

Energy Save New West

Research to Understand the Opportunities to
Improve the City of New West's GHG Community Energy Program



DISCLAIMER

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organisations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

This project was conducted under the mentorship of City of New Westminster and New West Electric Utility staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of City of New Westminster or the University of British Columbia.

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CITY OF NEW WESTMINSTER

Ryan Coleman / Project Coordinator / Energy Save New West / City of New Westminster

Steven Faltas / Business Process Manager / City of New Westminster

Leya Behra / Manager / Climate Action / City of New Westminster

Nayel Halim / Community Energy & Emissions Specialist / Climate Action / City of New Westminster

THE UNIVERSITY OF BRITISH COLUMBIA

Karen Tylor / Program Manager / UBC Sustainability Initiative / University of British Columbia

ESNW ENERGY CONSULTANTS

David McKay / Technical Services Advisor / City Green Solutions

Elena Dopfer / Energy Project Specialist and Client Services Supervisor / City Green Solutions

Peter Sundberg / Executive Director / City Green Solutions

EXECUTIVE SUMMARY

Launched in 2013, Energy Save New West (ESNW) has been running for more than seven years and has become one of Canada's most comprehensive community energy programs. Through ESNW, nearly 400 EnerGuide Rating System (ERS) energy evaluations for the City of New Westminster homeowners have been completed, and in collaboration with the UBC Sustainability Initiative, the City engaged a sustainability scholar to conduct a 250-hour research project to investigate the opportunities to improve ESNW's Existing Homes program.

In order to provide valuable insights into the program progress and future program initiative opportunities, the following objectives have been defined and accomplished:

- Technical data of ESNW's pre-retrofit energy evaluation reports and additional NRCan resources have been analyzed to quantify energy-saving opportunities and impact from installed energy conservation measures for participants who completed pre and post energy evaluations.
- An online survey has been designed and executed to gather program participants' feedback on the program experience from a motivations, barriers, and opportunities with energy retrofits standpoint.
- Select US-based energy efficiency programs have been reviewed to identify alternative practices and financing models.

To start, it was seen that the overall satisfaction level of the ESNW's Existing Homes program participants was particularly high. 89.4% of the survey participants were satisfied with the information presented in the energy evaluation reports, and 85.3% were also satisfied with the overall program experience. For participants who completed pre and post energy evaluations following their energy upgrade, on average, each household achieved 26.9% energy savings and 2.9 tonnes of GHG emissions reduction per year.

A majority (nearly 90%) of the assessed households use natural gas for space heating with modest fuel switching opportunities implemented. As a result, the actual amount of GHG reduction achieved was not as high as estimated from the ERS evaluations (50% Estimated vs. 24% Actual), and there remains significant opportunities for the City to promote adoption of low carbon solutions for space heating and domestic hot water in existing homes.

The most significant motivating factors for completing the Energy Efficiency Measure (EEM) upgrades were to save money on utility bills and to improve the comfort of their homes. Also, the potential primary barrier to the EEM implementation was, expectedly, the high cost associated

with the upgrades. It was also found that additional rebates/incentives and low-interest financing programs would highly influence the decision-making of energy upgrade implementation.

From the best practices review, it was seen that some of the US-based energy programs were offering more community-inclusive incentive/rebate programs that can help expand the customer bases. Such programs included but were not limited to; affordable housing programs and customized offers for income-eligible participants. Some of the other programs also included; smart technologies incorporated into programs and repurposed energy-efficiency programs encouraging fuel-switch with a focus on GHG reduction.

Based on the findings from the project research and analyses, a number of opportunities have been identified for Energy Save New West to consider as potential enhancements to improve the current program services, reduce GHG emissions and support City's climate change targets.

The key recommendations are summarized as follow:

- **Program Diversification** – Identify opportunities to expand program reach by incorporating new incentives for advanced technologies (e.g. smart thermostats, renewables, etc.) and provision of new services (e.g. affordable housing programs).
- **Accelerate Electrification** - Encourage clean energy use and heat pump technologies to accelerate the electrification of residential space heating and domestic hot water systems to support City GHG reduction targets.
- **Strategic Marketing** - Expand the portfolio of marketing strategies and provide education/training to local residents to raise awareness of the program and rebate/incentive options.
- **Financing Solutions** - Consider alternative and more inclusive funding/financial support strategies to improve the affordability of the EEM implementation.

TABLE OF CONTENTS

Acknowledgements	ii
Executive Summary	iii
Introduction	2
ERS Reports Analysis	
EnerGuide Rating System (ERS) Report.....	3
Pre-Retrofit EnerGuide Home Evaluation.....	3
Post-Retrofit EnerGuide Home Evaluation.....	8
Survey Analysis	
Introduction and Methodology.....	12
Results and Findings.....	12
Best Practices Review	
Efficiency Vermont.....	20
Mass Save.....	23
Energy Trust of Oregon.....	28
Key-Takeaways.....	32
Summary and Recommendations	33
References	38

INTRODUCTION

Energy Save New West (ESNW), launched in July 2013, is one of the longest-running and most comprehensive community energy programs in Canada. Designed to improve new and existing buildings' comfort and energy performance and reduce GHG emissions in New Westminster, ESNW provides local homeowners and businesses access to energy assessments and energy upgrade rebates and incentives.

ESNW's Existing Homes program provides a subsidy for homeowners to complete an EnerGuide Rating System (ERS) energy evaluation of their homes and access to government and utility rebates for home energy upgrades. The ERS evaluation provides homeowners with a detailed analysis of the current energy performance and the potential energy savings that can be achieved when the recommended upgrades have been implemented. As of July 2020, nearly 400 ERS energy evaluations have been conducted through the ESNW's Existing Homes program.

This research project aims to provide valuable insights into the results of the program's ERS evaluations and opportunities to support the City's energy and GHG reduction targets. A thorough analysis of ERS reports and participant survey data will be discussed along with best practices review of selected US-based energy efficiency programs.

In this report, ESNW's pre-retrofit energy evaluation data will be reviewed and analyzed along with additional data from NRCAN that will be evaluated to enrich the report analysis. The pre and post-retrofit energy upgrade information and performance will be quantified, and the survey participants' feedback on the program experience will also be discussed.

LIMITATIONS

This project was designed to be completed in 250 hours by a UBC sustainability scholar under the City of New Westminster/New West Electric Utility staff mentorship. Due to the time constraint, there have been some limitations in the depth of research and findings. The project scope was limited to the ESNW's Existing Homes program, and the pre and post-retrofit quantification may not reflect an accurate comparison due to the post-retrofit evaluation sample size. Additionally, government and utility program participation numbers were not available to the research project to analyze conversion rates from evaluation to upgrade and general participation numbers in rebate programs.

ERS REPORTS ANALYSIS

EnerGuide RATING SYSTEM (ERS) REPORT

Administered by Natural Resources Canada (NRCAN), the ERS evaluation and report provides a snapshot of your home's efficiency at time of the evaluation. Until March 2016, the pre-retrofit report was issued to homeowners as an Energy Efficiency Evaluation Report (EEER), where the EnerGuide Rating System used a 0-100 scale.

- A 0 rating represents a house with major air leakage, no insulation and high fuel consumption.
- A 100 rating represents an airtight, well-insulated house where energy purchased is equal to energy generated through renewable sources: a "net-zero" home.

In April 2016, NRCAN changed its rating system to a new scale that measures energy efficiency in gigajoules (GJ) per year and issued homeowners a Renovation Upgrade Report (RUR).

PRE-RETROFIT EnerGuide HOME EVALUATION

As of July 2020, the total number of 397 pre-retrofit energy evaluation reports have been issued as per the City Green's recorded data, and 396 reports have been evaluated for the analysis. Of the 396 reports analyzed, 266 were in EEER format and 130 were in the RUR format.

Participation in ESNW has averaged 57 energy evaluations per year since program launch. The main objectives of this analysis were; to better understand the home profiles of the households assessed; to quantify the energy-saving opportunities identified in the report.

The summary of the analysis is as follows.

HOUSE CHARACTERISTICS

Of the total 396 households analyzed, 354 (89.4%) were "Single Detached," 34 (8.6%) were "Row House," and 8 (2%) were "Detached Duplex."

89.4%
of assessed houses were
**SINGLE
DETACHED**

72.3%
of assessed houses were
50+ Years Old

The average number of openings for the “Row House” was 13.2, which was 36.5% less than “Single Detached” houses (20.8).

The average total floor area for all households was 213.8m² (2301 ft²) and the average total floor area for Row Houses (159.6 m² or 1717.9 ft²) was 27.2% smaller than the “Single Detached” houses (219.1 m² or 2358.4 ft²).

The average age of all households was 70 years old, and 72.3% were over 50 years old while only 3.8% were under 10 years old.

The average number of energy upgrades recommended for all households was 4.9. By housing type, it was 5.4 for “Single Detached,” 5.0 for “Row House,” and 3.9 for “Detached Duplex.”

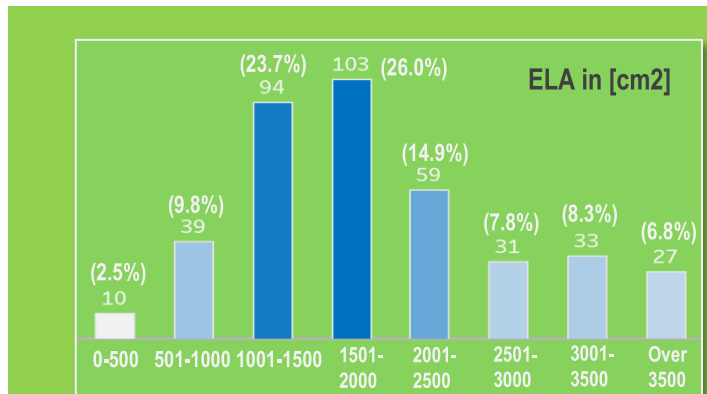
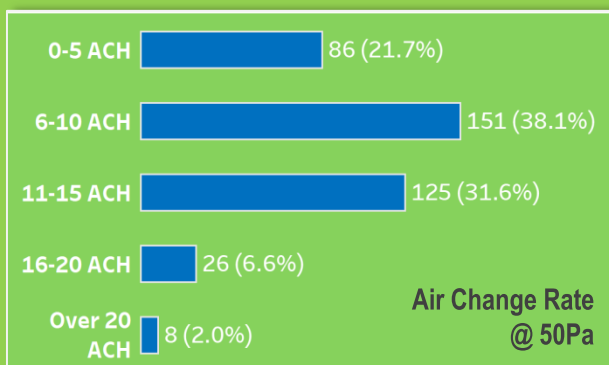
BUILDING ENVELOPE

AIRTIGHTNESS

Airtightness is defined as the resistance to air leakage through unintentional points or areas in the building envelope at a given reference pressure from the ERS of 50 Pa. When the per-hour air change rate of each household was analyzed, only 21.7% had under 5 ACH at 50 Pa, while 38.1% had an air change rate of 6-10 ACH, and 31.6% had 11-15 ACH. 8.6% of the households had over 16 ACH. The average air change rate for Single Detached houses was 9.9 ACH, and for the Row Houses, it was 35.4% less (6.4 ACH). As a reference point, a new home constructed to the BC Building Code 2018 requirements should achieve 2.5 ACH at 50 Pa.

