EVERGREEN

Sustainable Technologies
EVALUATION PROGRAM

Renewable Energy

Review of Renewable Energy Investments in Social and Affordable Housing

INTRODUCTION

The government of Ontario is planning to rapidly scale up low carbon investment in the social and affordable housing sector as part of the Climate Change Action Plan. Research and analysis is needed to help inform the structure of investment programs to deliver the greatest impact in terms of greenhouse gas (GHG) reductions and operating cost savings for housing providers. In order to develop insights on sector capacity for implementing low carbon investments, an evaluation of the Renewable Energy Initiative (REI) was sponsored by the Ontario Ministry of Municipal Affairs and Ministry of Housing, Canada Mortgage and Housing Corporation (CMHC), and Natural Resources Canada's Program for Energy Research and Development.

The evaluation was conducted by the Sustainable Technologies Evaluation Program (STEP) of the Toronto and Region Conservation Authority (TRCA) and Ontario Climate Consortium (OCC) in partnership with Evergreen. This technical brief summarizes the evaluation results in terms of the social, economic and environmental outcomes of the investments made in the REI program. It also provides insights on preferred investment strategies and policy interventions to scale up investment supporting the transition to net-zero communities in line with provincial and federal government GHG reduction commitments to the global community.

The social and affordable housing sector provides a significant opportunity for low carbon investment. The sector is large, much of the housing stock is aging, and there is the potential for energy efficiency retrofits on a massive scale. Furthermore, consolidated decision-making and long-term asset management means that when public funding is available, retrofits can happen quickly and with an aim for longer-term profitability.

Launched in 2010 as part of a comprehensive economic stimulus program targeting Ontario's social and affordable housing sector, the Renewable Energy Initiative (REI) disbursed approximately $57 million in provincial and federal funding to 161 different social and affordable housing providers within Ontario for the installation of renewable energy (RE) systems. Eligible technologies included solar photovoltaics (PV), solar domestic hot water (SDHW), solar air heating, geothermal and wind turbines.

BACKGROUND

The Social and Affordable Housing Sector in Ontario

Social and affordable housing represents 5% of Ontario's housing supply and 20% of the rental supply. This is approximately 260,000 units in total. Approximately 100,000 of these are public housing units under municipal responsibility and 160,000 are owned by non-profit or co-op organizations. A key issue in the sector is the lack of access to capital. The social and affordable housing stock is aging and in need of repair, especially the public-housing portion of the portfolio. Non-profit and co-op housing providers face the end of operating agreements in the near future and questions as to long-term fiscal viability are paramount. Furthermore, the lack of data on the condition of the housing stock province-wide hampers the ability to target investment on a priority basis and rising energy costs constrain budgets.

Despite these challenges, the current policy context is encouraging. Ontario's Long-Term Affordable Housing Strategy sets a requirement for service managers to create Local Housing Plans that include energy and environmental sustainability; the updated Growth Plan for the Greater Golden Horseshoe encourages municipalities to set GHG targets; and the Climate Change Action Plan commits $300 to $500 million for social and affordable housing. Furthermore, real estate portfolio management and capital planning expertise is growing within the sector.

There are many drivers positioning social and affordable housing as an important sector in municipal, provincial and national efforts to reduce energy consumption and GHG emissions. The size and condition of buildings in the sector indicates a potential for retrofits on a massive scale; retrofits can happen quickly through consolidated decision-making that is available through the network of service managers and housing providers; and social and affordable housing buildings are owned for longer than buildings in the private sector, allowing for longer-term investments. However, the sector also faces many barriers to reaching this potential, including:

- *Awareness* – housing providers may be unaware of available incentive programs, lack knowledge of new technologies, may be unaware of baseline energy, etc.
- *Technical* – housing providers may have limited access to trained and qualified technicians and contractors, may lack historical energy consumption data, etc.
- *Institutional* – housing providers may experience split incentives, perceive energy upgrades to be a low priority activity, grapple with tight funding timeframes, etc.
- *Financial* – housing providers may struggle to raise capital and make a business case for energy retrofits.

