt to evolving customer preferences.	High	Ameresco was very mindful of LDCSB's needs and preferences and factored them in well and consistently throughout the project. Ameresco shared their work schedules and project designs with LDCSB so that the scope of work was planned without interrupting school activities. LDCSB's feedback and recommendations were incorporated into Ameresco's project design and project planning.

[55] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
Ameresco Canada's ability to identify and adapt to evolving Policy and Regulatory landscape.	High	Ameresco effectively addressed the rate misclassification issue, taking all the recourses they had at their disposal, while still appreciating the work LH was doing with them. This prevented matters from escalating to a point where the project had to be disrupted. While Ameresco would have liked to engage more extensively in policy dialogue, they were able to work with the OEB in clarifying the rate misclassification issue. This demonstrates a considerable accomplishment on part of Ameresco.
Ameresco Canada's contribution to discussions and actions shaping the future-state sustainable energy system.	High	Ameresco's project itself has spurred a lot of conversations about the market participation of loads through LDCs. It is worth noting that they themselves have not intentionally started or sustained any of these discussions due to lack of capacity. However, they do want to change this moving forward.
Ameresco Canada's ability to cope with changing environments and future threats.	High	Ameresco has developed an elaborate method for them to account for and respond to changing environments and future threats. Policy and regulation changes could pose challenges to their work. Their project helped start conversations about these policies and regulations and Ameresco is trying to get more involved in such discussions to have a greater influence in such matters.
Ameresco Canada's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [56]	High	Ameresco has met great success on this project and are committed to taking this project—along with many others like it—Into the future. They also have demonstrated interest from both investors as well as prospective customers.
Ameresco Canada's capacity to embrace and utilize new technology.	High	Ameresco is championing mass adoption of this novel technology, which shall help alleviate the load on the grid and significantly increase the efficiency of DER integration into both the provincial and national grids.

4.4 COMPASS: A Benchmarking Tool for Energy Models

RWDI's Rating: Moderate (69%)

Table 34: RWDI's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of RWDI's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Moderate	RWDI has a good selection of stakeholders and community members that were involved throughout the project. However, there was no formal or rigorous process to gain input from these stakeholders.

[56] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
RWDI’s ability to identify and adapt to evolving customer preferences.	High	RWDI's Compass tool was built using customer data. RWDI's team recalibrated their design process by taking iterative feedback on wireframes rather than less-frequent feedback on final versions. In doing so, customers were involved throughout the entire project lifecycle.
RWDI’s ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	In the case of this project, there was no substantial policy impact. The project did face challenges that required adaptation, but this was due to program-level changes.
RWDI’s contribution to discussions and actions shaping the future-state sustainable energy system.	Moderate	The Compass project was presented at many industry conferences, webinars, workshops, and meetings across the entire Ontario energy industry. Their project was able to garner future-looking interest from municipalities and stakeholders outside of their original purview. They are considering further funding and business opportunities to promote a model which could be scaled more broadly.
RWDI’s ability to cope with changing environments and future threats.	Moderate	RWDI has developed a design process that is built on consistent and iterative feedback from its customer base, which prepares them well to cope with changing environments and future threats. Their model however did not seem particularly proactive from a risk mitigation point of view, as it did not consider risks beyond their traditional scope.
RWDI’s ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [57]	Moderate	RWDI has a tool that the market has shown demand for, and their design processes are resilient in keeping up with the demands of the future. However, they have not been very aggressive to pursue this as a business opportunity, which might hinder their growth in the absence of funding from institutional entities like the IESO.
RWDI’s capacity to embrace and utilize new technology.	High	RWDI's tool is novel in the industry and the industry has shown an appetite for this technology as well. With increasing needs for improving energy efficiency in the built environment, their tool could become widely adopted.

4.5 Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy

The Atmospheric Fund’s Rating: High (97%)

Table 35: TAF's "Drive and Guide the Sector" Rating

Description	Rating	Explanation

[57] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Quality and depth of The Atmospheric Fund's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	High	TAF dedicated a lot of time and effort to liaising with important stakeholders in government and industry to ensure that their program's potential is fully harnessed from a technical, as well as societal perspective. TAF has a dedicated policy team that focuses on such advocacy. TAF's efforts led to them authoring a letter of recommendation, along with HVAC industry leaders, around incentives for deep retrofits in Ontario to fulfill the government's Made-in-Ontario Environment Plan. They also tried to change existing discouraging discourse on heat pump retrofits in cold climates to pave the way for their own expansion as well as similar projects like theirs. TAF went to great lengths to ensure that the needs of the communities they served were considered in their project. A lot of buildings that TAF worked with as part of this project were part of community housing. They ensured that they were only working with building management that was engaging in any exploitative behavior with their residents and voiced residents' complaints to building management to facilitate necessary renovations.
The Atmospheric Fund's ability to identify and adapt to evolving customer preferences.	High	TAF went to great lengths to ensure that their customers'—building management as well residents—needs were considered in their project. For the former, they presented compelling economics to make a case for deep retrofits and quelled any concerns they might have had. For the latter, they ensured that they were only working with building management that was engaging in any exploitative behavior with their residents and voiced residents' complaints to building management to facilitate necessary renovations.
The Atmospheric Fund's ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	TAF is cognizant of the policy gaps that are hindering a wider rollout of deep retrofits to their full potential. They have also played an active role in shaping the policy landscape in Ontario. TAF has a dedicated policy team that focusses on such advocacy. TAF's efforts led to them authoring a letter of recommendation along with HVAC industry leaders around incentives for deep retrofits in Ontario to fulfill the government's Made-in-Ontario Environment Plan. They also tried to change existing discouraging discourse on heat pump retrofits in cold climates to pave the way for their own expansion as well as similar projects like theirs.

The Atmospheric Fund’s contribution to discussions and actions shaping the future-state sustainable energy system.	High	In the face of skepticism by many in the sector, TAF pushed the envelope on leading industry groups in discussions around what HVAC policy needs to ensure that deep retrofits can be pursued at scale in Canada. TAF has a dedicated policy team that focusses on such advocacy. TAF's efforts led to them authoring a letter of recommendation along with HVAC industry leaders around incentives for deep retrofits in Ontario to fulfill the government's Made-in-Ontario Environment Plan. They also tried to change existing discouraging discourse on heat pump retrofits in cold climates by displaying a successful demonstration, paving the way for their own expansion, and setting the precedent for similar projects like theirs.
The Atmospheric Fund’s ability to cope with changing environments and future threats.	Moderate	TAF demonstrated that they were agile in trying to address future challenges. One limitation, which is perhaps outside of their scope, is that continued success on projects such as this one will require advocacy and possibly policy measures which promote the benefits of deep retrofits in Canada, the need for deep retrofits in residential buildings, as well as funding to continue to make advances in the area. They have been proactive and learned from the experience, adapting to unforeseen circumstances outside of their control such as working with building owners who charged higher rent following retrofits.
The Atmospheric Fund’s ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [58]	High	TAF has demonstrated the effectiveness of their product to their customers. They have a well-structured business model that works at scale. They have also secured a lot of funding to actively pursue this rapid expansion. TAF is also cognizant of all the challenges they face and are actively participating in policy and industry discussions to bring about change in this regard. TAF's project has successfully commercialized the technology by serving as a case study for deep retrofits that utilize heat pumps in cold climates, paving the path for increased adoption of this technology. TAF has also attracted $13.5 million in additional investments to help scale and rapidly expand their project at a provincial level, far beyond the initial scope of the project. The project has already created jobs for the province and promises to continue doing so as it pursues its expansion.
The Atmospheric Fund’s capacity to embrace and utilize new technology.	High	TAF has served as a case study for deep retrofits using heat pumps in colder climates. Through their successful implementation, active engagement in policy and industry discussions about the matter, as well as ability to secure funding for expansion, they have paved the way for rapid adoption of this new technology at a provincial level.