Nearly 50% of the households had an Equivalent Leakage Area (ELA) of 1001 – 2000 cm², and 15.1% had over 3000 cm², while only 2.5% had under 500 cm² ELA. The average ELA of Single Detached houses was 2045 cm², while Row Houses had an average ELA of 947 cm²

97% of the households assessed were recommended to improve the air seal of the house. While 52.6% have been recommended to improve the air seal by 11-20%, 14.4% were recommended for over 40% improvements.



- **INSULATION**

66.7% of the households were recommended to increase the insulation value of their Attic/Cathedral Ceiling and/or Flat Roof, while only 35.4% were recommended for the Main Wall insulation upgrade.

35.3% were recommended to increase the Crawl Space/Foundation insulation values, and 37.3% were recommended for the Exposed Floor insulation upgrade.

- **WINDOWS AND DOORS**

67.7% of the households were recommended to replace their existing windows with new ENERGY STAR certified models, and 46.5% were recommended to upgrade the existing door(s).

MECHANICAL SYSTEMS AND WATER CONSERVATION

- **HVAC (SPACE HEATING, VENTILATION, AIR CONDITIONING)**

It was found that 89.7% of the assessed houses were using natural gas for their primary space heating system, while only 9.6% were using electricity. Less than 1% of the households were using oil.

For the supplementary heating system, 66% of the households had more than one supplementary system (e.g. electric baseboards, fireplace, etc.), with natural gas still being the majority fuel source for the primary supplementary heating system. 99.4% of the natural gas users had a gas fireplace(s) for their primary supplementary heating system, and 75.0% of the electricity users had baseboards.

52.1% of the households were recommended to upgrade their current space heating system, of which 99% were using natural gas-fueled heating systems. Although no recommendation was made for fuel switching of the primary heating system, 22.0% of the households were recommended to install a new air source heat pump, which can also be used as an A/C system.

While 13% of the households had a separate air conditioning system, only 2.6% had a balanced ventilation system, of which 90% were Heat Recovery Ventilators (HRV).

11.8% of the households with A/C system were recommended for an upgrade, and 1.5% of the total households were recommended to install an HRV or ERV system.

89.7%

consume

NATURAL GAS
for SPACE HEATING

82.3%

consume

NATURAL GAS
for DHW HEATING

- **DOMESTIC WATER HEATING**

As for the DHW heating system, 82.3% of the households were using natural gas, and 17.7% were using electricity. The most common type of water heating system was the conventional tank (91.5%), followed by instantaneous condensing gas-fired (5.7%) and direct vent system (2.4%). Only 0.5% of the households had induced draft fan type system.

Of the total households, 59.2% were recommended to upgrade their current hot water heating system, of which 97.4% were to install a new condensing gas-fired system. Only 8.3% of the electricity users were recommended to install a new electric tank-type, and 4.2% were recommended for a domestic solar system.

17.6% of the total households were also recommended to install a “Drain Water Heat Recovery” system.

- **WATER CONSERVATION**

For water conservation, toilet replacement was the only recommended measure found in the reports. Of the 396 households evaluated, 51.4% were recommended to replace their existing toilet(s) with new low-flush or dual-flush toilet(s).

ENERGY CONSUMPTION AND GHG EMISSIONS

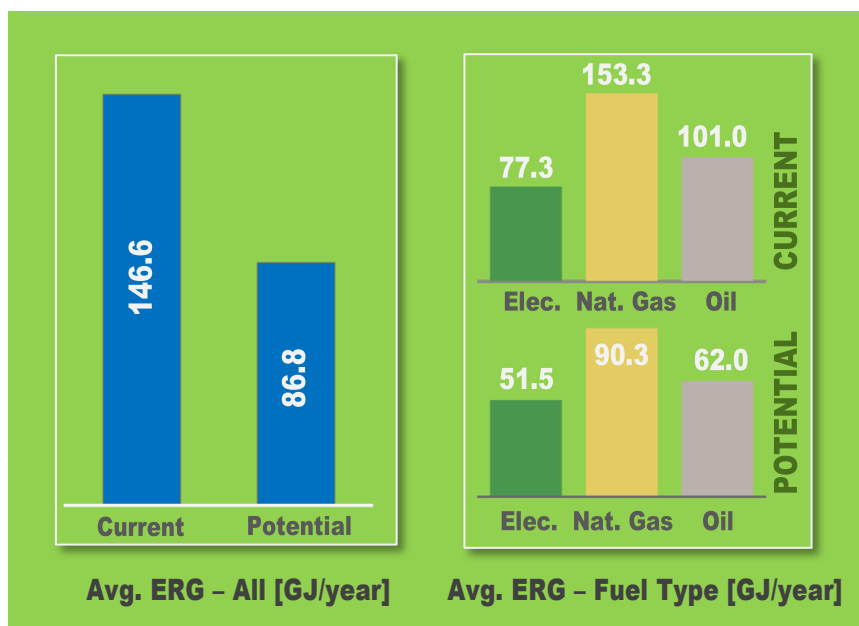
Due to the EnerGuide rating system change in the new report format, only 130 households that received Renovation Upgrade Reports with the ERS rating in GJ-per-year were included in the energy and greenhouse gas analysis.

- **EnerGuide (ERG) RATING**

The average EnerGuide rating of the 130 households was 146.4 GJ per year. For Single Detached, the average rating was 153.7 GJ per year, while Row Houses had 39.4% less. (93 GJ/year)

If all recommended energy efficiency upgrades were implemented in each of the 130 households, the potential reduction in annual energy consumption would be 59.6 GJ per household. (i.e. 40.7% energy saving)

For the households using electricity as the primary space heating fuel source, the



average ERG rating was 77.3 GJ per year, while the average rating for natural gas users was 153.3 GJ. For oil users, it was 101.0 GJ per year. If all energy efficiency recommendations were to be implemented, the potential energy savings for electricity and natural gas users would be 33.4% and 41.1%.

When the amount of energy consumed solely by space heating was evaluated, the electricity users consumed 35.0 GJ per year, while the natural gas users consumed over 3 times more (106.6 GJ). However, 50% of the electricity users were “Row House” homeowners with smaller footprints.

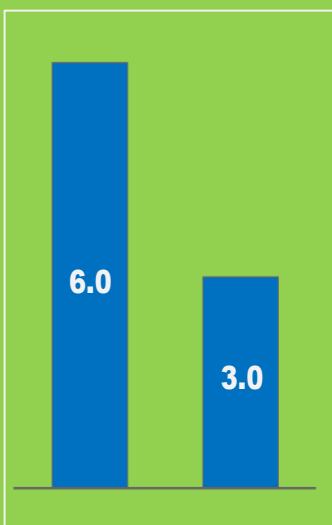
For the DHW heating, the electricity users consumed 15.9 GJ per year while natural gas users consumed 22.9 GJ.

▪ **GHG EMISSIONS AND FUEL TYPE**

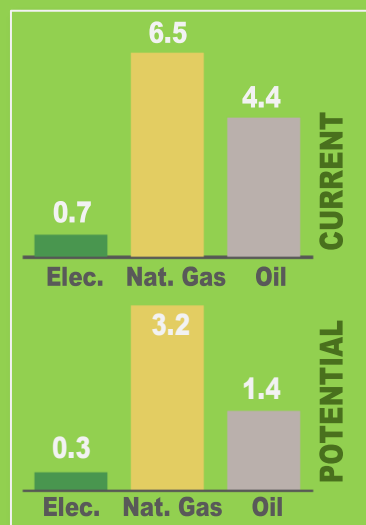
The average GHG emissions of 130 households were 6.0 tonnes per year per household. For the Single Detached houses, the average annual emission was 6.4 tonnes, while the Row Houses produced 2.9 tonnes on average. If all recommended energy upgrades were to be implemented for all 130 households, the potential annual reduction in GHG emissions would be a 50% reduction of 3.0 tonnes per household.

It was found that for households using natural gas as their primary space heating fuel source, the amount of average GHG produced per year was 9.3 times more than that of electricity users. (i.e. 6.5 tonnes vs. 0.7 tonnes) The average emissions for the oil users were 4.4 tonnes per year, which was 6.3 times more than the electricity users. The potential GHG reductions for electricity and natural gas users would be 57.1% and 49.2%, respectively.

The average annual consumption of natural gas for households who used natural gas for space heating was 3640m³ (135.8 GJ)ⁱ while electricity users (space heating only), on average, consumed



Avg. GHG – All Households
[tonnes/year]



Avg. GHG – Fuel Type
[tonnes/year]

135.8 GJ
of **NATURAL GAS**
consumed Each Year by **GAS USER**

5.3 GJ
of **NATURAL GAS**
consumed Each Year by **ELECTRICITY USER**

158.4m³ (5.3GJ) of natural gas per year. If 1m³ of natural gas emits 1.92kg of CO₂ⁱⁱ, (Ministry of EnvironmentBC, 2014), households that used natural gas for primary space heating would annually produce approximately 6685kg more CO₂ than those who used electricity for their primary space heating system.