These barriers can be conceptualized as a pipeline (Figure 1) and barriers at each stage of the pipeline can be strong enough to cause some providers to "bounce off." Successful implementation of energy sustainability projects in social and affordable housing over the long-term would require policy interventions that address each of these barriers.

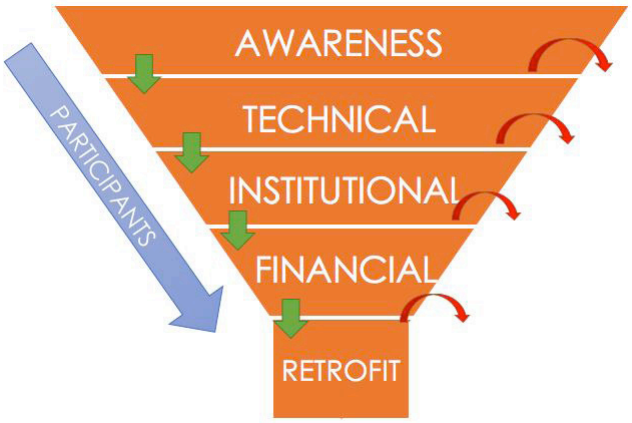

Figure 1. Conceptual model of barriers and drivers for energy retrofits.

The Renewable Energy Initiative

As a part of the 2009 Canada's Economic Action Plan, the federal government allocated $352 million to the Province of Ontario to renovate and retrofit the existing social and affordable housing stock in the Province. The Province matched federal funding, creating a total funding pool of approximately $700 million and forming the Social Housing Renovation and Retrofit Program (SHRRP). The aim of the SHRRP was to improve the quality of the housing stock, while helping low-income Canadians and creating jobs in construction and related industries.

The Province signed administration agreements with each of the 47 service managers in Ontario which set the framework for the administration of the SHRRP. Distribution of the SHRRP funding was governed by provincial funding agreements between the service managers and the Ministry of Municipal Affairs and Housing (MMAH)[1] and in turn, by municipal funding agreements between service managers and housing providers.

The Renewable Energy Initiative (REI) was created as a sub-component of the SHRRP and the Canada-Ontario Affordable Housing Program (AHP) to target investment in renewable energy technologies in Ontario's social and affordable housing sector. It generally operated in accordance with the overall program guidelines for the SHRRP. As a one-time capital cost subsidy, the REI program assisted the SHRRP-funded work by providing full funding for the installation of one of five approved technologies: solar photovoltaics (PV), solar domestic hot water (SDHW) heating, solar air heating, geothermal and wind turbines (Figure 2). No wind turbines were installed.

[1]Note that the MMAH is now two distinct ministries, the Ministry of Housing (MHO) and the Ministry of Municipal Affairs (MMA).

Photovoltaic (PV) systems produce electricity from sunlight. Within the REI, all PV systems were used to export electricity to the electricity grid via a microFIT or FIT contract.

Solar domestic hot water (SDHW) systems generate hot water from sunlight. Although SDHW systems are much more efficient than PV systems, thermal energy is less valuable than electrical energy.

Solar air heating systems come in different form factors. The most prevalent type is used to preheat building ventilation air by circulatoring the air behind solar absorbing cladding on a south-facing exterior wall.

Geothermal systems use the ground as a sink or source for heat energy. Heat energy from the ground is used to heat a building in winter. Heat energy is rejected back to the ground in summer, cooling the building.

Figure 2. Summary of system types funded by the REI.

The REI program required that vendors be selected from the Renewable Energy Technology (RET) Vendor List, created by the Ontario Power Authority (OPA; now merged with the Independent Electricity System Operator). Any vendor who met a set of eligibility criteria, and who applied through a dedicated website, was included on the list. Allocation of funding to service managers was based on a first-come first-served basis, with consideration of regional fairness across the province on the basis of a notional "fair allocation" in relation to the number of housing units within the regional portfolios.

