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# **AERIAL THERMAL IMAGING AND BUILDING ENERGY EFFICIENCY UPGRADES IN WATERLOO REGION: A SUSTAINABLE BUILDINGS PILOT PROJECT**

**McDiarmid**   
**Climate Consulting**  
heatheratp2@gmail.com

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Report prepared for ClimateActionWR  
by Heather McDiarmid  
of McDiarmid Climate Consulting

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## EXECUTIVE SUMMARY

Cutting emissions from Waterloo Region's residential and commercial buildings sectors will require large-scale investments in energy efficiency upgrades. Governments and utilities have been promoting such retrofits for decades, yet uptake remains low. This pilot project explored the potential for a new tool to overcome the awareness barrier to investing in upgrades: aerial thermal imaging. With this tool, each homeowner and commercial building owner or manager can access an aerial thermal image of their home/building and compare its performance to that of others in the community. The visual images and social comparison are meant to motivate owners to invest in building energy audits/assessments and energy efficiency upgrades. Commercial buildings were targeted with a community-based approach through a local Business Improvement Area organization, and residential buildings were targeted with three different engagement strategies: a community-based approach, a personalized approach, and a passive approach. A significant percentage of

building owners and managers actively sought out information about their building's thermal performance and two home energy audits were booked as a result of this pilot project. However, such a major investment decision often takes far longer than the 2-3 months available for this pilot project. The COVID-19 pandemic was also a complicating factor: adding stress to people's lives, straining the finances of commercial businesses and some homeowners, and making people hesitant to invite tradespeople into their homes or businesses. Yet, research into the outcomes of similar projects suggest that aerial thermal imaging is insufficient on its own to motivate investments in energy efficiency. Rather, the visualization and social comparison tools may be most useful as a part of a suite of programs aimed at motivating energy efficiency upgrades. These tools, especially if marketed using a personalized approach, could address the awareness barrier and boost the effectiveness of programs that address other barriers to energy efficiency upgrades.

## INTRODUCTION

Waterloo Region has committed to reducing its community greenhouse gas emissions (GHGs) by 80% below 2010 levels by 2050. Residential, workplace and school buildings accounted for 45% of our community's local emissions in 2015, and therefore promoting building energy efficiency upgrades will be essential to meeting our GHG reduction target. As part of a Federation of Canadian Municipalities (FCM) Transition 2050 grant, ClimateActionWR developed a short-term, small scope pilot project to test the impact of aerial thermal imaging and targeted marketing techniques on the rates of residential and commercial energy efficiency audits/assessments and energy efficiency upgrades.

Improving the energy efficiency of buildings has long been a goal of governments and utilities. The benefits are significant: lower utility bills and greenhouse gas emissions, greater indoor comfort and air quality, improved building stock, job creation, poverty alleviation, and more<sup>1</sup>. Yet uptake has been low: in Waterloo Region only 19% of low rise dwellings have undergone a home energy audit in the last twenty years, and 79% of these did not reach their recommended potential for energy efficiency despite the availability of major incentives<sup>2</sup>.

The barriers to performing energy efficiency upgrades include lack of awareness of the benefits, high upfront costs and long payback periods, split incentives (when the tenant pays for utilities, the owner may have no financial incentive

to invest in energy efficiency), the availability of tradespeople, and more<sup>3</sup>. For many building owners and managers, energy efficiency just isn't a major consideration: "if it ain't broke, don't fix it". Raising awareness of the value of these upgrades in a way that grabs the attention of a variety of building owners and managers therefore has the potential to increase investments in energy efficiency, especially if it comes from a trusted and impartial source such as ClimateActionWR.

Thermal imaging is a tool that has been used to visually map the heat loss of buildings and allow their energy performance to be compared to that of other buildings. The visual depiction of what is otherwise invisible or quantitatively described in technical language, has been effective at engaging greater numbers of building owners and managers<sup>4</sup> and motivating energy efficiency upgrades<sup>5</sup>.

Neighbourhood-based aerial thermal imaging is meant to be used as a qualitative tool for assessing a building's overall performance relative to its neighbours. The sensors used are highly sensitive, capable of differentiating between areas that vary in temperature by as little as 0.5°C. Based on the overall roof performance, each residential building is given a rating that shows how it performs relative to other buildings in the neighbourhood or city. While the thermal images may highlight areas with high heat loss, this rating is not meant to be a standalone diagnostic tool as its accuracy can be affected by many factors: building size, the presence of

roof structures over uninsulated spaces (e.g. garages), variations in roofing materials (e.g. solar panels, skylights), the emissivity/reflectiveness of the roofing material, overhanging vegetation, and ability to overlap GIS building information<sup>6</sup>. Furthermore, the rating and thermal image only reflect the performance of a building's roof: an area that often has added insulation, rarely has windows, and has minimal air leaks. The rating and thermal image may not, therefore reflect the overall energy efficiency performance of the entire building but may motivate an owner or manager to schedule a building audit or assessment to learn more about their building's energy performance and upgrade potential.

MyHEAT was chosen to perform aerial thermal imaging of homes and businesses in a small portion of Waterloo Region as a pilot study. Imaging took place during a clear night in April of 2020. A link to a website with thermal images of individual homes was shared with residents of three neighbourhoods and was also published in a newspaper article. Businesses were given information about the program and could request a link to a private webpage with information on their building(s) through ClimateActionWR. The website images were accompanied by information on rebates, links to professional energy audit/assessment service providers, and links to supporting organizations. The supporting organizations were Reep Green Solutions, a residential audit provider; Sustainable Waterloo Region, which supports organizations in reducing carbon emissions; and Project Neutral, a carbon footprint tool.

Help with the upfront costs of energy efficiency upgrades were also available to City of Waterloo homeowners during this pilot project through Enbridge's Home Efficiency Rebate program<sup>7</sup>. These rebates of up to \$5,000 were available for adding insulation, air sealing, upgrading windows/doors, upgrading space and water heating systems, and completing the associated home energy audits. However, homeowners must be ready to act quickly to benefit from these rebates as work must be completed within 180 days of the first home energy audit. Out of the FCM grant, an additional incentive of \$50 off the initial energy audit was offered to homeowners, and \$250 off a building envelope assessment was available for commercial buildings.

How an energy efficiency program is marketed can also have a major impact on uptake. Research has shown that direct, personal marketing tools are more effective than general marketing for promoting energy efficiency, and that the use of local networks for outreach can also increase participation<sup>8</sup>. We also know that information-based campaigns are often insufficient to motivate action on energy efficiency<sup>9</sup>. Behavioural research shows that people tend to assume they are performing better than average, but when homeowners have reason to believe that others are investing in energy saving measures, they are also more likely to do so: social norms are powerful motivators<sup>10</sup>. Social comparison framing can therefore also increase program uptake: when marketing messages encourage people to compare themselves to others, they may feel a pressure to conform to the average or even better their neighbours. Multiple engagement and marketing approaches were therefore used in the residential target area for the pilot project to allow comparisons.