POST-RETROFIT EnerGuide HOME EVALUATION

From the 431 recorded case data received from NRCan, 39 cases (9.0%) were identified to have participated in the post-retrofit energy evaluation (E-Evaluation) through ESNW, and 22 post-retrofit evaluation cases were done independently of the program.

The average number of Energy Efficiency Measures (EEM) implemented by the post-retrofit evaluation participants was 3.15.

The following summarizes the comparison of the 39 pre and post-retrofit reports evaluation.

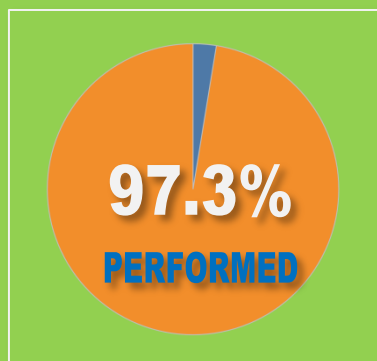
BUILDING ENVELOPE

AIRTIGHTNESS

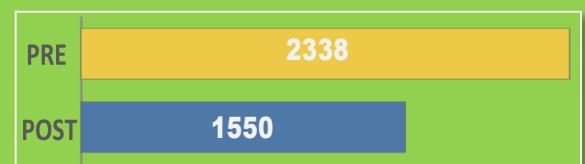
- 37 (94.9%) of homes were recommended to improve the airtightness, of which 36 (97.3%) households implemented the recommended energy efficiency upgrade.
- The average pre and post-retrofit ELAs were 2338 cm² and 1550 cm², respectively. On average, a 33.7% reduction in the ELA was achieved per household in the post-retrofit evaluation.
- The average pre and post-retrofit air change rate at 50 Pa was 11 ACH and 7.5 ACH. On average, a 31.8% improvement in the air change rate was achieved in the post-retrofit evaluation.

AIRTIGHTNESS

94.9%
were
RECOMMENDED
for AIR SEALING



Air Change Rate @ 50 Pa



Equivalent Leakage Area [cm²]

▪ **INSULATION**

- 32 (82.1%) of homes were recommended to increase the Attic/Cathedral Ceiling and Flat Roof insulation values, of which 21 (65.6%) households implemented the upgrade recommendation.
- 21 (53.8%) of homes were recommended to increase the Main Wall insulation value, of which 7 (33.3%) households implemented the upgrade recommendation.
- 22 (56.4%) of homes were recommended to increase the Crawl Space/Foundation insulation values, of which 13 (59.1%) households implemented the upgrade recommendation.
- 7 (17.9%) of homes were recommended to increase the Exposed Floor insulation value, of which 2 (28.6%) implemented the upgrade recommendation.

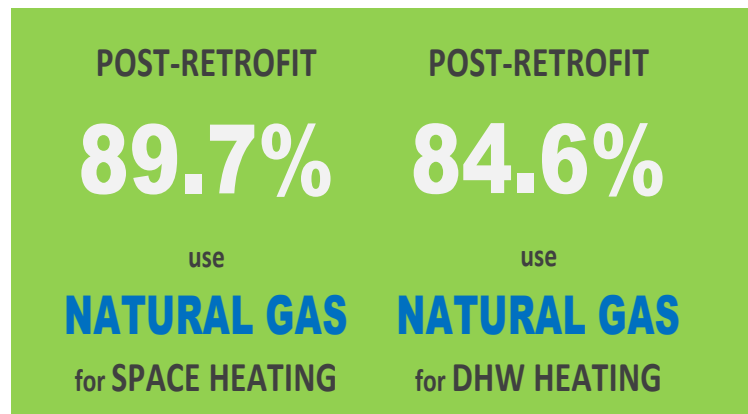
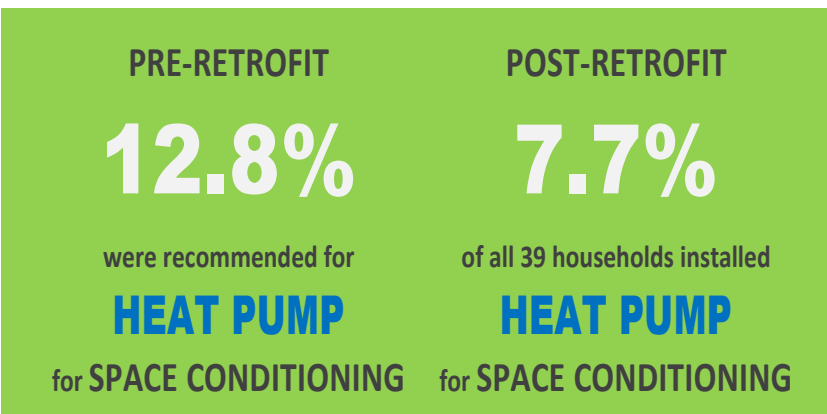
▪ **WINDOWS AND DOORS**

- 26 (66.7%) of homes were recommended to replace existing windows and doors with new ENERGY STAR certified models, of which 15 (57.7%) households implemented the upgrade.

MECHANICAL SYSTEM AND WATER CONSERVATION

▪ **HVAC (SPACE HEATING, VENTILATION, AIR CONDITIONING)**

- 38 (97.4%) of the total 39 households were using natural gas for the primary space heating system.
- 28 (59.0%) of homes were recommended to upgrade the primary space heating system, of which 9 (39.1%) households implemented the upgrade recommendation.
- 38 (100%) of the primary space heating system upgrade recommendation was to install a condensing gas-furnace or boiler.
- 5 (12.8%) of homes were recommended to install a new ENERGY STAR certified air-source heat pump (ASHP), of which 1 (20%) household implemented the recommendation.
- 2 (5.1%) of the 39 households installed a new ASHP, although it was not part of the energy upgrade recommendations provided in their pre-retrofit evaluation report.



▪ **DOMESTIC WATER HEATING**

- 31 (79.5%) of the 39 households were using natural gas for the domestic hot water heating system, and 8 (20.5%) were using electricity.
- 26 (66.7%) of homes were recommended to upgrade the existing DHW system to a condensing gas-fired system, of which 7 (26.9%) implemented the recommended upgrade.
- Of the 7 households who implemented the DHW system upgrade, 6 (85.7%) upgraded the existing system to a condensing gas-fired system, and 1 (14.0%) installed a direct vent system.
- 2 (5%) of the 39 households performed fuel switching from electricity to natural gas.
- 9 (23.1%) were recommended to install a drain water heat recovery system, but none implemented the recommendation.

ENERGY CONSUMPTION AND GHG EMISSIONS

▪ **EnerGuide (ERG) RATING**

- The average total pre and post-retrofit per-year ERG rating was 155.2 GJ and 105.3 GJ. An energy saving of 32.2% has been achieved.
- The average pre and post-retrofit per-year space heating energy consumption was 130.3GJ and 82.2GJ. A 36.9% reduction has been achieved in energy consumption for space heating.
- The average pre and post-retrofit per-year DHW energy consumption was 24.9GJ and 23.1GJ. A 7.2% reduction has been achieved in energy consumption for DHW heating by incorporating a new condensing gas-fired system.

▪ **GHG EMISSIONS AND FUEL TYPE**

- The average pre and post-retrofit evaluations for annual GHG emissions were 11.9 tonnes and 9 tonnes. A total of 24.4% reduction in GHG emissions has been achieved.
- The average total pre and post-retrofit evaluations for annual natural gas consumption was 4026m³ (150.2 GJ) and 2703m³ (100.8 GJ). A total reduction of approximately 2540kg of CO₂ emission has been achieved per year per household.

	Energy Upgrade Measure	Pre-Retrofit (% Recommended)	Post-Retrofit (% Performed)
Building Envelope	Air Sealing	37 (94.9%)	36 (97.3%)
	Attic/Ceiling Insulation	32 (82.1%)	21 (65.6%)
	Wall Insulation	21 (53.8%)	7 (33.3%)
	Crawl Space/Foundation Insulation	22 (56.4%)	13 (59.1%)
	Exposed Floor Insulation	7 (17.9%)	2 (28.6%)
	Windows & Doors	26 (66.7%)	15 (57.7%)
Mechanical & Water	Space Heating	28 (59.0%)	9 (39.1%)
	Heat Pump	5 (12.8%)	1 (20%)
	Ventilation and A/C	N/A	N/A
	DHW Heating	26 (66.7%)	7 (26.9%)
	Drain Water Heat Recovery	9 (23.1%)	0 (0%)

Table 2A. Pre and Post-Retrofit Comparison

	Rating	Pre-Retrofit	Post-Retrofit
Airtightness	Air Change Rate @ 50 Pa [ACH]	11.0	7.5
Energy Consumption	Overall ERG Rating [GJ per year]	185.4	135.6
	Space Heating ERG Rating [GJ per year]	130.3	82.2
	DHW ERG Rating [GJ per year]	24.9	23.1
Natural Gas Consumption	Percent of Natural Gas Users (Space Heating)	38 (97.4%)	35 (89.7%)
	Percent of Natural Gas Users (DHW)	31 (79.5%)	33 (84.6%)
	Overall Natural Gas Consumption [GJ/yr]	150.2	100.8
GHG	GHG Emissions [tonnes per year]	11.9	9.0

Table 2B. Pre and Post-Retrofit Comparison

	Energy Upgrade Measure and Rating	Pre-Retrofit		Post-Retrofit	
		All	D & E**	All (EST.)*	D & E**
Airtightness	Air Change Rate @ 50 Pa [ACH]	9.6	11.0	7.1	7.5
Energy Consumption [GJ per year]	Overall ERG Rating	146.4	185.4	86.8	135.6
	Space Heating ERG Rating	106.7	130.3	N/A	82.2
	DHW ERG Rating	24.5	24.9	N/A	23.1
Natural Gas Consumption	% of Natural Gas Users (Space Heating)	355 (89.7%)	38 (97.4%)	355 (89.7%)	35 (89.7%)
	% of Natural Gas Users (DHW)	326 (82.3%)	31 (79.5%)	347 (87.6%)	33 (84.6%)
	Overall Natural Gas Consumption [GJ/yr]	122.3	150.2	N/A	100.8
GHG	GHG Emissions [tonnes/yr]	6.0	11.9	3.0	9.0

Table 2C. Pre and Post-Retrofit Comparison (Estimated vs. Actual)

* Estimated Potential Rating of all households when all recommended energy upgrades have been implemented

** Average values for 39 Pre and Post-Retrofit Evaluations (D & E Evaluations)

SURVEY ANALYSIS

INTRODUCTION AND METHODOLOGY

The online survey was conducted from July 9 to July 24 2020, to gather qualitative insights from the ESNW participants on their energy program experiences. The survey questionnaires have been designed and developed with a focus on participants' motivations, barriers, attitudes and opportunities with energy retrofits of existing homes.

