City of Kamloops

Heat Pump Capacity Building Project Report

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Canada's Tournament Capital

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The author acknowledges that this project was conducted on Tk'emlúps te Secwépemc territory, situated within the unceded ancestral lands of the Secwépemc Nation. We honour and respect the people, the territory, and the land that houses our community.

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PURPOSE

The purpose of this project is to advance the implementation of the City of Kamloops' Community Climate Action Plan (CCAP) and the United Nations Sustainable Development Goals (SDGs) by promoting the use of heat pumps in buildings. Heat pumps are a high-efficiency, low-carbon space heating and cooling technology that have the capability to lower emissions in the building sector. The main goal of this project is to engage with the local building industry on the topic of heat pumps to gain a better understanding of the technology's barriers and benefits and how the City can best support industry capacity building. The goal of this research is to identify key challenges surrounding heat pumps in our region, how these can be overcome, and what next steps the City of Kamloops should implement to ensure local contractors and suppliers are ready for the anticipated increase in demand for heat pumps.

This report is divided into three chapters. Chapter 1 will offer a general overview of the types of heat pumps available and how the technology works. This chapter will also cover initiatives surrounding building electrification and the main barriers and benefits of heat pumps, as identified through literature review. Chapter 2 will discuss key findings from primary research conducted through surveys, focus groups, and interviews. Chapter 3 will cover recommendations and next steps for the City of Kamloops to enhance industry capacity building and successfully promote heat pumps to the community.

CONTEXT

The Intergovernmental Panel on Climate Change (IPCC) states that human activity has already caused an increased warming trend that has resulted in a rise of approximately 1ºC of global warming above pre-industrial levels. If this warming trend continues at its current rate, global warming will likely reach 1.5ºC between 2030 and 2052. The IPCC states that to avoid the most catastrophic impacts of climate change, we must not surpass a 1.5ºC rise in global warming.[1] In 2015 at the United Nations Framework Convention on Climate Change, nearly two hundred countries, including Canada, pledged to adhere to the Paris Agreement to "…limit the temperature rise to 1.5ºC above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change".[2]

The impacts of climate change are already experienced on a local and global scale. In British Columbia, this has resulted in an increase in extreme weather events such as wildfires, summer heat waves, droughts, and intense flooding. These impacts also negatively affect our natural environments and agriculture. To combat the impacts of climate change requires co-operation from all levels of government and our communities to decrease greenhouse gas (GHG) emissions and build climate resiliency.[3]

The City of Kamloops' CCAP was adopted by City Council on June 29, 2021—the hottest day in Kamloops' recorded history with a temperature high of 47.3ºC. This plan was created with the goal of "…reducing community greenhouse gas emissions that is in line with Kamloops' portion of global

[1] IPCC. (2018) "Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C", online: https://www.ipcc.ch/sr15/chapter/spm/.
[2] Paris Agreement to the United Nations Framework Convention on Climate Change. (December 12, 2015), online: https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
[3] City of Kamloops. (June 29, 2021) "Community Climate Action Plan", online: https://www.kamloops.ca/sites/default/files/docs/cityofkamloops_communityclimateactionplan_june2021_final_0.pdf, p. 3.

efforts to keep global temperature rise to 1.5ºC".[4] This plan aims to reduce emissions by 30% by 2030 and by 80% by 2050 in comparison to 2007 levels. To accomplish this, the CCAP outlines 8 "Big Moves", 24 strategies, and 66 actions to meet the community's climate targets.

This project focuses on Big Move 4: Zero-Carbon Homes and Buildings, the objective of which is "Ensuring all buildings maximize energy efficiency and use low-carbon energy sources."[5] In Kamloops, the building sector accounts for 29% of the community GHG emissions. Much of these come from fossil fuel-based systems (primarily natural gas) used for space heating and water heating. Building and retrofitting homes to be energy efficient and use low-carbon systems presents a massive opportunity to significantly reduce emissions, but also a major challenge as it requires a complete building industry transition.[6]

The United Nations' SDGs are a worldwide call for action to combat the effects of climate change while simultaneously providing strategies to improve global health and education, reduce inequality and poverty, and support economic growth. This was adopted by all members of the UN in 2015 as part of the 2030 Agenda for Sustainable Development and outlines 17 goals.[7] By implementing Big Move 4, the City of Kamloops is also advancing its efforts towards 5 of the 17 SDGs:

✓ Goal 7: Affordable and Clean Energy
✓ Goal 8: Decent Work and Economic Growth
✓ Goal 9: Industry, Innovation, and Infrastructure
✓ Goal 11: Sustainable Cities and Communities
✓ Goal 13: Climate Action

[4] City of Kamloops. (June 29, 2021) "Community Climate Action Plan", online: https://www.kamloops.ca/sites/default/files/docs/cityofkamloops_communityclimateactionplan_june2021_final_0.pdf, p. 7.
[5] City of Kamloops. (June 29, 2021) "Community Climate Action Plan", online: https://www.kamloops.ca/sites/default/files/docs/cityofkamloops_communityclimateactionplan_june2021_final_0.pdf, p. 15.
[6] City of Kamloops. (June 29, 2021) "Community Climate Action Plan", online: https://www.kamloops.ca/sites/default/files/docs/cityofkamloops_communityclimateactionplan_june2021_final_0.pdf, p. 41-44.
[7] United Nations. (September 2015) "Sustainable Development Goals", online: https://sdgs.un.org/goals.

Background Research

HEAT PUMPS IN BRITISH COLUMBIA

In British Columbia, 95% of the province's electricity is supplied by a low-carbon hydroelectric power generation system.[8] As a vast majority of heat pumps are electrically driven, this technology is able to take advantage of this renewable power source, resulting in a highly efficient, low-carbon space heating and cooling option. Implementing this technology has the potential to significantly reduce GHG emissions throughout British Columbia's building sector. However, fossil fuels still dominate the energy sector with clean electricity currently only accounting for 19% of energy use in the province's transportation, building, and industry sectors.[9] Although, with worldwide efforts to decrease fossil fuel use and a provincial-wide push towards building electrification, it is anticipated that the heat pump market will grow significantly in coming years.

There are a variety of heat pumps available for homes and buildings in British Columbia. For the Kamloops region, the most common heat pump systems are air-source heat pumps and ground-source heat pumps. For the purpose of this report, these are the two main heat pump technologies that will be discussed.

Ground-Source Heat Pumps

Ground-source heat pumps are an effective option able to extract heat stored below the ground in the form of solar energy and use it to heat homes and buildings. Ground temperatures remain fairly consistent throughout the year—between 7°C and 12°C for British Columbia —making ground-source heat pumps a reliable heat source for cooler climates.[10] To cool a home, ground-source heat pumps will remove heat from indoors and place it into the ground. Excess heat energy in the system can also be used to supplement water heating needs. Unfortunately, ground-source heat pumps face higher purchasing costs and more invasive installation procedures, making them the less popular option in comparison to air-source heat pumps.[11]

Air-Source Heat Pumps

Air-source heat pumps are the most common heat pump found in Canada. These operate by absorbing heat from the ambient air and distributing it through a home or building. Heat distribution is accomplished in two ways: a central-ducted system that uses pre-existing ductwork or a ductless mini-split system where an outdoor unit is connected by refigerant lines to an indoor mounted head. Air-source heat pumps are able to operate even when outdoor temperatures are lower than indoor temperatures because there is always a certain degree of heat energy in the air. The main challenge

[8] BC Hydro Power smart. (2022) "Powering a clean, sustainable future", online: https://www.bchydro.com/toolbar/about.html.