The goal of this pilot project was to test the effectiveness of aerial thermal images in spurring energy efficiency audits/assessments and energy efficiency upgrades, and also to compare the effects of community-based, personalized, and general engagement approaches.

Results of this pilot project were likely impacted by the COVID-19 pandemic. At the time of the project, Waterloo Region residents were asked to maintain physical distancing, limit social gatherings, wear masks when in indoor public settings, and obey reduced capacity limits in stores. Starting in late November, residents were asked to only leave their home for essential purposes<sup>11</sup>. This was a significant stressor for small businesses, many of which experienced declining sales during the extended pandemic. Many households were also under increased emotional and financial strain, from job losses, a shift to working from home, social isolation, disrupted school routines, and more.

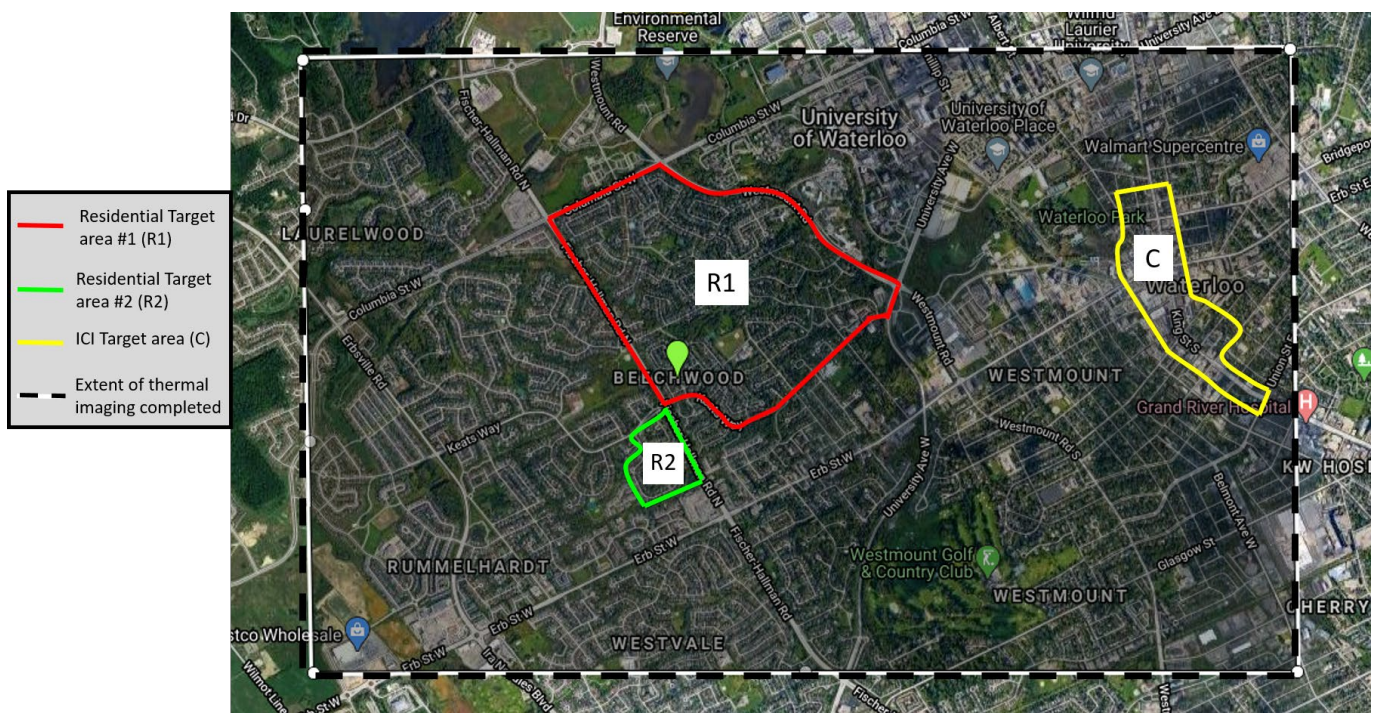


## PROCESS

The residential building pilot project was launched September 28, 2020, while the commercial building pilot project was launched October 7, 2020. The deadline to take advantage of incentives for both building types was December 15, 2020. Appendix A shows a timeline for the residential and commercial projects, including roll out of engagement tools and surveys.

### TARGETS FOR MyHEAT IMAGING AND ENGAGEMENT

One area in Waterloo Region was chosen for thermal imaging by MyHEAT (see Figure 1). The area contains both residential and commercial areas and includes organizations whose connections to the community could be leveraged in marketing the pilot project. The text below Figure 1 summarizes how the target areas were chosen and the engagement approach used for each. Appendix B provides full details of the selection criteria and engagement approach.



*Figure 1:* Area of Waterloo Region that underwent aerial thermal imaging. Residential homes in the area outlined in red were engaged with a community-based approach, residential homes in the green area were engaged with a personalized approach, and all residential homes in the black and white dotted area were engaged with a general approach. Businesses in the yellow area were engaged with a community-based approach.

## Residential

The three residential areas targeted by this pilot project can be seen in Figure 1: Beechwood Park (outlined in red), a nearby housing cluster (outlined in green), and all other homes located within the boundaries of the aerial thermal image (remaining homes in the black and white dotted box). These three areas were subjected to different engagement strategies to test the effectiveness of each.

### Residential Target Area #1: Beechwood Park

Beechwood Park in the City of Waterloo was selected as a target area as it has a strong community association (**Beechwood Park Homes Association** – BPHA) with a commitment to sustainability and established communication channels with their community. The area is more affluent than the regional average, and homeowners are therefore more likely to have the disposable income to invest in energy efficiency improvements.

Partnership with the BPHA allowed us to leverage their communications channels within our target community. The following communications strategies were used in this neighbourhood:

- An announcement on the BPHA website newspaper;
- A message on the main BPHA website;
- Direct email to BPHA membership base;
- Postings to BPHA facebook page;
- Presentation at a board meeting;
- Article in BPHA fall 2020 newsletter ; and
- [Article](#) in The Waterloo Record newspaper.

### Residential Target Area #2: Targeted housing cluster

The nearby housing cluster of 61 homes was chosen as: its housing profiles and household incomes were similar to, and therefore representative of, housing in the entire region; the homes had medium to high heat loss according to the MyHEAT ratings (indicating room for improvement); and few or no recent EnerGuide home energy audits had been completed in the area. The area was kept small to ensure ClimateActionWR had the capacity to engage the entire cluster.



Figure 2: Sample MyHEAT personalized door hanger flyers for Residential Target Area #2.



Engagement with this housing cluster occurred through a scripted door to door canvassing campaign and personalized flyers that were left hanging on door handles (see Figure 2). Ultimately:

- 30 homes were targeted for the door to door campaign, with a total of 16 residents engaged at the door (even though safety measures were taken including mask-wearing and physical distancing, the door to door campaign was then halted as residents were expressing concerns about COVID-19 transmission);
- 104 homes were targeted with the flyer campaign (44 of which were not part of the housing cluster); and
- An [Article](#) was published in The Waterloo Record newspaper.

