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Evaluation of Grid Innovation Fund Projects

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Proponent Name Abbreviations

The following abbreviations are used for project proponent names:

Alectra:	Alectra Utilities
BEWorks:	BEworks Inc.
Brickworks:	Brickworks Communications
CNDH:	Cambridge and North Dumfries Hydro
CME:	Canadian Manufacturers & Exporters Ontario
CUI:	Canadian Urban Institute
Electrale:	Electrale Technologies
EnWin:	Enwin Utilities
Evergreen:	Evergreen CityWorks
KWH:	Kitchener-Wilmot Hydro
NRC:	National Research Council
NOLH:	Niagara on the Lake Hydro
OCWA:	Ontario Clean Water Agency
TRCA:	Toronto and Region Conservation Authority
TAF:	Toronto Atmospheric Fund (now The Atmospheric Fund)
Toronto Hydro:	Toronto Hydro-Electric Systems Ltd.

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1 Executive Summary

1.1 Introduction

The objective of the Independent Electricity System Operator's (IESO's) Grid Innovation Fund (GIF) is to evaluate and advance innovative solutions to improve electricity affordability and reliability for Ontarians. The GIF seeks to achieve electricity bill savings for Ontario ratepayers by enabling customers to better manage their energy consumption or by reducing the costs associated with maintaining reliable operation of the province's grid. It supports projects that validate the performance and business case of promising emerging technologies, practices, and services. The GIF also supports projects that identify and mitigate market barriers or accelerate the adoption of competitive, cost-effective energy solutions.

In 2018, the IESO committed to undertake an independent third-party evaluation of the GIF's investments on a biennial basis. The evaluation activities are part of appropriately governing the GIF, and a commitment to the IESO's Board of Directors. The first evaluation was initiated in 2020. As GIF projects are provided up to 3 years to complete a project, this 2020 evaluation includes completed projects that were approved between 2014 and 2017. Most projects contracted in 2018 and later were not complete and therefore are not included in the evaluation.

In February 2019 the GIF was renamed and re-positioned to broaden its scope in light of the merger of the then Ontario Power Authority (OPA) and IESO. The projects included in this evaluation would have been initiated under the period before the GIF renewal, while it was still the Conservation Fund. Subsequent evaluations of the GIF will include completed projects that are contracted under the existing, broader version of the GIF.

This evaluation includes 27 projects that are classified into market facilitation, technology demonstration, and program pilot, with the GIF's contribution ranging between $34,650 and $2 million per project, supplemented with proponent and partner funding contributions. Project types are defined in the IESO Grid Innovation Fund Application Guideline, and are bundled into the three project categories, as follows:

- Market facilitation includes project types: tool, training program, community of practice, and strategic research.
- Technology demonstration includes project types: emerging technology demonstration and strategic opportunity that is functionally a technology demonstration.
- Program pilot includes project types: program and strategic opportunity that is functionally a pilot program.

1.2 Evaluation Goals and Objectives

The primary goal of this evaluation was to determine the GIF's effectiveness in achieving its objective of advancing innovative opportunities to improve electricity affordability and reliability for Ontario ratepayers. To achieve this goal and to provide useful insights to the IESO, the evaluation was categorized into three components that are typically used to evaluate innovative initiatives:

- Market effects: assess the extent to which each project has advanced innovative opportunities to achieve electricity bill savings for Ontario ratepayers, supported key IESO policy objectives related to energy efficiency, demand response, planning, etc. and broader innovation and policy landscape, and affected change and/or been adopted in the market. The evaluation is of projects that demonstrate or pilot new solutions. Evaluating the market effect considers the potential of the project, since the full market effect of the projects will only materialize when the project is fully commercialized.

- Impact evaluation: review and verify the accuracy of energy and demand savings for each of 13 GIF projects identified prior to the start of the evaluation. While 13 projects were reviewed, the savings from two could not be evaluated resulting in 11 projects included in the impact evaluation. The 11 projects included all of the projects classified as technology demonstration and some of the projects classified as program pilot.

- Value for money assessment: build upon the market effects and impact evaluations to determine key performance metrics of each project, project type, and the overall fund in achieving the GIF's objectives. Key performance metrics were calculated for projects as data allowed.

It is important to note that for innovative projects, a successful outcome of the project may include learnings. For projects that do not meet their expected outcomes, learnings on the shortcomings of the project are valuable and these learning help customers to avoid larger investments in broad scale solutions that do perform as expected, or do not meet their forecasted goals.

1.3 Results

1.3.1 Results Overview

Figure 1 plots the market effect rating and avoided cost / GIF funding (AC/GF) ratio for 20 GIF projects[1]. Market effects and AC/GF ratios are delineated according to the relative significance of the values as summarized in Table 1. The projects are listed in Table 2 in order of value for money in terms of market effect and potential avoided cost, represented by the market effects rating and AC/GF ratio. Avoided cost in this study shares the same definition as that used in

[1] The AC/GIF ratio is not applicable to six of the projects (see Section 3.3.2).

IESO's cost effectiveness testing and, correspondingly, relies on the avoided cost factors provided in the IESO's cost effectiveness tool. The projects with the most significant market effect and potential avoided cost are listed first. The project achievements demonstrated that the GIF had a substantial influence on promoting innovation that enhances customer affordability and improves grid reliability. Most of the projects demonstrated regional and/or provincial market effects and have the potential to result in substantial avoided costs. Although a few projects did not achieve their intended goals, the projects provided valuable lessons around program design, technologies, and customer behaviour, and were successful in avoiding larger scale investments in solutions that are not cost-effective.

Table 1: Relative Significance of Values

Significance	Market Effect Rating	AC/GF Ratio
Very High	90-100	>100
High	70-89	20-100
Moderate	30-69	2-19
Low	<30	<2

Figure 1: Market Effects versus Avoided Cost/GIF Funding Ratio

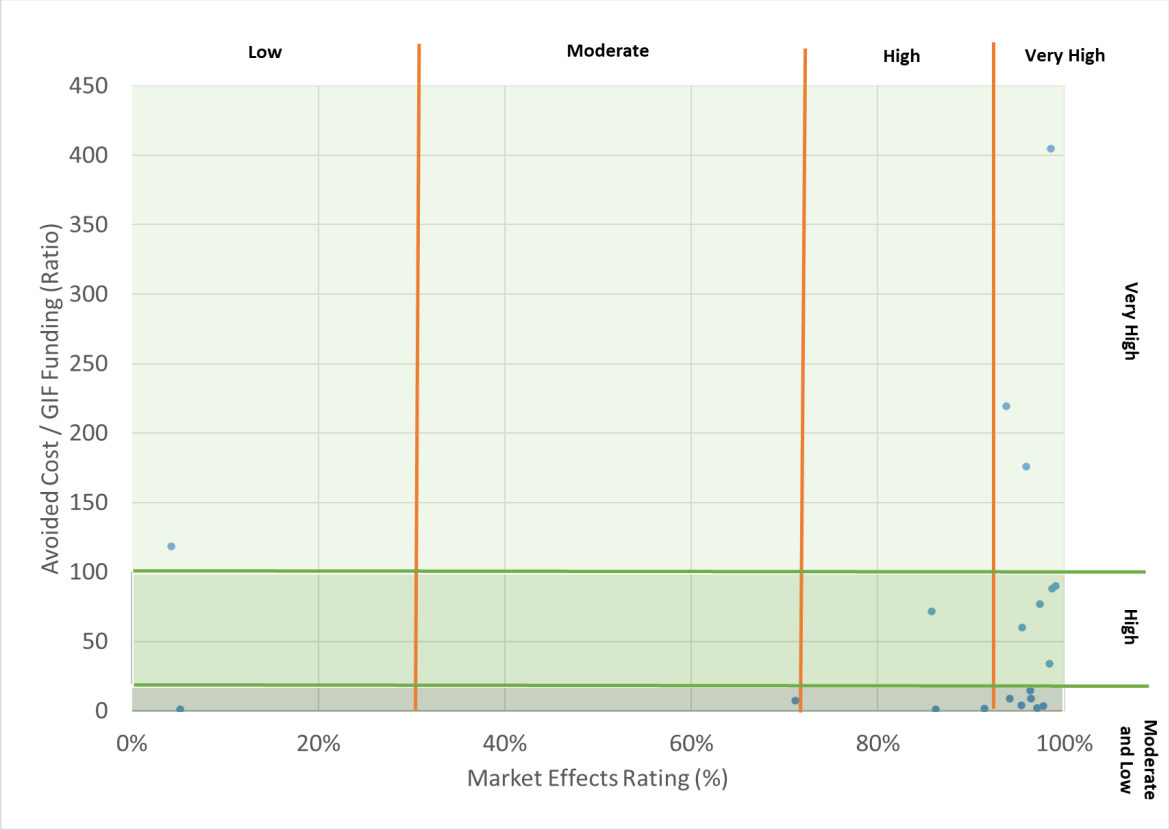


Table 2: Ranking of Projects Based on Market Effect and AC/GF Ratio[2]

Project Proponent	Description	Market Effect Rating	AC/GF Ratio
Toronto Hydro	Demand Response in the Multi-Unit Residential Building Sector (MURB)	94%	743
Canadian Urban Institute*	The Ontario Parking Area and Garage Project	99%	405
Alectra (Demonstration)	Residential Solar Storage	96%	176
Alectra (Pilot)*	Evolution of Advantage Power Pricing	99%	90
Toronto and Region Conservation Authority*	Performance Based Conservation Pilot Program	99%	88
Evergreen*	Tower Renewal Showcase Project (TRSP)	97%	77
Hydro Ottawa (Demonstration)	Conservation Voltage Regulation Leveraging AMI Data	98%	34
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	86%	71
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	95%	60
Cambridge and North Dumfries Hydro	Residential Demand Response Smart Thermostat Pilot	86%	53
BEworks*	Bills that Save	96%	15
Toronto Atmospheric Fund*	Pumping Energy Savings in EMURB	96%	9
Toronto Water*	Advancing Energy Efficient Water Services in Toronto	98%	4
Brickworks Communications	Freezer Temperature Modification	97%	2
EnWin Utilities	Building Optimization Pilot (BOP) – also known as Recommissioning (RCx) of Commercial Buildings	94%	9
Globe Electric and OSRAM Sylvania*, **	Upstream Lighting Program	95%	4
Ontario Clean Water Agency	Pay-for-Performance Pilot Initiative	91%	2
D+R International*	Home Appliance Market Lift	71%	8
Niagara on the Lake Hydro	Direct Install Energy Efficiency Measures for the Agricultural Sector	4%	118
Kitchener-Wilmot Hydro	Direct Install of Demand Control Ventilation Control System in Kitchens	5%	1

* Project did not undergo an impact review. Therefore, the AC/GF ratio presented in this table is based on the reported savings estimate not reviewed by Nexant.

** Globe Electric and OSRAM Sylvania were combined into a single project for this evaluation.

1.3.2 Market Effects

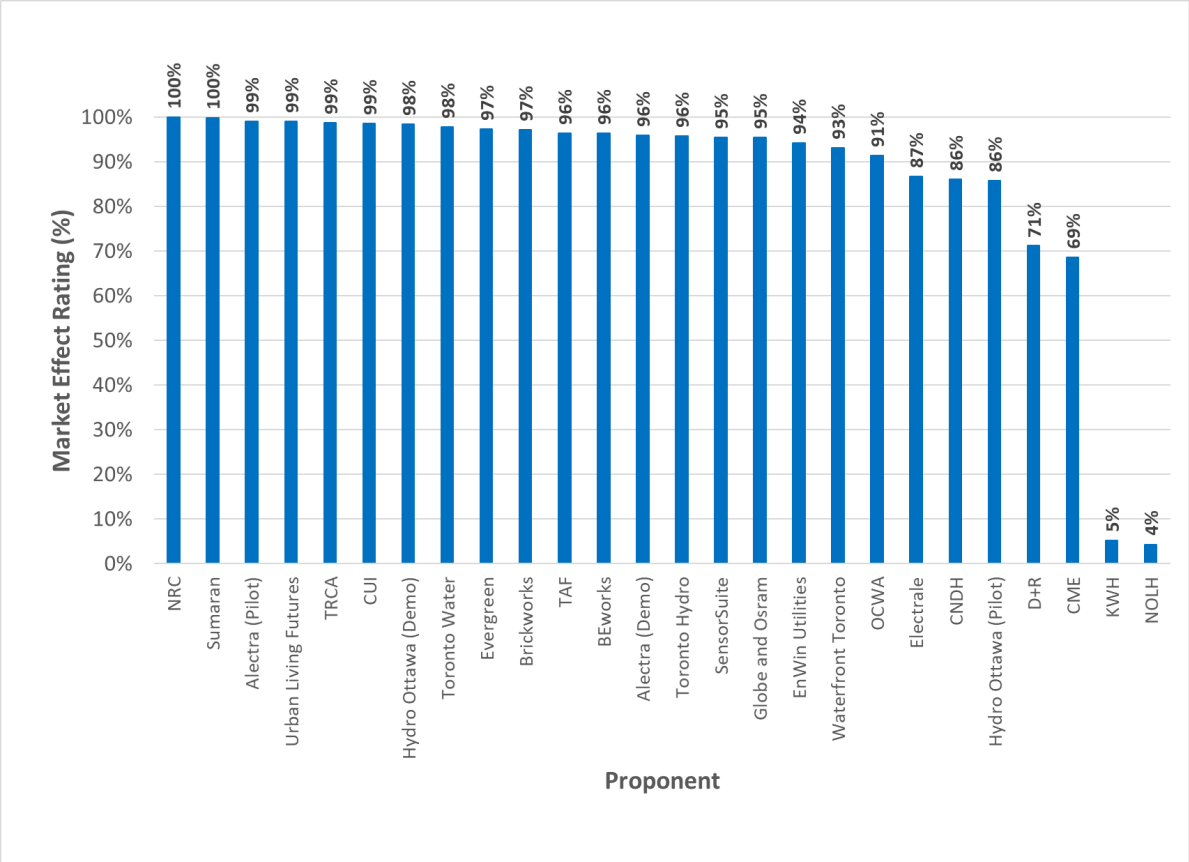
The GIF had a substantial influence on promoting innovation that enhances customer affordability and improves grid reliability. Most of the projects demonstrated regional and/or provincial market effects. The project outcomes contributed towards advancing innovation in the energy sector, such as accelerating technology adoption, influencing code and standards development, advancing policy, and furthering industry and regulatory discussion. Although a

[2] Projects with AC/GF ratio that is "not applicable", are excluded from the table.

few projects did not achieve their forecasted goals, these projects provided valuable lessons around program design, technologies, and customer behaviour and were successful in avoiding larger scale investments in solutions that are not cost-effective.

The market effects evaluation determined a market effects rating for each project. The market effects rating is expressed in percentage and is defined by the following four characteristics: project performance, GIF objectives, achieved market effects and potential market effects. The market effects ratings are illustrated in Figure 2.

Figure 2: Project Market Effects Rating



At the portfolio level, the average market effect rating was 86%. This means that the portfolio as a whole achieved significant market effects at the provincial level. Table 3 summarizes average market effect rating at the category level.

Table 3: Average Market Effect Rating by Category Level

Category Level	Average Market Effect Rating (%)
Market facilitation	95%
Technology demonstration	96%
Program pilot	73%

Project Performance

Individual project performance was determined by comparing a project's achieved outcomes and deliverables to the project proponent's forecasted goals and objectives. The objectives of market facilitation projects focused on knowledge sharing and the development of tools, while the focus of the technology demonstration projects was to demonstrate electricity savings and share knowledge. Program pilot projects aimed to address a wide range of objectives, including electricity savings, demand reduction, cost-effectiveness, knowledge sharing and tool development. Almost all the market facilitation and technology demonstration projects were very successful in achieving their goals and objectives. The program pilot projects achieved their goals with mixed results. A few projects (3 of 10) exceeded their goals, while a few projects (3 of 10) achieved less than 50% of their goals.

GIF Objectives

Two indicators define the GIF objectives characteristic: energy or demand savings; and grid reliability and resilience. The GIF projects were very well aligned with the GIF objectives:

- Almost all the projects (24 of 26, or 92%) have the potential to achieve the full market effect of saving electricity, or reducing demand, at a provincial scale.
- The GIF projects demonstrated significant potential in addressing grid reliability and resilience, which is assessed as the potential to reduce Ontario's forecasted summer capacity deficit. A substantial number of projects (7 of 18, or 39%) have the potential of a significant reduction, equal to more than 1% of Ontario's forecasted summer capacity deficit in 2025 each.

Market Effects Achieved and Market Effects Potential

The GIF projects achieved a significant market effect as summarized in Section 4.1. Nine of the GIF projects (35%) achieved a provincial market level effect (a rating of 100%). An additional nine projects achieved a market effect ranging between a regional or local market and provincial market levels (a rating more than 95%). This indicates that 70% of the GIF projects achieved a significant market effect. Market facilitation and technology demonstration projects tend to achieve significant market effects with an average of 95% or higher rating. Program pilot projects were very successful in achieving significant market effects in accelerating the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings or improving grid reliability and resilience.

Almost all of the GIF projects (23 of 26, or 88%) have the potential to influence the market at the provincial level. Of the remaining projects, one project's maximum market effect potential is to have an effect at the local level, and two projects have a maximum potential of creating awareness.

1.3.3 Impact Review

Eleven projects underwent an impact review which included evaluation on the reasonableness and accuracy of the methodology, assumptions, data, and energy savings calculations. Six of the 11 projects had post-project measurement and verification (M&V) performed by a third party and funded by the IESO, which was included in this evaluation's review.

Figure 3 and Figure 4 compare the reported and reviewed savings by project. The data is also presented in tabular form in Table 27. In this evaluation, reported savings are defined as the savings estimates provided by the project proponent and reviewed savings are defined as the savings estimates determined by the review conducted in this evaluation.

Four projects were reviewed to have either energy or peak demand savings lower than reported. The primary reasons for the differences between reported and reviewed savings were unsupported reported savings assumptions and measures were verified to not be implemented but still report savings.

Six projects were reviewed to have either energy or peak demand savings higher than reported. The main reason for the differences between reported and reviewed savings was that energy or peak demand savings estimates were not provided in the project documentation.