[9] CleanBC. (2021) "Roadmap to 2030", online: https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf, p. 27

[10] Natural Resources Canada. (2021) "Heating and Cooling with a Heat Pump", online: https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817.

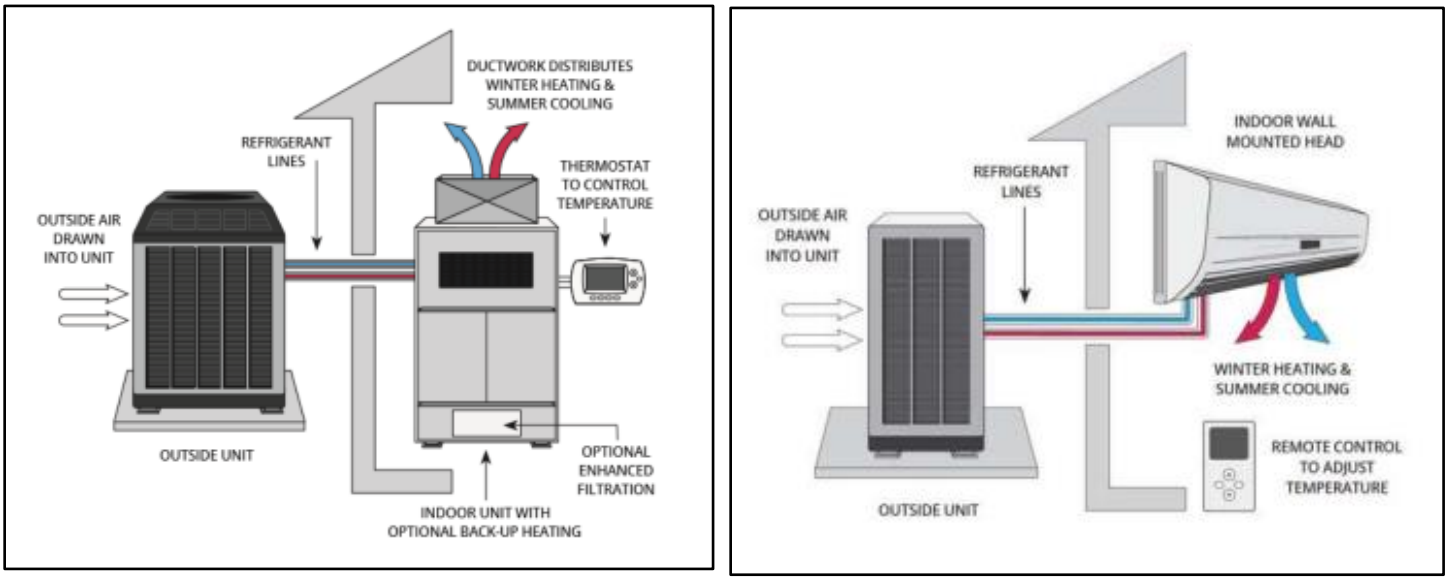
[11] Natural Resources Canada. (2021) "Heating and Cooling with a Heat Pump", online: https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817.

traditional air-source heat pump systems face in British Columbia is a dramatic drop in efficiency in sub-zero temperatures.[12]

Over the past decade, the ability of air-source heat pumps to maintain high efficiency levels at low temperatures has improved, and rigorous testing in Canadian winters has shown promising results. These are known as cold-climate air-source heat pumps, and though they are more expensive than traditional air-source heat pumps, they hold the potential to function in temperatures down to -30ºC.

There is also the option for air-source heat pumps to be dual fuel. This allows the integration of natural gas or propane furnaces, wood stoves, or other electrical systems to supply backup or supplementary heating during the coldest parts of the year.[13]

Diagram 1: How a Central Ducted and a Ductless Mini-Split Air Source Heat Pump work[14]



[12] BC Hydro. (2021) "What's a heat pump and how does it work?", online: https://www.bchydro.com/powersmart/residential/building-and-renovating/considering-heat-pump-info-tips.html.
[13] First Things First Okanagan. (December 1, 2021) "Heat Pump Webinar Deep Dive", online: https://www.youtube.com/watch?v=T9M-V5RoQSk.
[14] CleanBC Better Homes. (2022). "Heating and Cooling Systems," online: https://betterhomesbc.ca/product_categories/heating-and-cooling-systems/.

ELECTRIFICATION AND HEAT PUMP INCENTIVES

BC Building Electrification Roadmap

The BC Building Electrification Road Map, adopted in March 2021, outlines a pathway to decarbonize the building sector, which accounts for 11% of total emissions in British Columbia.[15] This road map details five core strategies to overcome barriers to building electrification and significantly reduce GHG emissions in British Columbia's building sector.[16] These core strategies are:

1. Create Market Demand
    a. Governments promoting heat pump use by adopting this technology in their buildings
    b. Setting a minimum efficiency standard for space heating equipment to push the industry to switch to electric systems which have higher efficiency ratings
    c. Raising the level of consumer awareness on the benefits of heat pumps
2. Improve Cost Competitiveness
    a. Increasing incentives can help close the cost gap between electric and gas systems
    b. Reducing equipment and installation costs to further improve cost competitiveness
3. Address Systemic Barriers
    a. Creating easy access to rebates
    b. Establishing clear guidelines for heat pump installation and operation
    c. Providing an interface where consumers can source quality information and rebates
4. Expand Industry Capacity
    a. Relevant and proper education and training are key to expanding industry capacity
    b. Promoting quality training materials and resources from industry associations and trades training schools
5. Increase Available Technologies
    a. Accelerating the certification of new heat pump technologies to expand the market and make them more readily available
    b. Supporting the development of high efficiency building and equipment standards

BC Energy Step Code

The BC Energy Step Code is an optional compliance path municipalities can adopt for their local building sectors. The purpose of the Step Code is to improve home and building efficiency in all new construction by implementing higher levels of energy efficiency above standard building code requirements. The goal of the Step Code is to have all new builds net-zero energy ready by 2030. Kamloops adopted the BC Energy Step Code and, as of January 1, 2022, now requires all Part 9 buildings to be 20% more efficient and all Part 3 buildings to be 10% more efficient.[17]

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[15] ZEBx. (March 2021) "BC Building Electrification Road Map", online: https://www.zebx.org/wp-content/uploads/2021/04/BC-Building-Electrification-Road-Map-Final-Apr2021.pdf, p. 4.

[16] ZEBx. (March 2021) "BC Building Electrification Road Map", online: https://www.zebx.org/wp-content/uploads/2021/04/BC-Building-Electrification-Road-Map-Final-Apr2021.pdf, p. 55-77.

[17] Energy Step Code. (2021) "Energy Step Code", online: https://energystepcode.ca/.

Home Performance Contractor Network

The Home Performance Stakeholders Council is a non-profit organization that focuses on whole-house performance and quality contractor training. The Home Performance Stakeholders Council recently launched the Home Performance Contractor Network as an initiative to develop a list of skilled contractors installing energy-efficient, low-carbon home performance solutions. The list is intended to be used by participants of residential energy efficiency and greenhouse gas emission reduction programs. Membership with the Home Performance Contractor Network requires applicants to undergo a certification process and mandatory training in topics related to their field. Membership with the Home Performance Contractor Network will be mandatory in order for contractors to participate in provincial rebate and incentive programs beginning July 1, 2022.[18]

Incentive Programs

Recent changes to provincial sales tax (PST) have left heat pumps exempt from PST and increased PST on fossil fuel combustion systems from 7% to 12%.[19] Furthermore, both the CleanBC Better Homes and BC Hydro Home Renovation rebate programs have stopped offering rebates for natural gas furnaces. On the other hand, a substantial number of rebate programs for heat pumps are available and are being heavily promoted by the province. In addition to these provincial programs, the federal government also offers rebates and many municipalities around British Columbia currently offer their own top-up incentives.