Individual housing providers were required to submit feasibility studies, prepared by qualified consultants, to the service manager in their area. Service managers were responsible for evaluating the feasibility studies and preparing a recommended priority list of projects for funding. No limitations were placed on service managers as to what criteria they should use to prioritize projects or on the content of the feasibility studies.

The program started allocating funding in 2010, and the final projects were completed by the end of 2012. The vast majority of approved projects were for PV installations. This was largely due to the concurrent delivery of the Feed-In-Tariff (FIT) and microFIT programs. Administered by the OPA, these programs allowed eligible renewable energy generators to sell electrical power back to the grid over a 20-year contract period. The guaranteed, fixed-term FIT price was designed to recover costs plus a reasonable rate of return. REI projects were treated the same as non-REI projects within the FIT and microFIT programs.

OBJECTIVE OF REI EVALUATION

The overall objective of the REI evaluation was to document the benefits of REI investments by analyzing their effectiveness in achieving social, economic and environmental outcomes for social and affordable housing providers and the Province of Ontario, while documenting insights on sector capacity, project implementation, program design and provider experience.

METHOD

This evaluation is based on work undertaken by the project team from May 2016 to February 2017. This included:

- review of REI program documents and program data;
- review of Ontario's policy frameworks;
- a literature review and inter-jurisdictional scan;
- an online survey of providers that participated in the REI;
- interviews and conversations with administrators, service managers and housing providers that received funding;
- site visits to REI funded installations;
- economic input-output analysis;
- analysis of estimated energy generation or savings;
- collection of performance data from REI-funded systems;
- analysis of estimated revenues and avoided costs; and
- estimated greenhouse gas reductions.

Data collection from housing providers and service managers is summarized in Figure 3. In total, 65 of 161 housing providers that received REI funding participated in the evaluation. Similarly, 11 of the 47 service managers participated. Within the participants there was diversity in ownership type, renewable energy technology, provider size and geographic location.

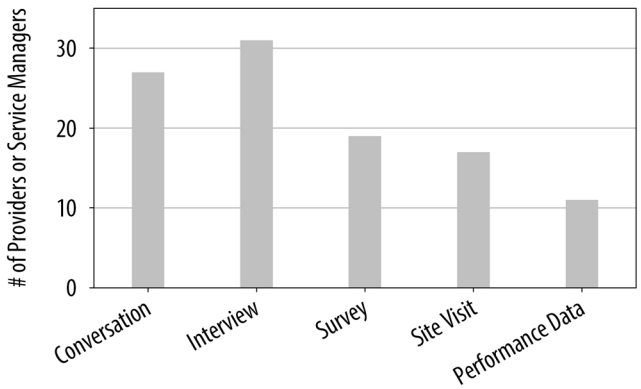

Figure 3. Overview of data collection from housing providers and service managers.

FINDINGS

Overall Impacts

Overall provider experience of the REI was positive. During interviews and surveys, the majority of housing providers responded positively when asked about their experience with the REI program and felt that the installed systems were a success. Most reported minimal significant barriers to participation or program administration issues, aside from tight application timelines. Approximately 70% of the REI program funding was provided for PV systems and these were reported to be working well and providing beneficial income.

Many social and affordable housing providers are enthusiastic about energy sustainability. For many providers, the REI helped to further pre-existing goals in regards to energy efficiency and sustainability. Many providers were enthusiastic about sustainability and some were passionate about playing a leadership role towards improving energy efficiency and environmental sustainability within the sector.

> "REI helped us continue our work to reduce our carbon footprint and has allowed us, through the generation of extra income, to keep our buildings in excellent condition thereby making the lives of our tenants that much more enjoyable."

