Facilitator Guide

COMMERCE DEPARTMENT

Getting the Most out of ASHP in Our Cold Climate

Course ID: MN ASHP COMF

Getting the Most out of ASHP in Our Cold Climate

This project was made possible by a grant from the Minnesota Department of Commerce.

Revision Date 7/01/2025

Disclaimer and Attribution

This Facilitator Guide was developed by CEE under contract with the Department of Commerce as part of a publicly funded effort to support education and training in the air-source heat pump (ASHP) sector.

The guide is intended to provide instructional support for delivering the associated training materials and may be used or adapted by third parties for non-commercial educational purposes.

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It is the responsibility of all users to ensure that delivery of this training complies with relevant local, state, and program-specific requirements.

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Table of Contents

INTRODUCTORY MATERIALS

MODULES

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Getting Started

About This Guide

What's the purpose of this guide?

This facilitator guide provides a master reference document to help you prepare for and deliver the "Getting the Most out of ASHP in Our Cold Climate" training.

What will I find in the guide?

This facilitator guide is a comprehensive package that contains

- the training delivery sequence
- checklists of necessary materials and equipment
- presentation content and key points to cover, and
- instructions for managing exercises.

How is this guide organized?

This section, "Getting Started," contains all of the preparation information for the "Getting the Most out of ASHP in Our Cold Climate" training, such as learning objectives, pre-work, required materials, and room set-up.

Following this section is the "Training At A Glance" table. This table can serve as your overview reference, showing the module names, timings, and process descriptions for the entire program.

Finally, the program itself is divided into *modules*, each of which is comprised of relevant lesson materials. A module is a self-contained portion of the program, usually lasting anywhere from 15 to 40 minutes. Each module begins with a one-page summary showing the Purpose, Time, Process, and Materials for the module. Use these summary pages to get an overview of the module that follows.

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About This Guide, continued

How is the text laid out in this guide?

Every action in the program is described in this guide by a text block like this one, with a margin icon, a title line, and the actual text. The icons are designed to help catch your eye and draw quick attention to "what to do and how to do it." For example, the icon to the left indicates that you, the instructor, say something next. The title line gives a brief description of what to do, and is followed by the actual script, instruction set, key points, etc. that are needed to complete the action.

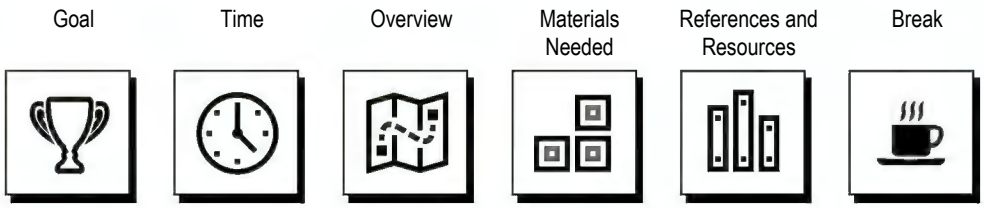
A complete list of the margin icons used in this guide is provided on the following page.