[58] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

4.6 IESO Distinguished Research Fellows

TMU's Rating: High (93%)

Table 36: TMU's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of TMU's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Moderate	TMU had regular meetings with the IESO who directly commissioned and funded the research. They also regularly contacted other industry vendors and stakeholders for their costs to factor into the case studies which led into their actual implementation of this research.
TMU's ability to identify and adapt to evolving customer preferences.	N/A	This project was guided and commissioned directly by IESO and was not in response to any customer need that TMU assessed.
TMU's ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	This project was guided and commissioned directly by IESO and was not in response to any policy or regulatory change that TMU assessed.
TMU's contribution to discussions and actions shaping the future-state sustainable energy system.	High	TMU has directly been in contact with multiple utilities, regulatory and governmental bodies, and other organizations on an international scale. They've directly translated their research into real world technology projects based on these partnerships and are continuing to implement innovative solutions across Ontario. In addition, TMU is using this program to influence the future of the sector. Members of the project were invited to participate in the Energy Transition Panel to help determine policy for the electrification of Toronto.
TMU's ability to cope with changing environments and future threats.	N/A	TMU did not encounter any significant issues or risks and as such, it did not have the ability to demonstrate its ability to be agile or handle adversity.
TMU's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [59]	High	TMU has demonstrated the ability to find new partnerships to implement technologies and products based on these white papers. It has already started working with both THESL and Toronto Community Housing on projects that have been commissioned and sponsored without assistance from the IESO. This pilot was able to create seven new, part-time jobs for post-doctoral fellows and Grad Students, as well as new research within its lab to address problems facing the energy grid.

[59] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
TMU's capacity to embrace and utilize new technology.	High	This pilot project has resulted in the creation of a lab where other entities can sponsor studies and the implementation of new technologies in the sector. TMU is directly translating cutting edge research into products that are working to transform the grid.

4.7 Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid

York University's Rating: Moderate (60%)

Table 37: York University's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of York University's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	High	York University worked with different stakeholders such as Alectra, CUTRIC, YRT, MiWay, Brampton Transit and Oakville Hydro that would help inform their municipal councils and transit authorities. York University's project did not move past a research/conceptual level, therefore, in the future, it would be beneficial for York University to engage in community outreach.
York University's ability to identify and adapt to evolving customer preferences.	N/A	This project did not reach a commercialized stage. Therefore, their consideration of customer preferences was not utilized or applicable.
York University's ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	The project did not reach commercialisation. Therefore, there were no policy or regulatory challenges faced by the project.
York University's contribution to discussions and actions shaping the future-state sustainable energy system.	Moderate	York University had some limited participation in energy dialogues, but with minimal influence on the broader discussion. They were able to share some of their findings published in IEEE and Nature, which is notable. York University's work on the Optimization Toolbox has been discussed within the context of the energy transition and efficient electrification for bus fleets at a couple of presentations and conferences. It has yet to understand, and clearly discern, the roles of consumers and utilities, and other relevant electricity sector topics.
York University's ability to cope with changing environments and future threats.	N/A	This project did not move past a research/conceptual level. York University explained that because they do not have tangible plans to commercialize this technology, it didn't consider its application in practice and did not address resiliency and adaptability to future needs.

Description	Rating	Explanation
York University's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [60]	Moderate	York University and the lab at which this research was undertaken have raised funding since the project, although not specifically for this project. The project was never commercialized, and the project leads have no intentions of pursuing it commercially in the future either. That said, their research has been published in industry-leading journals, which could perhaps lead to future uptake, even if by a different entity.
York University's capacity to embrace and utilize new technology.	Low	This project promotes the adoption of a novel technology that would lead to significant GHG emission reductions within the province's transit bus fleets. However, high capital investment costs along with no intentions or plan to continue commercializing the ideas means that it is unlikely that this technology will ever be used in real life.

4.8 Transactive Energy Network

GE Digital's Rating: Moderate (69%)

Table 38: GE's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of GE Digital's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Moderate	The project only progressed to the point where simulated deployments had occurred, the stakeholder LDCs indicated various regulatory and policy changes would need to occur in order for clear quantified business cases to be made for the operation of this project. The proponents took the feedback into consideration, and used it to implement changes to the software, but not major changes to the actual pilot.
GE Digital's ability to identify and adapt to evolving customer preferences.	N/A	No direct compensation or dispatch was included within the scope of the pilot due to its simulated nature.
GE Digital's ability to identify and adapt to evolving Policy and Regulatory landscape.	N/A	The pilot determined that the regulatory landscape to commercialize this project currently does not exist. GE Digital has determined that specific policy changes to need to be put in place before this project could be financially implemented.

[60] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
GE Digital's contribution to discussions and actions shaping the future-state sustainable energy system.	Moderate	The project has managed to attract many different international partners who are trying to implement DLMP-based transactive energy networks in their jurisdictions. Although it was not showcased at conferences or cited in journals, this project had an undeniable effect in proving the viability of transactive energy.
GE Digital's ability to cope with changing environments and future threats.	Low	The pilot's deployment was contained entirely within a simulation. It only had to deal with simulated data and the only risk was that this data was not robust enough.
GE Digital's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. [61]	High	GE Digital has shown that they can attract new partners and customers who are interested in the implementation of this technology. However, the implementation of any transactive energy project at scale relies on changes in policy to support the endeavour.
GE Digital's capacity to embrace and utilize new technology.	Moderate	GE Digital has used this project to springboard the discussion when it comes to the implementation of Transactive Energy Networks. They've paved the way for other projects in this area to be implemented and worked directly with LDCs to be able to determine exactly how to best implement this technology.