For every $1 million provided for RE systems, REI is estimated to have generated $1.22 - $1.27 million in lifetime benefits for providers (in 2010$) and carbon reductions of 554 tonnes CO_2e. Quantitative performance metrics for the program are shown in Table 1. These are best estimates based on a limited amount of data. The overall financial performance of the REI was driven by the PV systems, which could also obtain support under the FIT and microFIT programs. However, GHG reductions were driven by the other technologies because they reduced natural gas consumption.

Geothermal and solar air heating projects that reduced electrical usage had better financial savings than those that reduced natural gas consumption. Financial savings were achieved when these technologies offset the energy required from conventional sources like electricity or gas. When offsetting electricity, it was estimated that the geothermal systems provided net lifetime benefits of $2.8 million for every $1 million provided by the REI for geothermal. For solar air heating, it was $3.3 million. In both cases, it dropped below $1 million for systems offsetting gas. Natural gas is several times cheaper than electricity for the same energy content; electricity reduction has much stronger financial impacts.

> "We do it as a social obligation. We are in the forefront of showcasing [energy conservation and efficiency technologies] so that other people can understand that it works."

Table 1. Estimated quantitative benefits of REI program.

	PV	SDHW*	Solar Air*	Geo*	Total
Number of Systems	255	80	17	9	362**
Installed Capacity	3.7 MWp	4,560 m^2	3,790 m^2	162 ton	-
REI Funding [million 2010$]	39.1	12.1	3.7	2.5	57.4
Net Lifetime Benefits to Providers [million 2010$]	62.2	2.4 - 3.3	3.9 - 5.2	1.3 - 2.3	69.8 - 73.0
Benefits/Funding	1.59	0.20 - 0.27	1.0 - 1.4	0.52 - 0.91	1.22 - 1.27
Lifetime Energy Generation or Savings [GWh]	132	40	65	34	271
Lifetime GHG Savings [kton CO_2e]	6.6	6.9	11.1	7.2	31.8
Job Creation [FTE Jobs]	411	128	39	26	604

*This table assumes that 20% of the non-PV systems are offsetting electricity and 80% are offsetting natural gas (according to province-wide housing sector averages). Data on which fuel the systems were offsetting was not collected in the REI.
**Funding was provided for initial feasibility and engineering costs for one wind system, included in the total number of systems, that was not installed.

> "We are very proud of our solar panels on our roof... Solar is just the beginning, we want to continue to be as efficient as possible. Large projects are sometimes challenging for non-profit social housing providers, so we aim to lead by example."

Financial savings from SDHW was estimated to be poor in relation to the other technologies. This is primarily because system costs per unit area of SDHW collector were high in relation to the expected energy generation per unit area. Energy savings estimates for SDHW were also derated to account for suboptimal system operation that was observed during site visits and commented on during interviews.

The REI Program was estimated to have generated $62 million GDP and created 604 FTE jobs. Based on input-output analysis utilizing Statistics Canada data, the REI program was estimated to have generated as much as $62 million of additional Gross Domestic Production (GDP), and as many as 604 full-time-equivalent (FTE) jobs, in Ontario.

Barriers

Some providers located outside of major city centres reported difficulties finding RET-qualified vendors. Vendors were on the RET list if they applied and met certain criteria. However, some providers outside of large urban areas noted that the RET list made it difficult to find vendors.

"[The RET list] really limited the number of vendors we could be seeking to respond to our procurement process. We only had two at most, actually respond to our bids in the area. We had one project where we almost couldn't attract anybody…"

Program timelines were a barrier for some providers. As a joint federal-provincial initiative, the MMAH did not have full control over the REI application timelines and many housing providers reported that the timelines were challenging. Some providers commented that this barrier is less significant when they are prepared by having already-existing building condition assessments and familiarity with various retrofit options.

Lack of knowledge about potential benefits was a barrier for some providers. Service manager feedback indicated that some providers had a lack of knowledge about renewable energy systems and their potential benefits. For example, there was an incorrect perception from some providers, whose portfolio consisted of smaller buildings, that renewable energy systems were not applicable to their buildings.