The survey invitation was emailed to 705 registrants who registered for the program through the ESNW website. The registrants were categorized into three (3) groups according to the program participation level, and each group received a different set of questionnaires. The groups included:

- Type A - Registrants who did not proceed with an energy evaluation
- Type B - Registrants who proceeded with an energy evaluation but did not complete any home energy upgrades
- Type C - Registrants who proceeded with an energy evaluation and completed home energy upgrades

A total number of 173 responses was received, and 32 were removed after the data cleaning. For the final analysis, 141 responses have been evaluated. There were 66 responses for Type A, 11 for Type B, and 64 for Type C.

When converting the 5-point Likert scale; "Strongly Agree," "Agree," "Neutral," "Disagree," "Strongly Disagree" to a numeric scale, each term was assigned a numerical value; -1, -0.5, 0, 0.5, 1, respectively, and used for the calculations.

The following summarizes the results and key findings from the survey analysis.

RESULTS AND FINDINGS

PERCEIVED VALUE OF THE ENERGY EVALUATION (TYPE B & C RESPONDENTS)

- *The EnerGuide evaluation reports and energy upgrade recommendations were perceived as valuable, informative, and easy to understand and follow.*

In general, the respondents were satisfied with the information presented in the energy evaluation reports. When asked about the complexity of the report, less than 3% of the

respondents found the report too technical or complicated to understand, and 8% found the information in the report overwhelming.

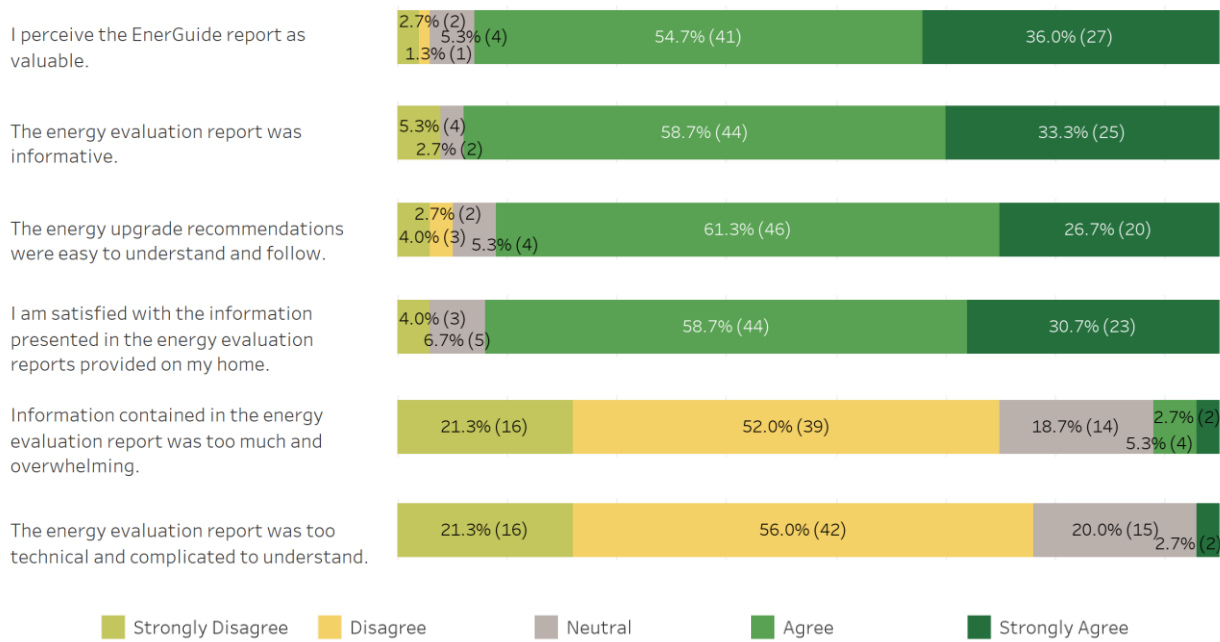


Fig. 1. Perceived Value of Energy Evaluation

- Overall evaluation and experience were perceived as satisfactory.

When asked about the overall energy evaluation and experience, over 80% of the respondents gave positive responses, while less than 6% responded negatively. 85.4% of the respondents were also satisfied with the energy advisor that conducted the energy evaluation.

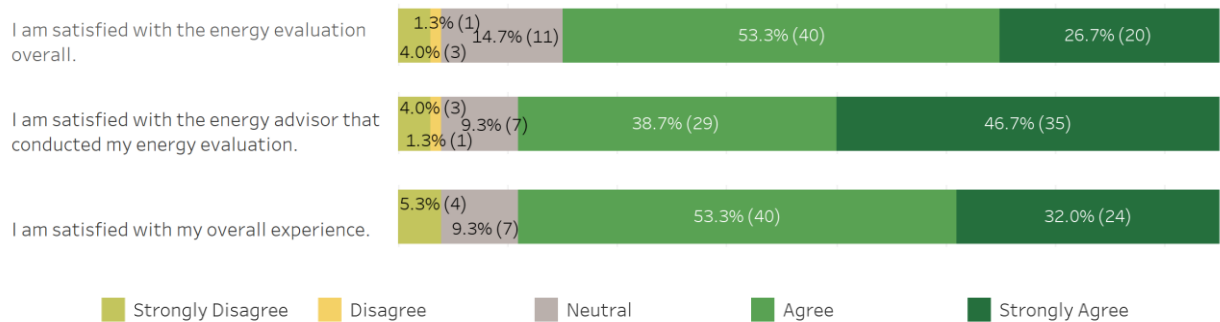


Fig. 2. Evaluation Experience

- 100% of the respondents would recommend the energy evaluation to others.

When asked if the respondent would recommend the energy evaluation to others, 100% of the Type B and C respondents responded, "Yes."

MOTIVATIONS FOR COMPLETING ENERGY EVALUATIONS AND UPGRADES

PROGRAM REGISTRATION (ALL RESPONDENTS)

- *The most significant motivating factor for the ESNW program registration was “Interested in learning how to reduce my energy bills.”*

When asked about motivations, 66.0% of the respondents responded that they registered with the program because they wanted to learn how to reduce their energy bills, and 58.9% also wanted to learn more about home energy rebates. Other factors included “conservation and reducing consumption,” “learning about inefficiencies in my home,” and “being a socially responsible homeowner.” 89% of the respondents also agreed that being more environmentally conscious was a determining factor for participating in the program.

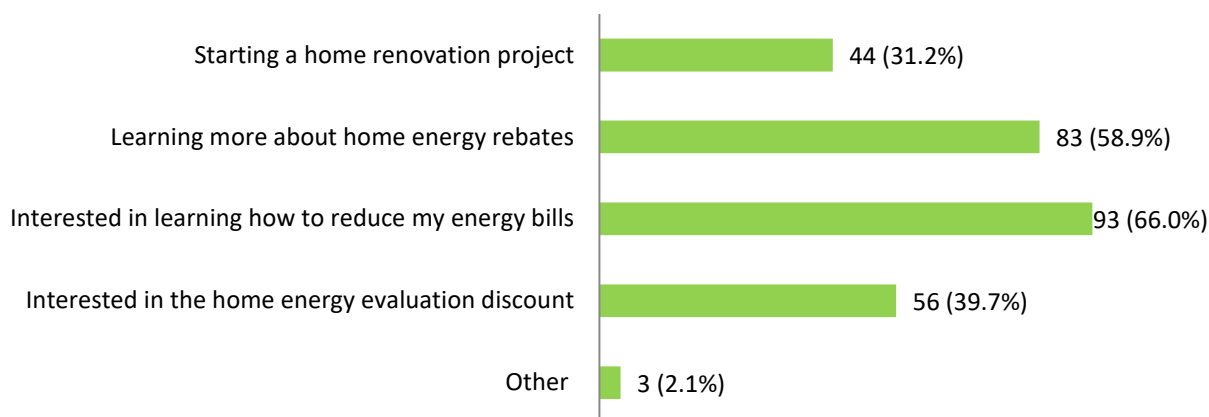


Fig. 3 Motivation for ESNW Program Registration

ENERGY EVALUATION (TYPE B & C RESPONDENTS)

- *The ESNW program discount available for the energy evaluation cost was a significant motivating factor for completing an energy evaluation.*

88% of the Type B & C respondents answered that the program discount on the cost of an energy evaluation influenced their choice to proceed, and 76% responded that they would not have completed the evaluation if the discount had not been available.

ENERGY UPGRADE (TYPE C RESPONDENTS)

- *The three (3) most significant motivating factors for Type C respondents to complete an energy upgrade(s) were; to save money on utility bills, to improve the comfort of homes, and “environmental consciousness and reducing household’s carbon emissions.”*

“Access to rebates and incentives,” “Existing Homes Energy Evaluation,” and “Information from energy advisors” were also perceived as positive motivating factors. The respondents were not

likely to be motivated by family/friends/neighbours/utility encouragements or concerns related to emergency preparedness. In addition, the respondents were 85.3% very likely to make energy-efficient upgrades as a result of the information received from the program.

Motivation Factors	Likert Scale Score (-1 to 1)	Rank
Save money on utility bills	0.63	1
Improve the comfort of my home	0.57	2
Environmental consciousness and reducing my households carbon emissions	0.48	3
Rebates/Incentives	0.43	4
Energy Evaluation	0.42	5
Information From Energy Advisor	0.40	6
Increase the resale value of my home	0.33	7
Concerns related to emergency preparedness (power outages, flooding, etc.)	-0.06	8
Encouraged by family/ friends/ neighbours/ utility	-0.13	9

Table 3. Motivation Factors for Completing Energy Efficiency Upgrades

BARRIERS TO COMPLETING ENERGY EVALUATIONS AND UPGRADES

ENERGY EVALUATION (TYPE A RESPONDENTS)

- *The two (2) most significant barriers to completing an energy evaluation were the “Cost” and “Time.”*

33.3% of the Type A respondents responded the energy evaluation was “Too Costly,” and 31.8% answered that they did not have enough time to complete an energy evaluation.