[61] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

4.9 Analysis of the Suite of Projects

Suite of Project's Rating: Moderate (76%)

Table 39: Suite of Project's "Drive and Guide the Sector" Rating

Description	Rating	Explanation
Quality and depth of Suite of Project's engagement with stakeholders, local and/or underserved communities, or indigenous communities.	Moderate	Across this suite of GIF projects, there is a wide spectrum of stakeholder engagement. Most projects involved some level of engagement/partnership from external stakeholders, be they private corporations, industry groups, governments, or civil society organizations. Some projects went above and beyond the scope of the project to work with the communities they were serving, helping advocate for their needs to higher authorities and adapting project implementation to the communities' benefit. There were also some projects that had limited engagement in this regard, although that could be partly attributed to differing goals of the project itself, such as those with a focus on research rather than implementation or program delivery.
Suite of Project's ability to identify and adapt to evolving customer preferences.	High	Nearly all projects within this suite of GIF funding that involved program delivery and, therefore, engagement with customers, displayed a great ability to identify and adapt to the evolving preferences of their customers. These projects consistently sought feedback from customers and ensured that their needs were accounted for in project design, project planning, as well as the final product itself. It is worth noting that the only projects that did not do so were research-focused pilot projects without a customer-facing component to them.
Suite of Projects' ability to identify and adapt to evolving Policy and Regulatory landscape.	High	Several projects within this suite of funding faced regulatory and policy issues due to their innovative nature. Others, like TMU or York University's white papers, were purely theoretical and did not have to deal with issues of this type. CUI and RWDI did not have to deal with any policy issues during their projects due to a lack of commercialization in the case of CUI, and no policies directly impacting the RWDI's Compass project. Ameresco ran into hurdles involving rate classification and operational issues with the LDC but were able to overcome them and are working towards finding solutions for the broader sector. Both TAF and NRStor actively worked to influence policy makers and regulators to push forward rules and laws that would enable their projects.

Description	Rating	Explanation
Suite of Project's contribution to discussions and actions shaping the future-state sustainable energy system.	Moderate-High	The projects that were part of this suite of GIF funding all contributed to discussions and actions to shape the future-state of the sustainable energy system in Ontario. All projects presented their work at workshops, conferences, and webinars to important stakeholders such as industry groups, governments, financiers, and potential customers, not just in Ontario, but across Canada and even the world. Their work was recognised in industry-leading journals as well as renowned media outlets. The novelty of their projects meant that they often spurred important conversations in the industry, such as the highlighting the evolving role of the LDC and the need for transmission-distribution communication ***(***Ameresco), the possibilities of incorporating a DLMP-based model for Transactive Energy (GE Digital), or the possibility of electrifying the province's transit systems (York University). Some projects went above and beyond in their contributions to this dialogue by having dedicated efforts to engage with policymakers as well. TAF not only changed discourse around the feasibility of deep retrofits for heat pumps in Canada but also wrote a letter of recommendation to the federal government to enact policies to improve the business case for deep retrofits. TMU's scholarship led members of the project to be invited to participate in Energy Transition Panel by the Ministry of Energy to help inform the province's electrification policy.
Suite of Project's ability to cope with changing environments and future threats.	Moderate	Most projects within the suite displayed an ability to cope with changing environments and future threats through dynamism in their project planning. However, some projects faced unexpected regulatory hurdles, while the research-focused projects did not move past the conceptual phase.
Suite of Project's ability to sustain project into the future, and ability to secure achievements beyond the completion of the project itself.[62]	Moderate-High	Most projects looked at in this report were able to use this pilot as a steppingstone to create additional market effects. Many of them were able to use the learnings and project results to form new partnerships or acquire more funding. NRStor, RWDI, Ameresco, TAF, Opus One (later acquired by GE Digital), and TMU were all able to reach out to new investors and partners regarding the results of their IESO projects. Of these proponents, TMU, NRStor, GE Digital, RWDI, TAF and Ameresco are all actively working on further similar projects in Ontario and beyond, some of them fully commercialized and others still pushing for technology adoption. Some projects however faced challenges that prevented the organization from going any further with the GIF project or securing achievements. Both CUI and York University struggled with commercializing their IESO projects and moving beyond the research level.

[62] (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.)

Description	Rating	Explanation
Suite of Project's capacity to embrace and utilize new technology.	Moderate-High	All projects displayed the possibilities of embracing and utilising new technologies in Ontario's grid. Projects like Ameresco, NRStor, RWDI, TAF, and TMU have successfully demonstrated the market's appetite for their technologies. With continued financial backing and policy support, their technologies are poised for widespread adoption. Although CUI was unable to commercialise their technology due to capacity constraints, they have demonstrated the effectiveness and feasibility of energy efficiency in water distribution systems. GE Digital's demonstrations have shown that the regulatory landscape is not ready for their technology, they have used this project to springboard the discussion on the best ways to implement Transactive Energy networks in Ontario. While the high capital costs of technology impede implementation, York University's project showed the possibilities of GHG reductions that can be achieved through transit electrification in the province.

5 Project Specific Recommendations

Considering that these GIF projects conducted simulations, demonstrations, or other types of pilots, there are continued opportunities for the projects to expand their scope by using project learnings and sharing them in the broader sector. This could be done by utilizing learnings to further inform regulatory and policy discussions. In this section, we elaborate on ways in which each of the GIF projects could further contribute to regulatory or policy discussions by providing some recommendations into the future.

5.1 Improving Electricity Conservation in Small-Medium Municipal Water Distribution Systems across Ontario

CUI's project identified the possibilities of achieving energy efficiency in municipal water distribution systems. Through their simulations, it is evident that these savings can be achieved through a simple tool. While they were not able to take the tool to commercialization due to capacity restraints, they have set the path for another entity to build on this work in the future.

CUI’s research provides detailed analyses of energy use and efficiency in several municipal water distribution systems in Ontario, focusing on the Lambton Area Water Supply System (LAWSS), Saugeen Shores, and Tri-County case studies. It includes comprehensive studies on current energy metrics, efficiency, and potential improvements for each system.

For the LAWSS case study, the report found an average energy efficiency of 28%, with inefficiencies primarily due to energy dissipation at pumps. An improved scenario was proposed by adjusting pump controls and Variable Frequency Drive (VFD) speed settings, leading to a 6.5% reduction in energy consumption and significant cost savings.

In the Saugeen Shores case study, an energy efficiency of 75% was identified, with inefficiencies again mainly due to pumps. By adjusting pump and tank controls, an 8% reduction in energy consumption was achieved, equivalent to considerable annual electricity cost savings.

The Tri-County case study revealed an average energy efficiency of 48%, with most inefficiency due to energy dissipation at pumps and a flow control valve. An improved scenario with the addition of a VFD led to a 5.2% reduction in energy consumption, resulting in notable annual electricity cost savings.

To contribute to regulatory and policy discussions and enhance the uptake of innovative technologies and solutions in Ontario, the project can:

- **Showcase Successful Case Studies:** Present the findings and successful implementation of energy-saving measures in these case studies to regulatory bodies and policymakers. This can demonstrate the potential for widespread energy conservation in water distribution systems.
- **Collaborate with Regulatory Agencies:** Work with regulatory agencies to integrate these energy-saving strategies into broader regulatory frameworks, encouraging other municipalities to adopt similar measures.
- **Develop Guidelines and Best Practices:** Create comprehensive guidelines and best practices documents based on the study's findings, assisting other municipalities in identifying and implementing energy conservation opportunities.
- **Conduct Workshops and Seminars:** Host educational workshops and seminars for municipalities and other stakeholders to disseminate knowledge about the tools and methodologies used in the study.

