Heat Pump Best Practices Installation Guide for Existing Homes
Agenda

- Section 1: Introduction
- Section 2: Overview of Guide
- Section 3: Heat Pump Basics
- Section 4: Overview of Best Practices
- Section 5: Conclusions and Q&A
- Section 6: Rebates for Heat Pump Installations
Section 1: Introduction

This section will introduce the presenters and the guide, and discuss the benefits of high-quality installations and potential consequences of a poor job.
Organizer

- Home Performance Stakeholder Council (HPSC)
  - Not-for-profit society that represents residential sector interests related to energy-efficiency and conservation
  - Helping the home performance industry develop and grow into a sustainable and profitable market segment that delivers products and services to:
    - Lower utility bills through reducing energy use
    - Improve home comfort and building durability
    - Reduce environmental impact
    - Improve air quality, health and safety
Partners

- Heat Pump Guide funded by:
  - FortisBC
  - BC Hydro
  - Government of British Columbia
  - City of Vancouver
Presenters

▪ Rob George, Residential HVAC Expert, ICF – TECHNICAL EXPERT
  • 56 years’ experience in the HVAC industry
  • Designed, fabricated, installed and serviced residential and commercial HVAC systems
  • Last 20 years focused on developing and delivering technical training programs for HVAC industry professionals

▪ Jordan Fisher, Mech Retrofit EE Consultant, FRESCo – LOCAL EXPERT
  • Energy efficiency consultant with a specific focus on mechanical retrofits
  • Supporting the improvement of residential HVAC installations in BC
  • Led development of the Installation Quality Guidelines for the FortisBC/BC Hydro Program Registered Contractors (PRC) initiative
  • Delivered in-person and online training to over 100 residential heat pump installers across BC
Presenters (cont’d…)

▪ John Dikeos, P.Eng., Senior EE Consultant, ICF - MODERATOR
  • Energy efficiency consultant with over 12 years of experience
  • Work has focused on assessments of energy efficiency technologies, energy efficiency potential studies, DSM program design, and the implementation of innovative energy efficiency programs
Webinar Logistics

- Interactive components (polls) included throughout the course
- Please submit any questions via chat window
  - Questions to be addressed during Q&A session near the end of the presentation
- Groups of participants under one registrant
- Opportunity to provide feedback on the webinar at the end of the session
Disclaimers

- Target audience:
  - Guide and Webinar targeted at Heat Pump Installers having significant experience in this field
  - This includes knowledge of:
    - Heat loss and heat gain calculations
    - Airflow/duct design
    - How to measure, test, and commission home comfort systems
    - Relevant codes and standards in BC
Disclaimers (cont’d…)

- General disclaimers:
  - Although proper care has been taken to confirm the accuracy of the information contained in the Guide and this Webinar, the authors, advisory group members, other contributors, funding partners, and publishers assume no liability for any loss, damage, or injury that may be incurred or suffered as a result of any type of use or reliance on the contents and recommendations of this Guide.
  - Guide and Webinar are not a substitute for proper training and relevant experience related to residential heat pump system design, installation, commissioning, and maintenance.
Purpose of Guide

- BC-specific best practice installation to support BC installers/contractors on the quality installation of air-source heat pumps in residential retrofit applications
- Main objective is to shift the marketplace towards best practices
- CleanBC Better Homes and BC Hydro/FortisBC Home Renovation Rebate programs may reference this Guide in the terms and conditions for Program Registered Contractors (PRC) in the near future
Guide Development Process

- Prepared by ICF, with support from FRESCo

- Leveraged the following sources:
  - Leveraged existing relevant best practices documents, ASHP installation guides, and related training material
  - Related codes and standards
  - Input from with subject matter experts, including experienced installers in BC, to address gaps and ensure that local context is well-represented

- Developed in consultation with an Advisory Group consisting of individuals and organizations involved in the residential HVAC industry.
  - Advisory Group provided detailed feedback on draft versions of the Guide
Poor Design and Installation of ASHP Systems

- Various studies have found significant reductions in the overall efficiency of heat pump systems as a result of design and installation issues
  - US Department of Energy (DOE) estimates that the majority of HVAC systems do not perform at their rated efficiency as a result of improper installation

- A recent study on ASHP installation practices in BC indicated that only 32% of the studied ASHP installations were well-matched with the heating requirement of the homes they were installed in
  - Study showed that the poorly installed single stage ducted systems were using about the same amount of energy as an electric furnace (i.e. the heat pump was barely operating at all)
# Benefits of Quality Installation