Other barriers identified by the respondents included:

- Not ready for renovation
- COVID-19
- Rental homes

ENERGY UPGRADE (TYPE B RESPONDENTS)

- *The two (2) most significant potential barriers to any energy upgrade implementation were the “High Costs” and “Lack of Financial Means.”*

When asked to rate the potential barriers to completing any energy upgrades, the cost and time-related factors were again top ranked, while the risks and information associated factors were perceived as non-barriers.

Potential Barriers	Likert Scale Score (-1 to 1)	Rank
High Costs	0.64	1
Lack of financial means (e.g. cash, financing, etc.)	0.41	2
Lack of time	0.32	3
Less of a priority (on my home improvement priority list)	0.27	4
Access to a contractor	0.18	5
No immediate benefit/value	0.05	6
High risks/uncertainties	-0.09	7
Complicated process/too much information	-0.18	8
Lack of information/support	-0.27	9
Concern regarding change	-0.32	10
Lack of awareness/interest	-0.32	10

Table 4. Potential Barriers

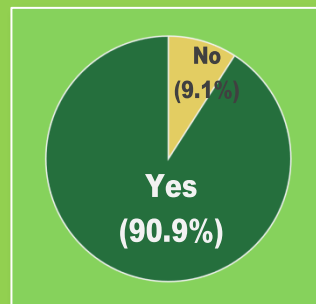
DECISION-MAKING AND PRIORITIZATION OF PROJECTS

The following summarizes the survey result findings for decision-making and prioritization of projects.

- *Environmental consciousness was a determining factor for participating in the program.*
- *The initial search and program registration involved an interest in “learning about rebates/incentives” and “how to reduce the energy bills.”*
- *The program discount was a critical factor for proceeding with an energy evaluation.*
- *The information received from the ESNW energy evaluation positively influenced the decision-making of energy-efficient upgrades.*
- *Only 25% of the Type C respondents completed a post-retrofit EnerGuide home evaluation, of which 68.7% responded that the post-retrofit evaluation was required to receive increased rebates.*

90.9%

would have implemented
UPGRADE RECOMMENDATIONS if
ADDITIONAL FINANCING PROGRAMS
 were available.



If **ADDITIONAL REBATES/INCENTIVES** were available, would you have **IMPLEMENTED UPGRADE RECOMMENDATIONS?**

- *“Additional rebates/Incentives” and “low or no interest financing” programs will highly influence the decision-making of energy upgrades.*

HOME ENERGY RETROFIT PROCESS AND PERCEIVED OUTCOMES (TYPE C RESPONDENTS)

- *Post-retrofit experience on the energy bill and home comfort levels was perceived as a relatively positive outcome.*

79.7% of the Type C respondents experienced an increase in home comfort levels after they completed the energy upgrades, and 51.6% experienced a decrease in their energy bills.

- *85.3% of the respondents who participated in the home energy evaluations completed energy upgrade(s), of which 68.6% completed more than one upgrade measure.*

The average number of energy measures implemented per household was 2.9, and 20.3% of the respondents also completed additional energy efficiency measures other than those recommended in the report. The additional measures included solar system installation and appliance and lighting upgrades.

When asked which energy conservation measures have been implemented, 64.1% of the respondents completed “Insulation Increase,” 57.8% completed “Air Sealing Improvements,” and 54.7% implemented “Space Heating/Cooling System Upgrade.” (Fig. 4) The percentage of the air sealing improvement implementation was found to be lower than that of the post-retrofit evaluation. In contrast, a higher percentage was observed for DHW system upgrade from the survey results.

For those who completed multiple energy efficiency measures, a breakdown of the priority measure was as follows; 31.8% implemented insulation upgrade, 29.5% did space heating/cooling system upgrade, and 13.6% completed airtightness improvements for their first measure.

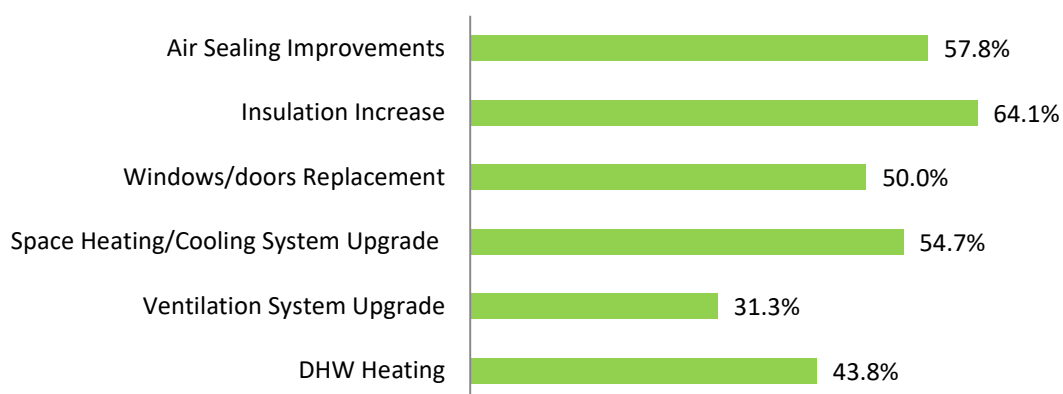


Fig. 4. What energy efficiency measures have you completed?

- *The most common budget range for home energy upgrade was \$5,000 - \$50,000, and over 50% implemented the upgrade recommendations within 1 year after the assessment.*

When asked about the home energy upgrade budget range, nearly 60% of the respondent responded that they spent \$5,000 - \$50,000, while 31.3% spent less than \$5,000. Only 4.5% spent over \$100,000. Regarding the implementation time, 53.1% implemented the upgrades within 1 year, while 17.2% took more than 3 years to complete the upgrades. 36.4% of the Type B respondents also responded that they would anticipate making home energy upgrades in the next 1 to 2 years, and 45.5% responded “Maybe.”

PERSPECTIVE ON ADMINISTRATION AND SUPPORT

- *Overall experience on the program registration and evaluation booking process was positively perceived, while the experience with the application process for incentives/rebates was perceived as rather neutral.*

While 88% of the respondents found the evaluation booking process hassle-free, 62.5% of the respondents perceived the incentives and rebate programs’ application process as a neutral or negative experience. Scheduling the evaluation during work hours was also inconvenient or difficult to coordinate by 24% of the respondents, and 38.7% remained neutral. When asked about help or support contacts, more than 50% of the respondents answered that they knew who to contact if in need of help or support, and only 16% responded negatively.

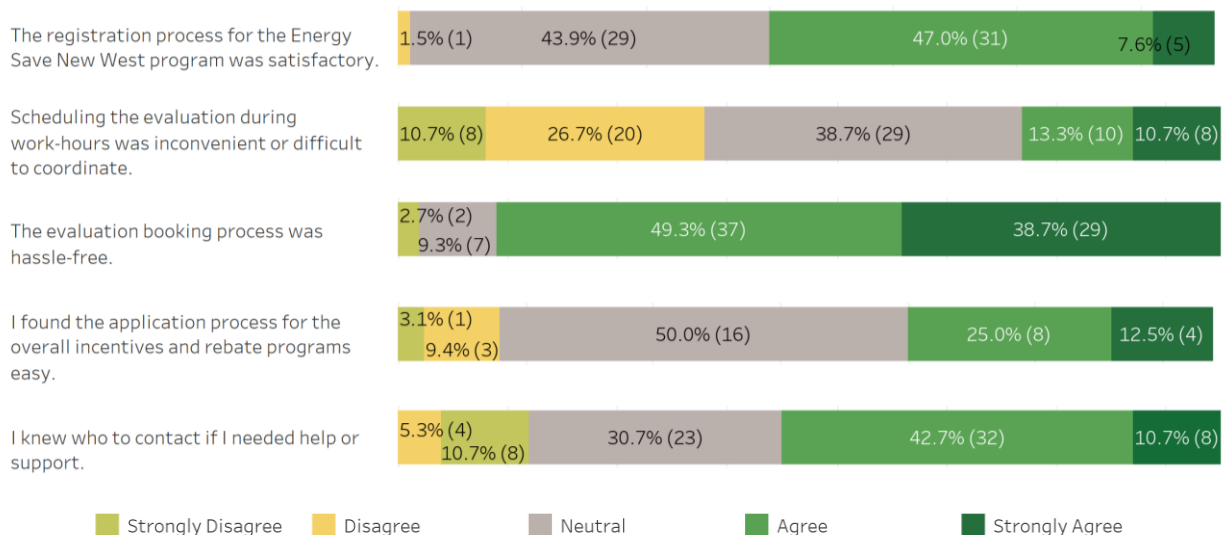


Fig. 5. Administration and Support

ESNW PROGRAM AND REBATE/INCENTIVE PROGRAM PROMOTION

- *The two (2) most effective promotion methods of the ESNW program were “Advertising” and “Internet.”*

42.5% of the respondents came across the ESNW program through “Advertising” (e.g. bill inserts, local newspaper, etc.), and 41.1% were through the “Internet” (e.g. social media, website, etc.). 8.9% heard through “Word of Mouth.” Other media included “City contact” and “Emails.”

- *Utilities’ rebate/incentive programs were more widely known to the respondents than the provincial program. More than 25% of the respondents did not know about any provincial or utilities’ rebate/incentive programs.*

When asked about rebate/incentive programs awareness, 60.1% were aware of the FortisBC home renovation rebate programs, and 53.2% were aware of the BC Hydro programs. Only 22% were aware of the Provincial CleanBC Better Homes rebate and financing programs. When asked about CleanBC’s Energy Coach service, 37.5% did not know about it, and only 17.2% actually used the service. The Provincial CleanBC Better Homes program and Energy Coaching services are recent additions to the residential energy-efficiency landscape, so limited awareness of these initiatives with local residents is to be expected.

Of the total Type C respondents, 54.3% applied for eligible incentives and rebates.