For three demand response (DR) focused projects (Toronto Hydro, CNDH, and Hydro Ottawa's pilot program), the peak demand period was defined as only during called events. For all other projects, peak demand period was defined by IESO's definition of 1pm to 7pm weekdays during June, July, and August.[3]

[3] IESO (2019). *EM&V Protocol and Requirements*. Website http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2019/IESO-EMV-Protocols-and-Requirements-V3-1Apr2019-vf.pdf?la=en

Figure 3: Reported vs. Reviewed Energy Savings

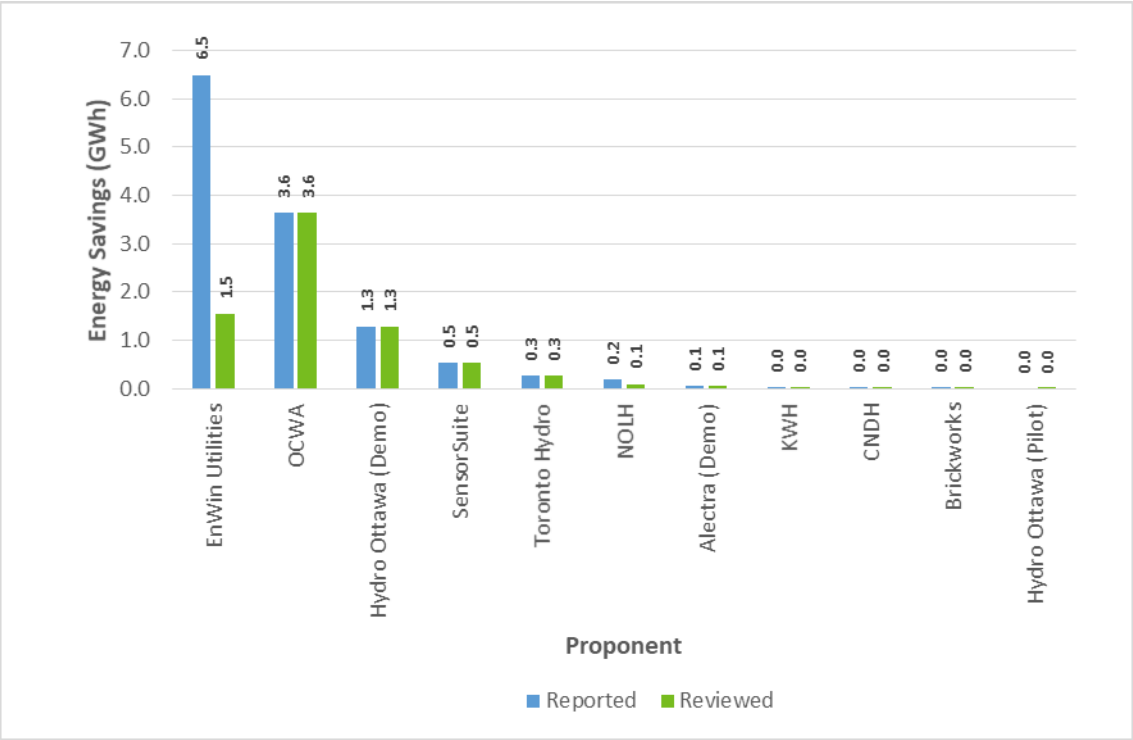
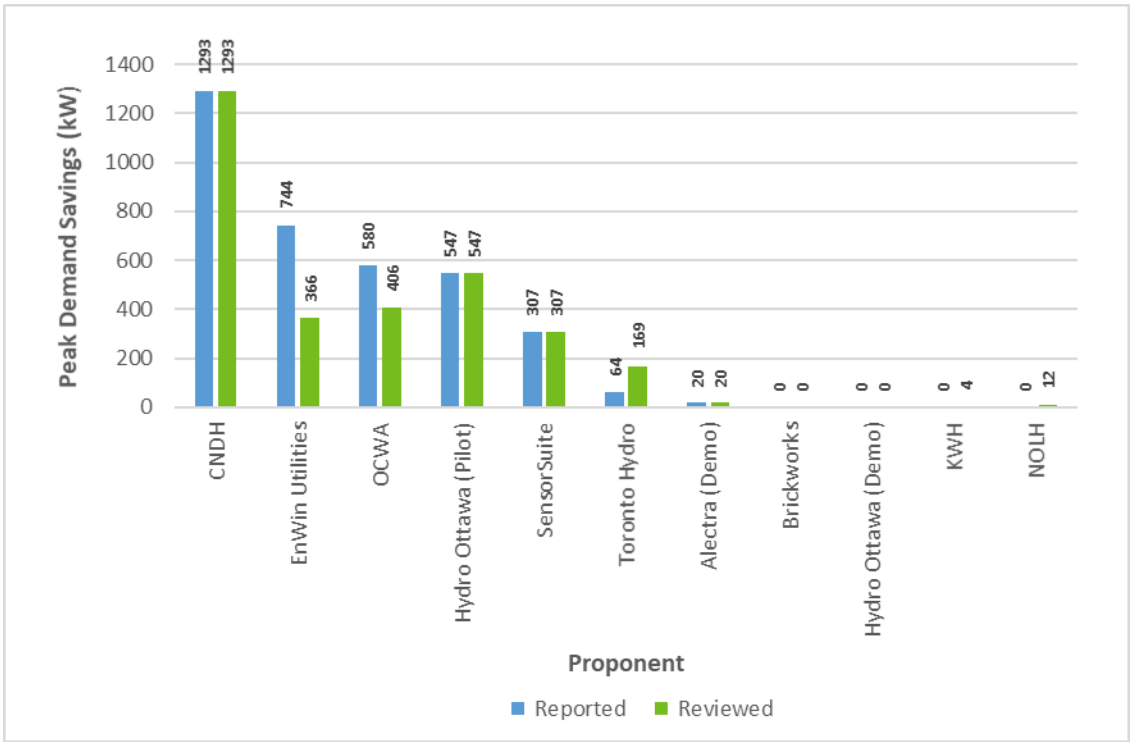


Figure 4: Reported vs. Reviewed Peak Demand Savings



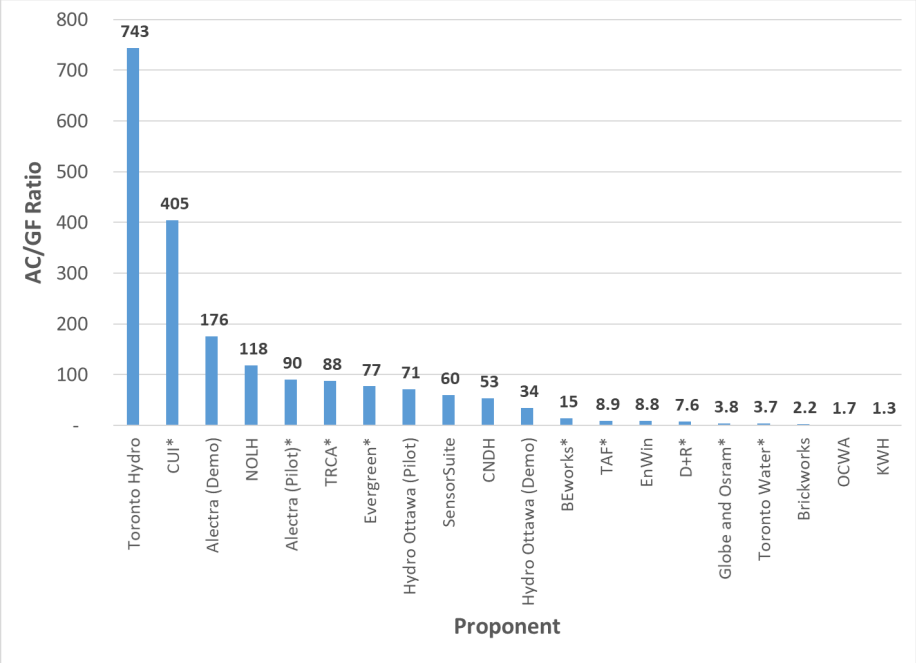
1.3.4 Value for Money

The value for money assessment combined the results of the market effects and impact evaluations to derive three distinct metrics for comparing performance across the GIF projects, which are discussed in detail in Sections 3.3 and 4.3:

- Market effect rating: a quantitative metric that expresses the relative success of a project in meeting its stated goals, achieving the GIF's objectives, and its influence in the Ontario market. The market effect rating is a weighted average of the four market characteristics (see Section 1.3.2). A market effect rating of 100% indicates the project achieved all its goals, fully met all the GIF objectives, and achieved provincial level market effects.
- Avoided Cost/GIF Funding (AC/GF) ratio: a metric that expresses the potential financial value of the energy and demand savings in 2025 (i.e. the benefit) obtained for the GIF money spent (i.e. the cost). The metric is the ratio of avoided cost versus GIF funding. For example, an AC/GF ratio of 70 indicates that for $ 1 of GIF funding the project resulted in $ 70 of potential avoided cost.
- Partner Contribution (PC) ratio: a quantitative comparison of the funding provided by GIF versus financial support provided by the project partners. The PC ratio is the ratio of project funding versus GIF funding. For example, a PC ratio of 1.5 indicates that for $ 1 of GIF funding the project contributed $ 1.5 of funding.

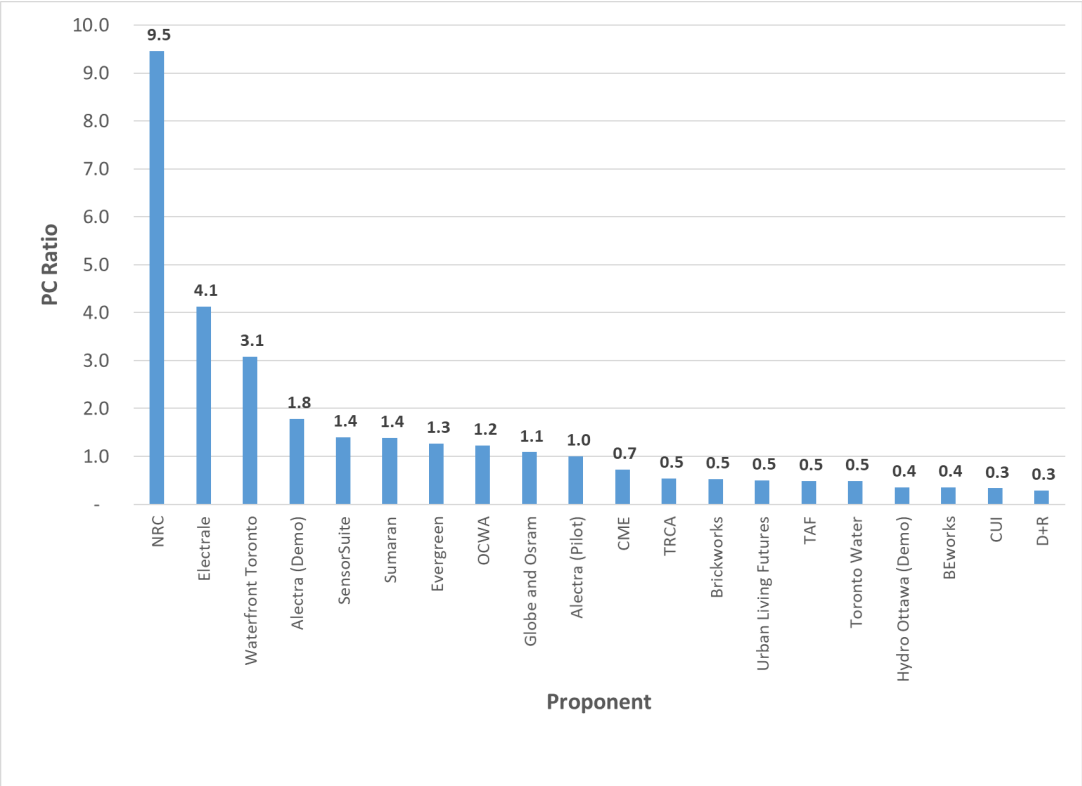
The market effect evaluation and ratings are summarized in Section 1.3.2. Figure 5 and Figure 6 present, respectively, the AC/GIF ratios and PC ratios for the projects.

Figure 5: AC/GIF Ratio by Project



* Project did not undergo an impact review. Therefore, the AC/GF ratio presented in this figure is based on the reported savings estimate not reviewed by Nexant.

Figure 6: PC Ratio by Project

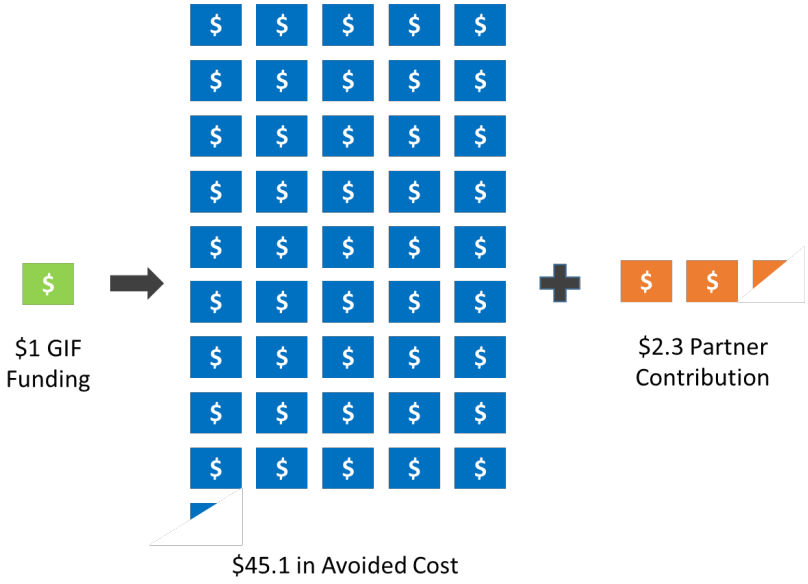


The averages of the market effects rating, AC/GF ratio and PC ratio at the portfolio level and category level are summarized in Table 4. At the portfolio level the GIF provided $ 11.3 million in funding, obtained $ 26.5 million in partner contributions and has the potential to result in $ 510 million avoided cost. To place this in perspective, the values were determined per dollar of GIF funding and are presented in Figure 7.

Table 4: Averages of Value for Money Metrics

Category Level	Average Market Effect Rating (%)	Average AC/GF Ratio	Average PC Ratio
Market facilitation	95%	99	1.7
Technology demonstration	96%	68	1.6
Program pilot	73%	110	0.9
Portfolio Level	**86%**	**98**	**1.5**

Figure 7: Avoided Cost and Partner Contribution Resulting from GIF Funding



The project-level results for each value for money metric are presented in Table 6, which is organized by project type classification. Market effects, AC/GF ratios and PC ratios are delineated and colour coded according to the relative significance of the values as summarized in Table 5.

Table 5: Value for Money Metrics Colour Scheme

Significance	Market Effect Rating	AC/GF Ratio	PC Ratio
Very High	90-100	>100	>2
High	70-89	20-100	1-2
Moderate	30-69	2-19	0.5-0.9
Low	<30	<2	<0.5
N/A	Not Applicable	Not Applicable	Not Applicable

Table 6: Value for Money Results by Project

Project Proponent	Description	Market Effect Rating	AC/GF Ratio	PC Ratio	GIF Funded Value ($)	Total Project Value ($)
Market Facilitation Projects						
NRC*	High Performance Buildings Program (Recommitment)	100%	N/A	9.46	2,000,000	20,920,221
Urban Living Futures*	UPPlift: Toronto	99%	N/A	0.49	499,375	746,425
TRCA*	Performance Based Conservation Pilot Program	99%	88	0.53	250,000	383,348
CUI*	The Ontario Parking Area and Garage Project	99%	405	0.33	134,929	179,855
Evergreen*	Tower Renewal Showcase Project	97%	77	1.27	150,000	340,000
Toronto Water*	Advancing Energy Efficient Water Services in Toronto	98%	4	0.48	100,000	148,000
TAF*	Pumping Energy Savings in Electrically Heated Multi-Unit Residential Buildings (MURBs)	96%	9	0.49	260,700	388,300
BEworks*	Utility Bills that Save	96%	15	0.35	428,500	578,500
Waterfront Toronto*	Energy Performance Tracking	93%	N/A	3.08	34,650	141,300
CME*	Energy Pathfinder Initiative	69%	N/A	0.72	289,500	499,000
Technology Demonstration Projects						
Sumaran*	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	100%	N/A	1.39	236,000	563,000
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	98%	34	0.35	305,681	413,231
Brickworks	Freezer Temperature Modification	97%	2	0.53	166,450	253,900
Alectra (Technology)	Residential Solar Storage Pilot	96%	176	1.79	500,000	1,393,605
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	95%	60	1.40	498,250	1,195,400
Electrale*	Hydraulic Air Compressor (HAC) Demonstration	87%	N/A	4.12	499,000	2,555,367
Program Pilot Projects						
Alectra (Pilot)*	Evolution of Advantage Power Pricing	99%	90	1.0	999,000	1,999,550
Toronto Hydro	Demand Response in the MURB Sector	96%	743	N/A	67,833	67,833
Globe Electric and OSRAM Sylvania*, **	Upstream Lighting Program	95%	4	1.1	200,000	417,400
EnWin	Building Optimization Pilot (BOP) – also known as Recommissioning (RCx) of Commercial Buildings	94%	9	N/A	700,000	700,000
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	91%	2	1.2	697,955	1,557,955
CNDH	Residential Demand Response Smart Thermostat Pilot	86%	53	N/A	706,311	706,311
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	86%	71	N/A	976,244	976,244
D+R International*	Home Appliance Market Lift	71%	8	0.3	299,568	384,268
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	5%	1	N/A	77,499	77,499
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	4%	118	N/A	216,427	216,427

* Project did not undergo an impact review. Therefore, the AC/GF ratio presented in this table is based on the reported savings estimate not reviewed by Nexant.

** Projects where no energy or peak demand savings estimate could be made or obtained do not have an AC/GF ratio.

*** Globe Electric and OSRAM Sylvania were combined into a single project for this evaluation.

The GIF projects provided a significant value for money as determined for the three metrics:

- Most of the GIF projects (19 of 26, or 73%) had very high market effects ratings, with a rating higher than 90%, whereby the average market effect rating of the portfolio of projects is 86%. These projects showed a high degree of success in achieving their goals and objectives, aligning well with the GIF objectives, and having a significant effect on the Ontario market.

- Half of the GIF projects (11 of 20, or 55%) had a significant AC/GF ratio of greater than 20. Of the three types of projects, the portfolio of program pilot projects had the highest AC/GF ratio at 110, and the portfolio of technology demonstration projects had the lowest at 68. The portfolio of projects have the potential to result in $ 510 million avoided cost.

- Almost half of the projects (10 of 21, or 48%) matched the GIF funding or contributed more than the GIF funding. The total GIF funding provided for the portfolio of projects was $ 11 million and the total partner contributions were $ 26.5 million. Partner contributions were not required for 2013 – 2014 LDC Innovation stream program pilots and the PC ratio is not applicable to these projects.

1.4 Key Findings and Recommendations

The evaluation of the GIF projects, resulted in findings and recommendations to inform the continuous improvement of the GIF. The findings and recommendations are summarized in Table 7.

Table 7: Findings and Recommendations

Finding	Recommendation
The AC/GF ratio of projects are driven by: ▪ The energy and demand savings per measure; ▪ The potential to install the measure at a large scale across the province; and ▪ The technical and economic feasibility to install the measure across the province.	To ensure future GIF projects continue to have high AC/GF ratios, evaluate projects by the three driving factors identified by the findings during the GIF project approval process.

Finding	Recommendation
The nature of the GIF projects are innovative and real world data is usually not available prior to the start of the project. To address the gap in data, proponents most often rely on theoretical estimates of participation, savings and cost effectiveness. The participation and savings achieved is often less than the theoretical estimates.	Provide additional guidance during the proposal stage, addressing participation, savings and cost effectiveness estimates. The recommended guidance may include requesting a range of expected participation, savings and cost effectiveness. The range can be based on a maximum expected value and the confidence in the data supporting the estimate of the maximum value.
Comparing the magnitudes of energy and peak demand savings scaling factors across the GIF projects indicates that there are common traits that tend to yield higher scaling factors, namely: applicable to a large population and economic and technical barriers are low.	To achieve larger potential provincial savings, projects that maximize the key contributors to scaling factors need to be prioritized. To this end, it may be helpful to create a framework for proponents to follow when determining potential future impacts if the measure is scaled to the province level.
The review of the GIF projects with cost effectiveness goals, observed a challenge achieving cost effectiveness when using typical cost effectiveness tests. The difference in scale of pilot programs and regional / provincial programs make the pilot programs much less cost effective when compared to regional / provincial programs.	When including cost effectiveness as a goal for a pilot program, the effect of program scale needs to be considered.
Projects with market effects ratings less than 85% had a market effect indicator where the market effect achieved was limited to creating awareness.	To assist projects in achieving a market effect beyond only creating awareness, the GIF can request proponents to include an outline of proposed steps or tasks that would enable the project to have a broader market effect.
Many projects did not report a peak demand savings, lacked documentation supporting reported peak demand savings estimates, or used a different peak demand definition. For example, full connected load demand savings were reported without taking into account a coincidence factor applicable to IESO's peak demand period definition.	Consider offering guidance or calculation tools to encourage proponents to consistently estimate savings and utilize IESO's definition of peak demand.

2 Introduction

The objective of the GIF is to evaluate and advance innovative solutions to improve electricity affordability and reliability for Ontarians. The GIF seeks to achieve electricity bill savings for Ontario ratepayers by enabling customers to better manage their energy consumption or by reducing the costs associated with maintaining reliable operation of the province's grid. It supports projects that validate the performance and business case of emerging technologies, practices, and services. The GIF also supports projects that identify and mitigate market barriers or accelerate the adoption of competitive, cost-effective energy solutions.

2.1 Objectives

The primary goal of this evaluation was to determine the GIF's effectiveness in achieving its objective of advancing innovative opportunities to improve electricity affordability and reliability for Ontario ratepayers. Furthermore, the review tasks involved in conducting this evaluation offered a valuable chance to assess opportunities for improvement to the GIF and provide those findings and recommendations to the IESO. To achieve the primary goal and provide useful insights to the IESO, the evaluation was categorized into three components, each with its own objectives: market effects evaluation, impact evaluation, and value for money assessment.