<table>
<thead>
<tr>
<th><strong>Contractor Benefits</strong></th>
<th><strong>Homeowner Benefits</strong></th>
<th><strong>Societal Benefits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved client satisfaction, leading to more referrals and fewer callbacks</td>
<td>More comfortable indoor environment (e.g. fewer cold spots, more consistent temperature distribution, etc.)</td>
<td>Improved province-wide uptake of heat pump systems</td>
</tr>
<tr>
<td>Differentiation between high quality and poor, lower cost and quality installations</td>
<td>Increased economic life of ASHP system and reduced maintenance issues</td>
<td>More efficient use of BC’s green electricity grid</td>
</tr>
<tr>
<td>Compliance with future codes, regulations, and permits</td>
<td>Improved utility bill savings</td>
<td>Important component to achieve BC’s climate change goals</td>
</tr>
</tbody>
</table>
## Risks of Poor Installation

<table>
<thead>
<tr>
<th>Contractor Risks</th>
<th>Homeowner Risks</th>
<th>Societal Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customers dissatisfaction and more callbacks</td>
<td>Uncomfortable indoor environment (e.g. cold spots, uneven temperature distribution, etc.)</td>
<td>Reduction in province-wide uptake of heat pump systems</td>
</tr>
<tr>
<td>Reputational risk and loss of future business</td>
<td>Wasted energy consumption and associated higher costs</td>
<td>Inefficient use of BC’s electricity grid</td>
</tr>
<tr>
<td>Bad reputation and may not be allowed to participate in available rebate programs</td>
<td>Decrease in useful life of the heat pump, health/safety risks, and/or potential void to warranty</td>
<td>Jeopardize achievement of BC’s climate change goals</td>
</tr>
</tbody>
</table>
Section 2: Overview of Guide

This section will give an overview of contents of the heat pump best practice installation guide and supplementary resources document.
Access Documents

  - HPSC website: http://homeperformance.ca/contractor-resources/
  - CleanBC Better Homes website: https://betterhomesbc.ca/contractor-support/
Guide Layout and Contents

Three (3) main sections:


3. **Contractor Section**: House as a System; Steps to a High-Quality Installation; Job-Site Survey and Pre-Changeout; System Design (Sizing and Selection); Installation; Equipment Commissioning; Homeowner Education and Maintenance; and Common Challenges and Solutions

- Guide also includes Glossary, Additional Resources, and References
Helpful Resources

- Pros and cons of different ASHP systems (Section 1.4)
- System selection reference guide (Section 2.3)
- Identifying quality installations (Section 2.4)
- Steps to a high-quality installation (Section 3.2)
- Job-site survey checklist (Exhibit 12, Section 3.3)
- Sizing of ASHP and supplementary heating systems (Exhibit 15, Section 3.4)
- Common challenges and solutions (Section 3.7)
Supplemental Resources

- Separate document with useful resources from guide, plus additional documents

Two (2) main sections:


2. **Contractor Resources**: Helpful resources from Guide and supplemental resources (i.e. Sample Quotation, Sample Best Practice Installation Checklists, Sample Heat Pump System Commissioning Report)
Section 3: Heat Pump Basics

This section will discuss basics of heat pump including different types of heat pump, standard and performance.
Heat Pumps

▪ Extracts heat from one location and transfer it to another location

▪ Two common types of heat pumps used for space heating in low-rise residential applications:
  • Air-source heat pumps (ASHPs)
  • Ground-source heat pumps (GSHPs)

▪ ASHPs are the most common type of heat pump currently installed in Canadian homes
  • Focus of Guide
Types of Air-Source Heat Pumps

- Types of air-source heat pumps (ASHPs):
  - Centrally Ducted
  - Mini-Split (Single zone or multi-zone)
    - Ductless
    - Mini-Ducted

- Conventional and cold climate variants
  - Conventional ASHPs: Operate in heat pump mode with outdoor temperatures as low as -8°C to -12°C
    - Lower heating capacity at colder temperatures
  - Cold Climate ASHPs: Operate in heat pump mode with outdoor temperatures as low as -25°C
    - Better performance at lower temperatures
    - Basic units incorporate a larger compressor and a larger outdoor unit
    - More advanced (and expensive) units can operate at colder temperatures.
ASHP System Layouts