Larger urban service areas used more of their fair allocation than smaller and rural service areas. The five largest service areas had a total fair allocation of approximately $40 million and they used 92% of that. The remaining service areas used 62% of their fair allocation. Fourteen service areas did not participate and all were from smaller service areas with less than $1 million in fair allocation. Northern service regions also used less of their fair allocation (Figure 4). This suggests a capacity gap for certain geographic segments of the sector.

Municipal providers used more of their total fair-allocated funding then private providers or co-ops. The analysis looked at funding disbursement against ownership type and found that municipal housing providers participated in the REI to a proportionately greater degree relative to private non-profit housing providers or co-ops (Figure 4), which indicates a capacity gap with respect to ownership type.

"… the ministry programs [have] fast turnaround and they don't give you much time to actually respond or to spend the money, so that's why it's so important to be prepared…. We are always aware of what our service needs are with our housing providers and in our own units. We have building condition assessments [for building improvements that we need], so we're ready to act quickly."

Feasibility and Implementation

System costs were not benchmarked against industry norms. Although not conclusive due to data limitations, there

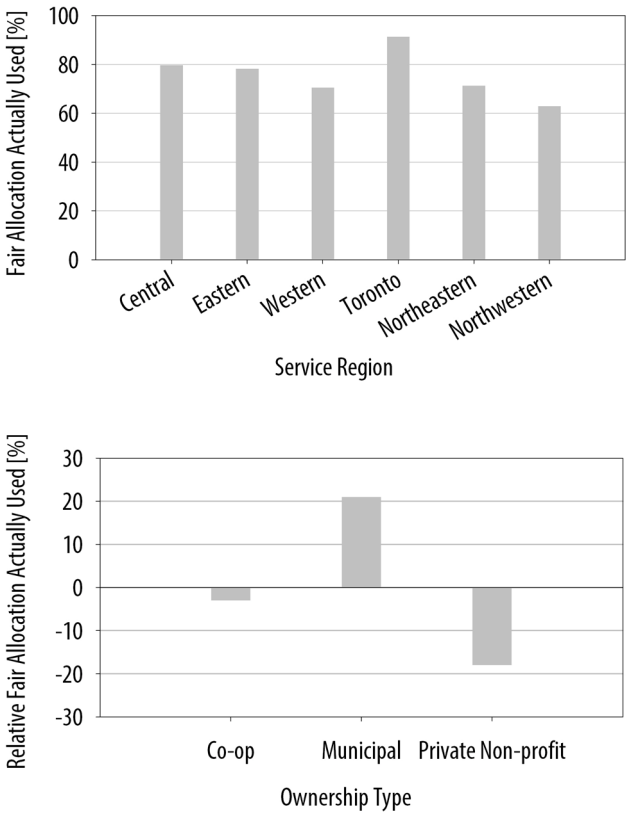

Figure 4. REI funding with respect to fair allocation for both the service regions and ownership type. In the bottom plot "0%" represents the expected funding based on fair allocation; "+20%" then means that the final funding was 20% more than what was expected based on fair allocation.

was some evidence to suggest that system costs within the REI may have been higher than elsewhere. While providers or service manager may have gone through their own procurement process to help keep system prices to a reasonable level, there were no formal limitations on system costs. As a 100% capital cost incentive with a tight application timeline and, in some cases, a limited pool of vendors, this may have resulted in overpayment for some systems.

Some housing providers noted that they were concerned about unanticipated future costs. In some cases, it appeared that full lifetime system costs were not adequately taken into account within feasibility studies. For example, providers were sometimes not informed that PV systems or SDHW systems would increase the costs of roof replacements or that there may be notable component replacement costs.

In some cases, providers may have benefitted more strongly from other energy efficiency upgrades. It is worth noting that a key goal of the REI program was economic stimulus for Ontario's growing RE industries. However, for individual providers, RE systems may not have always been the highest-impact retrofit in terms of cost or GHG reductions. Efficiency upgrades are typically the "lower hanging fruit."