2.1.1 Market effects evaluation

The main objectives of the GIF evaluation, as pertinent to the market effects evaluation, were to assess the extent to which each project had:

- Achieved success as defined by the project's proposal;
- Contributed to achieving the overall fund objective (at the time the project was awarded funding by the IESO or its predecessor the OPA) of advancing innovative opportunities to achieve electricity bill savings for Ontario ratepayers; and
- Either demonstrated or shown potential to affect change and/or be adopted in the market.

Specific research questions explored by the market effects evaluation to address these objectives included:

- Question 1: To what extent has GIF funding influenced changes to energy regulation, energy policy, codes and standards, market rules, and formalized planning and operational processes that relate to the fund's objectives?

- Question 2: To what extent has GIF funding accelerated the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings (including influencing program design)?
- Question 3: To what extent has GIF funding increased competition for the provision of services required to maintain reliable operation of the electricity system (both grid services, and transmission and distribution)?
- Question 4: To what extent has GIF funding accelerated the availability and adoption of technologies, services, or practices to improve customer and IESO-controlled grid reliability and resilience?
- Question 5: To what extent has GIF funding empowered policymakers and other decision-makers with information to avoid making poor program investments or policy decisions?
- Question 6: To what extent has GIF funding enabled Ontario innovators to secure additional investment such as, but not limited to, commercial sales for emerging technologies/services?
- Question 7: To what extent is GIF funding aligned with the organizational innovation priorities established in the IESO's 2019 Innovation Roadmap[4]?

2.1.2 Impact evaluation

The impact evaluation's goal was to verify the accuracy of energy and demand savings for a sample of GIF projects identified by the IESO. The 11 projects identified by the IESO for an impact review included all of the projects classified as "technology demonstration" and some of the projects classified as "program pilot".

The evaluation confirmed reported energy and peak demand savings for the projects whenever sufficient data were available. The impact evaluation included:

- Review the savings calculation used in the documentation applicable to each of the projects;
- Determine whether the methodologies and algorithms used in the savings calculations were appropriate;
- Determine whether the assumptions used were reasonable and appropriate;

[4] IESO (2019). *Innovation Roadmap*. Website: https://www.ieso.ca/en/Get-Involved/Innovation/Innovation-Roadmap

- Review all M&V plans, collected metered data, data submissions and project reports and determine their reasonableness and appropriateness; and
- Tabulate all energy and demand savings for all applicable projects.

2.1.3 Value for money assessment

The value for money assessment's objective was to build upon the market effects and impact evaluations to determine the overall effectiveness of each project, project type, and the overall fund. The evaluation is based on three distinct metrics: market effect rating, AC/GF ratio, and partner contribution ratio.

A detailed description of these metrics is found in Section 3.3.

2.2 Scope of Work

In order to achieve the objectives of the evaluation, a market effects evaluation and an impact evaluation were conducted, whereby they each contributed to the subsequent value for money assessment. Further detail regarding the methodology and assumptions made in this evaluation are provided in Section 3. The tasks conducted as part of these evaluations included the following:

- Reviewing project documents. IESO provided documents for each GIF project. Documentation types and level of detail included in the documents varied by project but generally included: proposal materials, contract agreements, milestone reports, data collected by the proponent, and M&V reports.
- Contacting project proponents. For both impact and market effects evaluations, Nexant called and emailed project proponent contacts to collect additional data, clarifications, and documents not contained in the original project files provided by the IESO. When applicable, Nexant also contacted other project stakeholders, such as contractors or government agencies, to gather additional data.
- Assessing the data. Collected data were assembled and analyzed to determine impacts and market effects. Impact evaluation analyses typically involved reviewing and performing spreadsheet-based savings calculations. Market effects assessments generally involved comparing project performance to benchmarks and converting that relative performance to an appropriate scale.
- Compiling results. Impact and market effects results were combined to inform the value for money assessment. The value for money assessment was comprised of three project performance metrics: market effect rating, AC/GF ratio, and partner contribution ratio.

- Reporting. The value for money assessment was compiled to report results at three levels: individual project, project classification (i.e. Market Facilitation, Technology Demonstration, Program Pilot), and overall fund.

2.3 Profile of GIF Projects

This evaluation covers 27 projects that were funded by the IESO's GIF between 2014 and 2017. Table 8 below lists these projects and provides key details about each project.

Table 8: Projects Funded Through the Grid Innovation Fund 2014-2017

Project Proponent	Project Name	Year Completed	GIF Funding Amount ($)	Total Funding ($)
Market Facilitation Projects				
BEworks Inc.	Utility Bills that Save	2019	428,500	578,500
CME	Energy Pathfinder Initiative	2018	289,500	499,000
CUI	The Ontario Parking Area and Garage Project	2016	134,929	179,855
Evergreen CityWorks	Tower Renewal Showcase Project	2016	150,000	340,000
NRC	High Performance Buildings Program	2019	2,000,000	20,920,221
TRCA	Performance Based Conservation	2018	250,000	383,348
TAF	Pumping Energy Savings in Electrically Heated MURBs	2017	260,700	388,300
Toronto Water	Advancing Energy Efficient Water Services in Toronto	2017	100,000	148,000
Urban Living Futures	Upplift: Toronto	2017	499,375	746,425
Waterfront Toronto	Energy Performance Tracking	2016	34,650	141,300
Technology Demonstration Projects				
Alectra Utilities (Technology)	Residential Solar Storage Pilot	2017	500,000	1,393,605
Brickworks Communications	Freezer Temperature Modification	2018	166,450	253,900
Electrale Innovation	HAC Demonstration	2018	499,000	2,555,367
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	2018	305,681	413,231
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	2019	498,250	1,195,400
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	2017	236,000	563,000
Program Pilot Projects				
Alectra Utilities (Pilot)	Evolution of Advantage Power Pricing	2016	999,000	1,999,550
CNDH	Residential Demand Response Smart Thermostat Pilot	2015	706,311	706,311
D+R International	Home Appliance Market Lift	2016	299,568	384,268
EnWin Utilities	Building Optimization Pilot	2016	700,000	700,000
Globe Electric / OSRAM SYLVANIA*	Upstream Lighting Pilot	2015	200,000	417,400
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	2015	976,244	976,244

Project Proponent	Project Name	Year Completed	GIF Funding Amount ($)	Total Funding ($)
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	2016	77,499	77,499
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	2016	216,427	216,427
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	2020	697,955	1,557,955
Toronto Hydro	Demand Response in the MURB Sector	2015	67,833	67,833

* Globe Electric and OSRAM Sylvania projects were combined into a single project for this evaluation.

3 Methodology and Assumptions

3.1 Market Effects Evaluation

The market effects evaluation determines a market effects rating for each project. The market effects rating is expressed in percentage and is defined by the following four characteristics:

- Project performance. Project performance is a measure of how well the project has achieved its forecasted goals.
- GIF objectives. The evaluation of the project against the GIF objectives determines to what extent the project met the GIF objectives of energy (or bill) savings and grid reliability and resilience.
- Achieved market effects. The achievement of a project is determined for six market effects indicators. The achievement is assessed against the project's forecasted goals to determine how successful the project was in achieving the goals as it pertains to the specific indicator.
- Potential market effects. The potential impact of a project on the market is determined for the seven market effects indicators. The market boundary is considered to be Ontario, and the maximum market potential is achieved when a project has a province-wide impact.

The market effects consider that promising projects that do not achieve their deployment goals still provide valuable learnings. These learnings are subsequently incorporated into the value for money analysis as creating awareness. The true value of these learnings, for example avoided ratepayer costs of large-scale investments in unsuccessful projects, is not captured in this evaluation but should be noted.

The GIF objectives and market effects characteristics are defined by the objectives and research questions listed in Section 2.1.1. The listed objectives and questions were aligned with the characteristics as summarized in Table 9. Three indicators were defined for the GIF objectives characteristic and six indicators for the market effects characteristic.

Table 9: Alignment of Indicators with Objectives and Research Questions

Indicators	Objective / Research Questions
GIF Objectives Characteristic	
Energy[5] / demand savings	Contributed to achieving the overall fund objective of advancing innovative opportunities to achieve electricity bill savings for Ontario ratepayers.
Grid reliability and resilience	To what extent each project, if broadly adopted across the province, could contribute to enhancing grid reliability and resilience.
Market Effects Characteristic	
Changed regulated and formalized structures	Question 1: To what extent has GIF funding influenced changes to energy regulation, energy policy, codes and standards, market rules, and formalized planning and operational processes that relate to the fund's objectives?
Accelerate availability and adoption	Question 2: To what extent has GIF funding accelerated the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings (including influencing program design)? Question 4: To what extent has GIF funding accelerated the availability and adoption of technologies, services, or practice to improve customer and IESO-controlled grid reliability and resilience?
Influenced program design	Question 2: To what extent has GIF funding accelerated the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings (*including influencing program design*)?
Increased competition	Question 3: To what extent has GIF funding increased competition for the provision of services required to maintain reliable operation of the electricity system (both grid services and transmission and distribution)?
Information to empower policy and decision-makers	Question 5: To what extent has GIF funding empowered policymakers and other decision-makers with information to avoid making poor program investments or policy decisions?
Enable innovators to secure investment	Question 6: To what extent has GIF funding enabled Ontario innovators to secure additional investment such as, but not limited to, commercial sales for emerging technologies/services?
Alignment with organizational innovation priorities of IESO Innovation Roadmap[6]	Question 7: To what extent is GIF funding aligned with the organizational innovation priorities established in the IESO's 2019 Innovation Roadmap?

The following sources of information were consulted to evaluate a project's market effects:

- The project documentation, including the project proposal, milestone deliverables, final deliverables, communication with IESO and financial summaries.

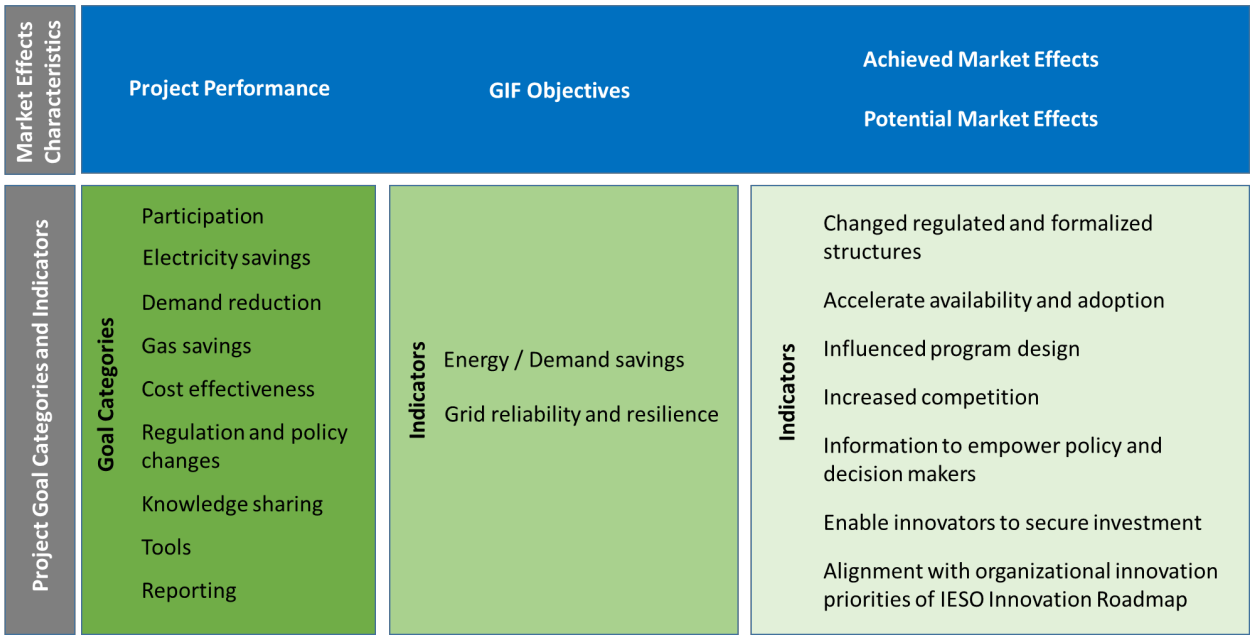
[5] Energy savings refers to electricity savings (kWh).

[6] Ibid.

- The participant and their representatives to provide clarification or address gaps in information.
- Other project stakeholders, such as contractors and government agencies, who could provide insight into the project's market effect.
- IESO representatives who could provide additional insight into the success and the project's market effect.

Project performance is defined by the project's forecasted goal categories, while the GIF objectives, market effects achieved and potential market effects are defined by indicators, as summarized in Figure 8. The sub-sections below describe the four market effects characteristics, and their associated project goal categories and indicators.

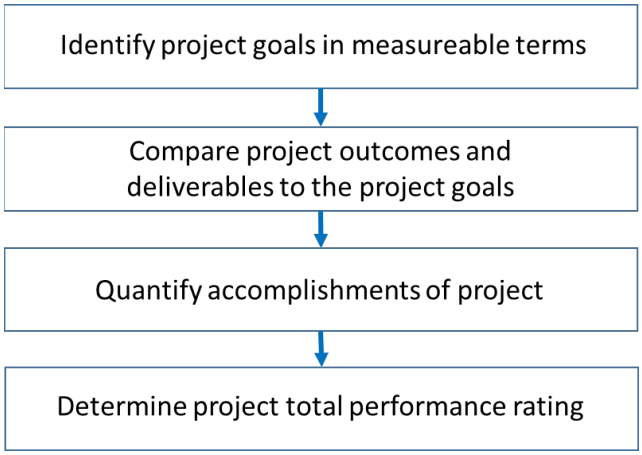
Figure 8: Project Goal Categories and Indicators Defining Market Effects Characteristics



3.1.1 Project Performance

The evaluation of project performance used the approach and steps summarized in Figure 9.

Figure 9: Project Performance Evaluation Steps



The project performance evaluation approach and steps included:

- The project forecasted goals were identified in measurable terms. For example, if a project had a goal to produce a report, the review will determine how many components or topics were to be included in the report. The proponent may have proposed the report to include a description of the methodology, results, recommendations, and a framework to implement the recommendations. This indicates the report included four components in its reporting goal. In many cases, the forecasted goals were best estimates as the solutions being demonstrated / tested had not been previously tested or proven in market.

- The project's outcomes and deliverables were compared to the forecasted goals, whereby the accomplishment of the goals was then quantified. To expand on the example in the preceding bullet point, if the report addressed all the components but did not include a framework, it would have met 75% (3 of 4) of its reporting goal.

- A total project performance rating was determined as the average of the scores allocated to individual goal categories. The goal categories included:

    - Participation
    - Electricity savings
    - Demand reduction
    - Natural gas savings
    - Cost-effectiveness
    - Regulation and policy changes
    - Knowledge sharing

- Tools
- Reporting

A total project performance score is calculated as the average of the project's goal categories scores.

3.1.2 GIF Objectives

Two indicators define the GIF objectives characteristic:

- Energy or demand savings
- Grid reliability and resilience

The approach to evaluating a project against the two indicators is described below.

Energy / Demand Savings

The evaluation determined a project's potential effects on energy and demand savings in terms of the number of customers, as defined by sectors (such as residential, commercial and industrial) and sub-sectors (such as multi-unit residential buildings, schools, mining, etc.). The rating metrics described in Appendix A: Rating Metrics guided the development of the rating criteria and scoring and are summarized in Table 10.

Table 10: Rating Scale for the Energy/Demand Savings Indicator

Score	Criteria
N/A	The project did not address the indicator.
0	No effect.
1	Measurable impact for a few customers (for example, less than 100 customers for SME, and less than 3 customers for large facilities).
5	Measurable impact for larger number of customers, but not for a total sub-sector or sector.
50	Measurable impact at local or regional subsector level.
95	Measurable impact at local or regional sector level, or at provincial sub-sector level.
100	Measurable impact at provincial sector level.

Grid Reliability and Resilience

A project's potential to decrease Ontario's forecasted summer capacity deficit is assessed to determine the degree of its effect on grid reliability and resilience. Based on a scenario in which existing resources are not available, Ontario's summer capacity deficit in 2025 is estimated to be 4,552 MW.[7] For each project, the maximum technical peak demand savings is determined for the year in which the project was completed. The technical potential peak demand savings

[7] IESO (December 2020). *Annual Planning Outlook*. Scenario 1 capacity deficit is used because it provides an indication of the maximum deficit to be addressed.

was estimated at the provincial level in the year 2025, using data and reports provided by the project and supplemented by sources, such as Statistics Canada, Ontario Energy Board, Ministry of Finance, and sector-specific reports. The ratio of achievable potential to technical potential from analogous measures listed in the IESO's 2019 Achievable Potential Study was applied to the technical potential to estimate the achievable potential.[8] The project's achievable potential demand savings is expressed as a percentage of the provincial summer capacity deficit in 2025.

GIF Objectives Score

An overall score for the GIF objectives characteristic is calculated as the weighted average of the two indicators. The weight of each indicator was determined in consultation with the IESO. The weight of each characteristic is summarized in Table 11.

Table 11: GIF Objectives Indicators and Weight Allocation

Indicators	Weight Expressed in Percentage
Energy/demand savings	95%
Grid reliability and resilience	5%

3.1.3 Achieved Market Effects

Table 9 summarizes the six market effects indicators used to determine a project's achieved market effects:

- Changed regulated and formalized structures
- Accelerate availability and adoption
- Influenced program design
- Increased competition
- Information to empower policy and decision-makers
- Enable innovators to secure investment

The achievement is assessed against the project's forecasted goals to determine how successful the project was in achieving the goals as it pertains to a specific indicator. The extent of the market effect was determined by assessing the market effect segment reached by the project. The market effect segments and rating were guided by the rating metrics described in Appendix A: Rating Metrics. The market effect segments define the criteria as summarized in Table 12. The market boundary is considered to be Ontario, and the maximum market effect is achieved when a project has a province-wide impact. A project's achieved market effects is the average of all the scores for the six market effects indicators.

[8] IESO (2019). *2019 Conservation Achievable Potential Study*. Website: https://www.ieso.ca/2019-conservation-achievable-potential-study

Table 12: Rating Scale for the Market Effects Indicators

Score	Criteria
N/A	Not applicable
0	No effect
1	It addressed the indicator and created awareness
5	It resulted in planning actions / activity
50	It resulted in design actions / activity
95	It had a measurable effect at the regional or local market level
100	It had a measurable effect at provincial market level

A total achieved market effects score is calculated as the average of the project's market effects indicators scores.

3.1.4 Potential Market Effects

A project's maximum potential market effect is determined for the same six market effects indicators as described in Section 3.1.3. Similar to the assessment of achieved market effects, the extent of the potential market effect was determined by assessing the maximum potential market effect segment the project could reach. The achieved market effects determine the effect achieved by the project, while the potential market effects determine the maximum potential effect the project could achieve if all challenges and barriers were addressed. The market effect segments and rating were guided by the rating metrics described in Appendix A: Rating Metrics. The rating scale is the same as the rating scale used to assess achieved market effects (see Section 3.1.3) and summarized in Table 12. The average of all the scores for the six market effects indicators was calculated.

The potential market effects rating include an assessment of the projects' innovation. The alignment with and advancement of the organizational innovation priorities established in the IESO's 2019 Innovation Roadmap were assessed to evaluate each project's innovation. The assessment was based on the degree of alignment with the roadmap's three focus areas and the priority areas defined for each focus area. It should be noted that all evaluated projects were completed before the development of the roadmap. As such, this indicator is retrospective.