Centrally Ducted System
ASHP System Layouts (cont’d...)
## ASHP System Comparison

<table>
<thead>
<tr>
<th></th>
<th>Centrally Ducted ASHPs</th>
<th>Ductless ASHPs</th>
<th>Mini-Ducted ASHPs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROS</strong></td>
<td>+ Effective solution for homes with central ducting</td>
<td>+ Easy and quick installation by qualified professionals</td>
<td>+ Concealed equipment improves visual appeal</td>
</tr>
<tr>
<td></td>
<td>+ Indoor units can be smaller than many conventional furnaces</td>
<td>+ Require no ductwork</td>
<td>+ Quieter operation than other ASHP systems</td>
</tr>
<tr>
<td></td>
<td>+ Far more energy-efficient and cost-effective than oil or electric resistance heat</td>
<td>+ Cost-effective method to heat individual rooms or zones that are routinely occupied</td>
<td>+ Can be a cheaper alternative to multi-head ductless ASHPs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Using multiple ductless systems improves HVAC system reliability</td>
<td>+ Effective solution for rooms with smaller heat loads</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONS</strong></td>
<td>- Upgrading of electrical connection may be required to accommodate new system</td>
<td>- Each indoor unit serves a single zone or room rather than the entire home</td>
<td>- Lower efficiency than ductless ASHPs</td>
</tr>
<tr>
<td></td>
<td>- Existing ducting in older homes may need to be improved/ upgraded</td>
<td>- Indoor wall units take more space and may look bulky to some</td>
<td>- Installation of ducting is challenging in some existing homes</td>
</tr>
<tr>
<td><strong>IDEAL FOR</strong></td>
<td>Larger homes with central heating and cooling (forced air system) having existing ductwork in good condition</td>
<td>Small or large homes with baseboard heating and no ductwork</td>
<td>Small or large homes with baseboard heating, no ductwork, and easy access to install ducting</td>
</tr>
</tbody>
</table>
Supplementary Heating

- Heat pump output drops with colder outdoor temperatures
- Where applicable, supplementary heating is used at colder temperatures (i.e. beyond thermal balance point)
- Also sometimes used during defrost cycles
- Two configurations:
  - Integrated with the heat pump system (e.g. electric resistance coil)
  - Supplemental heat (e.g. electric baseboards or fossil fuel furnace)
- Where it’s easily achieved, can be sized for emergency (backup) heating
Dual Fuel Systems

- Existing fossil fuel system can be used as supplementary heating system
- Existing system generally sized to meet entire space heating load
- May be an economic benefit to using existing system during colder weather, when heat pump is less efficient
- Electric grid benefits since there is reduced demand on the coldest days of the year
ASHP Performance

HEATING:
- **HSPF**: Heating Seasonal Performance Factor
  - BTUs of heating output per watt-hours of energy consumed
- **COP**: Coefficient of Performance
  - Heating output per unit of energy consumed

COOLING:
- **EER**: Energy Efficiency Ratio
  - BTUs of cooling per watt of electrical power
  - Efficiency of cooling equipment at test conditions
- **SEER**: Seasonal Energy Efficiency Ratio
  - Annual BTUs of cooling divided by annual electrical power input
  - Accounts for part-load performance throughout year

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Min Standard in BC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heating:</strong></td>
<td></td>
</tr>
<tr>
<td>Centrally Ducted ASHPs, Ductless ASHP, and Mini-Ducted ASHPs</td>
<td>Starting in 2020: HSPF V ≥7.39 (HSPF IV ≥8.5)</td>
</tr>
<tr>
<td><strong>Cooling:</strong></td>
<td></td>
</tr>
<tr>
<td>Split System – Ductless, Mini-ducted and Centrally Ducted</td>
<td>SEER = 14.5, EER = 11.5</td>
</tr>
<tr>
<td>Single Package System</td>
<td>SEER = 14, EER = 11</td>
</tr>
</tbody>
</table>

Source: Natural Resources Canada
Cold Climate ASHP Performance

Outdoor Temperature (Wet Bulb)

Source: https://www.mitsubishipro.com/pdfs/m-series-catalog.pdf
Section 4: Overview of Best Practices

THIS SECTION WILL DISCUSS THE ASHP BEST PRACTICE INSTALLATION CONSIDERING HOUSE AS A SYSTEM
House as a System

1. Solar radiation
2. Space heating
3. Appliances
4. Lighting
5. Fireplaces
6. Occupants
7. Windows and doors
8. Walls
9. Basement
10. Attic
11. Dryer ducts
12. Exhaust fans (ventilation system)
13. Combustion appliance flues
Steps to a High-Quality Installation

Step 1: Job-Site Survey and Pre-Changeout
- Initial assessment of the existing heating and cooling system, ducting system, and occupancy.