IMPORTANT NOTE

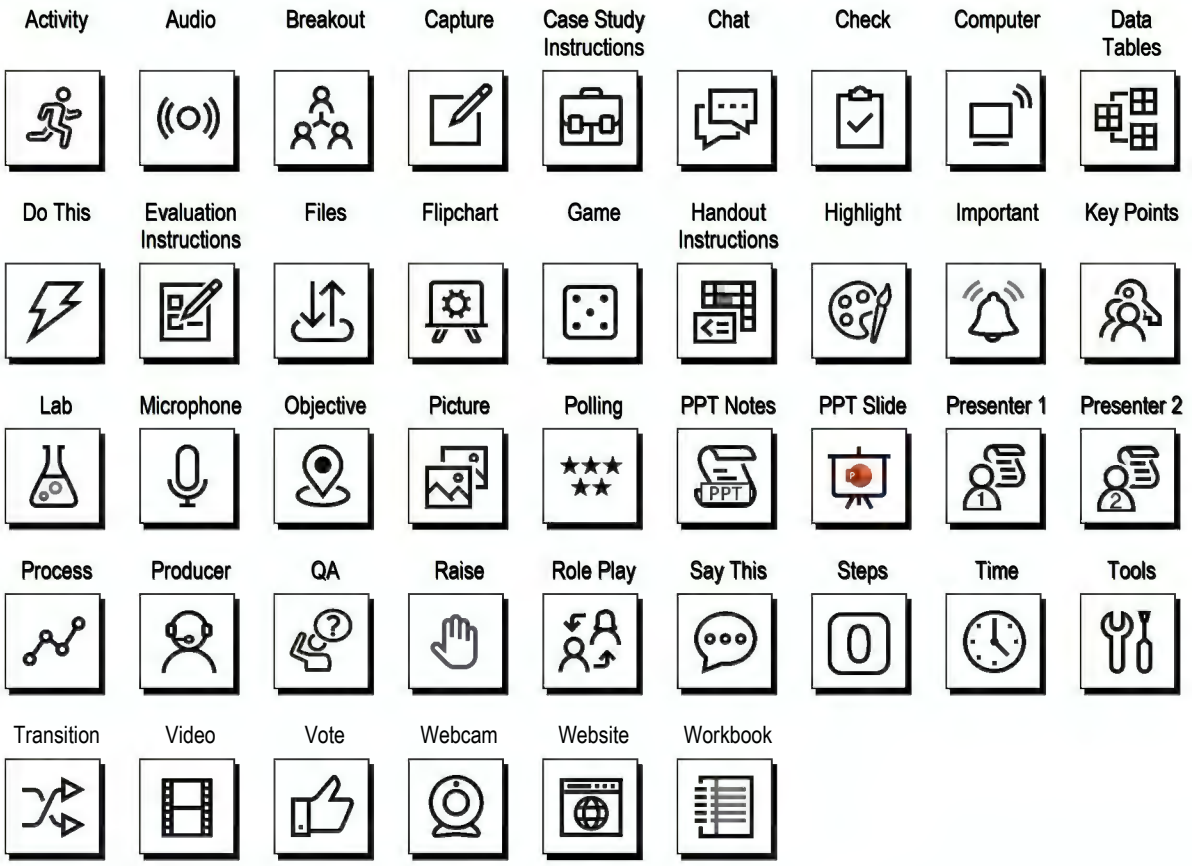
You may also occasionally find important notes such as this one in the text of this guide. These shaded boxes provide particularly important information in an attention-getting format.

Graphic Cues

Module Blocks



Lesson Blocks



The Program in Perspective

Why a "Getting the Most out of ASHP in Our Cold Climate" training program?

Participants will recognize Air Source Heat Pump (ASHP) technology benefits and identify key talking points to communicate the benefits of Cold Climate ASHP's with their customers. They will recognize the value of developing business opportunities to support heat pump sales growth and be ready to implement industry best practices as comfort advisors.

Learning Objectives

After completing this program, participants will be able to:

- Identify Cold Climate ASHP Technology Benefits and Business Opportunities
- Find and identify incentives for their customers based on location (utility & local programs), be able to clearly communicate savings opportunities to customers, and help them take advantage of stackable incentives.
- Recognize homeowner perceptions and priorities and provide excellent support, including homeowner education, throughout the sales and installation process.
- Recognize the importance of how to complete accurate load calculations, size accurately depending on the application, and the risks of oversizing and using rules of thumb for load calculations.
- Recognizes the importance of ductwork and airflow best practices and implements them in the system design and installation.
- Find and apply the available resources for equipment selection; recognize how using the resources can help implement strategies to overcome design challenges.
- Identify controls strategies for dual fuel heat pump systems; and apply them based on the selected thermostat and customer priorities.
- Implement installation best practices for heat pumps moving forward to ensure high quality installations and customer satisfaction.