### **All other imaged homes**

The thermal imaging map includes many more homes than just those that were included in the two neighbourhoods with targeted engagement campaigns. These homes were engaged through:

- Social media posts sent to neighbourhood association/groups and homes association sites for re-posting (Note, not all groups posted the engagement materials); and
- An [Article](#) was published in The Waterloo Record newspaper.

### **Commercial**

The commercial target area for this pilot project is outlined in yellow in the above map (Figure 1). Uptown Waterloo has a strong **BIA** (Business Improvement Area) organization with an interest in integrating sustainability programming and an ability to engage local businesses through its communication channels.

Partnership with the Uptown Waterloo BIA allowed us to leverage their communications channels. The following communications strategies were used with the Uptown Waterloo BIA:

- Direct emails from Uptown Waterloo BIA to its membership base;
- Personal introduction emails from a member of the BIA;
- Direct emails from ClimateActionWR to all businesses in the Uptown Waterloo business directory (183 businesses); and
- Attention was also drawn to the project by an [article](#) in the local newspaper The Record.

## THERMAL IMAGING

MyHEAT conducted a high resolution, aerial thermal imaging scan of the target area in April of 2020. Data collection occurred on a night that was cool, dry, and had low wind speed to minimize the effects of these environmental factors on the thermal images.

### Residential

For each residential home in the thermally mapped area, a MyHEAT online report was available. Figure 3 shows a sample report which included:

- a personalized heat loss rating;
- a comparative heat loss rating against neighbours (the 50 closest homes), and the entire mapped pilot area;
- an aerial thermal image; and
- links to information on booking a Reep Green Solutions energy audit, available rebates, and Project Neutral's carbon footprint calculator.

Homeowners concerned about privacy could request that their home's thermal image be removed from the thermal map.

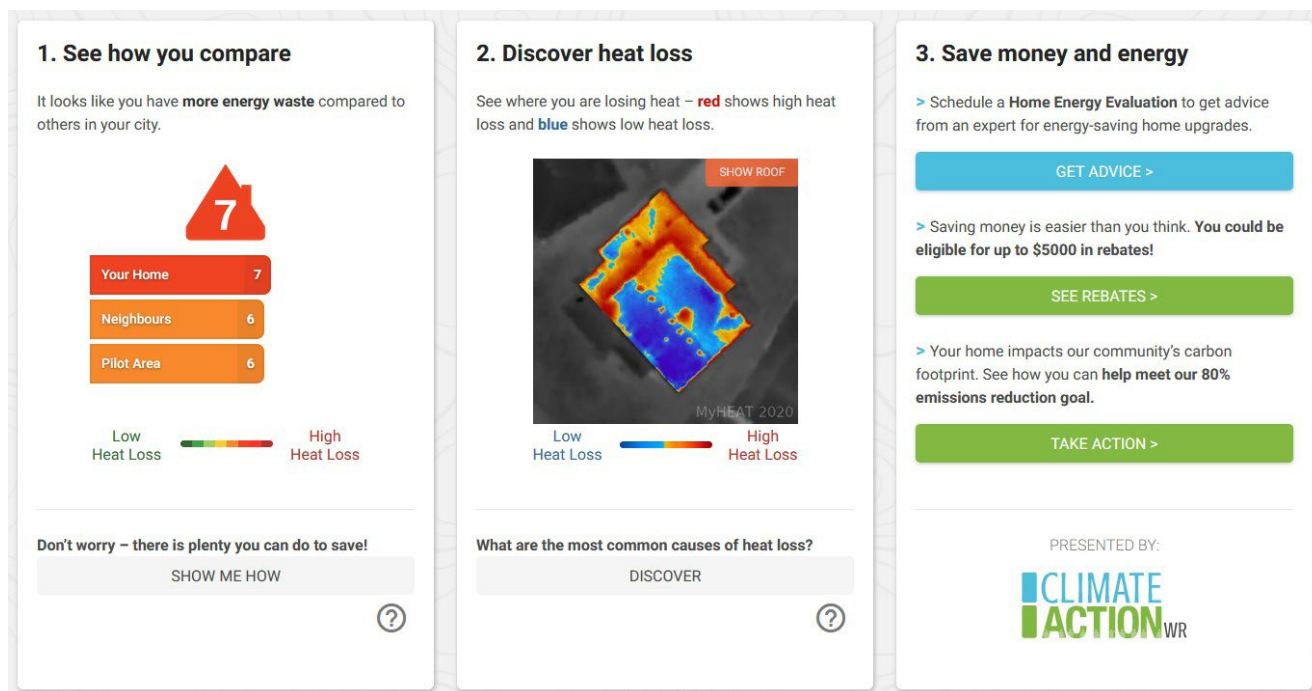


Figure 3: Sample MyHEAT online report for residential buildings in ClimateActionWR's pilot project area.

The home rating was on a scale of 1-10 based on the thermal attributes of the roof. On this scale, higher values represented higher heat loss. The scale was relative and scaled to the neighbourhood or city. Hence, a home with a heat loss rating of 4

in one city may achieve a different rating in another city where homes overall have higher or lower average thermal performance. Homeowners could compare this value to the average of their neighbourhood and/or city.

The aerial thermal image showed areas on the roof with high (**red**) and low (**blue**) heat loss which can suggest areas with inadequate insulation, leaky vents, or other causes of heat loss. These images were qualitative visualizations of heat

loss through the roof only and were not intended to be a diagnosis, rather a trigger to conduct a professional home energy audit that could provide a whole home assessment of how to reduce heat loss and save energy.

## Commercial

A sample commercial MyHEAT online report can be seen in Figure 4. The report included a thermal image of the building's roof and links to further information. Building or business owners concerned about privacy could request that their building's thermal image be removed from the thermal map.

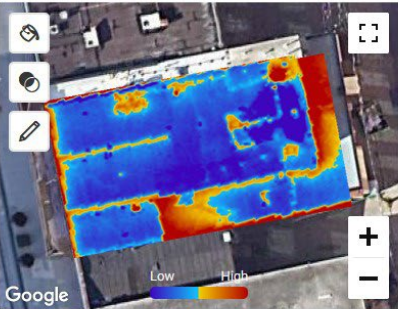
The aerial thermal image showed areas on the roof with high (**red**) and low (**blue**) heat loss which can suggest areas with inadequate insulation, leaky vents, or other causes of heat loss. Commercial buildings were not given a heat loss rating in this pilot project because

commercial buildings have more complex roofs with multiple materials and emissivities: methodologies for rating commercial roofs are currently under development with MyHEAT.

The links for further information on the MyHEAT platform included a list of local building envelope assessment service providers, information on available energy efficiency incentives and rebates, and links to resources from Sustainable Waterloo Region to help building and business owners operate more sustainably.

### 1. Explore your heat loss

The HEAT Map below shows the heat loss occurring from the rooftop of your building.