- **Engage in Pilot Projects:** Partner with other municipalities to implement pilot projects, using the study's methodologies to optimize their water distribution systems and demonstrate the benefits in various contexts.
- **Leverage Technology and Innovation:** Explore further technological advancements, such as advanced data analytics and AI, to optimize water distribution systems, and share these developments with policymakers to support the adoption of innovative solutions.
- **Policy Advocacy:** Advocate for policies that incentivize energy efficiency in municipal water systems, such as grants or tax incentives for municipalities that implement energy-saving measures.

By focusing on these strategies, the project can significantly influence the regulatory landscape and promote the broader adoption of efficient and sustainable practices in water distribution across Ontario.

5.2 Local Distributed Energy Resource (DER) Integration and Rental Program Pilot

NRStor, in partnership with other entities, has launched Canada's first major residential battery rental program in a densely populated and electrically congested neighborhood in Toronto. This project aims to provide affordable resilience to homeowners and deliver local and system-wide services to reduce electricity costs and emissions, thus avoiding costly substation upgrade infrastructure. The initiative supports Toronto’s sustainability targets and involves strategic siting of Tesla Powerwall units connected to the Cecil Street substation, acting as a decentralized battery.

NRStor demonstrated concerted efforts in regulatory engagement related to the Cecil non-wires alternative pilot. Their efforts focused on addressing technical, commercial, and regulatory challenges for home batteries and Distributed Energy Resources (DERs). The primary audiences for these regulatory efforts were the IESO, the OEB, Ontario LDCs, municipalities, and various industry groups. The summary includes details about the Cecil non-wires alternative pilot, which has been instrumental in enabling regulatory changes for home batteries and DERs in Ontario and across Canada.

This project's findings on the viability and demand for residential battery storage and virtual power plants can inform discussions regarding DER integration across the grid. It also can be used to examine the legislation and policy regarding the operation of BTM storage by distributors and the ways that this storage can be utilized.

For NRStor to further contribute to regulatory and policy discussions and enhance the broader uptake of innovative technology and solutions in Ontario, the following recommendations are proposed:

- **Expand Partnerships and Collaboration**: Engage with more local distribution companies (LDCs) and municipalities across Ontario to replicate successful pilots, promoting the benefits of home battery non-wires pilots.
- **Policy Advocacy and Regulatory Engagement**: Continue active participation in various industry working groups and regulatory bodies to shape policies that are favorable to the adoption of DERs and home battery systems.
- **Educational Initiatives and Workshops**: Host workshops and seminars to educate stakeholders, including utilities in other regions or provinces, on the learnings and successes of the project.

- **Demonstration and Documentation of Success Stories:** Document and publish detailed case studies demonstrating the success and impact of the Cecil non-wires alternative pilot and similar projects, to serve as persuasive evidence for policymakers and industry peers.
- **Leverage Public-Private Partnerships:** Strengthen collaborations with federal agencies, such as NRCan and CIB, to gain support and funding for expanding the scope of pilot projects.
- **Innovative Business Models:** Experiment with and advocate for new business models like battery rental programs, which can make energy storage affordable and accessible to a broader range of customers.
- **Engage in Policy Development for Energy Storage:** Participate in the development of codes and standards related to residential battery storage to ensure they are conducive to the growth of the storage industry.
- **Promote Grid Modernization Initiatives**: Advocate for grid modernization that incorporates DERs and home battery systems as key components, emphasizing their role in enhancing grid resilience and efficiency.

By focusing on these areas, NRStor can significantly influence the regulatory landscape and promote the adoption of innovative energy solutions in Ontario.

5.3 Program JP II Secondary School Carbon Free Microgrid Energy System

Ameresco's project served as a demonstration for how LDCs can help support loads become effective market participants in the grid. This has generated a lot of demonstrated interest from potential customers which, coupled with $100 million in debt funding from CIB, shall help Ameresco increase the broader uptake of DERs as well as microgrids in Ontario. Perhaps the biggest obstacle that Ameresco faced during its project was the rate misclassification with London Hydro, which other players would face as well. Although Ameresco did escalate the matter to the OEB, that was only for their specific case. Due to capacity constraints, Ameresco has not been able to participate in larger regulatory or policy discussions. There is a lot of potential for Ameresco to develop this area to bring about systemic change in this regard.
To further contribute to regulatory and policy discussions and enhance the uptake of innovative technology in Ontario, the following recommendations are proposed:

- **Engage in Policy Advocacy:** Actively participate in discussions with regulatory bodies to advocate for changes in market rules and regulations that better accommodate behind-the-meter assets.
- **Educational Outreach:** Conduct workshops, seminars, and tours of the finished project to educate stakeholders about the capabilities and benefits of behind-the-meter technologies.
- **Advocate for Transparency in Rate Classifications**: Work towards ensuring that utilities provide clear and accessible information on rate classifications and their implications for project economics.
- **Promote Demand Control Technologies**: Encourage the adoption and use of demand control technologies, emphasizing the role of utilities in making real-time demand data available to consumers.
- **Partnerships for Technology Development:** Form partnerships with technology providers and research institutions to develop and refine technologies that support the integration of behind-the-meter assets.

By focusing on these strategies, the Ameresco project can play a crucial role in shaping the future of Ontario's electricity sector, promoting sustainable and efficient energy solutions.

5.4 COMPASS: A Benchmarking Tool for Energy Models

The tools developed by this project help analyze the actual energy efficiencies in new ways via these models. This innovative way of viewing these models allows for broader conversations on how to promote the solving of these inefficiencies at a policy and technological level. The following are recommendations that RWDI could take to further engage with the policy and regulatory landscape:

- **Expand Collaborations:** Continue to strengthen collaborations with municipalities, regulatory bodies, and industry associations to ensure the tool aligns with current needs and standards.
- **Educational and Training Programs**: Develop educational programs and training sessions for industry professionals on the use of the Energy Benchmarking Tool, emphasizing its benefits in energy conservation and efficiency.
- **Enhance Tool Accessibility and Functionality:** Work on making the tool more user-friendly and accessible to a broader range of users, including small-scale builders and designers.
- **Address Confidentiality and Data Security**: Prioritize addressing data confidentiality and security concerns, ensuring that the tool adheres to privacy regulations and builds trust among users. Establishing appropriate data handling and confidentiality mechanisms will also be crucial for harvesting data ethically to demonstrate efficacy of project.
- **Promote Policy Integration:** Advocate for the integration of the tool into municipal and provincial building standards and programs, emphasizing its role in achieving energy efficiency targets.
- **Leverage Industry Feedback:** Utilize feedback from beta testing and industry engagement to continuously improve the tool and adapt it to changing market and regulatory requirements.
- **Showcase Success Stories:** Document and share successful case studies and benchmarks achieved using the tool to demonstrate its practical benefits and encourage wider adoption.

By implementing these strategies, the RWDI project can further influence Ontario's electricity sector, particularly in promoting energy-efficient building designs and practices.