IMPROVEMENT SUGGESTIONS BY RESPONDENTS

The survey respondents were asked to provide suggestions for the ESNW program improvements, and the responses were as follows.

- Better guidance on financial return on investment
- More rebate options or incentives
- More financing options
- Solar system support
- More information on energy efficiency appliances including smart home products
- More information on heritage home energy efficiency
- DIY support
- Better access to contractors

BEST PRACTICES REVIEW

For the energy-efficiency program analysis, a total of three (3) programs have been evaluated in details to identify alternative demand side program design, delivery practices, incentive/rebate/financing structure that could inform future initiatives for ESNW.

Due to the time constraint of the project, the programs were reviewed with publicly available online information only. All rebates and financing aids are shown in US dollars.

EFFICIENCY VERMONT

Efficiency Vermont was launched in 1999 by the Vermont legislature and the Vermont Public Utility Commission that offers thermal efficiency services to Vermont residents to reduce the use of fossil fuels, improve home comfort, and save on heating costs. The services they provide include; energy assessments, financing, income-based assistance, project support, and education and events.



Efficiency Vermont had a notably high participation rate, and they served over 72,000 customers and 27.9% households in 2019. From the “2019 Savings Claim Summary” report, it was found that they sent the program promotion mailer to over 50,000 customers in 2019. Between 2000 and 2019, they achieved 18.9 million MWh, 29 million MMBtu of energy savings and 12 million metric tonnes of CO₂ reduction.

The following summarizes the Efficiency Vermont program review.

ENERGY EVALUATION

Efficiency Vermont provides the following services for the home energy evaluation.

- **Over-the-Phone Consultations**

No cost DIY assessment with free tools and over-the-phone technical support.

- **Professional On-Site Assessments**

Efficiency Vermont provides two types of on-site assessment services.

➤ **Standard Home Energy Assessment**

Connects homeowners with a “Home Performance with ENERGY STAR” contractor for professional assessments that provide a more comprehensive evaluation of home’s energy use and energy-saving opportunities.

➤ **Healthy Home Energy Assessment**

Service intended for households with chronic illness or health risks such as asthma. Using the U.S. EPA Healthy Indoor Environmental Protocols for Home Energy Upgrades, a certified healthy home contractor identifies home health hazards based on the Vermont Department of Health’s principles of healthy homes, and provides a report with healthy home improvements as the highest priority.

STRUCTURE OF THE PROGRAM

- **Administration**

Efficiency Vermont is administrated by Vermont Legislature and the Vermont Public Utility Commission.

- **Program Funding**

In 2019, 80-90% of the funding came from Energy Efficiency Charge built into the overall utility rates, and the remaining funding came from Regional Greenhouse Gas Initiative (RGGI) and Forward Capacity Market (FCM).

TARGET MARKET

For the residential sector, the target market is all residential homeowners and rental property owners that are Vermont residents. There was no separate energy assessment category for multi-unit properties, however, many rebates/incentives were only applicable to single-family residences and rental properties with fewer than five units. “Multifamily Renovation & New Construction” service was available separately under the renovation and construction project support.

ENERGY SAVINGS & GHG EMISSIONS REDUCTION

- **Energy Savings**

18.9 million MWh and 28 million MBtu of energy savings were made from 2000 to 2019. The cost of saving electricity with efficiency was \$0.04 per kWh, and the cost of saving fossil fuel with efficiency was \$13.80 per MMBtu.

- **GHG Reduction**

12 million metric tonnes of CO₂ reduction was achieved from 2000 to 2019.

REBATES AND INCENTIVES

Efficiency Vermont provides various options for the rebate/incentive programs. Although there was a separate category for residential rental properties under the residential rebates, most rebates were available to homeowners only.

FINANCING OPTIONS

- **Home Energy Loan**

- 0% interest financing for low-moderate income residents.
- Finance up to \$40,000, and 100% financing of the project cost
- Loan terms of up to 15 years
- Limited time offer to cover the first six months of loan payments (up to \$900) for eligible borrowers

- **The NeighborWorks of Western Vermont Energy Loan**

- Low-interest loans of up to \$40,000 and 100% financing of the project cost

LOW-INCOME SUPPORT

- **Additional Rebates and Financing Incentives**

- Various options available for low-moderate income households

- **Bill Payment Assistance**

- Forgiveness of past-due energy bills
- Reduced fuel and electricity rates
- Other income-based crisis services

- **Energy Bill Reduction**

- Free products and appliances, based on income and energy use
- Free or reduced-cost weatherization for limited-income households, rental properties, and mobile homes. Weatherization service includes energy audits, insulation and air sealing.

ELECTRIFICATION AND RENEWABLE ENERGY SUPPORT

▪ **Heat Pump Rebates**

The following rebates were available for the new heat pump installation.

- Air-to-Water Heat Pumps - up to \$6,500 cash back
- Centrally-Ducted Heat Pumps – up to \$4,900 cash back
- Heat Pump Heating & Cooling System – up to \$500 off
- Heat Pump Water Heaters – up to \$800 cash back

▪ **Renewable Energy**

Renewable Energy Resource Center (RERC) administers renewable energy incentives and the following financial aid was available for Vermont homeowners.

- *Photovoltaic Panels and ENERGY STAR Certified Solar Water Heaters*
Residential Tax Credit can be claimed for 26% of the cost (including installation costs)

EDUCATION SERVICES

Efficiency Vermont offers free webinars and educational workshops for consumers and professionals. Workshops for community groups address actions consumers can take in homes to save money and energy, along with information on technical and financial aids. The following two educational workshops were available for home owner groups.

▪ **Efficiency + You = Savings and Comfort**

Overview of actions that can be taken to save money, energy, reduce carbon emissions, and improve home comfort that include information on heat pumps, renewable energy, and etc.

▪ **Energy Innovations for Your Home**

Provides information on the latest technology in heat pump, renewable energy, and smart & connected homes.

MASS SAVE

Mass Save was founded by the local electric and natural gas utilities in Massachusetts, and in collaboration with Mass Save, Massachusetts was ranked number one in State Energy Efficiency Scorecard by the American Council for an Energy Efficient Economy (ACEEE) for nine consecutive years.



The program services were only available to customers of the Sponsors of Mass Save, and the funding came from a charge on customers' energy bills.

ENERGY EVALUATION

Mass Save provides the following services for home energy evaluation, and to be eligible customers must live in a 1-4 unit home.

- **Virtual Home Energy Assessment**

No cost remote home assessments with free tools and over-the-phone technical support. Participants will receive no-cost targeted air-sealing service and also qualify for 100% off insulation installation (limited time offer). Some energy-saving products recommended during the assessment will also be delivered for DIY installation at no cost.

- **No-Cost Home Energy Assessment**

An Energy Specialist assesses the current energy use of customer's home and installs energy-saving products at no cost. Participants will receive no-cost targeted air-sealing service as well as an instant incentive for 75% off approved insulation improvements or up to 90-100% based on household income.

STRUCTURE OF THE PROGRAM

- **Administration**

The programs and services are managed and delivered by local electric and gas Sponsors. Mass Save was also working closely with the Massachusetts Department of Energy Resources.

- **Program Funding**

The funding was supported from a charge on customers' energy bills.ⁱⁱⁱ

TARGET MARKET

The residential programs and services were only available to residential customers of the Sponsors of Mass Save; Berkshire Gas, Blackstone Gas Company, Cape Light Compact, Columbia Gas, Eversource, Liberty Utilities, National Grid, Unitil. Customers residing in 1-4 family properties were eligible to apply for the "Home" program services, and residents of 5+ unit properties can apply for "Multi-Family" program.

REBATES AND INCENTIVES

Mass Save's rebates/incentives were mostly available to homeowners but some were available to renters/landlords of 1-4 unit properties.

- **Landlords/Property Managers of 1-4 Unit Rental Homes**
 - No-cost Home Energy Assessment
 - No-cost targeted air sealing
 - 75% - 90% off recommended insulation improvements

- **Homeowners**
 - No-cost Home Energy Assessment
 - No-cost targeted air sealing
 - Instant 75% - 100% off recommended insulation
 - Up to \$2,750 on qualifying energy-efficient heating, cooling, and water heating equipment

FINANCING OPTIONS

- **HEAT Loan**
 - 0% interest financing up to \$25,000

- **Expanded HEAT Loan**
 - 0% interest financing up to \$50,000 for expanded projects or removing barriers to weatherization and heating system upgrades

LOW-INCOME SUPPORT

- **Energy Assistance Program**
 - *Fuel Assistance*
Financial support to help with the heating bills

 - *Utility Discount Rates*
Automatically enrolled for "Fuel Assistance" receivers

 - *Payment Plans or Arrearage Management/Forgiveness Programs*
Spread out overdue portions of the bill or past-due balances may get waived

➤ ***Energy Efficiency and Weatherization Assistance Programs***

No-cost appliances, heating system or system repair, air sealing service available.

➤ ***Enhanced Insulation Incentive***

No-cost insulation upgrade available to low-moderate household income

ELECTRIFICATION AND RENEWABLE ENERGY SUPPORT

▪ Heat Pump Rebates

The following rebates were available for new heat pump installation.

- Central Heat Pump (Fuel Optimization) – Up to \$1,250 per ton
- Central Heat Pump (Product) – Up to \$250 per ton
- Mini-Split Heat Pump (Fuel Optimization) – Up to \$1,250 per ton
- Mini-Split Heat Pump (Product) – Up to \$250 per ton
- Heat Pump Water Heaters – Up to \$600 cash back

▪ Renewable Energy

There were three options introduced on the Mass Save website for solar energy system installation and use.

➤ ***Massachusetts Solar Loan Program***

Loan up to \$35,000 with a 10-year-fixed-rate and up to 12 months interest-only period

➤ ***Solar Lease or Power Purchase Agreement (PPA) through a Third-Party Owner (TPO)***

The TPO installs panels at customer's property and there is often no upfront or maintenance costs. Customers can buy electricity generated at a below-market rate.

➤ ***Community Solar***

There were a number of community solar providers in Massachusetts that were offering community solar share programs similar to the ESNW's Urban Solar Garden projects.

The following are the rebates and tax credits that were available for the solar system installation and power generation.