### 2. What is a HEAT Map?

- > Your unique HEAT Map gives you a bird's-eye view of where heat may be escaping from your building's envelope.
- > In this image, **red** is assigned to areas where the most heat loss may be occurring. Use your HEAT Map to identify areas for further investigation.
- > Next, take advantage of rebates and resources listed in the next section to help you make your building more energy efficient.

### 3. Save money and energy

- > Schedule a Building Envelope Assessment and get expert advice! See available rebates to make your project more cost effective.

[GET ADVICE >](#)

- > Access customized resources for employees, businesses, property managers, and building owners, and take the next step in your sustainability journey.

[VIEW RESOURCES >](#)

PRESENTED BY:

**CLIMATE ACTION**WR

Figure 4: Sample MyHEAT online report for commercial buildings in ClimateActionWR's pilot project area.

## SURVEY

Three surveys were prepared to help measure the impact of the pilot project: one for residential customers, one for commercial customers, and one for organizations that partnered in delivering this pilot project. These surveys were distributed as part of the website and social media engagement campaigns for residential homes, as part of the direct email campaign for commercial buildings, and with a direct email campaign for partner organizations.

## OUTCOMES

### THERMAL IMAGE VIEWS AND FOLLOW UP ACTIONS

As outlined below, this pilot project was very successful in generating interest in learning more about energy efficiency but did motivate investments in building audits/assessments or energy efficiency upgrades within the short, 2-3 month timeframe of the pilot project.

#### Website visits

The following summarizes the activity recorded on the MyHEAT platform for this pilot project.

#### Residential

- 11,324 homes had home profiles available to them (the entire pilot project area).
- 1,270 users viewed one or more home profiles (note: some of these may have accessed the profiles from the link in the Record article and may not have owned homes in the area).
- 2,059 home profiles were viewed (one user may have viewed many profiles).
- 139 users clicked an incentive link.

#### Commercial

- 15 different organizations made requests for MyHEAT thermal images (some, e.g. Universities requested images for multiple buildings).
- 79 users viewed a building profile.
- 29 users clicked an incentive link.

#### Residential and commercial building energy evaluations

A \$50 discount on the \$400 initial home energy audit was available to homeowners participating in this pilot project. If qualifying upgrades were performed within 180 days after the first home audit, the remaining cost of home energy audits were eligible for a rebate from the Enbridge's Home Efficiency Rebate program<sup>12</sup>. Two homeowners booked home energy audits of their home. Both homes were located in the Beechwood Park area. A third homeowner booked an audit, then changed their mind about the process and canceled. In the 11 weeks of this residential pilot project, no building upgrades are known to have occurred as a result of these efforts.

A \$250 discount was offered for commercial building envelope assessments. These assessments are priced individually based on the size of the building and other factors, but they typically cost several thousand dollars. However, no commercial building owner or manager booked an energy assessment as a result of this pilot project. No building upgrades are known to have occurred over the 8.5 weeks of this pilot project.



## SURVEY RESULTS

### Residential

The residential survey was completed by a total of 11 homeowners, one of which did not have a home in the pilot area. Key results are summarized below:

- 10 survey respondents' home ratings showed average or higher heat loss through the roof;
- 6 respondents indicated they were surprised by the high heat loss rating for their home;
- 1 respondent expected their home to have higher heat loss than was shown;
- 2 respondents reported scheduling a home evaluation as a result of this project (the only two home evaluations);
- 4 did not schedule a home evaluation because their home had been evaluated in the past (two of which occurred in the past 3 years);
- 2 felt that the process was unclear and too time-consuming;
- 1 was too busy with other concerns;
- 8 were considering taking one or more actions to improve the energy efficiency of their home as a result of the program;
- the average rating for the overall experience with the MyHEAT pilot project was 3.7/5, with the majority giving it a 4 out of 5 rating; and
- 1 respondent expressed concerns about the credibility of the thermal imaging.

### Commercial

The commercial survey was completed by a total of 5 building owners or managers, one of which did not view their building's custom heat profile. Key results are summarized below:

- 2 respondents were surprised by the heat loss from their buildings;
- 1 respondent expressed skepticism of the accuracy of the thermal images;
- 0 respondents have had a previous energy assessment;
- 0 respondents scheduled a further energy assessment;
- 2 respondents plan to explore this more in the future;
- The barriers to performing upgrades included:
  - » Cost (2 respondents),
  - » Not owning the building (2),
  - » Unclear process (2),
  - » Need to do more research (1), and
  - » Lack of available information or expertise (1);
- 1 respondent was considering taking one or more actions to improve the energy efficiency of their building as a result of the project; and
- the average rating for the overall experience with the MyHEAT pilot project was 2.4/5, with the majority giving it a 4 out of 5 rating.

## Partner organizations

Three partners provided feedback on the pilot project. For residential buildings, the project was described as intuitive, personalized, contactless (important during the COVID-19 pandemic), visually appealing and a good educational tool to raise awareness. Recommendations and concerns included:

- Rating all residential building types, not just single family homes;
- Increasing the project timeframe to give people a chance to plan and budget for audits and assessments;
- Increasing awareness of the project through wider promotion;
- Following up with resources, information, and services;
- Have commercial buildings receive heat loss ratings;
- Translate heat loss into financial costs to show the value of upgrades;
- Using MyHEAT as the 'face' of a wider deep energy retrofit program;
- Collaborate with local utilities to raise awareness of the project; and
- Plan for follow up data collection to show the impact of building upgrades.

Concerns about the project were also raised, including:

- Data reliability;
- How representative the heat loss from a roof is of the energy efficiency performance of the whole home; and
- The thermal images may not have enough information or details to result in buy-in from the building owners.

## ANALYSIS

### EFFECTS OF THE COVID-19 PANDEMIC ON PARTICIPATION RATES

#### Residential

Only two home energy audits were booked as a direct result of the MyHEAT pilot project. Many households experienced increased stress during the fall of 2020 as a consequence of the COVID-19 pandemic; many households suffered from job losses or shrinking business revenues; many households were fearful of inviting strangers, such as contractors or energy auditors, into their home; and many households were too absorbed by the day to day challenges of coping with the pandemic fallout to plan for the long term.

Yet a MyHEAT pilot project in Hamilton in 2017/2018 produced similarly low outcomes<sup>13</sup>. Home efficiency rebates, similar to those offered here, were available to Hamiltonians through Union Gas, and additional rebates were available through the provincial GreenON program<sup>14</sup>. These results suggest that the visualizations and social comparison benefits of aerial thermal images are insufficient to drive significant interest in home energy efficiency upgrades, even in the presence of government and utility-based rebates and even when the programs run for extended periods.

#### Commercial

There were no commercial building owners or managers who made use of the \$250 incentive to request an energy assessment. Providers of such services suggested that, due to COVID-19, businesses could not afford to engage energy assessment services unless the full cost was covered by incentives. Furthermore, deciding to invest in energy efficiency upgrades is a complex process for commercial buildings that may involve multiple stakeholders, complex return on investment assessments and conflicting interests between owner and tenant. For example, an owner may be unwilling to invest in an upgrade if it is the tenant who benefits from the energy savings, or a tenant may resist an energy efficient renovation that disrupts their business.