Table 1: Current rebates available in British Columbia (as of April 2022)

BC Hydro Home Renovation Rebates

- Up to $3,000 when switching from natural gas, oil, or propane
- $1,000–$2,000 for upgrades for homes already heated with electricity
    - www.bchydro.com/rebates

CleanBC Better Homes Rebates

- Up to $3,000 when switching from natural gas, oil, or propane
- $200–$500 per home for the Group Purchase Rebate program
    - www.betterhomesbc.ca (Single Home)
    - https://betterhomesbc.ca/rebates/GPR/ (Group Purchase)

FortisBC Rebates

- Up to $2,000 for replacing an existing electric heating system
    - https://www.fortisbc.com/rebates-and-energy-savings

[18] Home Performance Stakeholder Council. (2022) "Home Performance Contractor Network", online: http://homeperformance.ca/home-performance-contractor-network/.

[19] Province of British Columbia. (March 2022) "Provincial Sales Tax on Fossil Fuel Combustion Systems and Heat Pumps", online: https://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/notice-2022-003-provincial-sales-tax-on-fossil-fuel-combustion-systems-and-heat-pumps.pdf, p. 1.

Municipal Top-Ups (City of Kamloops)

- $350 when switching from oil, natural gas, or propane
- $1,200 when switching from wood or solid fuel
    - https://betterhomesbc.ca/municipal-offers/
    - Kamloops.ca/woodstove

Natural Resources Canada Greener Homes Grant

- Up to $5,000 when switching from natural gas, oil, or propane
    - https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/23441

BENEFITS AND BARRIERS

Recent initiatives and programs described in the previous section are all markers of a province-wide push towards electric systems over natural gas systems. However, before heavily promoting heat pumps in Kamloops, it is important to understand both the benefits and barriers of this technology. Knowing what challenges heat pumps face and how to overcome them will allow for the greatest chance of success in adopting this technology. See Tables 2 and 3 for a summary of the main benefits and barriers of heat pumps, as identified by University of British Columbia Sustainability Scholars research.[20]

Table 2: Main Benefits of Heat Pumps

Environmental	• Environmentally friendly option • Lower carbon footprint in comparison to conventional heating systems • Potential to decrease household emissions by 97.5% if switching from a fossil fuel-based system
Home Comfort	• Ability to both heat and cool reduces the need for an additional cooling unit • Air filtration and dehumidification capabilities protect homes from wildfire smoke, pollen, and pollution, improving home resiliency to climate change • Delivers more consistent and better distributed heat
Home Efficiency	• Three times more efficient at creating heat energy than traditional natural gas furnaces and other electric options • Longer life span with a potential service life of 15–20 years for air-source heat pumps and 20–25 years for ground-source heat pumps
Rebates & Incentives	• Carbon tax and increases in natural gas costs could lead to electricity becoming more cost competitive • Available incentives, rebates, and top-ups can significantly reduce cost of materials and installation
Trades Industry	• Heat pump market expected to expand significantly in the future • Huge opportunity for companies to boost sales and customer base • Economic stimulus and job creation as more green jobs open in the new home and retrofit industry • Abundance of training courses available throughout British Columbia to educate workers on quality installation and best practices

[20] UBC Sustainability Scholars. (August 2019) "Business Model Innovation to Support Heat Pump Retrofits in Metro Vancouver", online: https://sustain.ubc.ca/about/resources/business-model-innovation-support-heat-pump-retrofits-metro-vancouver, p. 5.

Table 3: Main Barriers associated with Heat Pumps

Affordability	• Natural gas is currently a third of the cost of electricity in British Columbia • Cheaper to install a new natural gas furnace than a heat pump • Inconsistent rebate offers causes swings in market demand • Potential for whole home upgrades to enjoy optimal heat pump efficiency
Availability	• Weak market presence in North America • Certain heat pump technologies are not yet available in Canada
Accessibility	• Difficult to find retailers and contractors due to a low level of awareness and familiarity with the technologies • Heat pump use often dissuaded by industry professionals • Lengthy installation process makes heat pump installations difficult in an emergency replacement situation • Architectural challenges if there is not enough space for outdoor units
Awareness	• Low visibility in the industry as they are not yet in widespread use • Information on heat pumps and current incentives and rebates can be difficult to find, confusing, and overwhelming • Consumers are unaware of the benefits of heat pumps
Acceptance	• Issues with older models has led to poor perceptions and skepticism • Perceived as loud due to higher noise levels associated with older models • Industry views heat pumps as a riskier, undertested, harder to use, and less efficient and reliable technology • Challenging for heat pumps to maintain home comfort during cold periods

Primary Research Findings

RESEARCH OVERVIEW

The City of Kamloops wants to ensure the local building industry is ready to meet the anticipated rise in demand for heat pumps before promoting heat pumps to the community. After conducting background research into the barriers and benefits of heat pumps, the next step was to engage with the local building industry. The objective behind this was to gain an insight into the experiences of building professionals and the general attitudes they have surrounding heat pumps. The main information the City was seeking is what types of challenges our local building sector is experiencing with heat pump technologies and what supports the City can offer to overcome these.

Primary engagement initiatives began with an online survey sent by email to local industry professionals in the heating, air-conditioning, and air-conditioning (HVAC) sector. Following this, the City of Kamloops' Climate and Sustainability Division hosted three focus groups that offered perspectives on heat pumps from both homeowners and local professionals in the building sector. This chapter will focus on these engagement initiatives and their primary findings.

Full survey results and more detailed focus group summaries can be obtained upon request by contacting sustainable@kamloops.ca.

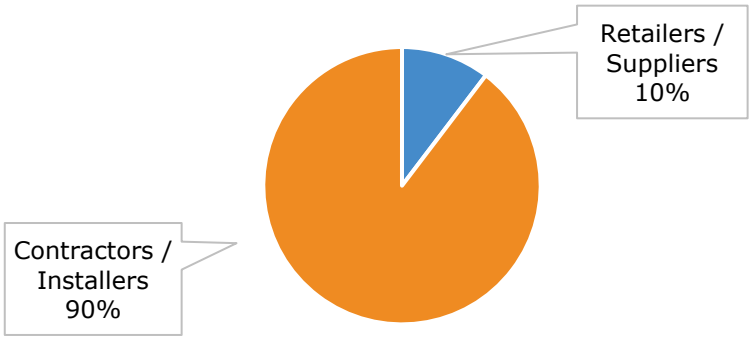
LOCAL HVAC INDUSTRY SURVEY

Survey Purpose and Demographics

In March 2022, the City of Kamloops launched a survey for local contractors and suppliers in the HVAC sector. This survey sought to better understand contractor and supplier experiences with heat pumps and the perceived barriers and benefits of this technology. The main goal of this survey was to identify the challenges the HVAC industry is facing with heat pumps and how the City can best support local capacity building.

Two surveys were sent out—one for contractors and installers and one for suppliers and retailers. The surveys were open March 2–14, 2022. In total, 29 responses were received, 27 of which completed the survey in its entirety.