➤ ***Federal Residential Renewable Energy Tax Credit*** up to 26% of the cost

➤ ***State Personal Income Tax Credit*** up to 15% of the system cost (\$1,000 maximum)

➤ ***Municipal Light Plant Solar Rebate Program***

This program was offering rebates of \$1.20 per watt, up to 50% of system costs on installation of 25 kW DC or less, and was only available for customers in Massachusetts Municipal Light Plant service territories.

➤ ***Solar Massachusetts Renewable Target (SMART) Program***

Investor-owned electric utilities pay incentives directly to solar system owners. A typical residential solar system can be registered for 10-year participation and receives monthly incentive payments.

➤ ***Net Metering***

This program was offering credits on customer's utility bill for excess solar power generation which can be used during time when the system is not generating enough electricity.

➤ ***Solarize Mass***

Discounts were available for group-buyings in participating communities.

▪ **ConnectedSolutions**

Mass Save provides a **ConnectedSolutions** program to residential customers offering incentives.

➤ ***Battery Storage***

Battery Storage incentives were available to Eversource and National Grid's residential customers with qualified battery systems. If enrolled in the program, energy stored in customer's battery will be drawn during the peak hours to help reduce the load on the electric grid and the incentives were as follow.

- ✓ \$225 per kW contribution during summer events (2pm – 7pm, June 1 – September 30)
- ✓ \$50 per kW contribution during winter events (2pm – 7pm, December 1 – March 31)

➤ ***Smart Thermostat***

When enrolled in the program, the customer's thermostat setting will not increase more than 4°F during peak demand to lower the energy use and the load on the grid. There was a \$25 enrolment incentive along with a \$20 annual incentive per thermostat connected to a central A/C.

EDUCATION SERVICES

- **Energy-Saving Fundraiser Program**

Mass save offers resources for students and teacher as well as Energy-Saving Fundraiser Program for students. The program teaches students the importance of energy efficiency and conservation, and provides the fundraiser products (LEDs, advanced power strips, etc.) at no cost. Schools get to keep 100% of the money collected through the fundraiser.

ENERGY TRUST OF OREGON

Energy Trust of Oregon is a non-profit organization working closely with various partners including participating utilities, trade and program allies, the Northwest Energy Efficiency Alliance, the Oregon Public Utility Commission, and government agencies.



Since 2002, Energy Trust of Oregon has helped more than 744,400 homes and buildings with cost reduction by saving energy and using clean renewable resource.^{iv} Their target market sectors include residential, commercial/public, industrial/agricultural, and renewable energy, and in particular, they strongly focus on renewable energy sector. Energy Trust issues monthly, quarterly and annual financial statements, and reports energy savings made in quarterly and annual reports.

ENERGY EVALUATION

- **Online Home Energy Review**

At the time of program evaluation, the Energy Trust's Home Energy Review webpage was under construction and the information available was limited.

- **Home Performance with ENERGY STAR Assessment**

A specially trained contractor tests and evaluates all components of home's health, safety and energy performance. The homeowner will receive a comprehensive home energy consumption report with energy improvement recommendations, comparison of the current costs and potential savings, and a list of available cash incentives. The assessment cost varies by contractor.

- **Solar Proposal**

Most often without a site visit, a solar contractor will provide a bid with estimated annual energy generation and utility bill savings, and home owner's costs after incentives and federal tax credits.

STRUCTURE OF THE PROGRAM

▪ Administration

Energy Trust of Oregon is a non-profit organization where the Oregon Public Utility Commissions (OPUC) oversees Energy Trust's investment of utility customer funds in energy-efficiency and renewable power programs.

▪ Program Funding

Energy Trust's funding comes exclusively from customers of the five utilities; Potland General Electric, NW Natural, Avista, Pacific Power, and Cascade Natural Gas. The revenue comes from a charge on the utility bills plus interest income and a subcontract to help develop and administer part of the Oregon Community Solar Program. Energy Trust's expected 2020 revenue is \$181.5 million, and the budgeted 2020 expenditure is \$204.6 million. The 2020 funding consists of Electric Efficiency Public Purpose Charge (29%), Electric Efficiency Supplemental Charge (46%), Gas Tariffs (18%), and Renewable Energy Public Purpose Charge (8%).^v

TARGET MARKET

The residential program provides services to single-family or manufactured home owners that are utility customers. Attached residences including duplexes were eligible to apply for the Multifamily program under Commercial sector.

ENERGY SAVINGS & GHG EMISSIONS REDUCTION

▪ Energy Savings

Energy Trust's 2020 energy goals for the residential sector are; Electric Savings of 7.4aMW (average megawatt) at 5.6 cents/kWh, Natural Gas Savings of 2.73 MMTh (million annual therms) at 41.5 cents/therm. Energy Trust also targets at generating 41% of the total renewable energy generation target (3.27 aMW) by Residential Solar system.

▪ GHG Reduction

No information was given on the Energy Trust's website for the GHG emissions reduction but given the estimated per-therm CO₂ emissions is 0.0549 metric tons^{vi}, with the targeted 2020 natural gas saving of 2.73 MMth, Energy Trust would achieve approximately 14,470 tonnes of CO₂ emissions reduction.

REBATES AND INCENTIVES

Energy Trust provides Energy Saver Kit and air sealing services at no cost, and offers various other rebate and incentive programs for appliances, lighting, insulation and window upgrades, heating and cooling systems, and water heating and treatment.

Energy Trust also provides increased incentives for rental homes and low income households.

- **Increased Incentives for Rental Homes**

Energy Trust residential program provides access to increased rebates and incentives for single-family and manufactured home rental properties. For example, incentive for ductless heat pump installation increases up to \$1,750 - \$2,000 for rental properties while homeowners will only receive \$500. The following shows the full list of residential incentives for rental homes.

Energy Improvement	Standard Incentives	Increased Incentives for Rental Homes
Ductless Heat Pump	\$500	\$1,750 - \$2,000
Ducted Heat Pump	\$700	\$1,000
Extended Capacity Heat Pump	\$650 - \$1,350	\$1,650
Gas Furnace	\$550	\$550
Heat Pump Water Heater	N/A	\$270
Smart Thermostat	\$100	\$100
Attic Insulation	\$0.25 / ft ²	\$0.50 - \$0.75/ft ²
Wall Insulation	\$0.30 / ft ²	\$0.50 - \$0.75/ft ²
Floor Insulation	\$0.30 / ft ²	\$0.40 - \$0.75/ft ²

Table 5. Incentive Comparison

FINANCING OPTIONS

Energy Trust provides access to on-bill repayment financing options for homeowners. Interest rates, terms and conditions vary depending on the location of home, income level, or utility providers.

- **Savings within Reach On-Bill Repayment**

Up to 6.49% interest financing up to \$10,000 with up to 10-year repayment term.

- **Oregon On-Bill Repayment**

Up to 7.15% interest financing up to \$10,000 with up to 7-year repayment term.

- **On-Bill Repayment for Homeowners in Washington**

Up to 5.14% interest financing up to \$15,000 with up to 15-year repayment term.

LOW-INCOME SUPPORT

▪ Solar within Reach and Savings within Reach

Energy Trust provides access to increased rebates and incentives for low-income households for energy efficiency upgrades and renewable energy credits. The list of increased incentives is as follows.

Energy Improvement	Standard Incentives	Increased Incentives for Low-Income
Ductless Heat Pump	\$500	\$1,000
Efficient Heat Pump	\$700	\$1,000
Heat Pump Controls	\$250	\$250
High-Efficiency Gas Furnace	\$550	\$550
Heat Pump Water Heater	N/A	\$270
Attic Insulation	\$0.25 / ft ²	\$0.50/ft ²
Wall Insulation	\$0.30 / ft ²	\$0.50/ft ²
Floor Insulation	\$0.30 / ft ²	\$0.40/ft ²
Solar	\$0.30/watt up to \$2,400	\$1.50/watt up to \$9,000

Table 6. Incentive Comparison

▪ Community Resources

Various low-income support resources are also available through local Community Action Agencies and community service providers.

ELECTRIFICATION AND RENEWABLE ENERGY SUPPORT

▪ Heat Pump Rebates

The following rebates are currently available for the new heat pump installation.

- Ductless Heat Pump –\$500
- Heat Pump – \$700
- Heat Pump Controls – \$250
- Extended Capacity Heat Pump (without backup gas heating system) – \$650 - \$1,350
- Heat Pump Water Heater – \$500 instant discount

▪ Energy Trust Incentives (Solar) and Federal Tax Credit.

Currently, \$0.30/watt up to \$2,400 per home is available for solar incentives. Increased incentives are also available for income-qualified homeowners as outlined in Table 6.

Federal Residential Renewable Energy Tax Credit up to 26% of the cost is also available for the solar system installation.

- **Solar Financing**

Energy Trust customers have solar financing options as follow.

- Solar Leases and Power Purchase Agreements (PPA)

Energy Trust notes that the solar electricity rate may or may not be less than customer's current electricity, however, if a customer choose a lease or PPA option, Energy Trust pays the incentives to the service provider so that the power purchase or lease price could become more affordable.

- Loans

Solar loans are available through various finance providers and interest rate, terms and conditions vary.

KEY-TAKEAWAYS

From the US programs review, some opportunities were seen for the future program initiatives that incorporated the following:

- New technologies (e.g. battery storage, renewable energies, heat pumps, etc.)
- Fuel switch/energy-efficiency programs repurposed on GHG reduction
- Community inclusion programs such as affordable housing programs and customized offers for income-eligible participants
- New rebates and financing models that provide a broader range of financial support options

SUMMARY AND RECOMMENDATIONS

Based on the energy analysis, survey results, and US-program review, there are a number of opportunities identified for Energy Save New West to consider as potential enhancements to improve the community energy-efficiency program, reduce GHG emissions and support City climate change targets.

As a starting point, it was seen that the overall satisfaction level of the ESNW's Existing Homes program participants was notably high. 89.4% of the survey participants responded that they were satisfied with the information presented in the energy evaluation reports, and 85.3% were also satisfied with the overall program experience. As a result of the energy upgrade implementation, on average, each household managed to achieve 26.9% energy savings and 2.9 tonnes of GHG emissions reduction per year.