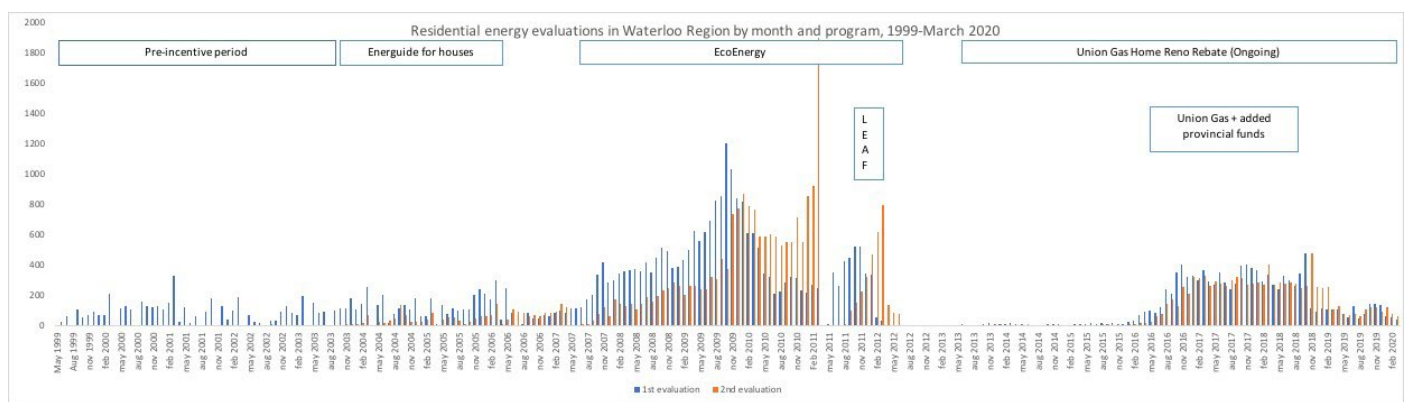
### THERMAL IMAGING AND PARTICIPATION RATES

#### Residential and commercial

The ultimate goal of the aerial thermal imaging was to spur building owners and managers into taking steps to improve the energy efficiency of their buildings. Yet this is not a simple decision. Aerial thermal images can make owners or managers aware of the potential to improve the performance of their building. This may be followed by a period of research, cost-benefit analysis and planning. An energy audit/assessment may follow, and/or consultations with contractors. It can take many months before the owner is ready to act on this new awareness (7-12 months has been suggested as a normal time lag for residential buildings<sup>15</sup>). This pilot project only resulted in two bookings

for home energy audits and no bookings for commercial building assessments, but time constraints meant that it ran for less than 3 months: too little time for such a complex decision. Hamilton's example, however, suggests that there may have been other barriers at play.

Time-limited offers, if of sufficient length (e.g. one year or more), may nevertheless be an effective strategy for motivating energy efficiency upgrades. For residential buildings, the rates of energy audits and energy efficiency upgrades correlate strongly with the availability of attractive rebates and incentives (see Figure 5). Spikes in audit bookings were seen in 2009, when these incentives were boosted to stimulate the economy; in 2011, when the program was scheduled to end (but later restarted); and in 2012 just before the program ended. Homeowners do seem to be motivated to act when an attractive offer is time-limited.



**Figure 5:** Home energy audit activity over time in Waterloo Region. (Figure by Phuong Linh Le<sup>16</sup>)

The MyHEAT pilot project was very effective at generating interest in learning about a user's building: 12–54% of building profiles were viewed on the platform (see Table 1). A significantly smaller number of users (0.8–8.2%) actively chose to follow up with one or more links to resources, rebates, and to book an audit/assessment. This suggests that the engagement strategies made building owners and managers curious about the performance of their building(s), but the visualizations and associated messaging did not motivate these users

to learn about how to improve that performance. A key marketing rule for promoting home energy upgrades is to sell something people want<sup>17</sup>. What may have been missing was compelling information on why people want to upgrade their buildings beyond reducing heat loss (which may not be compelling in the fall months when temperatures are moderate). The social comparison strategy may also have suffered from using the local average as a baseline: after all this implies that at least half of the buildings were 'good enough'.

## EFFECTS OF DIFFERENT ENGAGEMENT STRATEGIES

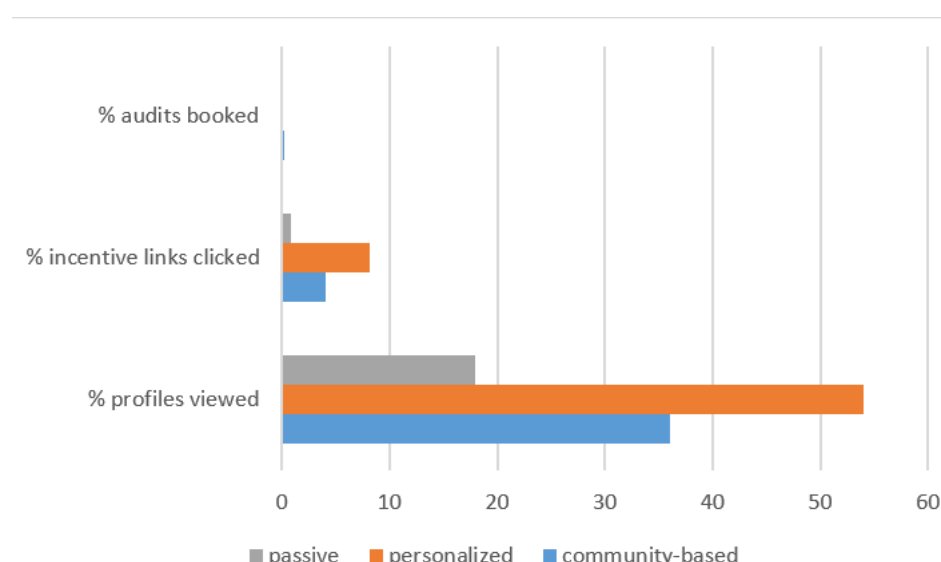
### Residential

For the residential sector, three engagement strategies were used. Beechwood Park was targeted with a community-based campaign that capitalized on existing communication channels within the neighbourhood association. A cluster of homes was targeted with a personalized engagement campaign that used door-to-door marketing and personalized door hangers. Finally, a more passive communication approach (word of mouth, social media re-posts, newspaper article) was used in the wider community. Aerial thermal images were available for all single family homes in these three areas. In all cases, the fact that ClimateActionWR lead the project likely helped to build trust in the legitimacy and impartiality of the program.