The following are the organizational innovation priorities in order of priority:

- Highest priority for resource allocation and engagement
  - Unlock the value of new and existing resources
  - Provide leadership to mitigate emerging cybersecurity risks
  - Increase the transparency and visibility of resources operating on the distribution system
  - Build new capabilities to collect, store, share, analyze and use data
- Important areas core to the IESO's mandate

- Address challenges associated with the growth in intermittent resources, distributed energy resources (DERs) and variable loads on grid operations
- Inform new distribution system operations and business models to support bulk market efficiency and reliability

- Monitor or support action of others
  - Prepare for an increase in customer and local distribution company (LDC) led DER deployment
  - Anticipate and prepare for changing consumer choice
  - Design alternative approaches to provide system resiliency

The roadmap provides a more detailed description of each of the priority areas. The rating criteria used to evaluate the extent of the project's alignment with the organizational innovation priorities are summarized in Table 13. The rating metrics described in Appendix A: Rating Metrics guided the development of the rating criteria and scoring.

Table 13: Rating Scale for Alignment with IESO Innovation Roadmap Priorities Indicator

Score	Criteria
N/A	▪ No alignment with the priorities
1	▪ Minimal alignment with one of the monitor/support priority areas
5	▪ Minimal alignment with one of the important areas, and/or ▪ Partial alignment with one of the monitor/support priority areas
50	▪ Minimal alignment with one of the highest priority areas, and/or ▪ Partial alignment with one of the important areas, and/or ▪ Full alignment with one of the monitor/support priority areas
95	▪ Partial alignment with one of the highest priority areas, and/or ▪ Full alignment with one of the important priority areas
100	▪ Full alignment with one of the highest priority areas

The degree of alignment was based on the following observations:

- Full alignment is in cases where the project fully, or to a very large extent, addresses the innovation roadmap priority.
- Partial alignment is when the project addresses aspects of the priority area but does not completely address the priority area.
- Minimal alignment is when the project addresses aspects fairly similar to an innovation priority area or implicitly addresses aspects of a priority area.
- No alignment is when the project does not explicitly or implicitly address any aspects of the innovation priority areas.

An overall score for the potential market effects characteristic is calculated as the weighted average of the six indicators' average and the score for alignment with the roadmap. The weight of each indicator was determined in consultation with the IESO and reflects the indicator's relative importance in expressing the market effect potential. The weight of each indicator is summarized in Table 14.

Table 14: GIF Objectives Indicators and Weight Allocation

Indicators	Importance Expressed in Percentage
Average of six market effect indicators	95%
Score for alignment with IESO Innovation Roadmap	5%

3.2 Impact Review

3.2.1 Introduction

The objective of the impact evaluation was to determine the reasonableness and accuracy of the project calculations, methodology, assumptions, and data. Further to this objective, the impact evaluation sought to confirm the accuracy of energy and demand savings for each of the IESO's 11 identified GIF projects and estimate corresponding reductions in greenhouse gas (GHG) emissions. The projects included in the impact review are summarized in Table 15.

Table 15: Summary of Projects in Impact Evaluation

Project Proponent	Project Name
Alectra (Technology)	Residential Solar Storage Pilot
Brickworks	Freezer Temperature Modification
CNDH	Residential Demand Response Smart Thermostat Pilot
EnWin	Building Optimization Pilot
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System
Toronto Hydro	Demand Response in the MURB Sector

Two additional projects were not able to be analyzed due to the nature of their research and related energy / demand savings. These two projects were Electrale's Hydraulic Air Compressor

Demonstration and Sumaran's Zoned Distribution Strategies and Cold-Climate Air Source Heat Pump Research.

3.2.2 Energy and Demand Savings Review

The impact evaluation included a measure-level analysis of impacts for the 11 identified projects to confirm claimed and/or reported energy and demand savings. In this evaluation, reported savings are defined as the savings estimates provided by the project proponent and reviewed savings are defined as the savings estimates determined by the review conducted in this evaluation. The impact review tasks included the following:

- Review the savings calculations used in the documentation applicable to each of the projects. The review of the peak demand savings referenced the methodology and peak definitions outlined in the IESO EM&V Protocols.[9]
- Determine whether the methodologies and algorithms used in the savings calculations were appropriate.
- Determine whether the assumptions used were reasonable and appropriate.
- Review available M&V plans, collected metered data, data submissions, equipment specifications, and project reports and determine their reasonableness and appropriateness. The review drew on references such as the International Performance Measurement and Verification Protocol (IPMVP)[10] and the United States Department of Energy Uniform Methods Project (DOE UMP)[11] as guides in reviewing the M&V plans, data, and reports. The four M&V options of IPMVP are summarized in Table 16.
- Contact the proponent by phone and/or email to discuss and verify details of the project, such as operational schedules, nameplate information, and baseline assumptions. Proponents were also requested to provide information where data gaps in the project documentation existed.
- Tabulate all energy and demand savings for all applicable projects.
- For three DR focused projects (Toronto Hydro, CNDH, and Hydro Ottawa's pilot program), the peak demand period was defined as only during called events. For all

[9] IESO (2019). *EM&V Protocol and Requirements*. Website http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2019/IESO-EMV-Protocols-and-Requirements-V3-1Apr2019-vf.pdf?la=en

[10] Efficiency Valuation Organization (2014). *International Performance Measurement and Verification Protocol (IPMVP)*. Website: https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

[11] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

other projects, peak demand period was defined by IESO's definition of 1pm to 7pm weekdays during June, July, and August.

- Report to the IESO the review results and provide a detailed description of the reasons for any differences between the reviewed and reported savings.
- Estimate the avoided greenhouse gas emissions achieved by each project.

Table 16: IPMVP Options Applicable to M&V

IPMVP Option	Description
Option A – Retrofit Isolation: Key Parameter Measurement	This method uses engineering calculations and site measurements of a limited number of important parameters to verify the savings resulting from specific measures. Parameters not selected for measurement are estimated through the use of historical data and engineer recommendations. The option is often used for calculating impacts for measures such as lighting, appliances, motors, and cooking equipment.
Option B – Retrofit Isolation: All Parameter Measurement	Savings are quantified by field measurements of the actual energy use of the systems affected by the energy conservation measure retrofit. The measurement frequency ranges from short-term to continuous, depending on expected variations throughout the reporting period. Engineering calculations and the field measurements are used to verify the savings resulting from specific measures.
Option C – Whole Facility	Savings are quantified by measuring energy use at the whole facility or sub-facility over a given reporting period. Measurements are recorded continuously throughout the length of the reporting period.
Option D – Calibrated Simulation	Savings are determined through a simulation of the energy use of the whole facility or sub-facility. The simulation aims to demonstrate and model actual projected energy performance.

3.2.3 Estimation of Avoided Greenhouse Gas Emissions

The IESO's Cost Effectiveness (CE) tool was utilized to determine avoided greenhouse gas emissions from energy and demand savings.[12] Where applicable, project information was input directly into the CE tool to calculate GHG emission reductions. However, some of the projects, notably the projects with demand response components, could not be directly modelled in the CE tool.

For projects that could not be directly modelled using the CE tool, the following steps were taken to estimate GHG emissions reductions:

[12] IESO (2019). *IESO Integrated Cost Effectiveness Tool*. Website link: http://www.ieso.ca/Sector-Participants/Energy-Efficiency/2019-2020-Interim-Framework (Download link located in Energy Efficiency Interim Framework Program Plan, June 2019)

- Estimate the project's annual hourly savings load profile (8760 savings load shape) based on available project documentation and data, reviewed savings calculations, and/or application of the most appropriate load shape from the IESO's library to the annual savings estimate.
- Extract the applicable hourly GHG emissions factors from the IESO's CE tool
- Multiply the project's savings by the corresponding GHG emissions factor for each hour
- Sum all emissions reductions across the year

3.3 Value for Money Assessment

The value for money assessment combined the results of the previously discussed market effects and impact evaluations to derive three distinct metrics for comparing performance across the GIF projects:

- Market effect rating – a quantitative metric that expresses the relative success of a project in meeting its stated goals, achieving the GIF's objectives, and its influence in the Ontario market.
- Avoided Cost/GIF Funding (AC/GF) ratio: a metric that expresses the provincial-level potential financial value of the energy and demand savings in 2025 (i.e. the benefit) obtained for the GIF money spent (i.e. the cost).
- Participation Contribution (PC) ratio – a quantitative comparison of the funding provided by GIF versus secondary financial support provided by the proponent.

Each of the three performance metrics was determined for each project and is described in further detail in the following subsections.

It is important to note that promising projects that fail in deployment still have valuable learnings, which are captured in the "market effect" rating. Pilot projects that fail demonstrate the lack of success of the solution with a relatively small investment, while avoiding the bigger investment in rolling out a solution that does not work. This added value of avoiding larger investments in unsuccessful programs or solutions is not considered in this evaluation but should be noted.

3.3.1 Market Effect Rating

The market effect rating quantifies a project's relative success in meeting its forecasted goals, achieving the GIF's objectives, and its influence in the Ontario market. The rating is the weighted average of the four market effects characteristics: project performance, GIF objectives, achieved market effects and potential market effects. These characteristics are defined in Section 3.1. The weight of each characteristic was determined in consultation with the

IESO and reflects the characteristic's relative importance in expressing the market effect of the project. The weight of each characteristic is summarized in Table 17.

Table 17: Market Effects Characteristics and Weight Allocation

Characteristics	Importance Expressed in Percentage
Project performance	10%
GIF objectives	40%
Achieved market effects	40%
Potential market effects	10%

3.3.2 Avoided Cost/GIF Funding (AC/GF) Ratio

A benefit/cost metric was developed for this evaluation in order to compare each project's potential province-wide benefit, normalized to the year 2025, to the funding provided by the GIF. This ratio is defined by the following:

Equation 3-1: AC/GF Ratio for the GIF Evaluation

$$AC/GF\ Ratio = \frac{Avoided\ Cost_{Provincial\ Achievable\ Potential\ In\ 2025}}{GIF\ funding}$$

The numerator uses avoided cost rather than directly referencing kWh savings or kW savings. The diversity of GIF project savings types was the primary reason avoided cost was selected as the comparative value. That is, some GIF projects focused on energy efficiency, while others focused on peak demand savings. Therefore, relying on a specific savings type (energy or demand) for comparison across all GIF projects would inherently favour projects that focused on the selected savings type. The evaluation accurately reflected both forms of savings by converting energy and demand savings to avoided costs.

The provincial achievable potential avoided cost was calculated using the approach described below for each GIF project. An example calculation is also provided in Appendix B for reference.

- Project Savings - Determine reviewed energy and demand savings for the GIF project. For projects included in the impact evaluation subset, the reviewed savings were referenced. For projects not included in the impact evaluation subset, the reported savings were referenced. For projects where there was insufficient information to calculate project savings, AC/GF ratios were not calculated.
- Provincial Technical Potential - Scale project level savings to a technical potential saving estimate for all of Ontario. The technical potential is the maximum potential savings from a measure across the province since the estimate does not consider elements of economic and achievable potential constraints that limit the feasibility of implementing the measure.

Therefore, Natural Resources Canada, Statistics Canada, and the IESO's planning data were frequently utilized for extrapolating project-level savings to a provincial level to determine the magnitude of the scaling factor, based on the appropriate scaling element for the project (e.g. resident population, restaurants, residential homes, water treatment plants, etc.) and did not apply economic or achievability factors. For the impact review, the provincial technical potential savings for each of the 11 projects were normalized to the year 2018 (i.e. the first year after the 2014-2017 period under review in this evaluation) to ensure the most accurate comparison across projects. For the market effects evaluation's grid reliability and resilience indicator, the provincial technical potential savings for each project were normalized to the year 2025.

- Provincial Achievable Potential – Pare provincial technical potential down to provincial achievable potential. In order to use a more realistic potential savings value, the evaluation needed to account for economic and achievable potential constraints in implementing each measure. These constraints are unique to each measure, and most typically are captured in potential studies conducted by utilities and grid operators. Therefore, the IESO's most recent achievable potential study (APS), published in 2019, was referenced for scaling technical potentials to achievable potentials.[13] The 2019 APS provided technical and achievable potential savings estimates for a wide variety of measures. To determine the achievable potential for each GIF project, the ratio of achievable potential to the technical potential for the most similar measure provided in the 2019 APS was applied to the provincial technical potential of the GIF project calculated in the previous step.

- Convert savings to avoided cost. The IESO's CE tool provides avoided costs for energy ($/MWh) and capacity ($/kW-yr). These factors were applied to the provincial achievable potential savings calculated in the previous step.

While comparing provincial achievable potential avoided costs across GIF projects may be useful for determining the highest overall potential impact, the comparison does not consider the costs required to achieve those avoided costs. Therefore, as Equation 3-1 displays, the avoided costs are divided by the IESO GIF funding contributed to the project. Adding this denominator, the ratio can reflect the expected total achievable savings benefits per dollar spent from the IESO's perspective.

It is important to note that, while Equation 3-1 references the funds by the IESO, they were not the only financial contributor on many projects. Therefore, a third metric, the partner contribution ratio, was calculated for each project and is discussed in the following section.

[13] IESO (2019). *2019 Conservation Achievable Potential Study*. Website: https://www.ieso.ca/2019-conservation-achievable-potential-study

3.3.3 Partner Contribution Ratio

The partner contribution ratio is a quantitative comparison of the funding provided by GIF versus secondary financial support provided by the participant and other stakeholders. The partner contribution ratio is defined by Equation 3-2.

Equation 3-2: Partner Contribution Ratio

$$Participant\ Contribution\ Ratio = \frac{Total\ Project\ Value - \ GIF\ Funding}{GIF\ Funding}$$

Where:

- Total Project Value: The total dollar amount participants will provide in cash to fund the project as stated in the GIF application, plus the equivalent dollar value of in-kind effort by participants to undertake the project, as stated in the GIF application, plus the total amount of GIF funding.
- GIF Funding: The total amount funded by the GIF for the project.

4 Results

The following subsections mirror the organization and sequence of the previous Methodology and Assumptions subsections, presenting results for the three primary evaluations: market effects, impact review, and value for money.

4.1 Market Effects

This section provides a summary of the projects' market effects, followed by the market effects evaluation results. The market effects are defined by four characteristics, as described in Section 3.1:

- Project performance
- GIF objectives
- Achieved market effects
- Potential market effects

4.1.1 Summary of Project Market Effects

The project evaluation assessed the project's achievements and its market effects. These achievements are summarized in Table 18, Table 19, Figure 10 and Figure 11, and demonstrated that the GIF had a substantial influence on promoting innovation that enhances customer affordability and improves grid reliability. Most of the projects demonstrated regional and/or provincial market effects. They contributed towards advancing innovation in the energy sector, such as accelerating technology adoption, influencing code and standards development, advancing policy, and furthering industry and regulatory discussions. Although a few projects did not achieve their intended goals, the projects provided valuable lessons around program design, technologies, and customer behaviour, and were successful in avoiding larger scale investments in solutions that are not cost-effective.

Most of the GIF projects (19 of 26, or 73%) had very high market effects ratings, with a rating higher than 90%, whereby the average market effect rating of the portfolio of projects is 86%. These projects showed a high degree of success in achieving their goals and objectives, aligning well with the GIF objectives, and having a significant effect on the Ontario market. The evaluation results of the market effects characteristics are discussed in detail in the Sections 4.1.2 to 4.1.5.

Table 18: Summary of Project and Market Effect Achievements

Proponent	Project	Summary of Project and Market Effect Achievements
Market Facilitation Projects		
BEworks.	Utility Bills that Save	The project aimed to re-engineer electricity bills to improve compliance to Time-of-Use (TOU) schedules using behavioral economic insights obtained through in-field experiments on customer bills. The pilot demonstrated significant reductions in on-peak usage as a result of the specific bill design. Due to the outcomes of the project, a local distribution companies (Alectra) subsequently tested the BEWorks approach within their dynamic pricing pilot, which was used to inform the Ontario Energy Board's (OEB) Regulated Pricing Plan (RPP) Pilots. The final pilot report was submitted in early 2021 and, together with other pilots, informs the evolution of OEB's RPP, which has a provincial-level market effect. Another LDC, Hydro One, used the project outcomes to inform their bill redesign.
CME	Energy Pathfinder Initiative	The project demonstrated the implementation of a Performance Energy Management (PEM) approach, which assists with identifying opportunities to improve, control or optimize energy-intensive industry processes. The outcome has the potential to reduce energy use and demand within Ontario's industrial sector at low or no capital cost. The results of the initiative were presented to the IESO and disseminated through workshops in Ontario, the CME website and newsletter, and direct mail of case studies and scorecards to over 500 industrial companies. There is no information available indicating that this approach was further adopted.
CUI	The Ontario Parking Area and Garage Project	The project aimed to build knowledge amongst owners/operators of private and public parking assets to encourage the replacement of the parking asset's lighting with LEDs. The project successfully disseminated knowledge that resulted in conversions to LEDs with an estimated annual saving of ~2 TWh and had a provincial-level impact. The project provided lighting policy recommendations for Ontario municipalities. It is unclear whether municipalities have adopted the recommendations and amended relevant municipal lighting by-laws.
Evergreen	Tower Renewal Showcase Project	The pilot provided input in revising the City of Toronto's zoning definitions, engaged many critical stakeholders, and resulted in the development of a financial tool that was used by Canada Mortgage and Housing Corporation (CMHC) to inform their retrofit fund. The pilot's research and knowledge sharing contributed to projects being implemented across Ontario. For example, the Ken Soble Tower Transformation project in Hamilton, which will be North America's first high-rise Passive House-certified retrofit (slated for completion in 2021).

Proponent	Project	Summary of Project and Market Effect Achievements
NRC	High Performance Buildings (HPBs) Program Recommitment	The HPB program completed the demonstration of a large number of research, design and development projects to advance the adoption of technologies. The projects addressed technologies applicable to new and existing commercial and institutional (C&I) buildings and residential construction. This effort resulted in outcomes and recommendations to be considered and incorporated in codes (for example, the National Energy Code of Canada for Buildings (NECB)) and standards (for example, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the Canadian Standards Association (CSA)). NECB training material has been developed and recently launched, which supports capacity development in the building sector as it relates to the adoption, enforcement, and application of the NECB. The project's market effects have an impact on almost all energy use aspects in buildings.
TRCA	Performance Based Conservation Pilot Program (PBC)	The TRCA project leveraged utility data and building profile information to benchmark and set performance savings targets (energy, gas, water) in commercial offices, retail and institutional buildings. Owners implemented energy efficiency measures based on these targets. The results included verified energy, water and gas savings for 205 buildings (17.2 million square feet) in the regions of Brampton, Halton Hills, Milton, and Peel. The following savings were achieved: 5.3 GWh for electricity, 359,791 m^3 for natural gas, and 57,635 m^3 for water. Almost $997,000 worth of energy and water savings were achieved, and over 1,000 tonnes of CO_2 greenhouse gas emissions were reduced. TRCA is currently working with utilities to bring the PBC approach to Ontario school boards, demonstrating a province-wide application of the PCB principles.
TAF	Pumping Energy Savings in Electrically Heated MURBs	The pilot conducted eight feasibility studies to ascertain the financial and technical viability for retrofitting Electrically-heated Multi-unit Residential Buildings (EMURB) properties with heat pumps, and quantified the energy savings of heat pumps. The project built awareness by demonstrating the business case for heat pump retrofits in EMURBS, develop recommendations, and undertaking stakeholder engagement activities. Due to the project's success, TAF obtained additional funding from the IESO's GIF to continue demonstrating the feasibility of the technology. TAF also secured additional government investment, leading to two high-rise apartment owners approving full building retrofit of recently emerged ASHP technologies. The project contributed to TAF's involvement and informed the Ontario Minister of the Environment, Conservation and Park's Made-In-Ontario Environment Plan commitment to accelerate heat pump uptake. Due to TAF's work on the project, TAF is contributing to Natural Resources Canada's national Space Heating Experts Team (SHET), informing government and industry action to advance heat pump market transformation.