Graph 1: Demographics of Survey Respondents



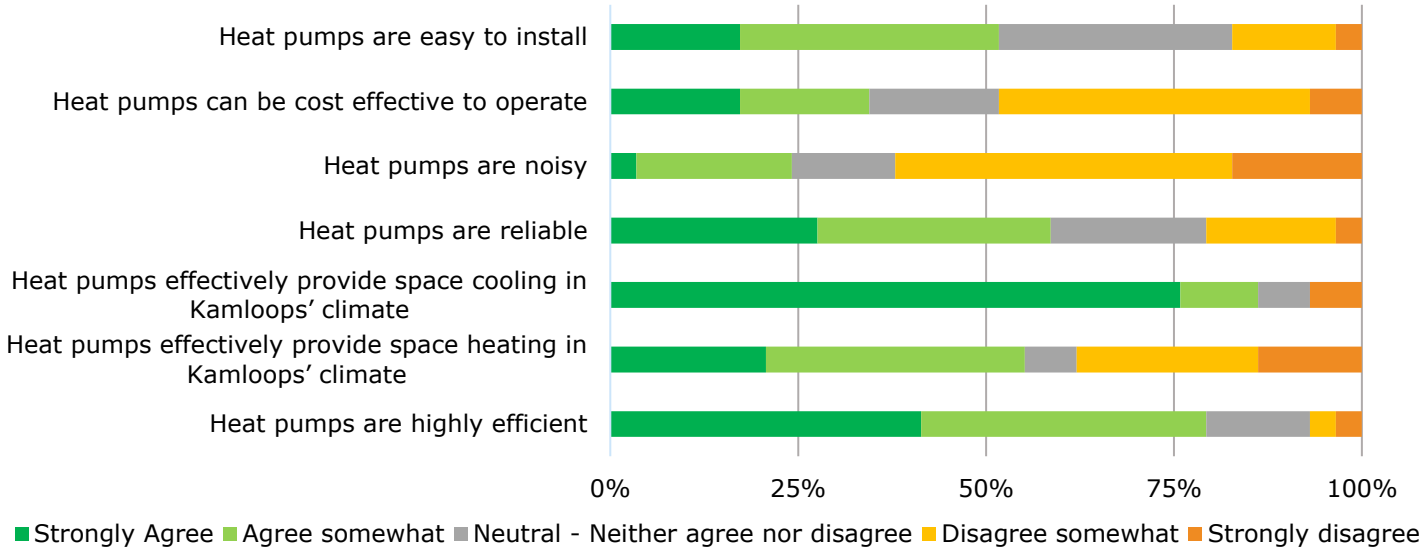
2 of 3 retailers/suppliers and 25 of 26 contractors/installers completed the entire survey

Of the survey respondents, 93% currently work with heat pumps, with a majority having operated with them for over five years. Most respondents were found to work with air-source and cold-climate heat pumps, and many are active in both the new build and retrofit building sectors. When asked to describe their level of knowledge and confidence with heat pump systems, 97% of respondents answered that they felt very knowledgeable and 83% felt very confident.

Benefits and Challenges of Heat Pumps

Survey respondents were then asked to state their level of agreement on some general statements surrounding heat pumps (See Graph 2). Answers obtained display the biggest perceived benefits of heat pumps to be high efficiency levels and the ability to provide space cooling. There is also a general disagreement that heat pumps produce high levels of sound, showing a shift away from past perceptions that heat pumps are noisy. In addition, results show that 50–60% of respondents view heat pumps as a reliable, easy-to-install technology capable of being an effective heat source in Kamloops. Close to 50% strongly or somewhat disagreed that heat pumps are cost-effective to operate, suggesting that cost is a major barrier.

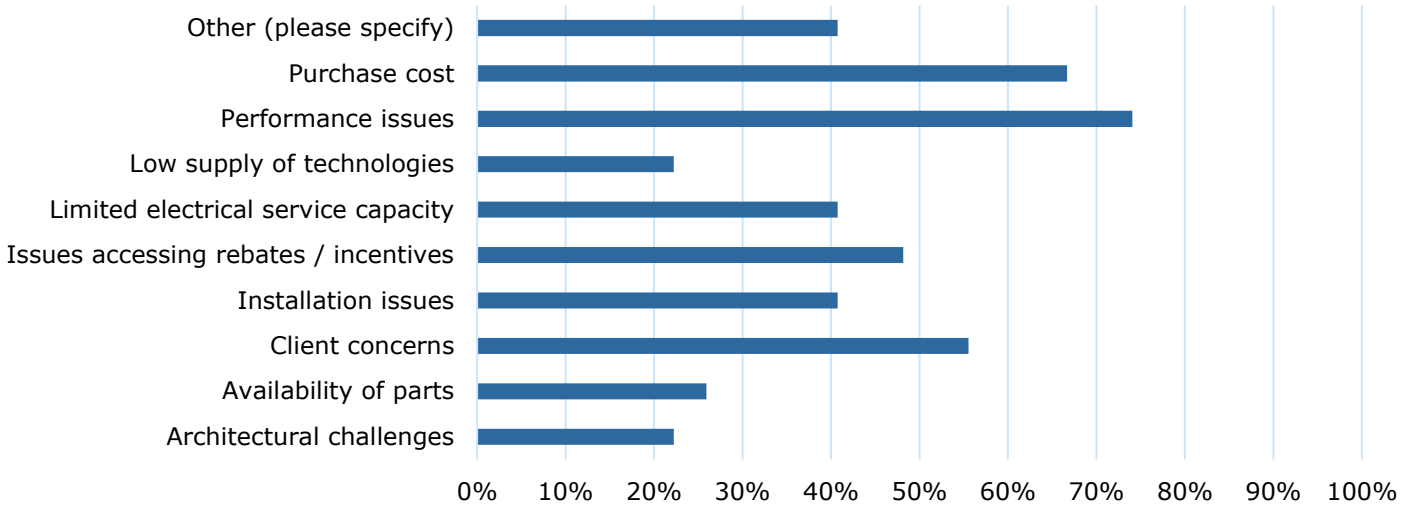
Graph 2: HVAC Industry Respondents' Perceptions of Heat Pumps



When asked what challenges respondents have encountered with heat pumps, the top three answers were performance issues, purchase cost, and client concerns (see Graph 3). Additional challenges with heat pumps that respondents identified were:

- High cost of electricity in comparison to natural gas
- Low efficiency rates in cold temperatures
- Limited availability due to the current global issues with shipping and transportation
- Advertisements leaving out key information resulting in homeowner misinformation
- High rates of heat loss in older homes making it difficult for heat pumps to keep up

Graph 3: Challenges with Heat Pumps Experienced by Respondents (multiple responses allowed)