	Beechwood Park	Targeted cluster	Other homes	Commercial
<b>Building type</b>	residential	residential	residential	commercial
<b>Marketing approach</b>	community-based	personalized	passive	
<b># buildings scanned</b>	1,190 <sup>a</sup>	134	10,000	673
<b># building profiles viewed</b>	423 (36%)	72 (54%)	1,764 (18%)	79 (12%)
<b># linked web pages viewed</b>	49 (4.1%)	11 (8.2%)	79 (0.79%)	29 (4.3%)
<b># audits booked</b>	2 (0.17%)	0	0	0

a - based on 2016 census tract data retrieved from CUSP<sup>18</sup>

**Table 1:** MyHEAT outcome metrics for different engagement strategies for residential and commercial buildings.



**Figure 6:** The effects of passive, personalized, and community-based engagement campaigns on the outcomes of % of homes booking audits, % of profiles viewed where an incentive link is clicked, and % residential profiles viewed.



As Table 1 and Figure 6 show, the personalized approach used in the targeted cluster was the most effective approach in terms of percentage of home profiles viewed. These homeowners were also more likely to connect to the web pages linked on the home profiles site. The passive marketing approach was the least effective for home profiles viewed and linked web pages viewed. This highlights the potential for personalized and community-based engagement approaches to garner greater interest in energy efficiency upgrades, at least among residential building owners. Both home energy audits booked were for homes in the Beechwood Park area. With only two audits booked, however, it is difficult to draw conclusions about their significance.

## Commercial

For commercial buildings, a community-based marketing approach that capitalized on communications channels within the Uptown BIA was used. Unlike the residential program where homeowners were provided with a website address from which they could access their home's profile, commercial building managers had to request their building's profile through ClimateActionWR. This extra step likely accounts for much of the reduced percentage of building profiles viewed. These building managers were, however, more likely to view the associated links: this rate is comparable to that of residential buildings targeted by community-based marketing. A more personalized approach may, therefore, also garner more interest from commercial building owners and managers.

## ALTERNATIVES TO MyHEAT

MyHEAT claims to be the only company offering aerial thermal imaging of neighbourhoods in Canada, and internet searches support that claim. Aerial thermal imaging of individual homes (rather than neighbourhoods) using drones is a common service but it is not cost-effective for large scale applications such as this one. Some alternative services to MyHEAT include drive-by thermal imaging, other energy mapping services, building energy benchmarking, and utility bill building energy reports. Although not examined in this report, some visual comparison tools for energy efficiency may be more cost-effective than others.

## Drive-by thermal imaging

Thermal images of buildings can also be taken from the street in a process analogous to Google Street View. Tens of thousands of homes can be imaged in one night and the images can reveal heat loss from walls, windows, doors, the tops of foundations and any other features that are visible from the street. Several companies offered this service in the 2010s in the United States, but these companies are either out of business or no longer offer that service. Sagewell Inc, for example, shifted from large scale thermal imaging to data analytics using smart meters to identify potential energy efficiency and electrification opportunities<sup>19</sup>. It seems that drive-by thermal imaging may not be a viable business model.

## Other energy mapping services

**Lightspark** offers a similar energy mapping service for residential buildings. Rather than relying on aerial thermal imaging, Lightspark uses data from more than 12 sources to model the carbon and energy intensity of each residential building. They claim to be able to estimate the heating and cooling loads of a home, building envelope performance, and air-tightness. Their “opportunity maps” include colour-coded ratings for each home that allows homeowners to compare their home’s performance to that of their neighbours. Most municipalities, however, are using this Lightspark service to model the energy and greenhouse gas emission reduction potential for their community and to develop residential archetypes that provide insights into how to target retrofit financing programs<sup>20</sup>.

## Benchmarking for commercial buildings

Large buildings (100,000 sq ft or more) in Ontario are currently required to report annual water and energy use every year. In 2023, this program will expand to buildings 50,000 sq ft or more<sup>21</sup>. This program can help building owners, managers, and their tenants understand their energy and water usage and compare it to that of similar buildings. However, benchmarking alone has shown to have a limited impact on energy use and greenhouse gas emissions in New York City where it has been mandated since 2010<sup>22</sup>. To achieve greater emissions reductions, New York City has mandated emissions caps for large buildings. Most of the commercial buildings imaged in this study are likely too small to be required to benchmark at this time, but utilities may be able to provide some of this information in an anonymized form through utility bill social comparison strategies.

## Utility bill building energy reports

Many utilities have experimented with providing home energy reports that show how a home’s energy use compares to that of similar homes in the neighbourhood: a form of social comparison framing. Studies of such strategies have shown these to be effective at encouraging behavioural changes<sup>23</sup> and even increasing the engagement of home energy audit services, yet they have a poor track record in motivating home energy efficiency upgrades on their own<sup>24</sup>.

## HOW A SERVICE LIKE THIS MIGHT BE USEFUL

### Residential and Commercial

An effective building energy efficiency program may need to address all major barriers to performing building upgrades in a coordinated and cost-effective manner. That might involve personalized marketing of the program; compelling visual images of heat loss alongside education on the multi-dimensional benefits of building upgrades; social comparison tools that frame most buildings as needing upgrades (e.g. a baseline consistent with future climate targets or that uses the 75th percentile for performance); attractive but time-limited rebates and incentives; access to low cost financing; access to an Energy Coach to facilitate the process; a streamlined contractor engagement process; and more. Some of these measures are part of the Region of Waterloo’s plans to develop a local retrofit financing with the help of funding from FCM, and some of these measures could be added to that program if cost-effective.

## RECOMMENDATIONS:

1. Programs that promote energy efficiency upgrades should run for at least a year to give owners and managers an opportunity to consider, research, and budget for an energy efficiency upgrade.
2. Seek new opportunities to explore the impacts of visualized energy loss and social comparative strategies as part of a larger program that addresses many barriers to energy efficiency upgrades simultaneously.
  - a. Pair visual images of energy loss with information on other benefits of energy efficiency upgrades.
  - b. When using social comparative strategies, consider using a baseline consistent with future climate targets or that uses the 75th percentile for performance.
  - c. Expand the types of buildings targeted to include attached housing, multi-unit residential buildings, different types of commercial buildings, and others.
  - d. Consider using personalized marketing strategies for buildings that have been identified as having the greatest energy efficiency improvement potential.
3. Consider testing community-based and personalized marketing strategies in future projects to gain further insights into their cost-effectiveness.
4. When planning communications strategies, recognize that it may be difficult to control
5. its distribution, especially when social media is involved.

## LESSONS LEARNED:

1. Homeowners and commercial building owners or managers need time to consider, research, and budget for energy efficiency upgrades: programs need to run for at least a year to evaluate the impact of energy efficiency programs.
2. The visual depiction of a building's heat loss and ability to compare a home's energy performance with that of other homes in the neighbourhood is very effective at peaking interest in a building's performance but likely insufficient on its own to motivate investments in energy efficiency upgrades, even in the presence of moderate rebates.
3. Homeowners and businesses are interested in learning about their building's energy performance but there are other barriers to performing upgrades.
4. It can be difficult to control the marketing message: ask to vet newspaper articles and other media posts where possible.