5.5 Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy

TAF's project has successfully commercialized the technology by serving as a case study for deep retrofits for heat pumps in cold climates, paving the path for increased adoption of this technology. TAF has also attracted $13.5 million in additional investments to help scale and rapidly expand their project at a provincial level, far beyond the initial scope of the project. The biggest challenge TAF faces is policy-focused: without a comprehensive rebate policy, deep retrofits of heat pumps are not feasible in the long-term. TAF is cognizant of all the challenges they face and are actively participating in policy and industry discussions to bring about change in this regard, with a dedicated policy team to spearhead such efforts. To further contribute to regulatory and policy discussions and enhance the uptake of innovative technology in Ontario, the following recommendations are proposed:

- **Continued Engagement in Policy Advocacy:** Continue active participation in discussions with the government to advocate for the introduction of greater, more lucrative incentives for heat pumps, cooling bylaws, and other relevant policies.

- **Educational Outreach:** Conduct workshops, seminars, and tours of the finished project to educate stakeholders about the capabilities and benefits of deep retrofits.
- **Partnerships for Technology Development:** Form partnerships with technology providers and research institutions to develop and refine technologies that help increase the efficiency of heat pumps.
- **Partnerships for Provincial Expansion:** Form partnerships with analogous organizations like TAF and property management companies to establish and grow this project beyond the GTA.

By focusing on these strategies, the TAF project can play a crucial role in making Ontario's electricity sector more equitable by combatting energy poverty and increasing quality of life.

5.6 IESO Distinguished Research Fellows

The projects findings on Transactive Energy Distribution Systems can continue to help legislators and policy writers make informed decisions on the future of the grid. In addition, smaller scale BTM projects can look towards their Energy Storage research papers to further optimize their revenue generation from DER systems that include storage. TMU can further engage with Ontario Sector via this project by implementing the following recommendations:

- **Invest in Private Partnerships:** Continue to invest resources in obtaining partnerships with private entities in the sector to push forward technology based on the research done in this lab.
- **Continue Promotion of Policy:** Advocate for policy and legislation reform based on the results of the research done. Push forward to enact the changes in policy needed for Ontario to make the energy transition.
- **Leverage Partner Feedback:** Use feedback from private partnerships to direct research resources based on trends in the sector.
- **Showcase Implementation:** Promote and share success stories of implementation and commercialization of research to showcase the benefits of the program.
- **Academic Partnerships:** Leverage TMU’s status to partner with other academic institutions both domestic and international to conduct research on Energy Storage and Transactive Energy in a wider context.

By focusing on these areas TMU can further influence the electrification of the province and play an important role in the energy transition for the sector.

5.7 Impacts of Adopting Full Battery-Based Electric Transit Bus Systems on Ontario Electricity Grid

The project's findings about the potential for decarbonization of the transit system through the tool as well as their identification of high initial capital costs being a barrier can help guide legislators to make investments in policies and R&D programs to make such technology more economically viable. To contribute to regulatory and policy discussions and enhance the uptake of innovative technologies and solutions in Ontario, the project can:

- **Showcase Successful Simulations:** Use the simulation data to showcase the benefits and viability of transit electrification in the province.

- **Promote Policy and Regulatory Changes:** Advocate for the changes in the landscape that are required for the widespread implementation of battery-based electric buses.
- **Leverage Partnerships:** Utilize global academic and industry partnerships to continue increasing the tool’s efficiency and understand how it can be implemented in different jurisdictions.
- **Pilots and demonstrations:** Work with transit authorities to run pilots to test the tool’s effectiveness and identify real-world constraints.
- **Commercialize Tool:** Work towards developing a commercially available tool that can be utilized for further research and development in different jurisdictions.

By focusing on these strategies, the project can significantly influence the regulatory landscape and push the envelope on electrifying Ontario’s public transit systems.

5.8 Transactive Energy Network

This project can be used as an example to push for the policy and regulatory changes that are needed for Transactive Energy Network systems to be implemented in Ontario. This project shows used simulations and the proponent's software platform to demonstrate the actual real time effect of this concept while factoring in real world details with regards to LDC needs. Prior to this Transactive Energy Networks had been primarily discussed theoretically in this sector and were therefore not a pressing need at a policy level. To further contribute to discussions in this sector, the following recommendations are proposed:

- **Promote Policy and Regulatory Changes:** Advocate for the changes in the landscape that are required for the commercialization and implementation of Transactive Energy.
- **Showcase Successful Simulations:** Use the simulation data to showcase the benefits and viability of Transactive Energy in real world scenarios.
- **Leverage International Partnerships:** Utilize the partnerships made in the UK cross border exchange to analyze the international context of Transactive Energy and how it can be implemented in different jurisdictions.
- **Scale Tool to Enterprise Level:** Continue work to implement DLMP capabilities into larger scale DERMS platform that can be implemented at an enterprise level.
- **Expand Partnerships:** Work to implement the tool in more jurisdictions with more LDCs to collect more real-world data on the effectiveness of Transactive Energy.

These are the main recommendations that GE Digital can use to advance the conversation of Transactive Energy in Ontario.

6 GIF Recommendations

Based on the outcomes of Guidehouse's analysis, the following recommendations have been proposed for IESO's consideration.

6.1 Supporting Proponent's Capacity to Address Policy and Regulatory Landscape.

To this end, it is recommended that IESO establishes dedicated support services to assist project proponents. This could involve compiling and disseminating case studies of projects that have faced regulatory challenges, providing valuable insights for future endeavors. Additionally, organizing workshops focused on navigating policy and regulatory areas effectively would be beneficial. These workshops, coupled with roundtable discussions involving both project proponents and regulatory bodies like the Ontario Energy Board (OEB), would foster mutual understanding, share lessons learned, and enhance exposure to regulatory processes. Furthermore, offering consultancy support from external experts could guide proponents through best practices in addressing regulatory challenges. Implementing monitoring and evaluation frameworks to assess the impact of regulatory changes on energy projects would also enable more informed decision-making and policy development.

6.2 Creating Monitoring and Evaluation Framework for Proponents

Another area of focus is the enhancement of performance measurement in energy projects. Many projects under the GIF have been limited to output-level metrics, such as reports and workshops, without demonstrating tangible outcomes like changes in behavior, usage, or knowledge. To address this, it is recommended to shift the focus towards outcome-based measures. This shift necessitates the integration of monitoring and evaluation frameworks into project contracts and milestone reports, ensuring tangible evidence of progress. Key Performance Indicators (KPIs) should be established at the onset of each project, incorporating a logic model that includes not just activities and outputs, but also outcomes and intended impacts. These KPIs should be clearly defined, along with detailed means of verification, including sources of information, methodologies, and calculations. Setting project milestones and target end measures will further facilitate the evaluation of success. Engaging monitoring and evaluation consultants to assist proponents in developing and tracking these plans alongside their milestone reports is also recommended.

Implementing these strategies will significantly strengthen the capacity of GIF project proponents to effectively navigate the regulatory landscape and enhance the measurement of project performance. This, in turn, will contribute to IESO's core strategy of driving and guiding the future of the energy sector in Ontario.