The following summarizes the recommendations for future consideration along with the key findings from the project analyses.

ENCOURAGE CLEAN ENERGY USE AND ADVANCED TECHNOLOGY

Although the post-retrofit annual GHG emission of 39 cases assessed was reduced by 24%, it was still far from the City's zero-emission goals. To support the City of New Westminster's 2020 Climate Action seven (7) bold steps towards a zero-carbon future by 2050, the community carbon emissions from all homes must be reduced significantly. Yet, with natural gas being the primary space heating fuel source for almost 90% of the single-family homes participating in ESNW, it will be challenging to achieve the City's goals.

- ***Encourage Electrification of Space Heating System***

While the electrification of a space heating system with high-efficiency equipment seems to be the solution for reducing a significant amount of GHG emissions, there were some barriers seen to the new heat pump installation.

As discussed in the EnerGuide report analysis, 22% of all assessed households were recommended for the new ENERGY STAR certified air-source heat pump installation. This included the homes that had existing A/C units as well as those who didn't. However, it was also often recommended with the household's primary heating system upgrade using fossil fuels. While many heat pump models require a back-up heating system for the coldest days, the current rebate programs only allow the city residents to access the rebate for whichever is the household's primary heating system. Moreover, if a heat pump gets used primarily for space heating after fuel switching from natural

gas, the cost of energy will likely increase due to the high cost of electricity over the natural gas cost. Since the most significant barrier to implementing any energy upgrade was the “high cost,” and the most motivating factor for energy evaluation was “interest in reducing energy bill,” it came as no surprise when the actual implementation rate of the heat pump installation was found to be only 20% in the post-retrofit analysis.

It was also found that the energy advisors have been actively encouraging the installation of heat pumps since May 2020 (75% recommendation rate), which indicates that a significant reduction of GHG emission is potentially achievable if the upgrade recommendations have been implemented by most of the participants. However, to increase the implementation rate, it is necessary to revisit the current rebates/incentives system to make it more affordable and attractive for end-users.

- ***Encourage Renewable Energy Use and Innovative New Technology Adoptions***

- **Innovative Energy Conservation Measures**

Technology is evolving every day and smart energy innovation is no exception. The use of smart energy technologies and increased connectivity will not only improve grid reliability and efficiency but also help consumers save more power and reduce the cost of electricity.

As seen in the Mass Save program review, programs facilitating the use of energy smart tools such as smart thermostats as well as the connected system of storage technology and renewable resources, would greatly help shape our zero-carbon future at a faster pace. Since the start of the COVID pandemic, people are getting more and more cautious about their home energy efficiency and cost. Now is time to incorporate advanced smart energy conservation measures into the energy upgrade recommendations.

- **Distributed Energy Generation/Solar Power**

Along with the increased recommendation rate for the heat pump installation, in June 2020, ESNW’s EnerGuide energy advisors also started to recommend installing a solar collector system. However, due to the high upfront investment cost and low ROI rate for PV panels, the actual implementation rate would be in doubt. Currently, there is no rebate or incentive program available in BC for solar system installation other than the PST Tax Exemption. Therefore, it is also recommended for the City to work with utilities and the province to offer more affordable financing options such as solar energy incentives, on-bill payment with low interest rate, and lease or PPA (Power Purchase Agreements) options discussed in the previous section. Advancing the development of more Urban Solar Garden projects can also be considered to encourage local energy generation and shared benefits.

CONSIDER ALTERNATIVE ENERGY EVALUATION STRATEGIES

- ***Virtual EnerGuide Energy Evaluation Method***

All of the US-based programs discussed in the previous section provided a DIY or virtual evaluation option with over-the-phone technical support, but currently, the ESNW program only offers a scheduled on-site energy evaluation with an energy advisor.

While the professional assessments will provide program participants with the most comprehensive energy evaluations of the current condition and potential savings, since the “high cost” was still one of the most significant barriers to the evaluation participation, it is expected that with the DIY or virtual evaluation option, the program cost will likely decrease and the participation rate could increase accordingly.

It was also found that the number of evaluation reports issued from January 2020 to July 2020 was considerably less than the previous years of the same duration. The most significant possible cause for the decreased participation for 2020 would be the ongoing COVID-19 situation which also indicates the urgent need for alternative evaluation methods. With the increased public interest and concerns about health and safety, it is also recommended that energy evaluations should put more focus on the health and safety factors of the home. That said, in-depth research and investigations will be required for virtual assessments or DIY participants to ensure the right tools and methods are identified to support the various visual assessments and performance tests needed to adequately evaluate the current energy condition of their homes.

- ***Alternative Strategies For Non-Strata Rental Households***

When motivation factors for the energy upgrade implementation were analysed, “improving the comfort of my house” was the second most significant factor. For rental homeowners, this might mean they are less likely to be motivated by this factor in implementing any upgrades for their rental properties.

As discussed in the best practices review, Energy Trust of Oregon had a special financial support category that offered increased incentives for rental homeowners. The Clean Energy Work’s PAYS (Pay-As-You-Save)^{vii} program was also made the energy upgrade more approachable for people renting the property. In order to increase the motivation level of rental homeowners and renters, an alternative approach for rental homes energy upgrade support needs to be further investigated and developed.

ACTIVE MARKETING TO INCREASE AWARENESS

- ***Active Programs Promotion***

According to the Statistics Canada 2016 census data, over 10,000 households were residing in single-detached or row houses or flat in a duplex in New Westminster. Since the program launch, approximately 400 energy evaluations have been conducted, which counted for 4% of the non-MURB residences. It was also seen that the program participation rate was highest when the energy evaluation was provided free of charge in 2013. Although the “cost of the program” factor

may be the most significant reason behind the lower participation, more effective marketing could also help increase the participation rate.

During the survey, when participants were asked about rebate/incentive programs provided by the Province and Utilities, only 22% were aware of the CleanBC Better Homes program. When asked to give suggestions about the ESNW program improvements, many of the suggested opinions were, in fact, already in place. This indicates the need for better promotion of the ESNW as well as the financial support programs.

While alternative methods and decreased energy evaluation costs can encourage the City residents to participate more, people need to be aware of the program first. Therefore, along with the conventional seasonal marketing and promotion methods, more proactive strategies such as providing an ongoing “Awareness” campaign could be considered to increase program participation.

- ***Provide Education/Training for Local Residents***

From the survey analysis, the environmental consciousness was the third most significant motivating factor for the Type C respondents for implementing the energy upgrades. Moreover, 89% of all survey participants responded that being more environmentally conscious was a determining factor for participating in the program.

These motivations can be boosted by providing regular information and training sessions to the wider resident groups. Mass Save offered various educational programs for local schools to teach young residents about energy efficiency and how their actions affect the environment. This provides opportunities for the young generation to grow more environmentally and energy efficiency consciously.

ESNW currently provides training for professionals in new home construction, and there are also valuable information and resources on the program website. However, there are no educational or training sessions offered for local residents with existing homes. Therefore, to increase awareness of our climate emergency and energy efficiency, it is recommended for the City to consider incorporating educational/training services for existing homeowners as well as our young generation.

CONSIDER ALTERNATIVE FUNDING/FINANCIAL SUPPORT STRATEGIES

This section discusses financial support, including incentives/rebates and financing options, and is provided for the City to further discuss with its program partners and sponsors.

- ***Incentive and Rebate Structure***

As already discussed, the two most significant barriers to implementing energy upgrades were the “high capital cost” and “lack of financial means.” Over 90% of the respondents answered that they

would have implemented the upgrade recommendations if more rebates/incentives or financing programs were available. It was also seen that the implementation rate was lower for those that required high capital cost and relatively longer construction time (e.g. space heating, exposed floor and wall insulation upgrade) compared to the ones that required less cost and less time. (e.g. air sealing, attic/ceiling insulation)

From the best practice review of the US-based programs, it was also found that considerably higher rebate (up to \$6,500 US) was being offered for the heat pump installation by Efficiency Vermont, while various solar energy incentives/rebates and financing options were provided by Mass Save and the sponsors of Energy Trust of Oregon. A more comprehensive range of options with increased rebates/incentives was also available for low to moderate income households. For the ESNW program to be more inclusive and expand, the City needs to re-evaluate the current financial support programs with its program partners and sponsors and provide more inclusive and lucrative rebate and incentive options for the residents.

While “saving on utility bills” achieved the highest score (0.63) in the motivation factor analysis, electrification of the primary space heating system could increase the utility bills, which can highly demotivate the participants to implement the heat pump installation. Therefore, to reduce the use of fossil fuels, a more aggressive approach in supporting the electrification of heating system needs to be designed and developed.

▪ ***Financing Options***

Currently, no financing program is being offered from the province and the utilities other than the CleanBC Better Homes Low-Interest Financing Program for New Westminster residents, and the CleanBC financing program is only applicable to fuel switching upgrade. No PACE (Property Assessed Clean Energy) or equivalent is available in BC.

Mass Save was offering 0% financing up to \$50,000 US for heating system upgrade projects, and some of the Canadian municipals were also offering financing options similar to PAYS (Pay-As-You-Save) or Energy Trust’s “On-bill Repayment” programs for their energy efficiency programs. To facilitate more rapid growth in energy savings and GHG reduction, it would be worth investigating further to provide more viable financing options that can lower the City residents’ affordability barrier.

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ⁱ Conversion rate retrieved from <https://www.nrcan.gc.ca/energy/energy-sources-distribution/natural-gas/natural-gas-primer/5641>

ⁱⁱ 2014 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions, Ministry of Environment, BC

ⁱⁱⁱ <https://www.masssave.com/en/about>

^{iv} <https://www.energytrust.org/about/explore-energy-trust/>

^v <https://www.energytrust.org/about/reports-financials/budget-action-plan/>

^{vi} <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>

^{vii} PAYS (Pay-As-You-Save) program provided by Clean Energy Works offers an inclusive financing option for energy efficiency upgrades regardless of a customer's income, credit score, or renter status. When a customer opts into a service agreement, utility will "invest in the energy upgrades and recover its cost with a charge on the bill that is capped at 80% of the estimated savings from the upgrade of the life of the upgrade." The investment is tied to the meter at the property which does not follow the customer.