Proponent	Project	Summary of Project and Market Effect Achievements
Toronto Water	Advancing Energy Efficient Water Services in Toronto	Annual electricity consumption of electric drinking water pumping stations was over 20% of electricity used by Ontario's water and waste treatment sector in 2018[1]. The project aimed to prove the effectiveness of a suite of software tools to calculate energy metrics based on the pressure and flow throughout the City of Toronto's water distribution system (twelve pressure districts). The water-energy performance tools were used to identify and evaluate energy efficiency opportunities and opportunities for improving water-energy planning in the City of Toronto. Building on the project's success, the Ontario Clean Water Agency (OCWA) and the Canadian Urban Institute (CUI) are currently completing a project that adapts the model and approach to small-medium municipal water distribution systems.
Urban Living Futures	UPPlift: Toronto	The project was a virtual technology accelerator aimed at helping innovators resolve challenges in the built environment. Out of 50 applications, the project selected 7 pilot projects to fund. Three of the seven pilots were installed by Quadreal Property Group, providing energy savings well beyond the project's completion. The pilot also led to the establishment of Innovate Cities (IC), a not-for-profit organization and Canadian-led network of innovators involved in developing and adopting smart city technologies. Currently, UPPlift is implementing the IC process at two Toronto sites, and they are discussing implementation in three Southern Ontario cities.
Waterfront Toronto	Building Sustainable Communities	The project collected and analyzed energy and water data from new, recently-occupied buildings and compared actual consumption with pre-construction design predictions. Based on the analysis, recommendations were provided on how Waterfront Toronto's Minimum Green Building Requirements (GBR) could be enhanced. These project learnings were considered when updating Waterfront Toronto's latest Green Building Requirements V3.0 (published January 2021). The Green Building Requirements are mandatory performance standards that are applicable to all new developments on Waterfront Toronto's land.

[1] IESO (2018). *Market Characterization and Conservation Potential for Ontario's Drinking Water and Wastewater Treatment Plants*. Website: https://www.ieso.ca/-/media/Files/SaveOnEnergy/Industry/Water-and-Wastewater-Report.ashx

Proponent	Project	Summary of Project and Market Effect Achievements
Technology Demonstration Projects		
Alectra (Technology)	Residential Solar Storage Pilot	The pilot demonstrated the technical feasibility of behind-the-meter distributed energy resources (DER) in aggregation and confirmed that the solar storage technology (also known as Power.House) has the technical capability to provide wholesale services in the electricity market. This inspired further policy and regulatory discussions and led to whitepapers on how to enable DERs in IESO-administered markets. The pilot developed test cases that were used to inform the establishment of standardized DER test cases for IESO-funded DER pilots. The pilot resulted in additional installations, for example, a 10-unit hybrid pilot in the City of Markham (with funding from NRCan)[2] and one unit in Thunder Bay[3].
Brickworks	Freezer Temperature Modification	The findings of the pilot resulted in amendments to a provincial regulation under the Health Protection and Promotion Act, 1990, which removed the maximum freezer set-point temperature requirement (-18 °C) for frozen foods, realizing persistent electricity savings province-wide. The revised regulation came into force on July 1, 2018. The IESO has promoted this change to the restaurant industry in partnership with trade organizations.
Electrale	HAC Demonstration Project	The project successfully demonstrated the commercial feasibility of the HAC technology. Subsequently, Electrale received additional funding from NRCan to bring the technology to commercialization in an Ontario mine, submitted several proposals and secured purchase orders. Ultimately the HAC was not implemented in the Ontario mine as the mine was required to close for maintenance activities. Research and development is ongoing to improve the HAC technology and cost-effectiveness, and to adapt certain components to suite other industrial applications.
Hydro Ottawa (Technology)	Conservation Voltage Regulation (CVR) Leveraging AMI Data	The pilot leveraged existing AMI infrastructure and innovative CVR technology to control load tap changers on substation transformers, resulting in a measured reduction of energy and reactive power consumption and the development of a CVR Evaluation Protocol. The results influenced provincial government policy, allowing utilities to count savings from CVR toward their CDM targets under the 2015-2020 Conservation First Framework. The pilot's outcomes resulted in accelerating the adoption of the CVR software and technology in provinces across Canada, most notably by New Brunswick Power, whose CVR program was informed by Hydro Ottawa's pilot.

[2] Natural Resources Canada (2018). *Power.House Hybrid: Minimizing GHGs and Maximizing Grid Benefits.* Website: https://www.nrcan.gc.ca/powerhouse-hybrid-minimizing-ghgs-and-maximizing-grid-benefits/22139

[3] CBC (2017). *Thunder Bay Hydro fires up city's first 'power house.'* Website: www.cbc.ca/news/canada/thunder-bay/power-house-thunder-bay-1.3955585

Proponent	Project	Summary of Project and Market Effect Achievements
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	The project developed and tested an intelligent, cloud-based Energy Management System (EMS) and demonstrated the commercial feasibility of the system across 22 MURBs located in Ontario. The algorithm, cloud platform and user interface proved to be successful and were used by building managers at twenty-two MURBs. Although the energy savings were less than the targeted savings, the lessons learned informed the continued development and commercialization of the technology, which ultimately allowed the platform to aggregate, coordinate and subsequently respond to IESO demand response calls using building HVAC assets. In 2019 SensorSuite received a contract to install its energy management system at a MURB in London, Ontario and achieved 31% annual building energy savings.
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pumps Performance	The project validated the energy and peak demand reduction potential of coupling zoning strategies with variable speed equipment. It demonstrated that a three-zone configuration is the most effective for energy/demand reduction. The testing of CC-ASHP concluded that they could replace domestic furnaces and perform well up to -20°C, and in some cases, -25 °C. The results of this project informed NRCan's Zoning Duct Design Guide, and the Zoning Decision Guide for Builders, which was adopted by the Heating, Refrigeration, and Air Conditioning Institute of Canada (HRAI) in their training for HVAC trades across the province. A significant achievement of this project was the design, construction and operation of a new Climate Controlled Test Facility (CCTF). The CCTF is being used in further research. For example, to validate alternative performance rating procedures to inform CSA standards and test innovative technologies such as CO_2 heat pump water heaters and heat-pump-integrated heat recovery ventilators. In addition, the outcomes of the pilot are contributing towards informing work to potentially implement certain zoning requirements in the National Building Code. The outcomes of this project, together with much broader industry research and initiatives, are building momentum to enable the adoption of zoning practices across the country, and the uptake of variable speed CC-ASHPs, thereby reducing energy consumption and customer bills.

Proponent	Project	Summary of Project and Market Effect Achievements
Program Pilot Projects		
Alectra (Pilot)	Evolution of Advantage Power Pricing	The pilot successfully demonstrated a year-round voluntary alternative rate structure that has the potential to reduce peak demand and energy consumption. The project outcomes enabled Alectra to receive OEB approval to expand their rate options and pilot them under a subsequent Regulated Price Plan (RPP) pilot (Alectra's Dynamic Pricing pilot), which is being used to inform the evolution of the RPP Roadmap. The Dynamic Pricing pilot tested the impacts on dynamic, overnight and enhanced pricing schemes and non-pricing interventions (programmable smart thermostat technology and "nudge reports"). The pilot also assessed behavioural responses to critical peak periods. Alectra issued its final report for the Dynamic Pricing pilot in January 2021.
CNDH	Residential Demand Response Smart Thermostat Pilot	The early smart thermostat pilots (such as CNDH's Residential Demand Response Smart Thermostat Pilot) and later programs (such as GreenON and Enbridge smart thermostat programs) have provided learnings that enabled the industry to use smart thermostats in aggregate to provide demand response grid services. For example, smart thermostat aggregators have been successful in wholesale market demand-response auctions and theYork Region non-wires alternative demonstration project.
D+R International	Home Appliance Market Lift	The project demonstrated an alternative model for program delivery. The pilot provided lessons learned on improving mid-stream programs and highlighted challenges with the approach, such as the data-sharing requirements, which proved to be a participation barrier for some retailers. The pilot provided lessons learned with program elements, such as recruiting retailers, establishing baselines and incentives, and negotiating data-sharing agreements. The pilot's research on whether retail-level incentives were more effective than customer-based incentives (i.e., coupons) resulted in a measured increase of product sales over the baseline, indicating that the program achieved some level of success. However, the absolute market lift could not be accurately measured due to existing ongoing programs at the time.
EnWin	Building Optimization Pilot	The pilot aimed to achieve 3,000 MWh in energy savings. It reported 8,286 MWh in energy savings (6,494 MWh from completed projects and 1,792 MWh in savings from additional future measures), of which 1,540 MWh Nexant verified as implemented. The results of the pilot have created awareness of market acceptance of RCx offerings and their cost-effectiveness. The pilot's outcomes and lessons learned are being considered in the development of provincial programs as part of the 2021 CDM Framework.
Globe Electric / OSRAM SYLVANIA	Upstream Lighting Program	The pilots demonstrated that a point-of-sale program could be cost-effective and result in a market lift if the right market is targeted. The pilots informed and influenced the transition from a coupon program to a point-of-sale program and had a measurable impact across the province.

Proponent	Project	Summary of Project and Market Effect Achievements
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	The early smart thermostat pilots (such as Hydro Ottawa's Residential Demand Response Wi-Fi Thermostat Pilot) along with later programs (such as GreenON and Enbridge smart thermostat programs) have provided learnings that enabled the industry to use smart thermostats in aggregate to provide demand response grid services. For example, smart thermostat aggregators have been successful in wholesale market demand-response auctions and the York Region non-wires alternative demonstration project.
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	The project aimed at achieving energy and demand reductions in commercial kitchens and to validate key business case assumptions and the availability of quick return projects (shorter payback periods. It also assessed the potential to roll out a province-wide commercial kitchens program and provided recommendations on how to enhance the program to improve participation from the sector. This project achieved very low participation rates and was therefore unable to validate or assess these items, and the demand and energy savings realized were insignificant, Barriers to participation included: ▪ Financial incentive rates were not high enough. ▪ Service providers had difficulty advertising and reaching out to customer decision-makers due to the constraints placed upon private companies surrounding advertising and email outreach. ▪ Customers were not well-versed in DCKV and the associated benefits of the technology. The project avoided larger scale investments in a program is would not be cost-effective.
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	The pilot had very low participation, and its evaluation determined that it was not cost-effective. The pilot provided lessons learned and recommendations to consider for future programs targeting the agriculture sector. The project avoided larger scale investments in a program is would not be cost-effective.
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	Drinking and wastewater treatment represents the largest energy use for most municipal governments and over a third of municipal energy consumption in Ontario[4]. The OCWA P4P pilot was able to penetrate an energy-intensive sector that historically has had little participation in energy efficiency programs. The pilot educated operators and decision-makers on energy efficiency opportunities and implemented solutions that resulted in province-wide verified persistent energy savings. The project resulted in 3.6 MWh and around 0.4 MW of persistent annual verified savings. The project validated to IESO that it could secure energy savings by entering pay-for-performance contracts with third-party program administrators, paving the way for the EE Auction Pilot and planned EE competitive procurements under the new EE framework.

[4] IESO (2018). *Market Characterization and Conservation Potential for Ontario's Drinking Water and Wastewater Treatment Plants*. Website: https://www.ieso.ca/-/media/Files/SaveOnEnergy/Industry/Water-and-Wastewater-Report.ashx

Proponent	Project	Summary of Project and Market Effect Achievements
Toronto Hydro	Demand Response in the MURB Sector	The pilot built on earlier studies and focused on controlling MURB in-suite technology (i.e. thermostats) and common area equipment (i.e. chiller) loads to investigate electricity savings and marginal demand reduction. Four buildings participated in four demand response events. While the pilot's approach was determined to be not cost-effective, lessons learned allowed Toronto Hydro to revise the approach and to include chiller control as a DR measure in their 2015-2019 Rate Application. The project avoided larger scale investments in a program is would not be cost-effective.

Table 19: Market Effects Ratings by Indicator and Project

Proponent	Description	Project Performance	GIF Objectives	Market Effects - Achieved	Market Effects - Potential	Market Effect Rating (Weighted Average)[1]
Market Facilitation						
National Research Council	High Performance Buildings Program (Recommitment)	100%	100%	100%	100%	**100%**
Urban Living Futures	UPPlift: Toronto	100%	100%	98%	100%	**99%**
Toronto and Region Conservation Authority	Performance Based Conservation Pilot Program	110%	95%	100%	98%	**99%**
Canadian Urban Institute	The Ontario Parking Area and Garage Project	118%	95%	98%	98%	**99%**
Toronto Water	Advancing Energy Efficient Water Services in Toronto	100%	95%	100%	98%	**98%**
Evergreen	Tower Renewal Showcase Project	100%	95%	98%	100%	**97%**
Toronto Atmospheric Fund	Pumping Energy Savings in EMURB	100%	95%	97%	98%	**96%**
BEworks	Bills that Save	88%	95%	100%	95%	**96%**
Waterfront Toronto	LEED Analysis	80%	95%	95%	91%	**93%**
CME	Energy Pathfinder Initiative	116%	100%	17%	100%	**69%**
Technology Demonstration						
Sumaran	Zoned Distribution Strategies	100%	100%	100%	98%	**100%**
Hydro Ottawa (Demonstration)	Conservation Voltage Regulation Leveraging AMI Data	87%	100%	100%	98%	**98%**
Brickworks Communications	Freezer Temperature Modification	94%	95%	100%	98%	**97%**
Alectra (Demonstration)	Residential Solar Storage	78%	95%	100%	100%	**96%**
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	81%	95%	98%	100%	**95%**
Electrale	HAC Demonstration Project	100%	100%	67%	100%	**87%**
Program Pilot						
Alectra (Pilot)	Evolution of Advantage Power Pricing	121%	95%	97%	100%	**99%**
Toronto Hydro	Demand Response in the Multi-Unit Residential Building Sector (MURB)	87%	95%	98%	100%	**96%**
Globe Electric and OSRAM Sylvania	Upstream Lighting Program	76%	95%	100%	98%	**95%**
EnWin Utilities	Building Optimization Pilot (BOP) – also known as Recommissioning (RCx) of Commercial Buildings	84%	95%	95%	98%	**94%**

[1] The weighted average of the market effect indicators is described in Section 3.3.1.

Proponent	Description	Project Performance	GIF Objectives	Market Effects - Achieved	Market Effects - Potential	Market Effect Rating (Weighted Average)[1]
Ontario Clean Water Agency	Pay-for-Performance Pilot Initiative	92%	95%	86%	98%	**91%**
Cambridge and North Dumfries Hydro	Residential Demand Response Smart Thermostat Pilot	107%	95%	68%	100%	**86%**
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	102%	95%	68%	100%	**86%**
D+R International	Home Appliance Market Lift	42%	95%	48%	98%	**71%**
Kitchener-Wilmot Hydro	Direct Install of Demand Control Ventilation Control System in Kitchens	42%	1%	1%	3%	**5%**
Niagara on the Lake Hydro	Direct Install Energy Efficiency Measures for the Agricultural Sector	34%	1%	1%	3%	**4%**

Figure 10: Project Market Effects Rating

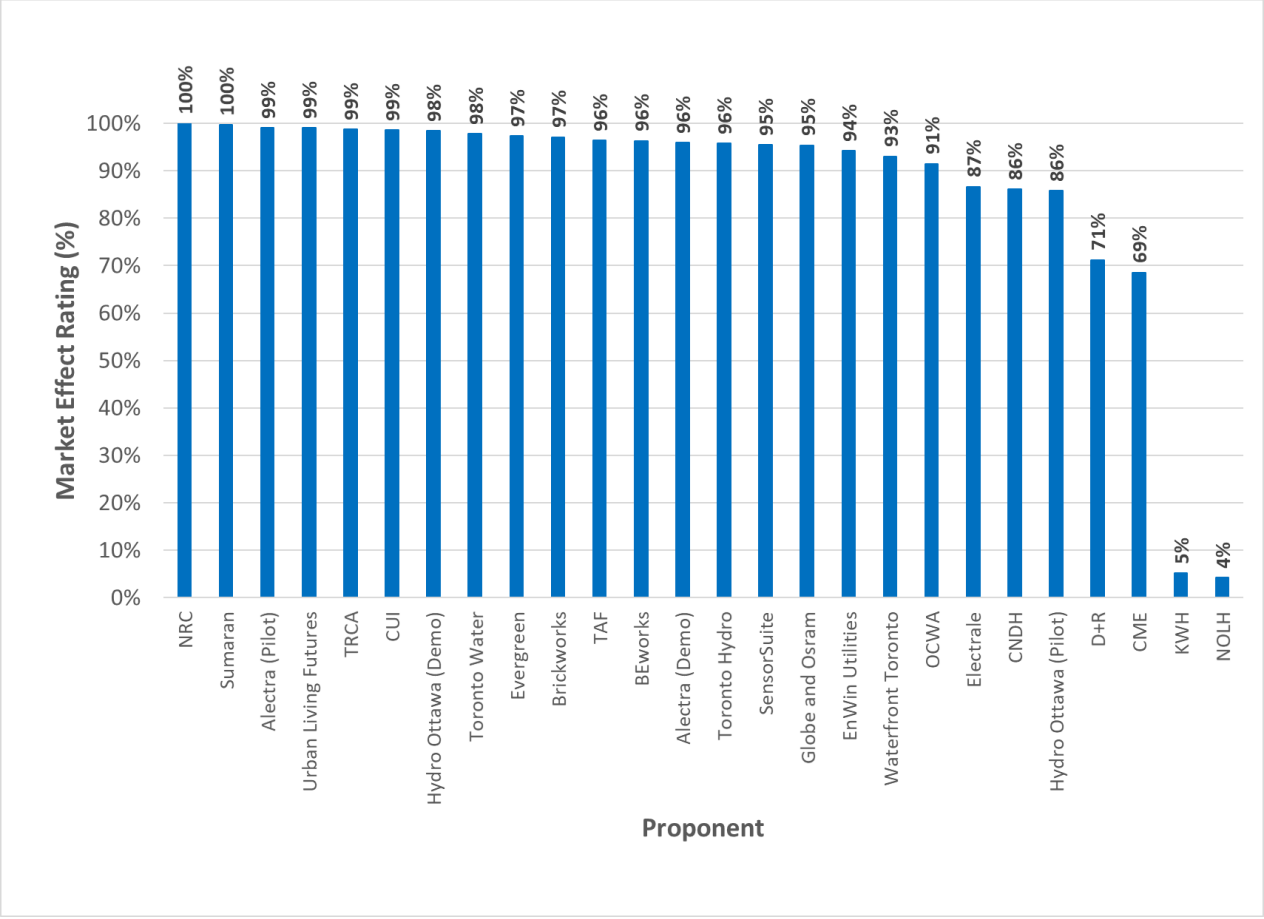
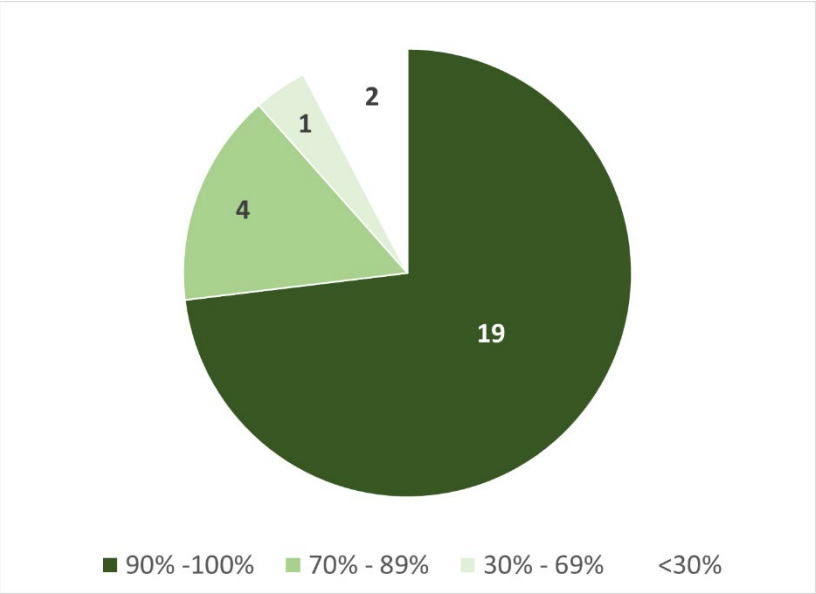


Figure 11: Number of Projects Delineated by Market Effects Percentages



4.1.2 Project Performance

Project performance was determined by comparing a project's final outcomes and deliverables to the project proponent's forecasted goals and objectives, as detailed in Section 3.1.1. It is important to note that the forecasted goals were best estimates as the solutions being demonstrated / tested had not been previously proven in market. The results of the project performance evaluation are summarized in Table 20 for the market facilitation projects, Table 21 for the technology demonstration projects and Table 22 for the program pilot projects. The tables only include the project objectives that are applicable to the projects in the specific category. For example, market facilitation projects included demand savings as an objective, while none of the technology demonstration projects included demand savings as an objective. This means Table 20 includes demand savings, while Table 21 does not include demand savings. When a project exceeded an objective, the project performance may exceed 100%. For example, if a project exceed its participation target by 37%, then it obtained 137% for the participation objective.