7 Appendices

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7.2 Energy Sector Impact Matrix

Table 40: Energy Sector Impact Matrix: Rating Model

Focus	Criteria	Description	Not Applicable (No points applied or penalized)	Low (1 point)	Moderate (3 points)	High (5 points)	Weight
Alignment with Core Strategy "Drive & Guide the Sector's Future"	1. Stakeholder and Indigenous Communities Engagement	Quality and depth of engagement with stakeholders and indigenous communities.	Does not speak to engagement or outreach strategies.	Minimal engagement efforts, lack of tailored outreach strategies, and **limited understanding of community needs.**	Regular engagement and outreach, with some tailored strategies, but **feedback may not always lead to tangible changes or actions.**	Deep, purposeful engagement, with comprehensive, tailored strategies. **Feedback is actively sought and consistently integrated into decision-making and policy.**	12.50%
	2. Responsiveness to Customer Choice and Policy Changes	2a. Ability to identify and adapt to evolving customer preferences.	Does not speak to customer preferences.	Slow or reactive responses to changes, with limited foresight or adaptability. **Customer feedbacks are often overlooked or not considered.**	**Moderate monitoring of customer trends,** with some proactive measures, but responses may lack timeliness or full alignment with needs.	**Agile and proactive adaptation to customer changes,** with robust mechanisms for anticipation and response. Initiatives are closely aligned with evolving needs.	6.25%
		2b. Ability to identify and adapt to evolving Policy and Regulatory landscape.	Does not address the policy or regulatory environment.	**Engages minimally in policy and regulatory discussions**, with little influence on evolution in these areas. Advocacy efforts for sustainable practices and innovation are sparse or ineffective.	**Participates in policy and regulatory discussions, though impact is moderate.** Advocacy efforts are evident but may lack the strategic approach necessary for substantial change.	**Plays a leading role in guiding policy and regulatory evolution**, effectively advocating for significant changes that support sectoral goals. Efforts substantially influence sustainable practices, affordability, and innovation.	6.25%

Focus	Criteria	Description	Not Applicable (No points applied or penalized)	Low (1 point)	Moderate (3 points)	High (5 points)	Weight
Project Impact to the Ontario Energy Sector and Market Advancement	3. Participation and in Sustainable Energy Dialogue	Contribution to discussions and actions shaping the future-state sustainable energy system.	Does not participate in sustainable energy dialogue. Has not and did not intend to inform sector discussions around the energy transition (etc.)	**Limited participation in energy dialogues**, with minimal influence on the broader discussion. **Contributions lack depth or innovative thinking**. Has minimally informed sector discussions around the energy transition (etc.) *	**Active participation** in dialogues, providing valuable insights **but may not be a leading voice in shaping the conversation**. Has somewhat informed sector discussions around the energy transition (etc.) *	**Leading role in energy dialogues**, driving discussions, and initiating action towards a sustainable future. **Contributions are influential, innovative, and shape sector trends.** Has informed sector discussions around the energy transition (etc.) *	25.00%
	4. Resilience and Adaptability	Ability to cope with changing environments and future threats.	Does not address resiliency and adaptability to future needs.	**Shows minimal preparation for future challenges,** with scant strategies for enhancing system resilience or adaptability. Reactive rather than proactive in addressing emerging threats or changes.	**Prepares for future challenges but may lack comprehensive strategies or resources.** Demonstrates some proactive measures, though responses to unforeseen circumstances are occasionally slow or ineffective.	**Excellently prepared for future challenges,** with robust strategies ensuring system resilience and adaptability. **Proactively addresses emerging threats,** demonstrating agility and effectiveness in response to change.	12.50%
	5. Market Effects	Ability to support positive effects to market and sustain project into the future.	Does not speak to improving market effects or economic stability of the model is irrelevant.	**Pays little attention to economic sustainability,** with negligible efforts to balance aspects such as obtaining seed funding, commercializing technology, creating jobs, or attracting investment to Ontario. Short-term focus on economic returns.	**Acknowledges the importance of economic sustainability but struggles with effective integration into projects or strategies.** Efforts are present to obtain seed funding, commercialize technology, create jobs, or attract investment to Ontario, however they lack cohesion or strategic planning.	Prioritizes economic sustainability in its endeavors (i.e., obtaining seed funding, commercializing technology, creating jobs, or attracting investment to Ontario). **Initiatives and strategies consistently support long-term sector viability and goals.**	25.00%

Focus	Criteria	Description	Not Applicable (No points applied or penalized)	Low (1 point)	Moderate (3 points)	High (5 points)	Weight
	6. Innovation and Technology Adoption	Capacity to embrace and utilize new technology.	Does not speak to the adoption of new technology or innovation of technology.	**Shows little to no initiative in fostering innovation or adopting new technologies.** Lacks a structured approach for supporting R&D and is resistant to integrating modern technologies into the grid.	**Takes steps to encourage innovation and technology adoption but lacks consistency or strategic focus.** Support for R&D is present but limited in scope or effectiveness.	**Actively and strategically drives innovation, robustly supporting R&D.** Embraces and integrates cutting-edge technologies, significantly contributing to the sector's modernization and progress.	12.50%
						Total possible points for project	**100%**

Table 41: Energy Sector Impact Matrix: Percentage to Rating

Rating for Ability to "Drive and Guide the Sector's Future"	Lower Threshold	Upper Threshold
High	85%	100%
Moderate	50%	85%
Low	0%	50%

7.3 Impact to the Proponent Matrix

The following matrix was used to categorize the projects as a Low, Medium, or High on each of the given variables of the Impact to the Proponent Matrix.

Table 42: Scoring model for Impact the Proponent Matrix

Score	Meaning	Project(s) lead to financial impact or growth	Project(s) activities drive new business models or implementation of novel approaches to technologies	Degree to which the project(s) would have been affected without securing IESO funding
N/A (No points given or penalized)	No change/impact; No likelihood of change/impact	No financial growth/impact	No new business or technological implementation	Project wouldn't have been affected at all without IESO funding.
Low (50)	Limited change/impact; Limited likelihood of change/impact	Limited financial growth/seed funding/etc.	Limited new business or technological implementation	Project would be minimally affected without IESO funding.
Moderate (75)	Some change/impact; Some likelihood of change/impact	Some financial growth/impact	Some new business or technological implementation	Project would have been somewhat affected without IESO funding.
High (100)	Considerable change/impact; High likelihood of change/impact	Considerable financial growth/impact	Considerable new business or technological implementation	Project would have been affected considerably without IESO's funding. It would not have been able to

7.4 Interview Guide

General question: What is the status of your project post IESO? Please elaborate, including steps taken to measure progress and operational challenges faced.

Alignment with Drive & Guide the Sector's Future

1. **Stakeholder and Indigenous Communities Engagement:**
   1.1. Did your project have any community outreach or stakeholder engagement? Please describe the communities/stakeholders you worked with, your outreach strategy, as well as if and how their feedback informed your project.
2. **Responsiveness to Customer Choice and Policy Changes:**
   2.1. Was your project informed by customer needs and preferences (did you use information about customer preferences for research, project design, etc.)? Why or why not?
   2.2. Was your project affected by any changes in policies or regulations? Please describe, including any future policy or regulatory challenges you anticipate.
3. **Participation in Sustainable Energy Dialogue:**
   3.1.1. Has your GIF project contributed to, been referenced or cited, or participated in any energy policy discussions or documents, news articles, media publications, conferences, workshops, or seminars? Please describe wherever applicable and elaborate on your project's influence on policy discussions or changes.
   3.1.2. Have any stakeholders, such as other utilities, regulators, or industry groups, reached out to you directly because of your GIF project? Please specify which stakeholders reached out and their primary interests or concerns regarding your project, as well as any resulting collaborations, partnerships, or changes in your project's direction.