## CONCLUSIONS

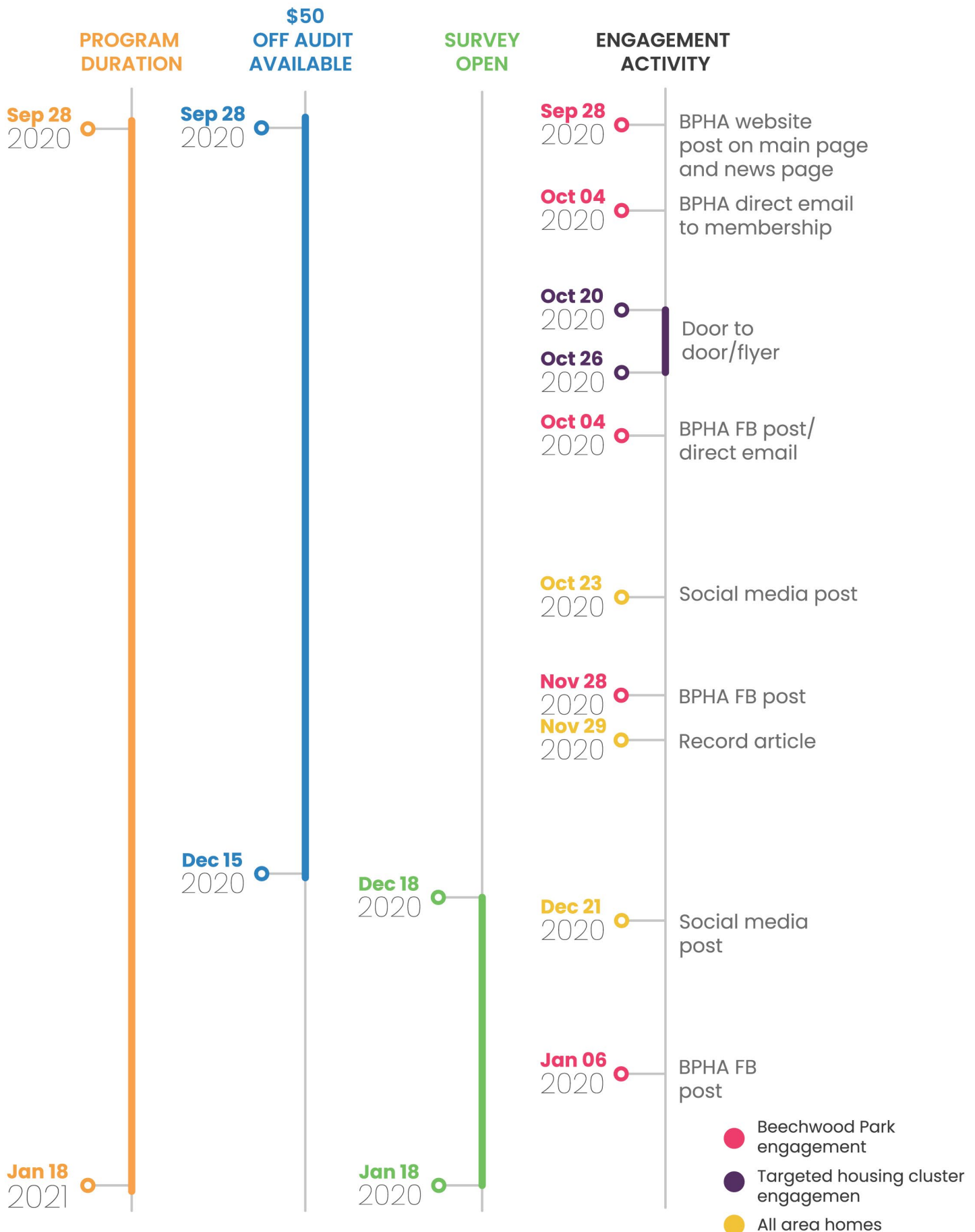
In the next one to three decades, nearly every building in Waterloo Region will need to be upgraded to improve its energy efficiency if we are to meet our GHG reduction targets. This will not be easy. Over the last few decades, governments, utilities and others have tried many strategies to achieve widespread energy efficiency improvements but it is clear that there are no simple solutions. MyHEAT offers aerial thermal imaging of building rooftops and a platform that allows owners and managers to visualize heat loss through the roof and compare the performance of their building to that of others. Visualizations can make abstract concepts, such as energy efficiency, accessible to the average person, while the social comparisons may provide pressure to upgrade a home's performance. The results, of this and other similar pilot projects, suggest that such an approach may be very effective at getting people to seek more information on their building's energy efficiency performance, but their impact on the booking of building energy assessments and energy efficiency upgrades is poor at best: there are many barriers involved. If cost-effective, visualizations and social comparative messaging may be most effective when used as part of a larger energy efficiency program that addresses those many barriers simultaneously. This pilot project also showed that for generating interest in learning about a home's energy performance and improvement options, personalized marketing was most effective, followed by a community-based approach, and then passive marketing.

In summary, promoting building energy efficiency upgrades at the levels needed to achieve our GHG reduction targets will require the coordinated use of many programs, of which aerial thermal imaging with personalized engagement may be one piece. An energy efficient building stock that contributes to a healthy community and stable climate is the goal, and we need every tool available.