Step 2: Design (Sizing and Selection)
- Calculating heating and cooling loads: CSA standard CAN/CSA-F280
- Sizing of equipment: CSA standard CAN/CSA-C273.5-11

Step 3: Installation
- Should meet CSA standard CAN/CSA-C273.5-11 and all other required codes and standards.

Step 4: Commissioning/Start-Up
- Tests to ensure the system is operating properly.

Step 5: Education and Maintenance
- Educate homeowners about operation and maintenance procedures.
Job-Site Survey and Pre-Changeout

- Interview homeowners
  - Homeowner’s expectations, concerns, and needs
  - Planned and/or recent home retrofits

- Evaluate existing HVAC systems
  - Type of system (space, central, split, package, etc.)
  - Ventilation system layout

- Evaluate building enclosure
  - Exposed above grade walls and basement walls
  - Ceilings, roof, windows, doors, and skylights
  - Foundation type and insulation

- Gather other site information
  - Relevant plans, sketches, and notes
  - Architectural and space constraints
System Design (Sizing and Selection)

- Determine requirements
  - Heating (or heating and cooling) displacement
  - Full HVAC system replacement
  - Isolated zone

- Determine heating and cooling capacity
  - Foundation of the system design procedure
  - CSA Standard F280-12 (Right-F280™, TECA Quality First™ Heat Loss & Heat Gain)
  - Use ‘smallest defensible load’ approach to optimize system performance and customer satisfaction
System Design (Sizing and Selection) (cont’d…)

- Section 5 of CAN/CSA standard C273.5-11

- The minimum capacity of the selected system (i.e. ability to modulate) is as important as the maximum capacity.

- When installing multi-zone systems, consider using separate single-zone systems or increasing the number of outdoor units, each with lower capacity and with fewer zones.

- The heating capacity of heat pumps declines with lower outdoor temperatures.
  - Proposed ASHP system must be able to provide the required heating at the outdoor design temperature where the system is being installed.
Sizing of ASHP and Supplementary Heating System

- In cooling and partial heating scenarios (rare in BC), size to 100-125% of design cooling load
- In other cases, size heat pumps using calculated heating load
- In warmer regions, use conventional heat pumps
  - No supplementary heating necessary (in addition to defrost) but can use existing heating system as backup
  - In case of duct constraints, use cold-climate units or supplemental electric coil
- In colder regions, use cold climate heat pumps
  - Heating down to -25°C
  - Supplemental heating to be employed where necessary
### Sizing & Selection Example

Calculated heating load: 14,000 BTU/h (4.1 kW)

Outdoor design temperature: -11°C

Nearest temperature below design temp: -15°C

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#### Model A: Capacity (kBTU/h), 12,000 BTU/h Rated Output

<table>
<thead>
<tr>
<th>Indoor Temp</th>
<th>20°C</th>
<th>-15°C (5°F)</th>
<th>-8.3°C (17°F)</th>
<th>0°C (32°F)</th>
<th>1.7°C (35°F)</th>
<th>8.3°C (47°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
</tr>
<tr>
<td></td>
<td>7.2</td>
<td>2.31</td>
<td>3.12</td>
<td>8.64</td>
<td>2.73</td>
<td>3.15</td>
</tr>
</tbody>
</table>

#### Model B: Capacity (kBTU/h), 18,000 BTU/h Rated Output

<table>
<thead>
<tr>
<th>Indoor Temp</th>
<th>20°C</th>
<th>-15°C (5°F)</th>
<th>-8.3°C (17°F)</th>
<th>0°C (32°F)</th>
<th>1.7°C (35°F)</th>
<th>8.3°C (47°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
</tr>
<tr>
<td></td>
<td>10.8</td>
<td>3.9</td>
<td>2.76</td>
<td>12.96</td>
<td>4.62</td>
<td>2.8</td>
</tr>
</tbody>
</table>