Project Impact on the Ontario Energy Sector and Market Advancement

4. **Resilience and Adaptability:**
   4.1. During project initiation, did your project consider future risks/ challenges? Please elaborate.
   4.2. Did you face any unexpected roadblocks or obstacles in your project during your funding journey with IESO? Please elaborate on obstacles and any mitigation steps taken.
   4.3. Do you foresee challenges in your path moving forward? Please elaborate on challenges and any mitigation steps taken.
5. **Economic Sustainability:** After IESO funding ended or during the lifetime of funding, were you able to accomplish any of the following? Please quantify wherever applicable.
   5.1. Obtained seed funding/ alternative funding (Yes/No)
   5.2. Commercialized technology (Yes/No)
   5.3. Created jobs (Yes/No)
   5.4. Attracted investment to Ontario (Yes/No)
   5.5. Increased revenue (Yes/No)
   5.6. Improved profit margin (Yes/No)
   5.7. Increased # of customers (Yes/No)
   5.8. Gained brand recognition or reputation (Yes/No)
   5.9. Lead to strategic partnerships or collaboration (Yes/No)
   5.10. Received Awards or recognition (Yes/No)

5.11. Please describe if and how IESO's contribution help the project in a particularly niche way, such as filling a critical funding gap or addressing another fiscal or other type of support.
5.12. How important were these accomplishments to the growth or financial success of your organization? (High, Medium, Low)
5.13. Would the project have gone ahead without IESO Funding? (Yes/No)
5.14. Did IESO's contribution help the project in a particularly niche way, such as filling a critical funding gap or addressing another fiscal or other type of support? (Yes/No)
5.15. Amongst the donors for this project, how important was IESO's contribution? (High, Medium, or Low)
5.16. Perceived ability of the proponent to sustain project into the future, and ability to secure achievements beyond the completion of the project itself. (e.g., seed funding obtained, technology commercialization, technology adoption, job creation, investment attracted to Ontario, etc.) (High, Medium, Low, N/A)

6. **Innovation and Technology Adoption:** Has your project involved the implementation of new or innovative technology or new business models? (Yes/No)
   6.1. (If yes) What is the new technology or business model? What were the effects in terms of adoption or use? Please quantify, if possible.
   6.2. (If yes) Is the technology or business model replicable or scalable? (Yes/No)
   6.3. (If yes) How will this technology affect the rest of the Ontario Energy Sector? (Open Answer)
   6.4. (If no) Could it lead to the implementation of new technology or new business models? If so, how? (Open answer)

7.5 Detailed Explanation of ROI Findings

Scaling Factor – Innovation Readiness Levels

Table 43: Calculation of Scaled Variable for Projects

	TRL	BRL	URL	IRL (Scaled Variable)	Explanation of scaled variable for given project
NRStor	5	4	3	4.00	The Innovation Readiness Level is 4 which is based on the three characterizations: **Technology Readiness Level:** Component and/or breadboard validation in relevant environment – The components making up the concept have been identified and are tested individually in a realistic environment. **Business Readiness Level**: Business Case Development and Testing. **User Readiness Level:** User Needs Observed.

	TRL	BRL	URL	IRL (Scaled Variable)	Explanation of scaled variable for given project
Ameresco	6	1	1	2.67	The Innovation Readiness Level is 2.67 which is based on the three characterizations: **Technology Readiness Level:** System/sub-system model or prototype demonstration in a relevant environment – A complete model or prototype of the concept, is tested in a relevant environment to validate system functionality. **Business Readiness Level:** Business Opportunity Identified. **User Readiness Level**: Opportunity Identified.
RWDI	7	2	5	4.67	The Innovation Readiness Level is 4.67 which is based on the three characterizations: **Technology Readiness Level**: System prototype demonstration in the planned operational environment – A prototype is tested in the environment in which the final product will operate. **Business Readiness Level**: Strategic Fit Verified. **User Readiness Level:** User Desirability Verified Using Low-Fidelity Prototypes.
TAF	6	1	3	3.33	The Innovation Readiness Level is 3.33 which is based on the three characterizations: **Technology Readiness Level:** System/sub-system model or prototype demonstration in a relevant environment – A complete model or prototype of the concept, is tested in a relevant environment to validate system functionality. **Business Readiness Level**: Business Opportunity Identified. **User Readiness Level:** User Needs Observed.
GE Digital	4	2	4	3.33	The Innovation Readiness Level is 3.33 which is based on the three characterizations: **Technology Readiness Level:** Component and/or breadboard validation in a laboratory environment – The concept has been tested to assure that the technical elements can be integrated together and achieve the desired performance, at a component and/or breadboard level. A product specification is formulated. **Business Readiness Level:** Strategic Fit Verified. **User Readiness Level:** Ideas Generated.

NRStor – Local Distributed Energy Resource (DER) Integration and Rental Program Pilot

Analysis of Power Advisory Report

Calculating different financial benefits from this project was done by using figures provided by NRStor who commissioned a research report on the financial benefits of a version of the project scaled to the entire province.

Step 1: Categorizing and Classifying benefits.

The commissioned report identified six value streams and the revenue that 50,000 units could generate in each stream over eight years.

Table 44: Power Advisory Value Streams for NRStor Project

Value Stream	Revenue
Energy Arbitrage	$9,700,000
Capacity Auction	$389,200,000
GHG Emission Reduction	$6,100,000
Utility T&D Deferral	$114,300,000
Utility Reliability	$3,000,000
Customer Value	$102,400,000

Each value stream was analyzed for accuracy and relevance and to ensure that they did not overlap in terms of financial benefits. The value streams were then matched to the ROI categories that Guidehouse had created for the benchmarking of this suite of projects.

Step 2: Scaling to Pilot Size

The revenues were then scaled to the size of the project. Each was multiplied by a scaling factor of 0.00026 (13 units in pilot/ 50 000 units in study). The revenues were then further divided in half to account for the four-year evaluation period used by Guidehouse as opposed to the eight-year period in the report. Then benefits that were already accounted for in other value streams were cut to ensure revenues were not counted twice.

The new values that were used are in the table below in the table below:

Table 45: Guidehouse Scaled Value Streams for NRStor Project

Value Stream	Revenue
Reduced Energy Consumption	$1,261
Uptake of New Tool or Technology	$50,596

Value Stream	Revenue
Deferral of Utility Transmission and Distribution Investments	$14,859
Improved DER Integration	$390
Avoided Energy Cost	$13,312

Step 3: Calculating Adjusted ROI

Adjusted ROI was calculated by summing the revenue streams to get a total value of $80,418. This value was then multiplied by the scaled variable of 4.00 (see Table 44: Calculation of Scaled Variable for Projects) and then divided by the IESO contribution of $348,100 to get an adjusted ROI of 16%.