## APPENDIX A:

### TIMELINE FOR RESIDENTIAL AND COMMERCIAL PROJECTS, INCLUDING ROLL OUT OF ENGAGEMENT TOOLS AND SURVEYS

#### Residential

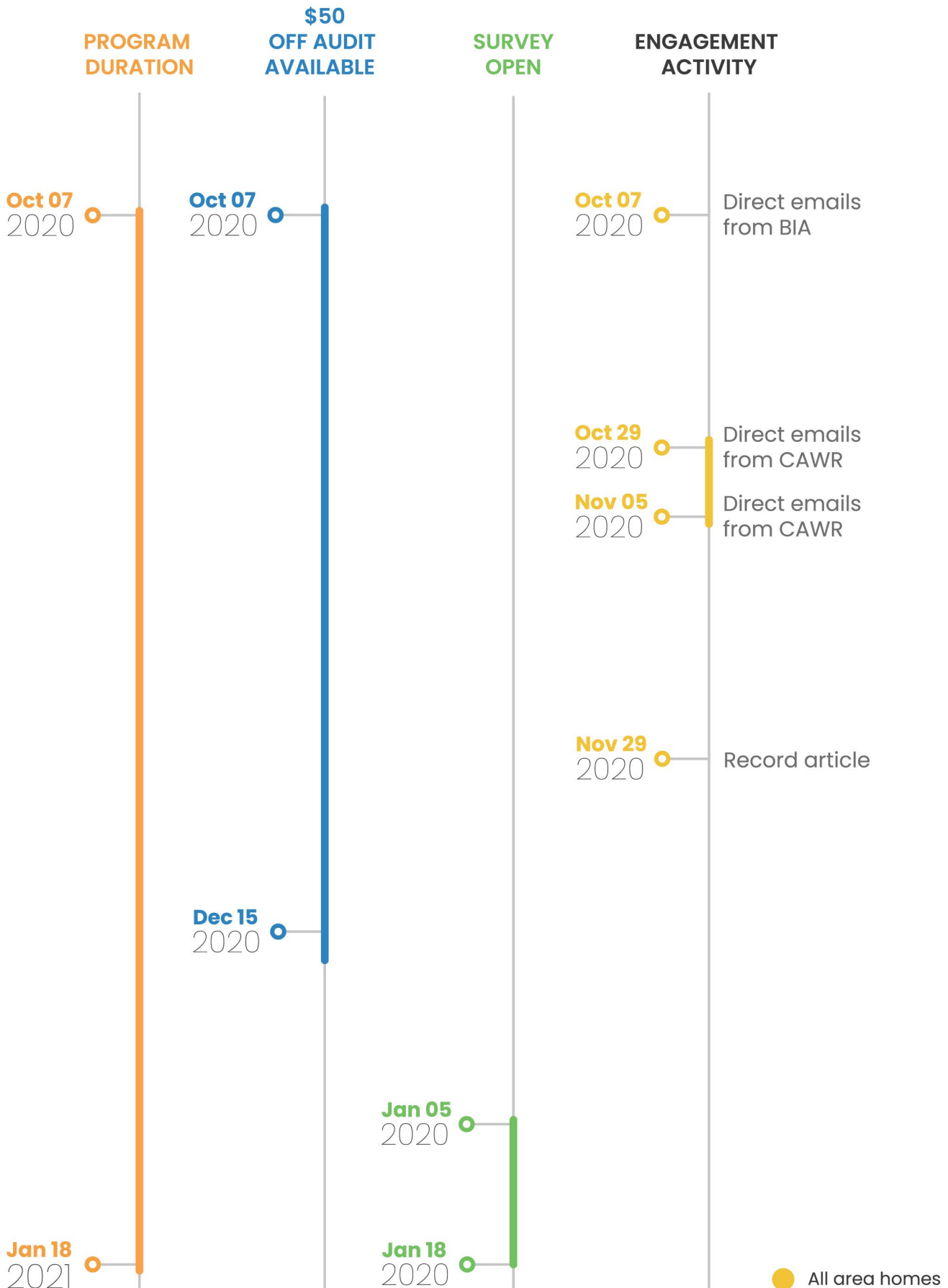




## APPENDIX A:

### TIMELINE FOR RESIDENTIAL AND COMMERCIAL PROJECTS, INCLUDING ROLL OUT OF ENGAGEMENT TOOLS AND SURVEYS

#### Commercial



## APPENDIX B:

### DETAILS OF NEIGHBOURHOOD SELECTION CRITERIA FOR THE RESIDENTIAL AND COMMERCIAL PILOT PROJECT

#### Residential Campaign 1: Homes Association Engagement

Beechwood Park Homes Association (BPHA) was the target audience for the homes association campaign. They are a very active community association, with at least 2 strong champions and advocates for this work. As part of our initial call for pilot project ideas, it was a member of the BPHA who introduced us to this pilot project idea via a public submission. During the pilot project timeframe, the BPHA was in the midst of a strategic planning process, NEXT50, planning for the next 50 years of their neighbourhood. Sustainability was an important part of this planning, and so the BPHA was seen as a likely contributor to increase our success rate, by partnering with existing initiatives and established social groups, rather than forging those relationships ourselves, from the start.

Partnering with the BPHA allowed us to gain support in the promotion and awareness of this project among BPHA members, by means of existing communications channels within the BPHA, including the following methods:

- An announcement on the BPHA website;
- Including the project in a BPHA newsletter;
- Periodic direct emails to the membership base;
- Mentioning the project on the BPHA Facebook page;
- Presenting at a BPHA member or board meeting.

#### Residential Campaign 2: Non-homes Association Engagement

The following streets were selected as the proposed second target area, that were not directly associated with a homes association:

- Barrington Lane, Waterloo (30 homes);
- Drake Circle, Waterloo (16 homes);
- Kingsford Place, Waterloo (15 homes).

These homes were selected based on:

1. Closest representation of Waterloo Region as a whole, according to recent census data. Using information publicly available via CUSP's Energy Poverty tool, the following criteria was used to compare several census tracts within the mapped area, to the average values for Waterloo Region as a whole:
  - a. household after-tax income,
  - b. home energy expenditure,

- c. households energy cost burden of spending 6% or more of after-tax income on home energy,
- d. single detached dwellings households,
- e. percentages of owner and renter households,
- f. ages of housing built before 1991, and
- g. homeowner affordability of spending at least 30% of income on housing.

The selected census tract compared extremely closely to Waterloo Region as a whole, making the case that homes within this area would be suitable to discover whether this approach could work region-wide.

Once we narrowed down the census tract we would be working within, we needed to decide which specific houses to select, since our capacity only allowed us to focus on a small number of houses that were in close proximity to each other, to enable flyer distribution and other manual engagement techniques to be efficient.

## 2. MyHEAT ratings, provided by MyHEAT.

We examined the MyHEAT ratings within the selected census tract. A MyHEAT rating is a value assigned to a building by MyHEAT, that compares its heat loss to others in its neighbourhood and city on a scale of 1–10. The higher the rating, the higher the heat loss. Ratings are generated through a machine learning process that assesses and sorts buildings based on unique thermal attributes of the roof.

We looked for a cluster of houses where the majority showed medium to high heat loss, as they represented houses that were more likely to request a home energy evaluation, and have a larger potential for energy efficiency home retrofits. We also deemed it important to have at least one house on each street with a below average MyHEAT rating (low heat loss), that could be used as an example for lower heat loss and energy demand, when neighbours were looking at the heat maps of their surrounding neighbours.

3. Previous energy audits conducted, according to Reep Green Solutions EnerGuide data. In order to avoid streets with many houses that had already received energy evaluations in the recent past (who would be less likely to seek one again), Reep Green Solutions data on historical EnerGuide home energy evaluations was used to identify this cluster as an area where there were no recent energy evaluations completed as part of their service offerings. Of the 61 houses in this target area, 4 houses had completed an energy evaluation with Reep Green Solutions, with the most recent being in 2011, which provided a substantial amount of time to pass whereby receiving a new evaluation at this time could be justified.

## Commercial Campaign:

**Goal:** To encourage business and building owners to purchase building envelope assessments. Because of previous conversations with the Uptown Waterloo BIA, regarding the possible integration of sustainability programming into their work, they were selected as the target audience of the commercial campaign. In addition to being within the mapped area, their network is part of a strong business community which had the ability to leverage existing communication channels to engage a number of businesses in that area.

To further engage with business and building owners in the Uptown Waterloo area, we explored partnering with the Greater Kitchener Waterloo Chamber of Commerce, to tap into any additional existing communications channels that could help us reach this target audience.

Collaboration with local partners benefited the project in many ways. We asked for support from the Uptown Waterloo BIA and KW Chamber of Commerce in the following ways:

- Mentions in newsletters and on social media;
- Provide warm introductions to businesses they know might be interested;
- Provide public support for the project;
- Mention or announce on their websites;
- Direct communications with membership bases.

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