#### Model C: Capacity (kBTU/h), 24,000 BTU/h Rated Output

<table>
<thead>
<tr>
<th>Indoor Temp</th>
<th>20°C</th>
<th>-15°C (5°F)</th>
<th>-8.3°C (17°F)</th>
<th>0°C (32°F)</th>
<th>1.7°C (35°F)</th>
<th>8.3°C (47°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
<td>Output</td>
<td>Input</td>
<td>COP</td>
</tr>
<tr>
<td></td>
<td>14.4</td>
<td>5.55</td>
<td>2.59</td>
<td>16.95</td>
<td>6.15</td>
<td>2.75</td>
</tr>
</tbody>
</table>
Location of Outdoor Units

- Away from fences, walls, and other surfaces to allow unimpeded air flow around the unit
- Maintain minimum distances from obstructions as recommended in OEM
- Keep refrigerant pipe run lengths and bends at minimum level
- Protected from the sea spray in coastal areas and sheltered from frost and strong winds.
- At a safe distance from any gas sources or appliances

Source: EECA, New Zealand
Location of Outdoor Units (cont’d…)

**DO NOT LOCATE:**

- Where operating noise may disturb home occupants or neighbors
- In any location that may impede airflow
  - For instance, there may not be enough airflow under the house or deck
- Below a window where the unit has a vertical discharge
- So that multiple outdoor units are competing for airflow
- Where people pass (i.e. close to an accessway or path) since freezing discharge can pose a slip hazard
- On a balcony or deck that is more than 1 m above a surface below in a way that facilitates climbing over any nearby railings.
Location of Indoor Units

- Maintain minimum distances from obstructions as recommended in OEM
- Adequate clearances for making all connections and servicing
- A clear airflow path is maintained
- Minimize refrigerant pipe run lengths and bends
- The condensate drainage piping can drain to outside without the need for a condensate pump

Source: EECA, New Zealand
DO NOT LOCATE:

- In a tight corner or space
- Behind a grille
- So that they direct air to a primary source of heat gain or loss, such as windows
- Where there may be any steam
- Within a kitchen or near an automatic insect repellent dispenser
- Above or close to any heat source, including electrical appliances, which could affect the performance or act as an ignition point
High-Level Steps to a Quality Installation

- Perform an F280 compliant load calculation to ensure the proper capacity system is selected.

- Evaluate the mechanical room layout/spacing and existing equipment to ensure availability of sufficient space for selected retrofit equipment.

- Ensure that the duct system can handle system airflow requirements by evaluating the existing duct system and comparing it to the required capacity.

- Follow equipment manufacturer’s installation guidelines.

- Ensure that all related local codes and standards have been met.

- Ensure that all health and safety considerations are addressed.
Installing Outdoor Units

- Should be level,* both side-to-side and front-to-back and cannot fall over
- Their weight is fully supported to prevent sagging
- Units create no vibration; in cases where vibration is unavoidable, anti-vibration mounts should be used
- Use wall brackets designed for attachment to foundation wall, where ground clearance allows

*excess clearance may be needed for use in freezing climates to avoid frost heave and/or differential settling.
Identifying Quality Installations: Outdoor Units

POOR INSTALLATION

Soil and Footing

Ground clearance

BEST PRACTICE

Wall penetrations sealed with insulative sealant at point of entry

Rigid line cover

Dedicated circuit

UV protected insulated line set and power connection

Riser block

Anchor foot to riser

Pad

Adhesive

Compact ground
Installing Indoor Units (Ductless)

- Install wall mounted indoor units with adequate clearance from the ceiling for making all connections, for servicing the unit, and for replacing the components contained.

- Ensure that the wall is structurally strong enough to carry the load of the unit

- Ensure that wall space where the unit is being installed is free from electrical cables, plumbing and cross bracings

- Ensure that the unit is securely seated

- If space allows, install floor-mounted units in larger living areas and lower levels of 2-story homes
Identifying Quality Installations: Line Set & Penetrations

POOR INSTALLATION

BEST PRACTICE

Line set insulation

Sealing penetrations
Refrigerant Line Set and Tubing (cont’d…)

DO NOT:

• Reuse manufacturer provided tubing flares and fittings
• Use an old R22 flaring tool for R410A refrigerant systems (i.e. R410A flaring tools create a larger flare wall to withstand the higher refrigerant pressures of R410A systems)
• Use line sets used for R22 for R410A systems without flushing them with an agent like RX11
• Use a saw blade to cut the pipe
• Mix polyolester oil and mineral-based oil
• Use leak lock or PTFE tape, as these are not plumbing joints
• Cross thread the fittings, as you may damage them
Refrigerant Charge and Adjustment