There were some reports, specifically with SDHW, that systems were not optimally designed. In many cases, RE

technologies may need some level of support to achieve profitability against conventional alternatives. However, a 100% capital cost subsidy may encourage the installation of systems that are *very* far from profitability. This may result in less efficient use of funding or other implications.

Operations and Maintenance (O&M)
Measurement and Verification (M&V)

Detailed data on energy generation or savings was typically only collected for PV systems. M&V was not required in the REI program. However, many PV systems were provided with built-in performance monitoring. PV performance data was shared by several providers for this evaluation. Performance data from non-PV systems was typically not collected. Provider opinions on the savings generated by the different RE technologies were most often based on an informal review of utility bills. The lack of M&V may have meant that some systems could fail with minimal indications of failure. Providers that did not install equipment for M&V often expressed that they would like to know how much their RE system is saving. Control systems (like a BAS) are capable of measuring the parameters required for performance verification but this often requires additional sensors, and must be specified in the RFP.

PV systems worked well with minimal O&M. PV systems comprised the majority of REI funding and these were reported to be working well with minimal O&M required. PV system performance was confirmed for a small subset of systems.

The O&M of SDHW was challenging for some providers. SDHW systems are not intrinsically prone to failure. However, they do need to be put in a context where basic system parameters are periodically checked. Unfortunately, if a SDHW system fails, there may be no obvious signs of failure because it is used as a supplemental heating system; the conventional DHW system will ensure that there is still hot water. This is an issue for any supplemental RE system (for example, solar air heating is also supplemental). Sub-optimal operation occurred in some of the REI SDHW systems. For example, performance issues were identified in 3 of 7 SDHW site visits. SDHW system owners with proactive internal maintenance personnel reported better results but some noted that the savings provided was very low, even when functioning properly. Previous experience with SDHW suggests that pre-packaged systems tend to work more reliably than custom systems.

> On SDHW: "I run them. I [do preventative maintenance on] them. I've also reviewed the gas bills and [have] done all the base-line calculations for them. I'm an engineer. That's what we do. I'd be out of pocket I guess [due to high O&M costs in relation to gas savings]."

> "We are very thankful for REI programs and funding…. but we lack expertise in-house and are thus unable to troubleshoot technical issues. Due to a 'one-time funding model' for grant programs, the burden of maintenance and capital repairs over the lifetime of the system comes directly from the municipally-funded social housing operating and maintenance budgets."

Solar air heating was reported to require minimal O&M. Solar air heating systems are mechanically simple and were reported within the REI to require minimal O&M. However, their performance was not confirmed with actual performance monitoring data.

The experience of geothermal was generally positive. Geothermal systems were viewed positively in the REI, especially when offsetting electricity or adding cooling to a building where there was none before. However, at least one provider used a maintenance contract for the O&M of their geothermal system and were not satisfied with the level of service. In that case, the provider was capable of performing some operations tasks had training been provided.

Providers reported that fully paid up-front maintenance contracts often resulted in poor service. Many providers recognized that they needed help with the O&M of their system and procured a maintenance contract. The REI consisted of a one-time payment and therefore required that maintenance contracts be fully paid up-front. With no financial leverage, providers often felt dissatisfied with the level of service.

> "We included [a 10-year maintenance contract] in the asking price… I didn't want to pay for it up front but the ministry said we had to expend the funds by a certain time so I had to pay it up front. Hence, I've got no leverage to get [the maintenance contractor] back."

Evaluation

The program review would have benefitted from additional centralized record-keeping. Due to data gaps, the program evaluation relied heavily on estimation when calculating performance metrics. It would have been beneficial to centrally record basic system data (capacity, efficiency, orientation, etc.), itemized system costs, maintenance contract costs (if applicable), fuel being offset (if applicable), basic data on existing systems, and the annual/lifetime estimated energy savings/generation based on feasibility study results.