Market facilitation projects were very successful in achieving their forecasted goals and objectives. Eight of the ten market facilitation projects achieved or exceeded their project goals. The remaining two projects were close to achieving their goals at 88% and 80%. As expected for market facilitation projects, the objectives of these projects focused on knowledge sharing and the development of tools. The projects were very successful in achieving the goals set for the focus areas. To support these focus areas, additional goals were set for participation and reporting. The market facilitation projects were very successful in achieving goals set for participation and reporting.

Table 20: Project Performance – Market Facilitation Projects[2]

Proponent	Project	Participation	Electricity Savings (Forecast vs. Actual)	Demand Reduction (Forecast vs. Actual)	Regulation and Policy	Reporting	Knowledge Sharing	Tools	Average
CUI	The Ontario Parking Area and Garage Project		173%			100%	100%	100%	**118%**
CME	Energy Pathfinder Initiative	100%				100%	148%		**116%**
TRCA	Performance Based Conservation	137%				100%	92%		**110%**
Evergreen	Tower Renewal Showcase Project	100%				100%	100%	100%	**100%**
NRC	High Performance Buildings Program	100%			100%	100%	100%	100%	**100%**
TAF	Pumping Energy Savings in Electrically Heated MURBs	100%				100%	100%	100%	**100%**
Toronto Water	Advancing Energy Efficient Water Services in Toronto	100%				100%	100%	100%	**100%**
Urban Living Futures	UPPlift: Toronto	100%				100%	100%	100%	**100%**
BEworks	Utility Bills that Save	100%		40%		100%	100%	100%	**88%**
Waterfront Toronto	Energy Performance Tracking	60%				100%			**80%**

The technology demonstration projects were very successful in achieving their forecasted goals and objectives, with all projects achieving a score between 78% and 100%. The primary focus of the technology demonstration projects was to demonstrate or test an innovative technology, and determine related electricity savings. Similar to the market facilitation project, goals were set for participation and reporting to support the focus areas. Low project performance scores are mainly due to electricity savings being less than forecasted at the project outset.

Projects provided lessons learned to address the energy savings of the technologies when applied in future projects and programs. For example, following the completion of their GIF-funded projects, SensorSuite secured a commercial contract to install its energy management system at a MURB in London, Ontario and achieved 31% annual building energy savings, and Alectra's Residential Solar Storage pilot resulted in additional installations, including a 10-unit hybrid pilot in the City of Markham and one unit in Thunder Bay, to assist in demonstrating the technology and quantifying the energy savings.

[2] Empty cells = not applicable

Table 21: Project Performance – Technology Demonstration Projects[3]

Proponent	Project	Participation	Electricity Savings (Forecast vs.	Reporting	Knowledge Sharing	Tools	Average
Electrale	HAC Demonstration	100%	100%	100%	100%		**100%**
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance				100%		**100%**
Brickworks	Freezer Temperature Modification	100%	74%	100%	100%		**94%**
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	60%		100%	100%		**87%**
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	102%	20%	100%		100%	**81%**
Alectra (Technology)	Residential Solar Storage Pilot	100%	33%	100%			**78%**

Program pilot projects aimed to address a wide range of objectives, including electricity savings, demand reduction, cost-effectiveness, knowledge sharing and tool development. The projects achieved their goals with mixed results. A few projects (3 of 10) exceeded their forecasted goals, while a few projects (3 of 10) achieved less than 50% of their goals. All the projects achieved their reporting goals. Three projects achieved their participation goals, while the remaining projects achieved 75% or less of their participation goal. The primary purpose of the program pilots was to test program concepts. Projects with low success scores provided valuable insights into challenges, barriers and lessons learned to inform program design, and avoided larger scale investments in projects that would not be cost-effective. Low project performance scores for program pilot projects are mainly the result of:

- Lower participation than forecasted
- Electricity and demand savings were less than forecasted at the outset of the project
- Cost effectiveness of programs were less than forecasted.

Since the nature of the projects is innovative and most concepts had not been previously tested or implemented, real-world data was usually not available. To address this data gap, proponents most often rely on theoretical estimates of participation, savings and cost-effectiveness. Additional guidance addressing these three items can assist future projects (especially program pilots) in achieving their forecasted goals. The recommended guidance includes providing a

[3] Empty cells = not applicable

range of expected participation, savings and cost-effectiveness, which is based on a theoretical estimate and confidence in the data supporting the theoretical estimate.

Table 22: Project Performance – Program Pilot Projects[4]

Proponent	Project	Participants	Electricity Savings (Forecast vs Actual)	Demand Reduction (Forecast vs Actual	Gas Savings	Cost Effectiveness	Regulation and Policy	Reporting	Knowledge Sharing	Tools	Average
Alectra (Pilot)	Evolution of Advantage Power Pricing	185%		100%			100%	100%			**121%**
CNDH	Residential Demand Response Smart Thermostat Pilot	69%		151%				100%			**107%**
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	98%		109%				100%			**102%**
OCWA	Pay-for-Performance Pilot Initiative		76%					100%	100%		**92%**
Toronto Hydro	Demand Response in the MURB Sector	63%	100%	120%	100%	39%		100%			**87%**
EnWin	Building Optimization Pilot	75%	51%			94%		100%		100%	**84%**
Globe Electric and OSRAM Sylvania	Upstream Lighting Program	99%	28%					100%			**76%**
D+R International	Home Appliance Market Lift	50%	16%	3%				100%			**42%**
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	2%	4%	4%					100%	100%	**42%**
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	16%	3%			15%		100%			**34%**

The evaluation of the GIF projects indicated that these theoretical estimates are most often higher than real-world applications. For example, the program pilot projects' actual participation is about 67% of the proposed participation and the actual electricity and demand savings are about 40% of the proposed savings[5]. For technology demonstration projects, the actual electricity savings is about 57% of the proposed savings. It is recommended that the proponent offers a maximum expected value (based on theoretical estimates) and a lower expected value

[4] Empty cells = not applicable

[5] The average was calculated for the program pilots with the outliers (highest and lowest values) excluded.

(scaled downward based on confidence in the data supporting the theoretical estimate) to account for the uncertainty of the proposed values. Projects that have secured a commitment from participants, which is most often the case for market facilitation and technology demonstration projects, would not require participation estimates to be scaled back. It is recommended to encourage GIF applicants to secure commitment from participants during the application stage. An example of a data confidence scaling framework to be applied to program pilot projects is summarized in Table 23. To derive the lower expected value the scaling factor would be applied to the maximum expected value. The scaling factors are based on the GIF project performance evaluation results.

Table 23: Data Confidence Scaling Factors

Confidence Level	Data Confidence Definition	Scaling Factor
High	Data is based on results of real-world projects that is very similar to the proposed project.	80%
Medium	Data is based on results of other pilots or demonstration projects that provides a reasonable approximation of the proposed project.	50%
Low	No data is available, or data is limited to theoretical or simulated data with limited or no real-world pilots or demonstration examples.	20%

The challenge in achieving cost-effectiveness using traditional testing was identified in the analysis of GIF projects with cost-effectiveness goals. For example, for program pilots, the administrative cost is generally a significant portion of the total program cost. In contrast, the administrative cost is a significantly smaller portion of the program cost for larger regional or provincial programs. Because of the contrast in scale between pilot programs and regional/provincial programs, pilot programs are rendered substantially less cost-effective. When setting a cost-effectiveness goal for a pilot program, the effect of the program scale needs to be considered.

4.1.3 GIF Objectives

GIF projects were assessed to determine how well the projects align with the GIF objectives. As described in Section 3.1.2, the projects were assessed against the following two indicators:

- Energy or demand savings
- Grid reliability and resilience

The results of the assessment are summarized in Table 24. The GIF projects were very well aligned with the GIF energy or demand savings objective as is evident by the rating scores in Table 24. Almost all the projects (24 of 26, or 92%) have the potential to achieve the full market effect of saving electricity, or reducing demand, at a provincial scale.

The GIF projects demonstrated significant potential in addressing grid reliability and resilience, which is assessed as the potential to reduce Ontario's forecasted summer capacity deficit in 2025. All the program pilot projects have the potential to reduce Ontario's summer deficit. Five of the ten program pilot projects have the potential of a significant reduction, equal to more than 1% of Ontario's forecasted summer capacity deficit in 2025. The most significant potential reduction is for demand response smart thermostat programs piloted by Hydro Ottawa, and Cambridge and North Dumfries Hydro with a potential of close to 9% reduction in Ontario forecasted summer capacity deficit in 2025, if smart thermostats were adopted broadly across the province and used as aggregated demand response resources

Half of the market facilitation and half of the technology demonstration projects addressed grid reliability and resilience. Two projects, Alectra's Solar Storage pilot and SensorSuite's Intelligent MURB EMS, have the potential to make a significant contribution in reducing the Ontario summer deficit, with a respective reduction of 6.3% and 3.2% in Ontario's forecasted summer capacity deficit in 2025.

Table 24: GIF Objectives[6]

Proponent	Project	Energy / Demand Savings	Grid Reliability and Resilience	Weighted Average
Market Facilitation Projects				
CME	Energy Pathfinder Initiative	100%		**100%**
NRC	High Performance Buildings Program	100%		**100%**
Urban Living Futures	UPPlift: Toronto	100%		**100%**
TRCA	Performance Based Conservation	100%	1.16%	**95%**
Evergreen	Tower Renewal Showcase Project	100%	0.59%	**95%**
CUI	The Ontario Parking Area and Garage Project	100%	0.36%	**95%**
BEworks	Utility Bills that Save	100%	0.32%	**95%**
Toronto Water	Advancing Energy Efficient Water Services in Toronto	100%	0.02%	**95%**
TAF	Pumping Energy Savings in Electrically Heated MURBs	100%	< 0.01%[7]	**95%**
Waterfront Toronto	Energy Performance Tracking	95%		**95%**
Technology Demonstration Projects				
Electrale	HAC Demonstration Project	100%		**100%**
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	100%		**100%**
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	100%		**100%**
Alectra (Technology)	Residential Solar Storage Pilot	100%	6.28%	**95%**

[6] Empty cells = not applicable

[7] The estimate did not take into account electrification (i.e. fuel switching of existing MURBs from gas-based heating to electric). It considered only existing e-MURBs and applied the same growth rate of MURBs.

Proponent	Project	Energy / Demand Savings	Grid Reliability and Resilience	Weighted Average
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	100%	3.22%	**95%**
Brickworks	Freezer Temperature Modification	100%	0.08%	**95%**
Program Pilot Projects				
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	100%	8.95%	**95%**
Alectra (Pilot)	Evolution of Advantage Power Pricing	100%	5.19%	**95%**
CNDH	Residential Demand Response Smart Thermostat Pilot	100%	8.95%	**95%**
Toronto Hydro	Demand Response in the Multi-Unit Residential Building Sector	100%	4.70%	**95%**
EnWin	Building Optimization Pilot	100%	0.40%	**95%**
D+R International	Home Appliance Market Lift	100%	0.12%	**95%**
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	100%	0.05%	**95%**
Globe Electric and OSRAM Sylvania	Upstream Lighting Program	100%	<0.01%	**95%**
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	1%	0.01%	**1%**
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	1%	1.21%	**1%**

4.1.4 Achieved Market Effects

The market effects achieved by a project were assessed against the project's forecasted goals to determine its success in achieving the forecasted goals as it pertains to each of six market effects indicators outlined in Section 3.1.3. The extent of the market effect was determined by assessing the market effect segment reached by the project as described in Section 3.1.3. The market boundary is considered to be Ontario, and maximum market effect is achieved when a project has a province-wide impact. A project's achieved market effects score is the average of all the scores for the six market effects indicators. The results of the evaluation of achieved market effects are summarized in Table 25.

The GIF projects predominantly focused on the following market effects:

- Almost all the projects (24 of 26) had an effect on accelerating the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings or improving customer and IESO-controlled grid reliability and resilience.
- All the program pilot projects had an effect on accelerating the availability and adoption of technologies, services, or practices that influenced program design. Only a few market facilitation projects (3 of 10) had a focus on achieving this market effect, while none of the technology demonstration projects had such a focus.

- Most of the market facilitation projects (7 of 10) empowered policymakers and other decision-makers by providing them with information to avoid making poor program investments or policy decisions. Half of the technology demonstration projects and half of the program pilot projects also achieved this.

A number of projects included the three market effect indicators representing changed regulated and formalized structures, increased competition, and enabled innovators to secure investment. In some cases, these market effects overlapped or duplicated the market effects achieved for one of the three market effect indicators the project focused on: accelerate availability and adoption, influenced program design, and information to empower policy and decision-makers. When an overlap or duplication occurred, the priority market effect was rated, and the market effects with less focus were considered as not applicable.

The GIF projects achieved a significant market effect as summarized in Section 4.1.1 and observed from the market effect ratings presented in Table 25. A rating of 95% indicates the project had a measurable effect at the regional or local market level and a rating of 100% reflects a measurable effect at the provincial market level. Nine of the GIF projects (35%) achieved a provincial market level effect. An additional nine projects achieved a market effect ranging between a regional or local market and provincial market levels. This indicates that 70% of the GIF projects achieved a significant market effect.

Market facilitation and technology demonstration projects tend to achieve significant market effects with an average of 95% or higher rating. Program pilot projects were very successful in achieving significant market effects in accelerating the availability and adoption of technologies, services, or practices that resulted in direct customer bill savings or improving customer and IESO-controlled grid reliability and resilience. On average (6 of 10), the market effect of program pilot projects to accelerate the availability and adoption of technologies, services, or practices that influenced program design included:

- Creating awareness;
- Resulting in planning actions/activities; or
- Resulting in design actions/activities.

It often requires significant time and resources for pilot programs to develop into local, regional or provincial programs. With sufficient resources and development over time, these pilots have the potential to achieve their full market effect, as discussed in Section 4.1.5. The pilots also informed utilities to avoid larger scale investments in programs that are not cost-effective, saving significant ratepayer dollars.

Table 25: Achieved Market Effects[8]

Proponent	Project	Market Effect Indicators						
		Changed Regulated and Formalized Structures	Accelerate Availability and Adoption	Influenced Program Design	Increased Competition	Information to Empower Policy and Decision Makers	Enable Innovators to Secure Investment	Rating (Average)
Market Facilitation Projects								
NRC	High Performance Buildings Program (Recommitment)	100%	100%				100%	**100%**
BEworks	Utility Bills that Save		100%			100%	100%	**100%**
TRCA	Performance Based Conservation		100%	100%		100%		**100%**
Toronto Water	Advancing Energy Efficient Water Services in Toronto		100%			100%	100%	**100%**
Evergreen	Tower Renewal Showcase Project	95%	100%			100%		**98%**
CUI	The Ontario Parking Area and Garage Project		100%			95%		**98%**
Urban Living Futures	UPPlift: Toronto		95%	100%	95%		100%	**98%**
TAF	Pumping Energy Savings in Electrically Heated MURBs		95%			100%	95%	**97%**
Waterfront Toronto	Energy Performance Tracking	95%						**95%**
CME	Energy Pathfinder Initiative		1%	1%		50%		**17%**
Technology Demonstration Projects								
Alectra (Technology)	Residential Solar Storage Pilot		100%			100%	100%	**100%**
Brickworks	Freezer Temperature Modification	100%				100%		**100%**
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	100%	100%			100%		**100%**
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	100%	100%		100%			**100%**
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System		100%		95%		100%	**98%**
Electrale	HAC Demonstration Project		50%		50%		100%	**67%**
Program Pilot Projects								
Globe Electric and OSRAM Sylvania	Upstream Lighting Program		100%	100%		100%		**100%**
Toronto Hydro	Demand Response in the MURB Sector		95%	100%	95%	100%		**98%**

[8] Empty cells = not applicable

Proponent	Project	Market Effect Indicators						
		Changed Regulated and Formalized Structures	Accelerate Availability and Adoption	Influenced Program Design	Increased Competition	Information to Empower Policy and Decision Makers	Enable Innovators to Secure Investment	Rating (Average)
Alectra (Pilot)	Evolution of Advantage Power Pricing	95%	95%	95%		100%	100%	**97%**
EnWin	Building Optimization Pilot		95%	95%				**95%**
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative		100%	50%		95%	100%	**86%**
CNDH	Residential Demand Response Smart Thermostat Pilot		100%	5%	100%			**68%**
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot		100%	5%	100%			**68%**
D+R International	Home Appliance Market Lift		95%	1%				**48%**
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens		1%	1%			0%	**1%**
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector		1%	1%				**1%**

4.1.5 Potential Market Effects

Similar to the assessment of achieved market effects, the extent of the potential market effect was determined by assessing the maximum potential market effect segment the project could reach. The maximum potential market effect of the project is determined for the same six market effects indicators that were evaluated to assess the market effects achieved by the project, as described in Section 3.1.3. The results of the potential market effects evaluation are summarized in Table 26. The predominant and priority market effects remained the same as for the achieved market effects discussed in Section 4.1.4. Almost all of the GIF projects (23 of 26) have the potential to influence the market at the provincial level. One project's maximum market effect potential is an effect at the local level, and two projects have a maximum potential of creating awareness. The Waterfront Toronto project focused on providing recommendations on how Waterfront Toronto's Minimum Green Building Requirements (GBR) could be enhanced. The tailored recommendations are specific to Toronto local level. Very low participation in the two projects by Niagara on the Lake Hydro and Kitchener-Wilmot Hydro is the main reason why these projects have a maximum market effect that is limited to creating awareness. The technologies used in the projects may be viable to achieve a larger market effect and the two program pilots provided lessons learned, which would inform future program designs to address the low participation.

As outlined in 3.1.4, the potential market effects rating include an assessment of the projects' innovation. The assessment of a project's alignment with the 2019 Innovation Roadmap utilizes the Roadmap's priority areas in determining degrees of innovation. The Innovation Roadmap was published in 2019 after the GIF projects were completed, therefore the projects did not have a goal to align with the Roadmap. This indicator is retrospective.

Close to half of the GIF projects (11 of 26) have a very high degree of alignment with the GIF innovation objective, achieving a 100% rating score for the innovation indicator. These projects have full alignment with the highest priority or important priority areas of the IESO's Innovation Roadmap. Most of the remaining projects (12 of 26) have a 50% alignment with the innovation objective. Currently proponents are referred to the Roadmap, and alignment with the Roadmap is an evaluation criteria for all new proposals.

Almost all the projects (24 of 26) have a total potential market effects rating above 90%. The two projects with low ratings have a maximum potential of creating awareness, which is discussed above.