- Refrigerant charging must be carried out in accordance with CAN/CSA B52
- Ensure that the HVAC system has the proper refrigerant charge.
- Improper charging will lower the life expectancy, efficiency, and capacity of the unit.
- Verify proper refrigerant charge - Superheat, subcooling and other methods approved by OEM
- Compare subcooling/superheat measurement results with OEM data to evaluate refrigerant charge.
Weigh-In Charge

- Can/should be performed year-round**

<table>
<thead>
<tr>
<th>Liquid Line Set Diameter</th>
<th>Oz. per 5 ft. (grams per 1.5 m) adjust from 15ft. (4.5 m) line set*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 in. (10 mm)</td>
<td>3 ounces per 5 feet (85g per 1.5 m)</td>
</tr>
</tbody>
</table>

*If line length is greater than 15 ft. (4.5 m), add this amount. If line length is less than 15 ft. (4.5 m), subtract this amount.

**Check OEM specifications for factory charge data and instructions.
Ducting Considerations

- Duct system design must follow NBC (Section 9.33.6) and the TECA Forced Air Guideline, HRAI Residential Air System Design manual (SAR-R2), or ACCA Manual D

- Always ensure that any existing ductwork is adequately sized for the heat pump airflow requirements and available static pressure

- Ducts systems should be designed to minimize friction losses

- Pay close attention to available static pressure, especially with mini-ducted air handlers

- New supply and return ducts must be sealed with suitable long-life material to minimize air leakage

- Avoid ducts in unconditioned spaces when possible

- Use rigid ducting when possible
System Controls

- Contractors should ensure proper selection and functioning of system controls

- **Operating controls:**
  - Thermostats, humidistats, economizer controls, hydronic outdoor reset controls, etc.

- **Safety controls:**
  - Temperature limit switch, airflow switch, condensate overflow switch, etc.
Commissioning: Benefits

- Improved project execution
- Ensure that the system meets the homeowner's requirements
- Optimized energy usage
- Corrective actions are completed by contractor at the project completion
- The number of contractor call backs is significantly reduced
  - Ensure warranty is maintained
  - Ensure equipment longevity
- Show due diligence in a court of law
Commissioning

- Testing and commissioning must comply with the Section 6.3 of CSA Standard C273.5-11
- Confirm that all control settings are done as per manufacturer’s specifications taking the economic cut-off and thermal balance point setting into consideration
- Check all control and electrical wiring connections before starting the system
- Clean all ductwork (where requested by homeowners), accessories, and existing air handlers and install a clean filter as per design before start-up
Commissioning (cont’d…)

At a minimum, the following operational checks and measurements should be completed:

- **Airflow:** The airflow across indoor coils shall be as per manufacturer’s specifications.

- **Refrigerant charge:** Refrigerant charge evaluation relies on measurement of operating pressures and comparison to pressures specified by the manufacturer.

- **Power inputs:** Power inputs of the circulating fan motor and compressor motor should be as per manufacturer’s specification.

- **Performance:** Calculate actual BTU/h performance
Homeowner Education and Maintenance: Contractor Benefits

- Contractors must educate the homeowner on both proper operation and maintenance of the HVAC equipment.
  - This benefits both homeowners and contractors
  - Educated homeowner/operator means efficient operation of the equipment and satisfied customer
  - Helps customers to differentiate between bad and good contractors
  - Leads to long term maintenance contracts
  - Improved relationship with homeowners, which leads to more business referrals
Homeowner Education and Maintenance

▪ Homeowner’s understanding of how to operate and maintain the new system is the biggest factors in their satisfaction.

▪ Contractors should provide and/or educate homeowners on the following items:
  • Original equipment manufacturer (OEM) equipment performance information and Owner’s Manual
  • Model and serial numbers of all equipment
  • Proper operation of the system, including operation and programming of the indoor temperature controller (i.e. thermostat)
  • Explanation of the proper service and maintenance requirements
Homeowner Education and Maintenance (cont’d…)

- A discussion of other common maintenance concerns
- Warranty coverage of the ASHP system and control system including servicing requirements for compliance with warranty policy
- Copy of installation record and commissioning checklist
- Proper labeling of switches
- Information on heat pump heating characteristics
Discussion Questions

▪ What is the most common issue you run into with installing heat pumps in existing homes?