Program Timing

Requires: 4 hours, 0 minutes

Number of Participants

Minimum: 12 Maximum: 300 Optimum: 35-40

Program Preparation

Pre-Training Communications

Email Communications and Pre-Learning PDF – See Appendix A

Required Materials

- Create an agenda for the training including scheduled breaks and provide a handout for each attendee
- Activity Worksheet (2-sides) One handout for each attendee – See Appendix A
- Evaluation Form One handout for each attendee – See Appendix A
- Pens for each attendee
- Blank Notepaper for people who want to take notes
- Nametags
- Check-In Sheet
- Tech/Laptop/Presentation Clicker

Room Set-Up

a. Appropriate seating/tables/desks for attendees
b. AV set up- projector, mic (if large group)
c. Logistics for slides- bring laptop to plug in or email slides ahead of time?
d. Logistics for virtual attendees (if applicable)
    1. Camera/mic so they can see/hear in-person attendees
    2. Teams/Zoom link
e. Food/Coffee/Water logistics (if applicable)

Instructor Preparation

Read through entire facilitator guide, become familiar with the PPT slide content, rehearse content, walk-through the worksheet exercises to be comfortable leading the activities.

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Training at a Glance

Time	Module	Description
0 hours, 15 minutes.	Introduction	Identify and explain an overview of heat pump technology, business opportunities, and benefits for customers.
0 hours, 30 minutes.	Incentive Sources & Minimizing Operational Costs	Show where to find, and then explain the basics of available utility rebates & rates for the customer.
0 hours, 30 minutes.	Homeowner Education	Share high priority topics to discuss with homeowner and tips on how to provide a high level of customer care to assure comfort and positive outcomes.
0 hours, 30 minutes.	Best Practices for Sizing & Load Calculations	Identify the various sizing methods that are recommended in completing high-accuracy load calculations (Manual J or equivalent).
0 hours, 30 minutes.	Ductwork & Airflow	Reveal the importance of ductwork assessment with high level steps. Identify the risks and impacts to system operation as a result of ductwork being improperly sized or maintained.
0 hours, 30 minutes.	Control Strategies	Identify controls strategies for dual fuel heat pump systems; and apply them based on the selected thermostat and customer priorities.
0 hours, 30 minutes.	Equipment Selection	Utilize available equipment selection tools to support the accuracy of your work and increase customer confidence. Apply appropriate Manual S tables.
0 hours, 30 minutes.	Installation Best Practices	Implement installation best practices for heat pumps moving forward to ensure high quality installations and customer satisfaction.

Time	Module	Description
0 hours, 15 minutes.	Summary & Closing	Summarize content highlights from the day and answer outstanding questions. Provide access to additional training resources and contact information. Allow time to give an opportunity for participants to evaluate the training and provide feedback. ***Note: Schedule breaks as needed throughout the day.***

Introduction

Goal

Identify and explain an overview of heat pump technology, business opportunities, and benefits for customers.

Time to complete: 0 hours, 15 minutes.

Number of lessons: 1

Overview

- Why Minnesota is transforming the HVAC market with air source heat pumps.