Table 26: Potential Market Effects[9]

Proponent	Project	Indicators								
		Changed Regulated and Formalized Structures	Accelerate Availability and Adoption	Influenced Program Design	Increased Competition	Information to Empower Policy and Decision Makers	Enable Innovators to Secure Investment	Average of Six Indicators	Alignment with Innovation Roadmap	Total Rating (Weighted Average)
Market Facilitation Projects										
NRC	High Performance Buildings Program (Recommitment)	100%	100%	100%			100%	**100%**	100%	**100%**
Urban Living Futures	UPPlift: Toronto		100%	100%	100%		100%	**100%**	100%	**100%**
Evergreen	Tower Renewal Showcase Project	100%	100%			100%		**100%**	100%	**100%**
CME	Energy Pathfinder Initiative		100%	100%		100%		**100%**	100%	**100%**
CUI	The Ontario Parking Area and Garage Project	100%	100%			100%		**100%**	50%	**98%**
TRCA	Performance Based Conservation		100%	100%		100%		**100%**	50%	**98%**
TAF	Pumping Energy Savings in Electrically Heated MURBs		100%			100%	100%	**100%**	50%	**98%**
Toronto Water	Advancing Energy Efficient Water Services in Toronto		100%			100%	100%	**100%**	50%	**98%**
BEworks	Utility Bills that Save		100%			100%	100%	**100%**	5%	**95%**

[9] Empty cells = not applicable

Proponent	Project	Indicators								
		Changed Regulated and Formalized Structures	Accelerate Availability and Adoption	Influenced Program Design	Increased Competition	Information to Empower Policy and Decision Makers	Enable Innovators to Secure Investment	Average of Six Indicators	Alignment with Innovation Roadmap	Total Rating (Weighted Average)
Waterfront Toronto	Energy Performance Tracking	95%						**95%**	5%	**91%**
Technology Demonstration Projects										
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System		100%		100%		100%	**100%**	100%	**100%**
Alectra (Technology)	Residential Solar Storage Pilot		100%			100%	100%	**100%**	100%	**100%**
Electrale	HAC Demonstration Project		100%		100%		100%	**100%**	95%	**100%**
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	100%	100%		100%			**100%**	50%	**98%**
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	100%	100%			100%		**100%**	50%	**98%**
Brickworks	Freezer Temperature Modification	100%				100%		**100%**	50%	**98%**
Program Pilot Projects										
Alectra (Pilot)	Evolution of Advantage Power Pricing	100%	100%	100%		100%	100%	**100%**	100%	**100%**
Toronto Hydro	Demand Response in the MURB Sector		100%	100%	100%	100%		**100%**	100%	**100%**
CNDH	Residential Demand Response Smart Thermostat Pilot		100%	100%	100%			**100%**	100%	**100%**
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot		100%	100%	100%			**100%**	100%	**100%**
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative		100%	100%		100%	100%	**100%**	50%	**98%**
Globe Electric and OSRAM Sylvania	Upstream Lighting Program		100%	100%		100%		**100%**	50%	**98%**
D+R International	Home Appliance Market Lift		100%	100%				**100%**	50%	**98%**
EnWin	Building Optimization Pilot		100%	100%				**100%**	50%	**98%**
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens		1%	1%			0%	**1%**	50%	**3%**

Proponent	Project	Indicators								
		Changed Regulated and Formalized Structures	Accelerate Availability and Adoption	Influenced Program Design	Increased Competition	Information to Empower Policy and Decision Makers	Enable Innovators to Secure Investment	Average of Six Indicators	Alignment with Innovation Roadmap	Total Rating (Weighted Average)
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector		1%	1%				**1%**	50%	**3%**

4.2 Impact Review of Energy and Demand Savings

4.2.1 Achieved Savings

Table 27 presents a comparison of the reported and reviewed savings estimates for the 11 projects included in the impact review. The total reviewed energy savings were 40% less than the reported energy savings and the reviewed peak demand savings were 12% less than the reported peak demand savings.

For three DR focused projects (Toronto Hydro, CNDH, and Hydro Ottawa's pilot program), the peak demand period was defined as only during called events. For all other projects, peak demand period was defined by IESO's definition of 1pm to 7pm weekdays during June, July, and August.

Six projects each had an IESO-funded post-project Measurement and Verification (M&V) report that was conducted by a third party. These M&V reports were included in the impact review for relevant projects. Projects with third-party M&V reports included OCWA, EnWin, SensorSuite, Niagara on the Lake Hydro, Alectra's technology demonstration project, and Hydro Ottawa's technology demonstration project.

Table 27: Reported and Reviewed Achieved Savings by Project

Proponent	Project	Energy Savings (kWh)			Peak Demand Savings (KW)		
		Reported	Reviewed	% Difference	Reported	Reviewed	% Difference
OCWA	Water Treatment Plant Pay-For-Performance Pilot Initiative	3,629,603	3,640,492	+0%	579.7	405.8	-30%

Proponent	Project	Energy Savings (kWh)			Peak Demand Savings (KW)		
		Reported	Reviewed	% Difference	Reported	Reviewed	% Difference
EnWin	Building Optimization Pilot	6,494,259	1,539,807	-76%	744.3	366.3	-51%
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	1,270,000	1,270,000	0%	0.0	0.0	0%
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	527,000	527,000	0%	307.0	307.0	0%
Toronto Hydro	Demand Response in the MURB Sector	263,872	263,872	0%	63.8	168.8	+165%
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	187,745	90,117	-52%	0.0	11.9	+N/A
Alectra (Technology)	Residential Solar Storage Pilot	51,202	51,202	0%	19.8	19.8	0%
CNDH	Residential Demand Response Smart Thermostat Pilot	21,640	31,116	+44%	1,292.9	1,292.9	0%
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	29,551	20,655	-30%	0.0	4.4	+N/A
Brickworks	Freezer Temperature Modification	13,405	13,405	0%	0.0	0.0	0%
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	0	3,489	+N/A	546.7	546.7	0%
Total		**12,488,277**	**7,451,155**	**-40%**	**3,554**	**3,124**	**-12%**

A 0% difference in Table 27 indicates that the reviewed savings are in agreement with the reported savings. In instances where the reviewed savings differ from the reported savings, the causes for variations are outlined below for each project.

Ontario Clean Water Agency – Nexant's review referenced an M&V evaluation previously completed on this pilot program, and Nexant's review agreed with the previous evaluation's findings. Reported and verified energy savings estimates only differed by minor differences in operational parameters such as equipment run hours. Verified peak demand savings were lower

than the reported peak demand savings due to reported savings estimates not employing a coincidence factor to account for the equipment not operating every hour of the year.

EnWin – The Nexant review referenced an M&V evaluation previously completed on this pilot program, and the review agreed with the previous evaluation's findings. Of the 249 measures included in the previous evaluation's sample, 132 had at least some (greater than zero) reported savings. Of those 132 measures with reported savings, only 31 were verified to have been implemented and yielded at least some (greater than zero) savings. This indicated that 101 measures claimed savings but were verified to not produce savings.

Toronto Hydro – Nexant's review found that the reported hourly demand savings calculations contained several errors, including misapplication of the growth rate (i.e. the hourly percent change of consumption from the baseline day). Errors also included removing data from certain event hours that showed demand increases without supporting the decision and calculations referencing the incorrect raw data.

Niagara on the Lake Hydro – The Nexant review referenced an evaluation previously completed on this pilot program, and the review agreed with the previous evaluation's findings. The evaluation found that the difference between reported and verified energy savings was due to the reported savings using assumptions to estimate savings prior to implementing the measures. The verified savings had the advantage of collecting operation and performance data of the new equipment after it was installed. Peak demand savings were not reported. Verified peak demand savings were estimated as part of the previous evaluation of this pilot.

Cambridge and North Dumfries Hydro – The project proponent did not report project-level energy savings. For this evaluation, Nexant calculated the project-level reported energy savings by summing all event-level impacts over the pilot period. Nexant calculated the reviewed savings by applying a weighted average saving per device multiplied by the number of devices in each year. The project proponent also did not report project-level peak demand savings. The reported results are shown as event summary outputs and do not provide a means to compile the results into a project total reported peak demand savings value. Therefore, Nexant calculated both the reported and reviewed peak demand savings by multiplying the total quantity of devices in the program by the weighted average peak demand savings per device.

Kitchener-Wilmot Hydro – Nexant was unable to obtain the derivation of the reported energy savings, and peak demand savings were not reported. The reviewed energy and peak demand savings referenced the IESO's Measures and Assumptions List for the Demand Control Kitchen Ventilation measure.[10]

[10] IESO (2020). *IESO Prescriptive Measures and Assumptions List April 2020*. Website: https://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/Measures-and-Assumptions/IESO-Prescriptive-Measures-Assumptions-List-2020.ashx

Hydro Ottawa (Pilot) – Only demand savings were reported for the project as it was focused on the demand response. To estimate reviewed energy savings, Nexant applied several assumptions to the reported event-level demand savings, which included assuming that demand savings were constant during each event and assuming pertinent snapback characteristics.

4.2.2 Achieved Greenhouse Gas Reductions

Achieved annual GHG reductions for each project are summarized in Table 28. OCWA's Pay for Performance program achieved the largest GHG emissions reduction, while Alectra's Residential Solar Storage project and Hydro Ottawa's Wi-Fi Thermostat project achieved the smallest reductions. A major factor in achieved GHG emissions reductions was the relative size of the project in terms of energy savings. Referencing Table 27, OCWA's project saved the most energy, at 3.64 GWh, while the Alectra and Hydro Ottawa projects had some of the lowest achieved energy savings.

Table 28: Achieved Greenhouse Gas Emissions Reduction by Project

Proponent	Project	GHG Emissions Reduction (tonnes CO_2)
OCWA	Water Treatment Plant Pay-For-Performance Pilot Initiative	729.2
EnWin	Building Optimization Pilot	235.5
Toronto Hydro	Demand Response in the MURB Sector	178.7
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	171.7
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	55.5
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	12.2
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	3.0
Brickworks	Freezer Temperature Modification	2.5
CNDH	Residential Demand Response Smart Thermostat Pilot	1.5
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	1.0
Alectra (Technology)	Residential Solar Storage Pilot	1.0

4.2.3 Provincial Potential Savings

Adjusted To Year 2018

Table 29 provides a summary of each project's achieved savings, provincial achievable potential as of 2018, and the resulting scaling factor. The scaling factor is defined as the 2018

provincial achievable potential divided by the achieved savings. For example, the energy savings scaling factor for the NOLH project is calculated as 122,362 MWh in 2018 provincial achievable potential divided by 90 MWh in project achieved savings to produce a scaling factor of 1,358. This factor indicates how much a particular project may be expected to scale if it were to be implemented province-wide.

Table 29: Provincial Achievable Potential Estimates by Project (Year 2018)

Proponent	Project	Energy Savings			Peak Demand Savings		
		Project Achieved Savings (MWh)	2018 Provincial Achievable Potential (MWh)	Scaling Factor	Project Achieved Savings (MW)	2018 Provincial Achievable Potential (MW)	Scaling Factor
Alectra (Technology)	Solar Residential Storage Pilot	51	215,800	4,215	0.0	54.1	2,728
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	90	122,362	1,358	0.0	16.9	1,417
EnWin	Building Optimization Pilot	1,540	65,829	43	0.4	17.3	47
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	1,270	42,035	33	0.0	0.0	-
Toronto Hydro	Demand Response in the MURB Sector	264	26,279	100	0.2	16.8	100
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	527	9,260	18	0.3	11.5	37
OCWA	Water Treatment Plant Pay-For-Performance Pilot Initiative	3,640	2,853	1	0.4	0.3	1
Brickworks	Freezer Temperature Modification	13	842	63	0.0	0.1	-
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	21	779	38	0.0	0.2	39
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	3	758	217	0.5	47.4	87
CNDH	Residential Demand Response Smart Thermostat Pilot	31	611	20	1.3	25.4	20

The provincial achievable potential considers several factors, including the magnitude of a single measure's savings, the total population where the measure could be implemented, and economic and technical barriers. For example, the Alectra Utilities Residential Solar Storage project has the highest potential savings (both energy and demand) given its applicability to a large population (residential buildings) and relatively large savings per home. Conversely, the Kitchener-Wilmot Hydro Demand Control Kitchen Ventilation project yields relatively low potential savings. Although the savings per measure is not small relative to other projects, it is only applicable to kitchen ventilation equipment in the commercial sector.

Projects with the largest scaling factors in Table 29 are indicative of the best prospects at scaling to the provincial level. The Alectra Residential Solar Storage project has the largest scaling factor for energy and peak demand, as discussed in the previous paragraph. The lowest scaling factor for both energy and demand savings was for the OCWA project, since the quantity of potential participating facilities across the province (water and wastewater treatment plants) is much smaller than the quantity of potential facilities for other projects.

Adjusted To Year 2025

As part of the grid reliability and resilience indicator presented and discussed in Section 4.1.3, the evaluation determined provincial achievable potentials for projects where sufficient data was available, normalized to the year 2025. These results are shown in Table 30.

Both Alectra projects and the Canadian Urban Institute projects show the highest potential energy savings. Similar to the discussion regarding Table 29, the projects with the largest potential in 2025 tend to have a combination of one or more of the following attributes: applicable to large population, yield relatively high per measure savings, and expected to have relatively low economic and technical barriers to implementation.

Table 30: Provincial Achievable Potentials by Project (Year 2025)

Proponent	Project	Energy (GWh)	Peak Demand (MW)
Market Facilitation Projects			
CUI*	The Ontario Parking Area and Garage Project	1,472	16.2
TRCA*	Performance Based Conservation	321	52.6
Evergreen*	Tower Renewal Showcase Project	174	26.7
BEworks*	Utility Bills that Save	93	14.5
TAF*	Pumping Energy Savings in Electrically Heated MURBs	56	0.0
Technology Demonstration Projects			
Alectra (Technology)	Residential Solar Storage Pilot	984	286.0
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	260	0.0**
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	118	146.4
Brickworks	Freezer Temperature Modification	6	0.7
Program Pilot Projects			

Proponent	Project	Energy (GWh)	Peak Demand (MW)
Alectra (Pilot)*	Evolution of Advantage Power Pricing	1,213	236.3
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	405	55.3
Toronto Hydro	Demand Response in the MURB Sector	334	213.9
EnWin	Building Optimization Pilot	75	18.3
D+R International*	Home Appliance Market Lift	34	5.3
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	20	2.2
Globe Electric and OSRAM Sylvania*	Upstream Lighting Program	17	0.4
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	7	407.2
CNDH	Residential Demand Response Smart Thermostat Pilot	5	218.3
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	1	0.3

* Project did not undergo an impact review. Therefore, the savings presented in this table are based on the reported savings estimates not reviewed by Nexant.

** Peak demand savings could not be determined.

Note: Only projects where a savings potential could be calculated are shown.

4.3 Value for Money

As discussed in Section 3.3, the value for money assessment combined the results of the market effects and impact evaluations to derive three distinct metrics for comparing performance across the GIF projects:

- Market effect rating – a quantitative metric that expresses the relative success of a project in meeting its stated goals, achieving the GIF's objectives, and its influence in the Ontario market.
- Avoided Cost/GIF Funding (AC/GF) ratio: a metric that expresses the potential financial value of the energy and demand savings in 2025 (i.e. the benefit) obtained for the GIF money spent (i.e. the cost).
- Partner contribution (PC) ratio – a quantitative comparison of the funding provided by GIF versus secondary financial support provided by the proponent.

The results of the three metrics are discussed in the subsequent subsections.

4.3.1 Market Effect Rating

The market effect rating quantifies a project's relative success in meeting its forecasted goals, achieving the GIF's objectives, and influencing the Ontario market. The market effects rating of the GIF projects is summarized in Table 31. Most of the GIF projects (22 of 26, or 85%) had very high market effects ratings, with a rating higher than 85%, whereby the average market effect rating of the portfolio of projects is 85%. These projects showed a high degree of success

in achieving their goals and objectives, aligning well with the GIF objectives, and having a significant effect on the Ontario market.

Table 31: Market Effect Rating by Project and Project Type

Proponent	Project	Market Effect Rating
Market Facilitation Projects		
National Research Council	High Performance Buildings Program (Recommitment)	100%
Urban Living Futures	UPPlift: Toronto	99%
Toronto and Region Conservation Authority	Performance Based Conservation Pilot Program	99%
Canadian Urban Institute	The Ontario Parking Area and Garage Project	99%
Evergreen	Tower Renewal Showcase Project	97%
Toronto Water	Advancing Energy Efficient Water Services in Toronto	98%
Toronto Atmospheric Fund	Pumping Energy Savings in EMURB	96%
BEworks	Bills that Save	96%
Waterfront Toronto	LEED Analysis	93%
CME	Energy Pathfinder Initiative	69%
Technology Demonstration Projects		
Sumaran	Zoned Distribution Strategies	100%
Hydro Ottawa (Demonstration)	Conservation Voltage Regulation Leveraging AMI Data	98%
Brickworks Communications	Freezer Temperature Modification	97%
Alectra (Demonstration)	Residential Solar Storage	96%
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	95%
Electrale	HAC Demonstration Project	87%
Program Pilot Projects		
Alectra (Pilot)	Evolution of Advantage Power Pricing	99%
Toronto Hydro	Demand Response in the Multi-Unit Residential Building Sector (MURB)	96%
Globe Electric and OSRAM Sylvania	Upstream Lighting Program	96%
EnWin Utilities	Building Optimization Pilot (BOP) – also known as Recommissioning (RCx) of Commercial Buildings	94%
Ontario Clean Water Agency	Pay-for-Performance Pilot Initiative	91%
Cambridge and North Dumfries Hydro	Residential Demand Response Smart Thermostat Pilot	86%
Hydro Ottawa (Pilot)	Residential Demand Response Wi-Fi Thermostat Pilot	86%
D+R International	Home Appliance Market Lift	71%
Kitchener-Wilmot Hydro	Direct Install of Demand Control Ventilation Control System in Kitchens	5%
Niagara on the Lake Hydro	Direct Install Energy Efficiency Measures for the Agricultural Sector	4%

The four projects with market effects ratings of less than 85% were the only projects achieving a market effect limited to creating awareness for a market effect indicator. To assist projects in

achieving a market effect beyond only creating awareness, the GIF can request proponents to include an outline of proposed steps or tasks that would enable the project to have a broader market effect.

Other contributing factors resulting in lower market effect ratings included lower than expected participation rates and energy or demand savings. These factors are discussed in Section 3.1.3, and the recommendation includes guidance on providing a range of expected participation, savings and cost-effectiveness, which is based on a theoretical estimate and confidence in the data supporting the theoretical estimate.

4.3.2 Avoided Cost (Achievable, 2025)/GIF Funding Ratio

The AC/GF ratio measure was used to determine the financial value of the energy and demand savings obtained for the GIF money invested. The AC/GF ratio expresses the benefit in terms of the potential avoided cost in 2025 for energy savings and demand reduction at the provincial level, while the cost is expressed as the GIF-funded value. Table 32 presents the AC/GF ratios for each project and lists projects in descending order within each project category.

For projects where energy or peak demand savings could not be estimated, the AC/GF ratio is deemed not applicable and is not included in the table. Reviewed savings were used to determine avoided costs for the 11 projects included in the impact evaluation, while reported savings were used to determine avoided costs for the remaining nine projects that were not included in the impact evaluation.

Higher AC/GF ratios indicate projects that have the potential to result in higher avoided costs (i.e. larger energy and demand savings) per unit of GIF funding. The key elements that drive the magnitude of the AC/GF ratio are:

- The savings (energy and peak demand) per measure implemented.
- The potential quantity of a measure that could be implemented across the province.
- Minimal economic and technical constraints to implement a measure throughout the province.
- The cost to the GIF to fund the project.

Therefore, projects with high AC/GF ratios have a combination of large savings per measure, applicability to a wide population, low implementation barriers, and/or low GIF project funding.

Table 32: Avoided Cost / GIF Funding Ratios by Project and Project Type

Proponent	Project	AC / GF Ratio
Market Facilitation Projects		
CUI*	The Ontario Parking Area and Garage Project	405
TRCA*	Performance Based Conservation Pilot Program	88
Evergreen *	Tower Renewal Showcase Project	77
BEworks*	Utility Bills that Save	15
TAF*	Pumping Energy Savings in Electrically Heated MURBs	9
Toronto Water*	Advancing Energy Efficient Water Services in Toronto	4
Technology Demonstration Projects		
Alectra	Residential Solar Storage Pilot	176
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	60
Hydro Ottawa	Conservation Voltage Regulation Leveraging AMI Data	34
Brickworks	Freezer Temperature Modification	2
Program Pilot Projects		
Toronto Hydro	Demand Response in the MURB Sector	743
NOLH	Direct Install Energy Efficiency Measures for the Agricultural Sector	118
Alectra *	Evolution of Advantage Power Pricing	90
Hydro Ottawa	Residential Demand Response Wi-Fi Thermostat Pilot	71
CNDH	Residential Demand Response Smart Thermostat Pilot	53
EnWin	Building Optimization Pilot	9
D+R International*	Home Appliance Market Lift	8
Globe Electric / OSRAM SYLVANIA*	Upstream Lighting Pilot	4
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	2
KWH	Direct Install of Demand Control Ventilation Control System in Kitchens	1

* Project did not undergo an impact review. Therefore, the AC/GF ratio presented in this table is based on the reported savings estimate not reviewed by Nexant.