Ameresco – JP II Secondary School Carbon Free Microgrid Energy System

Emissions Reductions

Calculating the financial benefits from this project was done by using figures provided by Ameresco on the project's annual GHG reductions.

Step 1: Social Cost of Carbon

The annual GHG reductions for Ameresco's project were 277 tonnes of CO_2 equivalent. These were analyzed over a span of 2.5 years, (project has been functional since May 2021), multiplying the reductions with their respective SCC price. These were then discounted using a 2% real discount rate and summed to find the social cost of carbon abated by Ameresco's project.

Table 46: Ameresco Social Cost of Carbon

(A) Year	(B) Annual CO2 Emission Reductions (million tonnes)	(C) SCC Estimate	(D) Annual Societal Benefits (C$ millions) = BxC	(E) Real Discount Rate (2%)	(F) Discounted Benefits (C$) = DxE
2021	0.000162	$252	$0	0.98	$39,921
2022	0.000277	$256	$0	0.96	$68,158
2023	0.000277	$261	$0	0.94	$68,127
				Total	**$176,206**

Step 2: Calculating Adjusted ROI

Adjusted ROI was calculated by taking the total savings value, multiplying by the scaled variable of 2.67 (see Table 44: Calculation of Scaled Variable for Projects) and then dividing by the IESO contribution of $500,000 to get an adjusted ROI of 29%.

RWDI – COMPASS: A Benchmarking Tool

Reduced Energy Consumption

For Compass, the financial benefit calculated was the energy saved from using the new proposed building designs over the reference designs. Below is a calculation of the energy consumption.

Step 1: Determine Difference in Energy Consumption

In their final report, RWDI stated that proposed buildings in uploaded to COMPASS had 25% EUI (kWh/m^2) reduction when compared to reference material. RWDI had also stated that they had modeled 2.5 million square meters across the proposed projects uploaded to the tool.

Table 47: EUI (kWh/m²) by Building Type Statistics

The report also contained Figure 3, located above. This figure was used to find the total amount of EUI models in COMPASS by multiplying the average EUI value by the count on building type. This EUI was then summed up to 22341.6 kWh/m^2. This total EUI figure was then multiplied by the total square meter figure of 2.5 million to get a total kWh value of 55,854,000,000.00, the total lifetime kWh consumption.

Step 2: Calculate Savings

This total lifetime kWh proposed figure was then divided by 0.75 to find the total kWh of the reference buildings; 74,472,000,000.00. The difference between the two was then taken as the total lifetime saved kWh: 139,984,962.41 kWh. This savings figure was then divided by a 40-year life span, then multiplied by four to get a four-year savings figure, 13,998,496.24 kWh, benchmarking it at the same timespan as the other ROIs. This figure was then multiplied by 0.15 to fall in line with a conservative assumption that only 15% of these buildings will be built according to the specifications in Compass, yielding a value of 2,099,774.44 kWh.

That kWh was then multiplied by the average 2022 HOEP price of 0.05 CAD/kWh due to it being the most forward-looking electricity price we had access to, this gave a total savings of $104,988.72.

Step 3: Calculating Adjusted ROI

Adjusted ROI was calculated by taking the total savings value, multiplying by the scaled variable of 4.67 (see Table 44: Calculation of Scaled Variable for Projects) and then dividing by the IESO contribution of $464,053 to get an adjusted ROI of 28%.

TAF – Pumping Energy Savings Phase II: Demonstration and Scale-up Strategy

Reduced Energy Consumption

Step 1: Social Cost of Carbon

The annual GHG reductions for TAF's project were 68 tonnes of CO_2 equivalent. These were analyzed over a span of four years, starting 2020, multiplying the reductions with their respective SCC price. These were then discounted using a 2% real discount rate and summed to find the social cost of carbon abated by TAF's project.

Table 48: SCC Calculation for TAF

(A) Year	(B) Annual CO2 Emission Reductions (million tonnes)	(C) SCC Estimate	(D) Annual Societal Benefits (C$ millions) = BxC	(E) Real Discount Rate (2%)	(F) Discounted Benefits (C$) = DxE
2022	0.000068	$256	$0	0.96	$16,732
2023	0.000068	$261	$0	0.94	$16,724
				Total	**$33,456**

Step 2: Avoided Costs of Energy Generation

The annual avoided energy generation for TAF's project was 590,000 kWh. This was multiplied by two years, since when TAF's IESO-funded projects have been operational from. To calculate the costs of avoided energy generation, the total avoided energy generated was multiplied with the average cost of electricity for residential user in Toronto using a TOU (Time of Use) model, which is taken to be $0.1195/kWh. This brings the avoided cost of energy generation across two years to be $141,010.

Step 2: Calculating Adjusted ROI

Adjusted ROI was calculated by taking the total savings value, multiplying by the scaled variable of 3.33 (see Table 44: Calculation of Scaled Variable for Projects) and then dividing by the IESO contribution of $500,000 to get an adjusted ROI of 51%.

GE Digital– Transactive Energy Network

Avoided Energy Consumption

Due to its status as a pilot simulation, the only revenue stream that could be calculated for GE Digital was the reduced cost of energy during their simulations, scaled to the four-year benchmark of the adjusted ROI analysis. The figure was calculated as follows.

Step 1: Identify Scenarios and Fit to Normal Distribution

The simulation had several different scenarios that showcased different grid behaviour and the savings that would occur, according to the normal loading scenario used during the simulation. The savings for the day generated by the pilot is the difference in cost in this case $98.00 dollars. This savings figure was fitted to a normal curve along with a high loading scenario with congestion worth $3.56 representing one standard deviation and a scenario with high loading and high losses worth $3.10 representing two standard deviations.

Table 49: System Wide Comparison of Normal Scenario

	Scenario 1A - No Market Participants	Scenario 1A - With Market Participants
Substation Generation [kWh]	53638.833	49084.084
Total Battery Generation [kWh]	0	0.773162
Total Solar Generation [kWh]	1800	1800
Total Synchronous Machine Generation [kWh]	1440	3880
Load [kWh]	55728	53688
Losses [kWh]	1150.833	1076.085
Cost [$]	2608.142	2510.004

Step 2: Sum and Scale

These scenarios were then summed based on fitting the normal curve to a year. For example, the normal scenario was calculated to happen 68.2% of the year, so $98.00/day * 0.682*365 gives $24,395.14. The rest of the scenarios were similarly calculated and then added together to give a per year value of $24,621.91. This annual figure was then multiplied by four to scale it the four-year benchmark, and then multiplied by three due to the simulations being in use at three different LDCs.

Step 3: Calculating Adjusted ROI

Adjusted ROI was calculated by taking the total savings value, multiplying by the scaled variable of 3.33 (see Table 44: Calculation of Scaled Variable for Projects) and then dividing by the IESO contribution of $1,000,000 to get an adjusted ROI of 28%.