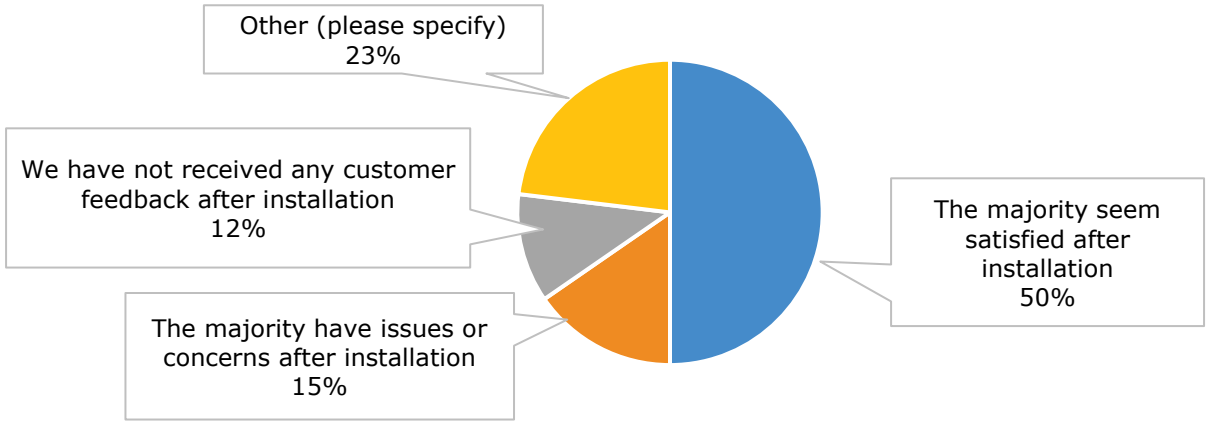
Client Interactions: Education and Rebates

In terms of homeowner education, 92% of respondents stated that they provide homeowners with basic education on heat pumps. Topics they cover include:

- Basic system operation
- Pros and cons of heat pumps
- What to expect and how to operate the system in various weather conditions
- How defrost and operation in colder temperatures work
- Setup and use of their thermostat
- How to maintain their system and ensure it is operating efficiently
- Expected costs for installation, operation, and maintenance

In addition, 88% of respondents promote at least one incentive or rebate program to their clients, with a majority promoting the BC Hydro Home Renovation and CleanBC Better Homes rebate programs. Of the respondents, 50% claim that the majority of their clients are satisfied with their heat pumps after installation and 70% said they are either very likely or somewhat likely to recommend heat pumps.

Graph 4: Perceived Satisfaction Levels of Heat Pump Clients



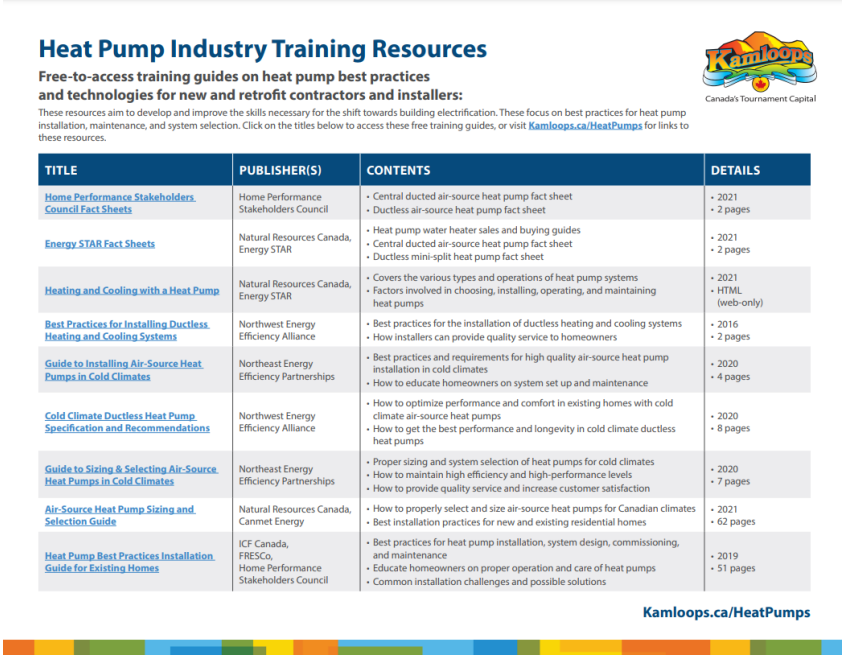
Other client feedback received by respondents included:

- A learning curve in accepting "cool heat" produced by a heat pump

- Varied performance reviews, especially in temperatures below -5ºC
- Higher than expected electrical bills during the colder months
- Lack of customer service from the manufacturer

Survey Results Highlights

- Nearly all HVAC industry respondents feel knowledgeable and confident with heat pumps.
- Two-thirds of respondents strongly or somewhat agree that heat pumps are an efficient technology that they are highly likely or somewhat likely to recommend.
- The main concerns respondents have with heat pumps are the higher operational and purchasing costs and the perception that they do not work well in colder climates.
- Many respondents were also interested in receiving educational resources, especially on the topics of rebates and the Home Performance Contractors Network. Resources were developed by the City of Kamloops and sent to all respondents who requested them (see Appendix II).



Heat Pump Industry Training Resources

Free-to-access training guides on heat pump best practices and technologies for new and retrofit contractors and installers:

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These resources aim to develop and improve the skills necessary for the shift towards building electrification. These focus on best practices for heat pump installation, maintenance, and system selection. Click on the titles below to access these free training guides, or visit Kamloops.ca/HeatPumps for links to these resources.

TITLE	PUBLISHER(S)	CONTENTS	DETAILS
Home Performance Stakeholders Council Fact Sheets	Home Performance Stakeholders Council	• Central ducted air-source heat pump fact sheet • Ductless air-source heat pump fact sheet	• 2021 • 2 pages
Energy STAR Fact Sheets	Natural Resources Canada, Energy STAR	• Heat pump water heater sales and buying guides • Central ducted air-source heat pump fact sheet • Ductless mini-split heat pump fact sheet	• 2021 • 2 pages
Heating and Cooling with a Heat Pump	Natural Resources Canada, Energy STAR	• Covers the various types and operations of heat pump systems • Factors involved in choosing, installing, operating, and maintaining heat pumps	• 2021 • HTML (web-only)
Best Practices for Installing Ductless Heating and Cooling Systems	Northwest Energy Efficiency Alliance	• Best practices for the installation of ductless heating and cooling systems • How installers can provide quality service to homeowners	• 2016 • 2 pages
Guide to Installing Air-Source Heat Pumps in Cold Climates	Northeast Energy Efficiency Partnerships	• Best practices and requirements for high quality air-source heat pump installation in cold climates • How to educate homeowners on system set up and maintenance	• 2020 • 4 pages
Cold Climate Ductless Heat Pump Specification and Recommendations	Northwest Energy Efficiency Alliance	• How to optimize performance and comfort in existing homes with cold climate air-source heat pumps • How to get the best performance and longevity in cold climate ductless heat pumps	• 2020 • 8 pages
Guide to Sizing & Selecting Air-Source Heat Pumps in Cold Climates	Northeast Energy Efficiency Partnerships	• Proper sizing and system selection of heat pumps for cold climates • How to maintain high efficiency and high-performance levels • How to provide quality service and increase customer satisfaction	• 2020 • 7 pages
Air-Source Heat Pump Sizing and Selection Guide	Natural Resources Canada, Canmet Energy	• How to properly select and size air-source heat pumps for Canadian climates • Best installation practices for new and existing residential homes	• 2021 • 62 pages
Heat Pump Best Practices Installation Guide for Existing Homes	ICF Canada, FRESCo, Home Performance Stakeholders Council	• Best practices for heat pump installation, system design, commissioning, and maintenance • Educate homeowners on proper operation and care of heat pumps • Common installation challenges and possible solutions	• 2019 • 51 pages

Kamloops.ca/HeatPumps

Recommendations for the City

The results of this survey indicate a potential role for the City of Kamloops in the following areas:

- Clearly state the reasoning behind the push for heat pumps, including other indicators around the province that display a transition towards building electrification. This will ensure local industry is aware of potential changes and can ready itself for growth in the heat pump market.
- Offer access to training, workshops, and educational materials to increase industry capacity building.
- Increase awareness of the Home Performance Contractors Network and access to incentive and rebate programs.
- Provide information on cold-climate heat pumps and case studies that show the potential for heat pumps to work in cold climates, to boost confidence and decrease contractor and client concerns.