▪ What are the most common reasons for call backs on heat pumps?
## Common Challenges and Solutions

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>New system sized based on the size of the old unit, some “rule of thumb” or up-sized ‘just in case’.</td>
<td>Perform a comprehensive load calculation to determine what the home needs and select equipment accordingly.</td>
</tr>
<tr>
<td>Undersized ductwork – existing ductwork in a retrofit application that was either not initially sized correctly or can’t handle the airflow requirements of the new system.</td>
<td>Check existing system’s static pressure to diagnose problems ahead of time. Perform a duct design calculation to determine what is required and develop a scope of work to include duct repair or renovation.</td>
</tr>
<tr>
<td>Proper clearance around heat pumps – Newer higher SEER units are typically bigger than older units. The older unit’s location may not afford proper space or clearances.</td>
<td>Locate/relocate new unit to ensure proper clearances.</td>
</tr>
</tbody>
</table>
## Common Challenges and Solutions (cont’d…)

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turning the system on and walking away assuming everything is ok, and the customer will call if there’s a problem.</td>
<td>A <strong>commissioning procedure</strong> should be conducted and recorded to verify the equipment is operating as designed.</td>
</tr>
<tr>
<td>System making unusual noises – <strong>Heat pumps operate differently than straight cooling units.</strong></td>
<td><strong>Homeowner education</strong> – homeowners should be told what to expect as normal sounds such as during the defrost cycle, long running cycles in heating, steam coming off the unit and so on. Alert them regarding abnormal sounds and conditions and when to call for service.</td>
</tr>
</tbody>
</table>
Section 5: Conclusions and Q&A
Conclusions

- Seeking to maximize the energy savings and GHG emissions reductions associated with heat pumps by increasing the quality of sizing, installation, and commissioning

- High-level overview of contents of Guide and Supplemental Resources

- Contractor resource documents for heat pump installations available here:
  - [http://homeperformance.ca/contractor-resources/](http://homeperformance.ca/contractor-resources/)
  - [https://betterhomesbc.ca/contractor-support/](https://betterhomesbc.ca/contractor-support/)

- May be referenced by residential retrofit EE programs in BC in near future
Q&A
Section 6: Rebates for Heat Pump Installation

This section provides an overview of available rebate programs in BC for heat pump installations and how to participate in them to better serve your customers.
# Heat Pump Rebates – BC Hydro
(Electric to Electric)

**Effective April 1, 2019**

<table>
<thead>
<tr>
<th>Qualifying system</th>
<th>Requirements</th>
<th>Rebate</th>
</tr>
</thead>
</table>
| Mini-split single head      | • HSPF ≥10.0, SEER ≥18  
• Variable speed compressor required | $1,000  |
| Mini-split multi-head       | • HSPF ≥9.30, SEER ≥16  
• Variable speed compressor required | $1,000  |
| Central heat pumps          | • HSPF ≥9.30, SEER≥16  
• Variable speed compressor required | $2,000  |
# Heat Pump Rebates – FortisBC Electric (Electric to Electric)

**Effective April 1, 2019**

<table>
<thead>
<tr>
<th>Qualifying system</th>
<th>Requirements</th>
<th>Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-split single head</td>
<td>• HSPF ≥10.0, SEER ≥18&lt;br&gt;• Variable speed compressor required</td>
<td>$1,200</td>
</tr>
<tr>
<td>Mini-split multi-head</td>
<td>• HSPF ≥9.30, SEER ≥16&lt;br&gt;• Variable speed compressor required</td>
<td>$2,000</td>
</tr>
<tr>
<td>Central heat pumps</td>
<td>• HSPF ≥8.50, SEER≥15&lt;br&gt;• HSPF ≥9.30, SEER≥16&lt;br&gt;• Variable speed compressor required</td>
<td>$1,200</td>
</tr>
</tbody>
</table>
# Heat Pump Rebates - CleanBC Better Homes (Convert to Electric)

Effective April 1, 2019

<table>
<thead>
<tr>
<th>Qualifying system</th>
<th>Requirements</th>
<th>Rebate</th>
</tr>
</thead>
</table>
| Mini-split (single and multi-head) | • HSPF ≥9.30, SEER ≥16  
• Variable speed compressor required | $3,000  |
| Central heat pumps           | • HSPF ≥8.50, SEER≥15                                                       | $1,200  |
|                              | • HSPF ≥9.30, SEER≥16  
• Variable speed compressor required | $3,000  |
Municipal Top-Up Rebates