More than half of the GIF projects (12 of 20, or 60%) have a significant AC/GF ratio of greater than 10. Projects with the most significant AC/GF ratio were completed by Toronto Hydro, Canadian Urban Institute, and Alectra.

To ensure future GIF projects continue to have high AC/GF ratios, it is recommended to consider the following during the GIF project approval process:

- The energy and demand savings per measure. Higher savings per measure would be more beneficial.
- The potential for installing a measure on a large scale across the province.
- The technical and economic feasibility of installing a measure across the province.

Table 33 summarizes the total avoided cost, GIF funding and AC/GF ratio at the portfolio level[11]. The total potential avoided cost of the 20 GIF projects is $ 510 million, and the total GIF funding for these projects is $7.7 million. The AC/GF ratio of the 20 projects is 66, indicating a significant potential value for the GIF funding. Of the three types of projects, the portfolio of technology demonstration projects had the highest AC/GF ratio at 86, and the portfolio of program pilot projects had the lowest at 58.

Table 33: Portfolio Avoided Cost / GIF Funding Ratio*

Type of Projects	Potential Avoided Cost (million $)	GIF Funding (million $)	AC / GF Ratio
Market Facilitation	97	1.3	74
Technology Demonstration	129	1.5	86
Program Pilot	284	4.9	58
Total	**510**	**7.7**	**66**

* Included only the 20 projects where an AC/GF ratio could be determined.

4.3.3 Partner Contribution Ratio

The partner contribution (PC) ratio is a quantitative comparison of the funding provided by the GIF versus secondary financial support provided by the proponent, as discussed in Section 3.3.3. Partner contributions were not required for 2013 – 2014 LDC Innovation stream program pilots and the PC ratio is not applicable to these projects.

The PC ratios of the projects are summarized in Table 34. Almost half of the projects (10 of 21, or 48%) matched the GIF funding or contributed more than the GIF funding (PC ratio equal to, or greater than 1). The total GIF funding provided for the portfolio of projects was $ 11 million and the total partner contributions were $ 26.5 million[12]. The three projects completed by National Research Council, Waterfront Toronto and Electrale made substantial contributions compared to the provided GIF funding.

Table 34: Partner Contribution Ratio by Project and Project Type

Proponent	Project	PC Ratio
Market Facilitation Projects		
NRC	High Performance Buildings Program (Recommitment)	9.46
Waterfront Toronto	Energy Performance Tracking	3.08
Evergreen	Tower Renewal Showcase Project	1.27
CME	Energy Pathfinder Initiative	0.72
TRCA	Performance Based Conservation Pilot Program	0.53

[11] The portfolio of projects included for the AC/GF ratio analysis only includes the 20 projects where an AC/GF ratio could be determined.

[12] The values include all GIF project, including 2013 – 2014 LDC Innovation stream program pilots.

Proponent	Project	PC Ratio
Urban Living Futures	UPPlift: Toronto	0.49
TAF	Pumping Energy Savings in Electrically Heated MURBs	0.49
Toronto Water	Advancing Energy Efficient Water Services in Toronto	0.48
BEworks	Utility Bills that Save	0.35
CUI	The Ontario Parking Area and Garage Project	0.33
Technology Demonstration Projects		
Electrale	HAC Demonstration Project	4.1
Alectra (Technology)	Residential Solar Storage Pilot	1.8
Sumaran	Zoned Distribution Strategies and Cold Climate Air Source Heat Pump Performance	1.4
SensorSuite	Development and Demonstration of Intelligent MURB Energy Management System	1.4
Brickworks	Freezer Temperature Modification	0.5
Hydro Ottawa (Technology)	Conservation Voltage Regulation Leveraging AMI Data	0.4
Program Pilot Projects		
OCWA	Water Treatment Plant Pay-for-Performance Pilot Initiative	1.2
Globe Electric / OSRAM SYLVANIA	Upstream Lighting Pilot	1.1
Alectra	Evolution of Advantage Power Pricing	1.0
D+R International	Home Appliance Market Lift	0.3

If the 2013 – 2014 LDC Innovation stream program pilots are excluded, the total GIF funding was $ 8.5 million and the total partner contributions were $ 26.5 million (as summarized in Table 35). The resulting PC ratio is 3.1, as summarized in Table 35. When the portfolio of market facilitation projects is compared with the portfolio of technology demonstration projects, the PC ratio of the market facilitation projects is more than double that of the technology demonstration projects. The PC ratio of the technology demonstration projects is almost double that of the program pilot projects.

Table 35: Portfolio Partner Contribution Ratio[13]

Project Types	Secondary Funding Support ($ million)	GIF Funding ($ million)	PC Ratio
Market Facilitation	20.1	4.1	4.9
Technology Demonstration	4.2	2.2	1.9
Program Pilot	2.2	2.2	1.0
Total	**26.5**	**8.5**	**3.1**

[13] The values exclude 2013 – 2014 LDC Innovation stream program pilots.

The market effect ratings results discussed in Sections 4.1 and 4.3.1 indicates that lower market effects ratings were mainly due to:

- Lower than expected participation, energy/demand savings and cost effectiveness.
- Projects do not include an outline of proposed steps or tasks that would enable the project to have a broader market effect.

The recommendations to address these findings are not dependent on the amount of funding the projects received, but are applicable to the methodology and approaches applied by the projects. The value for money assessment and the recommendations to address lower market effect ratings lead to the conclusion that the GIF funding provided for the projects was appropriate.

5 Findings and Recommendations

The evaluation of the GIF projects, resulted in findings and recommendations to inform the continuous improvement of the GIF. The findings and recommendations are summarized in Table 36.

Table 36: Findings and Recommendations

Topic	Finding	Recommendation
Achieving high AC/GF ratio	The AC / GF ratio of projects are driven by: ▪ The energy and demand savings per measure; ▪ The potential to install the measure at a large scale across the province; and ▪ The technical and economic feasibility to install the measure across the province.	To ensure future GIF project continue to have high AC/GF ratios it is recommended to consider during the GIF project approval process: ▪ The energy and demand savings per measure. Higher savings per measure would be more beneficial. ▪ The potential for installing a measure on a large scale across the province. ▪ The technical and economic feasibility to install a measure across the province.
Participation, savings and cost effectiveness lower than expected	The nature of the GIF projects are innovative and real world data is usually not available prior to the start of the project. To address the gap in data, proponents most often rely on theoretical estimates of participation, savings and cost effectiveness. The participation and savings achieved is often less than the theoretical estimates.	Provide additional guidance during the proposal stage, addressing participation, savings and cost effectiveness estimates. The recommended guidance may include requesting a range of expected participation, savings and cost effectiveness. The range can be based on a theoretical estimate and the confidence in the data supporting the theoretical estimate.
Scaling savings from project to province	Comparing the magnitudes of energy and peak demand savings scaling factors across the GIF projects indicates that there are common traits that tend to yield higher scaling factors, namely: applicable to a large population and economic and technical barriers are low.	To achieve larger potential provincial savings, projects that maximize the key contributors to scaling factors need to be prioritized. To this end, it may be helpful to create a framework for proponents to follow when determining potential future impacts if the measure is scaled to the province level. The framework can address the key parameters or reference sources to be used for scaling. For example, proponents can be directed to follow an approach similar to the one

Topic	Finding	Recommendation
		outlined in Section 3.3.2. This will standardize many assumptions regarding economic and technical barriers, enabling a more clear comparison between opportunities the Fund is considering.
Cost effectiveness affected by program pilot scale	The review of the GIF projects with cost effectiveness goals observed a challenge achieving cost effectiveness when using typical cost effectiveness tests. The difference in scale of pilot programs and regional / provincial programs make the pilot programs much less cost effective when compared to regional / provincial programs.	When including cost effectiveness as a goal for a pilot program, the effect of program scale need to be considered.
Achieving market effect beyond creating awareness	Projects with market effects ratings less than 85% had a market effect indicator where the market effect achieved was limited to creating awareness.	To assist projects in achieving a market effect beyond only creating awareness, the GIF can request proponents to include an outline of proposed steps or tasks that would enable the project to have a broader market effect.
Reporting peak demand savings estimates (when demand savings are expected)	Many projects did not report a peak demand savings, lacked documentation supporting reported peak demand savings estimates, or used a different peak demand definition. For example, full connected load demand savings were reported without taking into account a coincidence factor applicable to IESO's peak demand period definition.	Consider offering guidance or calculation tools to encourage proponents to estimate savings and utilize IESO's definition of peak demand. An option is to require proponents provide a peak demand savings estimate with supporting documentation confirming the IESO's definition of peak demand was used.

Appendix A: Rating Metrics

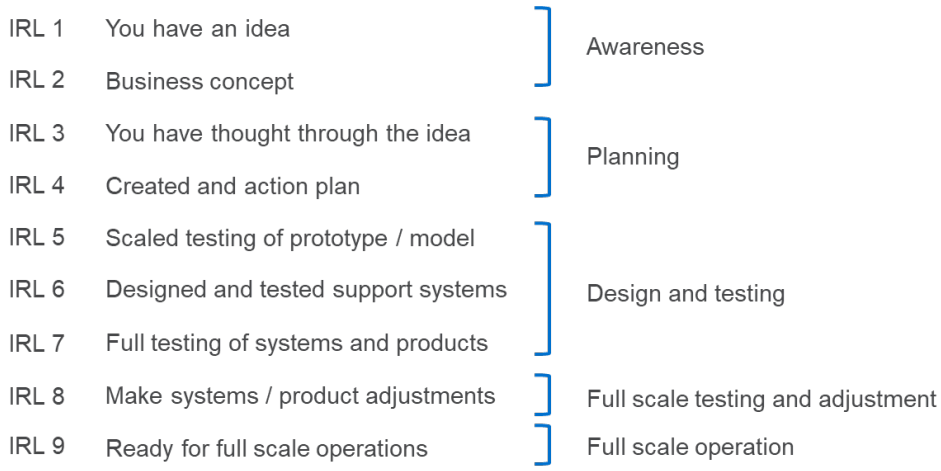
The GIF funded market facilitation, technology demonstration and program pilot project categories. To assess the extent of the market effect of the projects, an evaluation approach was developed that is informed by the following frameworks:

- Innovation readiness level
- Technology diffusion in the market
- CDM program life cycle

The three frameworks are defined as follows:

- Innovation readiness level (IRL): The concept of IRL is similar to the Technology Readiness Level (TRL) developed by NASA in the late 1980s for technology innovations. The groupings within an IRL are directly related to the amount of time and effort committed to an idea. This does not mean that every innovation must follow the same steps in the same order, as there will always be exceptions. However, it reinforces the fact that developing innovation or starting a business requires significant effort. Figure 12 provides a summary of the nine IRLs and the typical grouping of the IRLs into five stages[1].

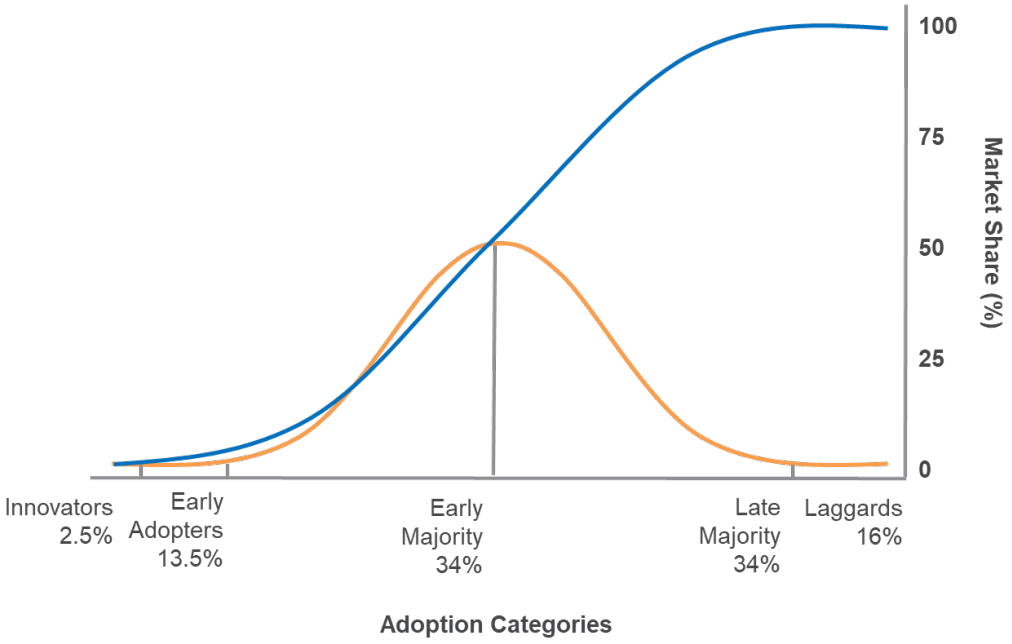
Figure 12: Innovation Readiness Levels (IRLs) and Typical Grouping



[1] Smith, S.W. (2017). *Innovation Readiness Levels.* Website: https://blog.theentrepreneursadvisor.com/2017/10/innovation-readiness-level/

- Technology diffusion in the market. Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technologies spread in the market. The time element of the diffusion process allows one to generate diffusion curves and classify adopters into categories. Because individuals in a social system do not adopt an innovation at the same time, innovativeness is the degree to which an individual is relatively earlier or later in adopting new ideas than other members of a social system. According to the theory of diffusion, the diffusion of an innovation usually follows a normal, bell-shaped curve where adoption is plotted overtime on a frequency basis. If the cumulative number of adopters is plotted, the result is an S-shaped curve, and adopters can be categorized into five categories: innovators, early adopters, early majority, late majority and laggards, as illustrated in Figure 13[2] [3]. A typical technology adoption lifecycle bell curve is used to set the time intervals (since innovation is introduced) at which each consumer group reaches its market share. These time intervals are then used to estimate the full market share of the consumer group (using the S-Curve), which also represents the total area under the bell curve.

Figure 13: Diffusion of Ideas and Technology in Market



[2] Boston University School of Public Health (2019). *Behavioral Change Models: Diffusion of Innovation Theory*. Website: https://sphweb.bumc.bu.edu/otlt/mph-modules/sb/behavioralchangetheories/behavioralchangetheories4.html

[3] Lumen Learning (2021). *Diffusion of Innovation.* Website: https://courses.lumenlearning.com/suny-marketing-spring2016/chapter/reading-diffusion-of-innovation/

- CDM program life cycle. CDM programs typically progress through the following five phases[4]:
  - Concept
  - Planning
  - Design and testing
  - Program delivery: launch
  - Program delivery: mature

Table 37 summarizes the segments used in the frameworks and the resulting segments derived for the framework to assess the extent of GIF market effects, where the market boundary is the provincial market.

Table 37: Segments Used in Frameworks

Framework	Segments				
	1	2	3	4	5
Innovation readiness levels	Awareness	Planning	Design and testing	Full scale testing and adjustments	Full scale operation
Technology diffusion in market	Innovators	Early adopters	Early majority	Late majority	Laggards
CDM program life cycle	Concept	Planning	Design and testing	Program delivery launch	Program delivery maturity
Extent of GIF project market effect	***Awareness***	***Planning***	***Design***	***Regional impact***	***Provincial impact***

To quantify the extent or impact of each segment on the market, the market share is estimated based on the technology diffusion in the market, as expressed in Figure 13. An S-curve was developed where 50% adoption equals 50% market share. The potential market share for each segment is the maximum market share for each segment, as summarized in Table 38.

[4] US EPA (2015). *National Action Plan for Energy Efficiency: Chapter 6 - Energy Efficiency Programs.* Website: https://www.epa.gov/sites/production/files/2015-08/documents/napee_chap6.pdf

Table 38: Extent Scoring of Market Effect per Segments

Parameter	Segments				
	Awareness	Planning	Design	Regional impact	Provincial impact
Extent (impact) score	1	5	50	95	100

Appendix B: Example Provincial Achievable Potential Avoided Cost Calculation

Calculating provincial achievable potential avoided cost for each project involved four primary steps. Below is an example calculation of those four steps for the OCWA project.

Step 1: Project Savings - Determine reviewed energy and demand savings for the GIF project.

OCWA was one of the projects included in the impact evaluation subset. Therefore, the reviewed savings were referenced, which were 3,640,492 kWh and 405.8 kW.

Step 2: Provincial Technical Potential - Scale project level savings to a technical potential saving estimate for all of Ontario.

At the program's conclusion, 51 projects across 48 unique sites were implemented, meaning that the average savings per site was 75,844 kWh and 8.5 kW.

In 2018, there were 340 wastewater treatment plants and 423 drinking water plants in Ontario, for a combined total of 763 plants.[1] Absent specific data projecting the growth in water and wastewater treatment plants over time in Ontario, the Ontario population over time was used as a proxy to estimate the future quantity of water and wastewater treatment plants. Between 2018 and 2025, Statistics Canada estimates a 8.6% increase in Ontario's population.[2,3] Therefore, the estimated quantity of treatment plants in the year 2025 is calculated to be 829. Subtracting out the 48 facilities which already participated in the program, we are left with 781 facilities.

781 facilities multiplied by the average savings per site noted previously yields a total provincial technical potential of 59.2 GWh and 6.6 MW.

[1] Posterity Group, December 2018, *Market Characterization and Conservation Potential for Ontario's Drinking Water & Wastewater Treatment Plants*, https://www.ieso.ca/-/media/Files/SaveOnEnergy/Industry/Water-and-Wastewater-Report.ashx

[2] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710013401

[3] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710005701, Projection scenario M4 was selected as a reasonable average

Step 3: Provincial Achievable Potential – Pare provincial technical potential down to provincial achievable potential.

The OCWA project contained multiple measures, but could be generally categorized as the following three measures from the most recent IESO potential study: industrial pump system optimization, industrial pump equipment upgrades, and industrial fan system optimization. [4]

For each of these three measures, the 2025 achievable potential listed in the study was divided by the 2025 technical potential listed in the study. The resulting three ratios were averaged to yield a ratio of 34%.

This 34% was applied to the technical potential calculated in the previous step, which produced an estimated achievable potential of 20.0 GWh and 2.2 MW.

Step 4: Convert savings to avoided cost. The IESO's CE tool provides avoided costs for energy ($/MWh) and capacity ($/kW-yr). The 2025 values are copied in the two following tables.

Table 39: Avoided Energy Cost by Season and Time-of-Use Period ($/MWh)

Year	Winter On Peak	Winter Mid-Peak	Winter Off-Peak	Summer On Peak	Summer Mid-Peak	Summer Off-Peak	Shoulder Mid-Peak	Shoulder Off Peak
2025	$44.37	$43.42	$42.15	$40.28	$43.89	$39.21	$36.29	$36.05

Table 40: Avoided Capacity Costs ($/kW-yr)

Year	Generation	Transmission	Distribution
2025	$162.15	$3.83	$4.73

The most relevant load shape for the OCWA project in the IESO CE tool's library was determined to be "PSP-Industrial-Miscellaneous_Industrial-Motors_Pumps". Therefore, the corresponding formatted load profile from the CE tool is shown below:

Table 41: Formatted Load Profile for Industrial Motors Pumps

Look Up Values	Winter Peak	Winter Mid-Peak	Winter Off Peak	Summer Peak	Summer Mid-Peak	Summer Off Peak	Shoulder Mid-Peak	Shoulder Off Peak
PSP-Industrial-Miscellaneous_Industrial-Motors_Pumps	0.0707	0.0806	0.1801	0.063	0.0897	0.1815	0.1528	0.1815

[4] IESO (2019). *2019 Conservation Achievable Potential Study*. Website: https://www.ieso.ca/2019-conservation-achievable-potential-study

Multiplying the formatted load profile by the avoided energy costs and annual provincial achievable potential energy savings in 2025, the avoided cost from energy savings was estimated to be $798,582.

Similarly, multiplying the provincial achievable potential demand savings in 2025 and the avoided capacity costs, the avoided cost from demand savings was estimated to be $380,742.

The combined avoided cost from energy and demand savings is therefore $1,179,324.

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