LOCAL HVAC SUPPLIER AND CONTRACTOR FOCUS GROUP

Introduction

Following the HVAC industry survey, a group of local contractors and suppliers were invited to participate in a focus group to provide a more in-depth view on their experiences. This focus group received four participants, which will be referred to as Participants A, B, C, and D.

Demographics

Participant A: HVAC instructor at the local university's trades and technology school with many years of experience in the field prior to this.

Participant B: Wholesale supplier new to Kamloops with previous experience elsewhere in the Okanagan and the Lower Mainland; heavily promotes cold-climate heat pumps.

Participant C: Over 30 years of experience in Kamloops' HVAC industry and previous standing professional relationships with Participants A and D.

Participant D: Obtained their schooling and training in Germany and worked with Participant C for 10 years after moving to Kamloops before starting their own company, which focuses on geothermal energy systems.

Main Challenges and Installation

Participants agreed that ground-source heat pumps are not an issue in Kamloops in terms of functionality and efficiency. Their main challenge is a higher purchase and installation cost. As such, air-source heat pumps are more common, though they face more installation challenges that result in inefficient systems. According to participants, a dual-fuel heat pump system is most appropriate for Kamloops' climate, as even with a high-efficiency cold-climate heat pump, supplementary heating is still needed during the coldest parts of the year. Participants named three elements to focus on to achieve best practices for dual-fuel heat pump installations.

1. **Thermal Point**: The point where a heat pump gives over to the backup heating source is known as the thermal point or crossover point. Participant D states it is important to understand where to set this point as this will help save on costs and reduce environmental pollution (i.e. avoid the use of natural gas as much as possible). The challenge is that the thermal point of each system is different and must be calculated individually.

2. **Ductwork and Airflow**: How ducting is laid out is key to having an efficient system as dual-fuel systems are typically ducted and heat pumps require more airflow than a furnace. Participant D says a contractor must calculate how much air is needed throughout the whole home in order to install an appropriate unit. Participant A says this is an issue as "no one" checks for proper airflow. To avoid this, Participant C believes contractors need to accurately assess the thermal load required in each room, how much airflow needs to be delivered to satisfy this, and the size of ductwork required. However, this process requires extra time and costs and is therefore typically overlooked.

3. **Heat Loss**: Participants agreed that a lack of heat loss calculations being done when installing a heat pump is a common issue in the industry. This often results in systems that are incorrectly sized to meet the needs of a home. To avoid this, Participant D says the best method is to do room-by-room heat loss and heat gain calculations. Participant C added that the challenge is this approach is detailed and takes extra time and money, which, again, is why this step is often skipped. Another challenge raised is that if the heat loss of a house is calculated, there is often nowhere to store the data, which means it will have to be recalculated every time an upgrade is done, resulting in more time and money spent. To this, participants suggest creating a database where heat load calculations can be saved and are easily accessible.

Additional challenges participants mentioned include:

- Cost savings from PST exemptions for heat pumps and PST increases for fossil fuel effectively cancel each other out as a majority dual-fuel systems use both these components
- Debate on whether BC Hydro's grid has the electrical capacity and Kamloops has the infrastructure to support a transition to full-electrification
- Current labour shortage further exacerbates the ability to support installation best practices
- Switching from a gas-based system to a heat pump in an emergency replacement situation is difficult, as for a dual-fuel system the heat pump and back-up have to match for a homeowner to be eligible for rebate programs
- The process for rebates, especially the federal program, can take months to complete

Homeowner Education

Participant B believes that as the price of natural gas is on the rise and rebates for heat pumps are currently substantial the real challenge is less about cost and more about a lack of client confidence due to misconception and misinformation. To address this, participants believe it is key to educate homeowners on the benefits of a heat pump while also setting realistic expectations of them, including how they differ from conventional gas-fired furnaces. Topics mentioned for homeowner education include:

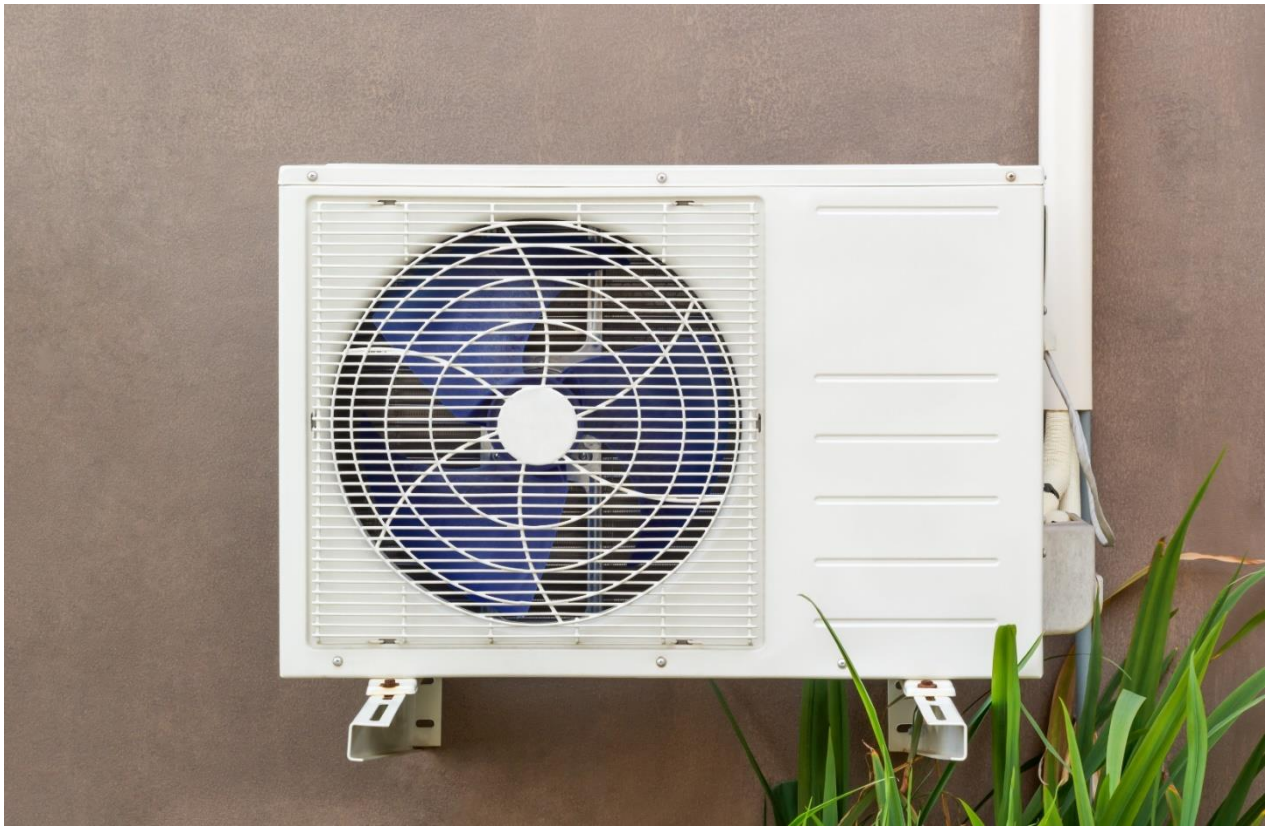
- Awareness of consistent "cool heat" delivered by heat pumps as opposed to the bursts of hot air homeowners are familiar with receiving from furnaces
- Eliminating the practice of "night set-back" in which homeowners have been taught to turn their gas furnace down at night to save energy as heat pumps have a slower heat recovery time and will use less energy maintaining a temperature
- The importance of having a well-insulated home that will optimize heat pump efficiency