- No additional application required
- Eligibility is automatically assessed with the submitted CleanBC Better Homes and Home Renovation Rebate application for the applicable rebates

- For further information on municipal top-ups: https://betterhomesbc.ca/municipal-offers/

- For details on available rebates, eligibility requirements, application process, FAQs, etc.: https://betterhomesbc.ca/rebates/cleanbc-better-homes-and-home-renovation-rebate-programs/
Eligible systems are listed on the Heat Pump Qualifying List available at: [www.bchydro.com/qualifying heatpumps](http://www.bchydro.com/qualifying heatpumps)

Search divided into 2 types:
- Mini-Split Single Head
- Mini-Split Multi Head
- Variable Speed Central Heat Pump
- Central Heat Pump

Downloadable lists also available
Eligible Central Systems

Eligible systems are listed on the Heat Pump Qualifying List available at: www.bchydro.com/qualifyingheatpumps
Contractor Incentive Program

- $50 per unit contractor incentive available if:
  - Heat pump is installed and replaces a fossil fuel (oil, natural gas or propane) heating system
  - Mini-split, multi-split and central ducted systems qualify

- Monthly payments will be made by cheque to the company

- Municipal contractor incentive top-ups available:
  - City of Vancouver: $300
  - City of North Vancouver: $50
  - Municipality of Whistler: $50
  - District of Saanich: $50
How to Apply

▪ Read the program Terms and Conditions to confirm eligibility

▪ Complete the online application form

▪ Must be submitted within 6 months of upgrade installation

▪ Upload copies of all required supporting documentation including invoices
  • www.bchydro.com/homerebates
  • www.fortisbc.com/homerebates
  • www.betterhomesbc.ca
More Information and Support

Home Renovation Rebate:
• BC Hydro: Tony Ceh, Anthony.Ceh@bchydro.com
• FortisBC: Erica Gugay, Erica.Gugay@fortisbc.com

CleanBC Better Homes:
• Ministry of Energy, Mines, and Petroleum Resources: betterhomesbc@gov.bc.ca

Customer Support:
• BetterHomesBC Energy Coach: 1-844-881-9790
• BC Hydro: 1-800-224-9376
• FortisBC (gas): homerebates@fortisbc.com
• FortisBC (electricity): homerebates@fortisbc.com

Websites:
• BetterHomesBC: www.betterhomesbc.ca
• BC Hydro: www.bchydro.com/homerebates
• FortisBC: www.fortisbc.com/homerebates
- Download the Better Homes BC Rebate Chart for an at a glance guide to current rebates and offerings: https://betterhomesbc.ca/better-homes-bc-rebate-chart/

Rebate Overview

Rebates and Incentives

### Home Heating Rebates

<table>
<thead>
<tr>
<th>Upgrade Category</th>
<th>Upgrade Type</th>
<th>Technical Details</th>
<th>Sponsor</th>
<th>Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini Split Heat Pump</td>
<td>High Efficiency</td>
<td>Furnishings &amp; More</td>
<td>CleanBC</td>
<td>$1,000</td>
</tr>
<tr>
<td>Central Heat Pump</td>
<td>High Efficiency</td>
<td>Furnishings &amp; More</td>
<td>CleanBC</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

**Note:** Local governments in BC are offering additional municipal rebates. See if your municipality is participating online at betterhomesbc.ca/homeperformance/stakeholders.

### Home Upgrade Rebates

<table>
<thead>
<tr>
<th>Upgrade Category</th>
<th>Upgrade Type</th>
<th>Technical Details</th>
<th>Sponsor</th>
<th>Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furnace Replacement</td>
<td>High Efficiency</td>
<td>Furnishings &amp; More</td>
<td>CleanBC</td>
<td>$1,000</td>
</tr>
<tr>
<td>Water heater Replacement</td>
<td>High Efficiency</td>
<td>Furnishings &amp; More</td>
<td>CleanBC</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

**Note:** Local governments in BC are offering additional municipal rebates. See if your municipality is participating online at betterhomesbc.ca/homeperformance/stakeholders.

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Find more at BetterHomesBC.ca
Thank You!