The elapsed time since the inception of the program was a barrier for the program evaluation. This contributed to difficulties collecting important data and information needed

to conduct a comprehensive program evaluation due to staff turnover, and possibly, the ability of study participants to accurately recollect their experience of the REI.

Investment Strategies

The social and affordable housing sector may benefit from opportunities to leverage third-party capital for energy retrofits. This study evaluated eight strategies for scaling up low carbon investment in the social and affordable housing sector, aside from the one-time capital cost subsidies used in the REI. The results indicate that energy performance contracting (EPC), where a third party provides the capital and receives some of the savings for a retrofit, merits deeper consideration. EPC markets are relatively mature for other sectors in Ontario and expanding their reach to social and affordable housing may help unlock the massive potential within in the sector.

Summary of Findings

The REI was estimated to provide more in savings or income to providers than was disbursed to fund the systems, while also providing ancillary benefits like job creation and GHG reductions. The financial performance of the program was driven by PV, which could also obtain support under the FIT and microFIT programs. The performance of non-PV technologies depended on the fuel being offset. Financial performance was estimated to be much stronger when offsetting electricity relative to natural gas. However, GHG reductions are much stronger when offsetting natural gas due to the relatively clean Ontario electricity grid. Without more detailed information on which fuels were being offset, the final performance metrics were calculated assuming a ratio 80%/20% for gas/electricity as the primary heating fuel for the housing units, approximately in line with provincial averages.

The REI was most beneficial to those that had the capacity to participate in the program. Many segments of the sector had lower participation due to a capacity gap; this included Northern, private and small-scale social and affordable housing providers. The retrofit process can be pictured as a journey map, the last stage of which is funding. As a 100% capital cost subsidy, the REI was most effective at helping those already at the last stage. Broader efforts beyond the funding of systems would help promote readiness across the sector and also promote funding disbursement more in line with what would be expected from a fair allocation based on the numbers of housing units in each service area portfolio.

The capability of the providers to effectively operate and maintain their RE systems varies across the sector. This was not an issue for PV, the largest component of the REI, because it requires minimal O&M and notable system issues are normally straightforward to detect. Some level of O&M is required for the other system types and insufficient O&M contributed to sub-optimal performance in some cases. Complete up-front funding of maintenance contracts was not effective.

This study identified an opportunity for providers to play a greater role in the O&M of their systems and, in the process, help to safeguard the investments made in the sector. O&M guidance and training incorporated into an incentive program could help identify how to include RE system inspections alongside other maintenance inspections, what to look for and how often, and what O&M activities require specialized expertise. Additional M&V would help to detect system issues and facilitate the program evaluation.

The program evaluation faced challenges related to the time elapsed since the inception of the program and the availability of key data. It is possible that the elapsed time may have affected the quality of the feedback on certain topics. Quantitative performance metrics relied heavily on estimation and are best assessments based on limited data.

Future Program Considerations

Considerations for future programs are listed below:

1. The reduced availability of RET-qualified vendors in certain service areas should be addressed.
2. Paid up-front maintenance contracts should be avoided.
3. Incorporating O&M training or guidance would help empower housing providers, both to choose a retrofit appropriate for their context and to operate it effectively.
4. Formal M&V requirements would help providers detect system issues and accurately quantify performance.
5. The program evaluation should be incorporated into the program roll-out, including the collection of key data necessary for an accurate evaluation.
6. It would be beneficial if all feasibility studies calculated a common set of performance metrics. This would help program evaluators determine expected program performance, help service manager rank systems, and help providers identify whether or not their system is at risk of poor financial performance.
7. Opportunities for leveraging third-party capital should be explored.
8. Broader efforts to promote sector-readiness for incentive programs would help all providers along the retrofit journey to the point where they may benefit from programs.
9. Greater flexibility in terms of program timelines would