Recommendations for Training and City Support:

Participants believe that increased training and accountability is necessary to strengthen the heat pump industry. When asked if the City of Kamloops needs to make training more accessible, Participant A responded that they do not think training is the City's responsibility, rather it is "setting the standard." Participants agreed there needs to be a minimum set of certifications and standards for heat pumps in the HVAC industry to ensure best practices are followed. Ideas participants had for the City to consider are:

- Ensuring training courses offered in Kamloops are flexible, on time, and incentivized

- Educating building inspectors on how to properly evaluate heat pumps
- Issuing local government permits on air conditioning and heat pump systems
- Requiring certification tickets for the refrigeration side of the industry
- Following the lead of other municipalities (such as Kelowna) that require contractors to complete courses on heat loss and ductwork in order to work with heat pumps
- Considering mandatory training and certifications



KAMLOOPS HEAT PUMP HOMEOWNERS FOCUS GROUP

Introduction

To gain a perspective of client experiences, a group of Kamloops homeowners with heat pumps was invited to participate in a focus group. The focus group comprised four separate households, which will be referred to as Houses A, B, C, and D. At least one member of each household is an active member of the British Columbia Sustainable Energy Association Kamloops Chapter, an organization that has been actively engaged in supporting the City of Kamloops' heat pump research.

The goal of this focus group was to discuss the process of installing a heat pump, experiences working with local trades companies, any barriers and benefits they encountered, and what supports they would have found beneficial.

Demographics

House A: Ductless mini-split air-source heat pump (new build), backup: electric baseboards
House B: Central ducted air-source heat pump (retrofit), backup: high-efficiency gas furnace
House C: Central ducted air-source heat pump (retrofit), backup: high-efficiency gas furnace
House D: Ductless cold-climate mini-split air-source heat pump (retrofit), backup: wood stove

Contractor Experience

Participants had varying experiences working with local companies to install their heat pump systems. House A and House D claimed their experiences were positive ones. In their previous home, House A installed an air-source heat pump with a high-efficiency furnace as backup in 2009 and were quite pleased. They then moved into a new apartment complex, which came with a heat pump already installed. House D had been in regular contact with one company that they knew and trusted and who had done other heat pump installations in Kamloops. This company did their retrofit, and House D found the crew who installed it to be competent.

House B and House C both initially experienced pushback against their choice to install heat pumps as their primary heating source. House B was told that heat pumps are not effective in the local climate or economically feasible and ended up trying three different companies before finding one that agreed to the installation. House C said a salesperson did not want to quote them for a heat pump and kept steering the conversation towards a new furnace.

Homeowner Education

Out of the four homes in this focus group, only one received any education on their system. They were shown how to use the thermostat but received no further instruction on how to use or maintain their heat pump. House A said they also received some education on their thermostat, but only because they called the company who had done the HVAC work on their apartment complex to learn more. This participant commented:

> *"It's a weak spot. When going to this kind of technology, businesses need to address that the homeowner needs information on the system they are using."*

Installation Experience

While all participants are pleased with their heat pump systems, many experienced some issues during the installation process, which can be grouped under three common themes:

1. **Improper installations:** Examples of this include screws dropped into a unit resulting in a gurgling noise, water buildup in exhaust lines that were not sloped enough and had to be reinstalled, and vibrations felt from aspects of the systems that were poorly located. These led to homeowners having to call contractors back to fix issues that were potentially avoidable.

2. **Inaccurate heat load calculations**: Participants expressed they were uncertain whether proper heating load calculations were performed. It was suggested that incorrect sizing often has to do with the "rule of thumb" method contractors use for sizing furnaces, which does not consider the higher efficiency of heat pumps or the specific architectural designs of a home. In particular, one household found out their system was undersized to meet their heating needs as it had been calculated to accommodate their air conditioning load instead of heating load. The household had agreed to size their system for their cooling load rather than heating because their contractor had told them that the heat pump would not be useful for heat in the winter anyways.

3. **Lack of cold-climate considerations:** Only one household was recommended a cold-climate unit, which are better suited for Kamloops' climate, and the others have traditional air-source heat pumps, which typically only maintain efficiency to -5°C. A couple participants felt that contractors did not know the difference between these. One noted that:

"I don't think any of the 3 companies we talked to even know that cold climate heat pumps exist."

Main Benefits

The participants in this group are passionate about low-carbon, clean energy solutions, and their greatest motivation for installing a heat pump was to lower their homes' emissions. All households are happy with their systems and identified the main benefits as follows:

- Environmental benefits and reduced carbon footprint
- Consistent temperatures creating a more comfortable home
- Ability to heat rooms separately (for those with mini-split systems)

Recommendations

All participants stated that they are highly likely or likely to recommend heat pumps to others. Participants did suggest that interested homeowners book an energy audit first, address other home efficiency measures such as insulation and draft proofing, and look into cold-climate heat pump options. All households also noted that it would have been helpful to receive additional support from the City, such as:

- A list of certified professional contractors
- Active individual support through the process
- Clear and easy access to rebates and other incentives
- Community events and displays aimed at educating homeowners
- Resources aimed at cold-climate heat pumps and Zone 5 climates
- A central database where they can access all these materials

Other major takeaways from this focus group revolve around homeowner-industry interactions. The experiences of the participants display a hesitancy, and even outright pushback, against working with heat pumps in Kamloops. Contractors who were willing to install them may have been less familiar with the technology, leading to improper installations. This reinforces the need for the City of Kamloops to support contractor capacity building, specifically in the areas of:

- Best practices for heat pump installation
- Delivering homeowner education on the use and maintenance of heat pumps
- Encouraging proper heat load calculations to be completed prior to installation
- Heightening awareness of cold-climate systems
- Increasing acceptance and confidence of heat pump systems among the trades community
- Promoting awareness around available rebates and incentive programs

HOME ELECTRIFICATION RETROFIT INTERVIEW

Introduction

A participant of the Kamloops Heat Pump Homeowners focus group referred another Kamloops homeowner who had recently retrofitted their home heating system to be completely electric. A short phone interview was conducted about their experience.

Retrofit Process

The interviewed homeowner had removed the natural gas furnace, hot water tank, and air conditioning unit from their downtown Kamloops residence in favour of an electrical furnace, electric hot water heater, and a high-efficiency air-source heat pump. To further decrease their carbon footprint, this homeowner also sold their gas vehicle and replaced it with an electric vehicle. They upgraded the electric service to the home, from 100 amps to 200 amps. This took three days to do and was quite costly, though the homeowner did manage to take advantage of the available rebates and encountered no significant issues with this upgrade.

Main Challenges

When temperatures started to drop at the end of September, a couple of months after the installation, this homeowner began experiencing some issues. They felt as though the electric furnace was not keeping up, and upon receiving their electricity bills, they were shocked at the excessive cost. After calling a contractor, they discovered that three of the four heating elements in the furnace had failed. This took a couple of months to fix, during which time their electric bills remained high.

In terms of the heat pump, this homeowner does not use it when temperatures drop below freezing but claims the system seems to work well. The only problem they encountered with it also occurred over winter when temperatures warmed and the melting snow from the roof would hit the heat pump, refreezing into an ice ring around the unit. This resulted in a high noise level due to the unit's fan working against the ice. This was so noticeable a neighbor came over to make the homeowner aware of the problem. To combat this, the homeowner shut off the heat pump, removed the ice, and built a temporary cover over top of it.

The main challenge this homeowner encountered has been with keeping operating costs down in colder temperatures. Regardless, the homeowner claims they are happy to have moved away from fossil fuels. This homeowner recognizes they are still in the learning stage with using this new technology and are curious to learn about the experiences of other homeowners with similar systems. This interview solidified the need to educate homeowners on the benefits and challenges of electric heating systems, the realistic operational costs involved, and the importance of additional home upgrades.

CHBA-CI FOCUS GROUP

Introduction

The Canadian Home Builders' Association of the Central Interior (CHBA-CI) is made up of a diverse group of professionals operating in the housing industry. As the CHBA-CI is on the forefront of building innovation, a panel of their members was invited to discuss their experiences with heat pumps. The goal of this group was to help the City understand the general attitudes industry professionals have of heat pumps and how the City can work with the CHBA-CI to best support local industry.

Demographics

This focus group had seven participants, all of who are current CHBA members. Of these participants, three are builders, three are trades contractors, and one is an energy advisor. In addition, three of these participants currently sit on the CHBA-CI Board of Directors.

Main Challenges

All of the participants are supportive of heat pumps; however, the majority do not believe the technology is at a point where it can meet the heating needs of a home in cooler climates without a supplementary heat source. Participants agree that for Kamloops, a dual-fuel system is the best option for achieving high home efficiency and lowering GHGs given that today's gas appliances are more efficient and produce less emissions than in the past. However, participants recognize there are still challenges that must be considered.

1. **Electricity:** The cost of electricity in comparison to natural gas still poses one of the largest challenges for heat pumps. Participants explain that homeowners will often experience a jump in their electric bills in the winter when a heat pump is working harder and drawing more power. This makes a dual-fuel system the most cost-effective for homeowners as they can use a cheaper natural gas source for their heating in winter. Unfortunately, this can be a challenge for homeowners who want to go full electric as while there are electric backup options available, they will continue to raise the energy bills of a home.

2. **Dual Fuel:** The main challenge raised with dual-fuel systems is that manufacturers will not pay to test their equipment with other brands, meaning there is no AHRI number, which is required for homeowners to obtain rebates. So, in the case of a retrofit, homeowners cannot simply add a heat pump to their existing system. They must remove their pre-existing heating system and install a new one to match the heat pump. This is beneficial if the old system is at the end of its life cycle, but if it is not, then replacing it prematurely is both wasteful and more expensive for the homeowner as the replacement cost will likely be more than the rebate they will receive.

3. **Retrofits:** A majority of emissions come from homes already built, not future homes, which have higher efficiency standards. There is a general agreement among participants that if the goal is to reduce building emissions, the focus should be on retrofits. The problem is that there is often a need for additional home upgrades prior to installing a heat pump. Participants said most homes in Kamloops have a 100 amp energy panel, which must be upgraded to meet the increased power demands of a heat pump. For optimal efficiency and cost savings, additional upgrades should also be made to seal the home's building envelope. Participants acknowledge this is an expensive and time-consuming ask for homeowners, especially since housing affordability is an increasing issue in the province.

Homeowner Education

A common theme throughout the focus group was the need for homeowner education on heat pumps and home efficiency. Participants hope to see better education on:

- Setting realistic expectations about heat pumps and their capabilities
- Recognizing that heat pumps are a low-heat heat source and will not provide homeowners the burst of hot air that come from a furnace
- Retraining behaviours, such as "night set-back", that have been learned from conventional heating systems
- Being prepared to experience higher operating costs over the winter months
- Understanding rebate eligibility requirements for heat pump systems
- Being aware of the potential need of other home-efficiency upgrades

Recommendations and Next Steps

The background and primary research conducted through this project highlights key areas for the City of Kamloops to consider in its pursuit of promoting the use of heat pump technologies.

Recommendations for Industry Capacity Building

- Educate industry on the City's objectives for promoting low-carbon technologies such as heat pumps (i.e. CCAP, building electrification road map, etc.)
- Continue to foster and maintain good relationships with industry members
- Increase opportunities for promoting and supporting the green building sector
- Promote training and ensure courses are held locally and are flexible, readily accessible, and incentivized (where applicable)
- Support industry growth by providing quality training materials, workshops, and courses, including demonstration sites and equipment (i.e. in collaboration with TRU School of Trades and Technology)
- Promote a "home as a system" approach regarding new home construction and retrofits
- Raise awareness of the Home Performance Contractors Network and its benefits
- Promote best practices for heat pump installation
- Explore the opportunity to establish a minimum standard for certifications to ensure industry is adhering to best practices such as heat load calculations, ducting, etc.

Recommendations for Homeowner Education

- Place a strong emphasis on homeowner education, especially on the topics of how to properly operate heat pumps and the importance of additional home upgrades (e.g. building envelope performance)
- Promote the importance of an "efficiency first" approach when aiming to lower a home's carbon footprint
- Recognize that dual-fuel heat pump systems may provide a suitable "hybrid" solution given the local climate and the high prevalence of natural gas heating
- Consider a program to allocate funds to homeowners who are looking to add a heat pump to their current natural gas system but do not yet need to replace their furnace as a way of incentivizing the portion of the community that may otherwise not qualify for rebates
- Establish a central database where all current and relevant information concerning heat pumps can be easily accessed

Next Steps

Heat pumps are a complex topic and to gain a better understanding of the opportunities and challenges surrounding them further research is required. It is important moving forward that the City continue to engage with local industry and homeowners to learn more about their experiences and the supports they need. Other potential next steps for the City to take are listed below.

- Continue research on heat pumps, focusing on community engagement and lifecycle cost-analysis
- Until heat pumps can maintain efficiency in extreme cold, the focus should be on promoting dual-fuel systems or heat pumps with electric backup heating (i.e. electric furnace), especially for older, leaky homes that experience higher rates of heat loss
- Electric-only installations are more suitable for well-insulated, airtight homes and new builds that are meeting higher energy performance criteria of the BC Energy Step Code or multi-family units where shared walls reduce exterior heat loss

- Follow the steps laid out in provincial building electrification plans to continue implementing stricter building laws that require higher standards for energy efficiency
- Promote heat pump use in the City's facilities and other institutional buildings to further promote the technology
- Collaborate with contractors who want to be leaders in the heat pump industry and showcase their success
- Create a dialog within the building industry and among homeowners so shared experiences can help others avoid common issues and challenges
- Increase incentives and municipal top-ups for heat pumps and ensure industry professional and consumers are aware of these
- Balance heat pump promotions with homeowner education to ensure consumers have realistic expectations of heat pumps

Conclusion

Heat pumps are a promising technology for achieving the CCAP's Big Move 4: Zero-Carbon Homes and Buildings and advancing local and global climate and sustainability goals. As consumer demand for heat pumps increases, a large opportunity is presented for Kamloops to utilize this technology to decrease community emissions. Understanding the benefits and barriers of heat pumps and how to overcome their challenges will allow the City of Kamloops to successfully provide the support, education, and incentives needed to promote this technology and work towards a greener future.

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