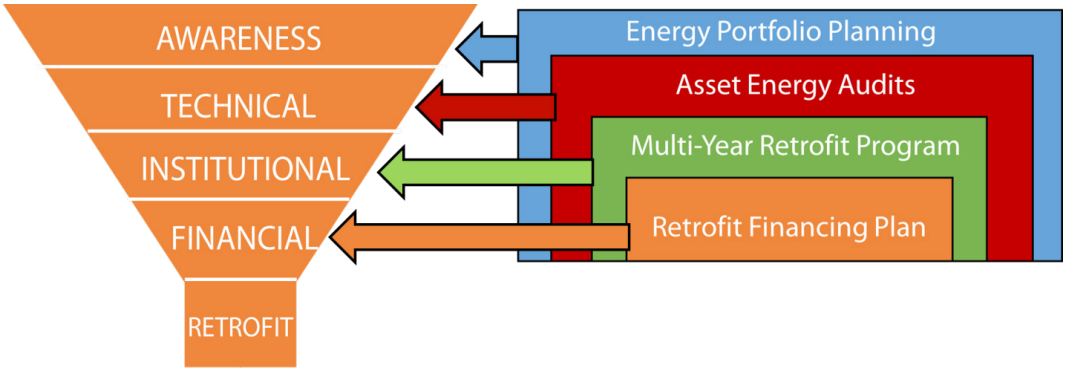

Figure 5. A generic energy portfolio management framework modeled after MHO's Strategic Asset Management Framework.

help many providers participate in programs.

10. Additional RE technologies warrant consideration and RE technologies should be considered alongside other energy efficiency retrofit options(e.g. insulation, boiler upgrades, etc.) to maximize financial and GHG benefits.

11. Barriers to funding access by non-municipal and smaller service areas should be addressed.

12. Benchmarking system costs against industry norms may help reduce the risk of overpayment for systems.

13. Some of the RE system fuel savings should be added to the operational budget for the building mechanical systems so as to ensure that money is available for RE system O&M; otherwise, O&M may be insufficient.

14. Requiring initial performance verification ensures that appropriate instrumentation is installed and that operators have the information needed for O&M of their RE system.

The findings of this evaluation suggest that unlocking the full potential of energy savings in social and affordable housing will require a long-term program that improves overall program participation by reducing barriers at each stage of the retrofit journey. A generic energy portfolio management framework was developed, modeled after MHO's Strategic Asset Management Framework, to help providers and service managers embed energy performance into existing asset management strategies (Figure 5). It has the following stages:

1. *Energy Portfolio Planning* – service managers develop portfolio-wide building energy assessments.

2. *Asset Energy Audits* – service managers, in consultation with housing providers, perform energy audits to prioritize cost-effective energy upgrades across their portfolio.

3. *Multi-year Retrofit Program* – service managers or housing providers develop a long-term plan for energy performance upgrades, integrating it into Local Housing Plans.

4. *Retrofit Financing Plan* – Equipped with a retrofit plan and an M&V protocol, housing providers can solicit funding investments to pay for energy retrofit plans.

There is an underlying enthusiam for energy sustainability amongst many within the social and affordable housing sector and emerging champions are leading the way. The sector represents a massive opportunity to reduce GHG emissions in line with federal, provincial and municipal commitments, and in the process, lower the energy costs for housing providers and improve the quality of life of tenants. However, results of this evaluation agree with findings from similar programs around the world, in that fully realizing this opportunity requires comprehensive and strategic policy interventions that address the multiple barriers on the retrofit journey map and foster retrofit success post-installation.

This document was prepared by the Toronto and Region Conservation Authority's Sustainable Technologies Evaluation Program (STEP) in partnership with the Ontario Climate Consortium and Evergreen. The evaluation was sponsored by the Ontario Ministry of Municipal Affairs and Ministry of Housing, Canada Mortgage and Housing Corporation (CMHC), and Natural Resources Canada's Program for Energy Research and Development. Additional funding support was provided by the City of Toronto, Region of Peel and York Region. For more information about this project, please contact STEP@trca.on.ca.

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For more information about STEP and our other Energy Conservation and Efficiency studies, visit our website or email us at STEP@trca.on.ca.

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