Materials Needed

- Technology and Room Set-up
- Agenda handouts
- PPT Presentation

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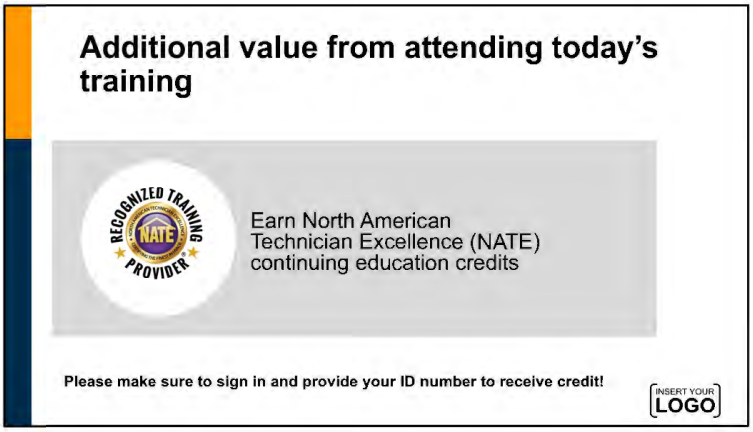
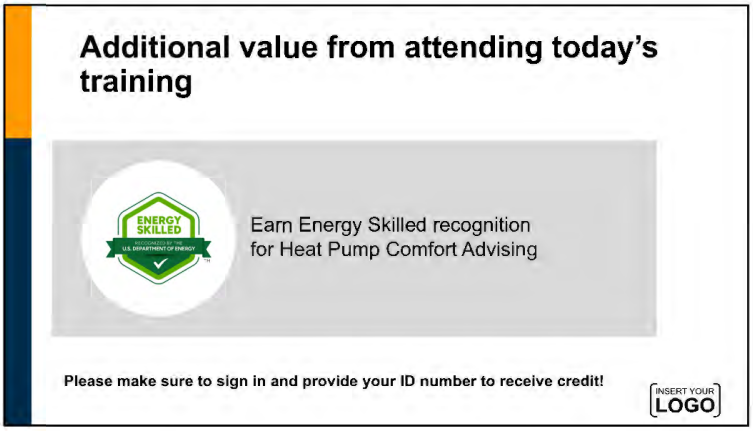
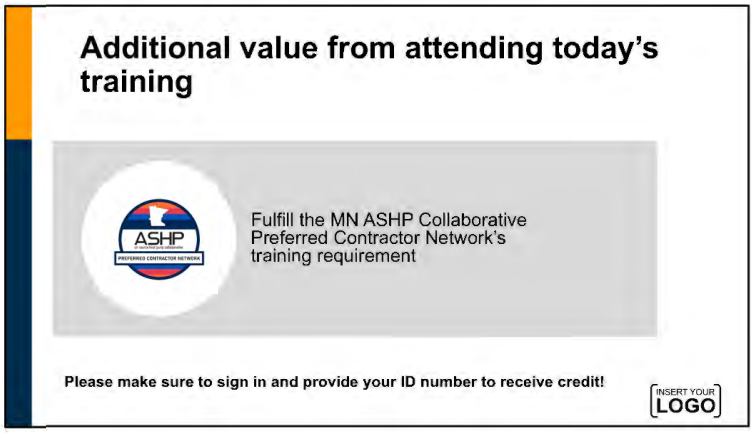
Welcome

	Facilitator	Notes
	Cumulative time: 0 hours, 0 minutes Time to complete this lesson: 15 minutes.	
Slide 1		5 min Live: Presenters introduce themselves. Virtual: Hello, thank you for joining this presentation to learn about air source heat pumps and how to optimize them for MN's climate.
Slide 2		

Welcome

	Facilitator	Notes
Slide 3		
Slide 4		
Slide 5		

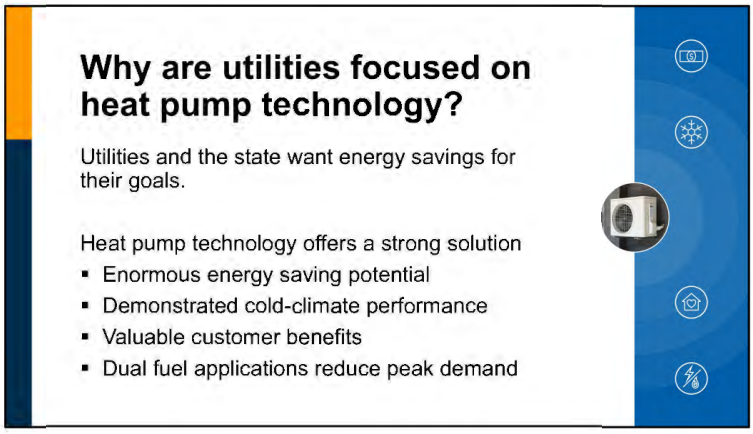
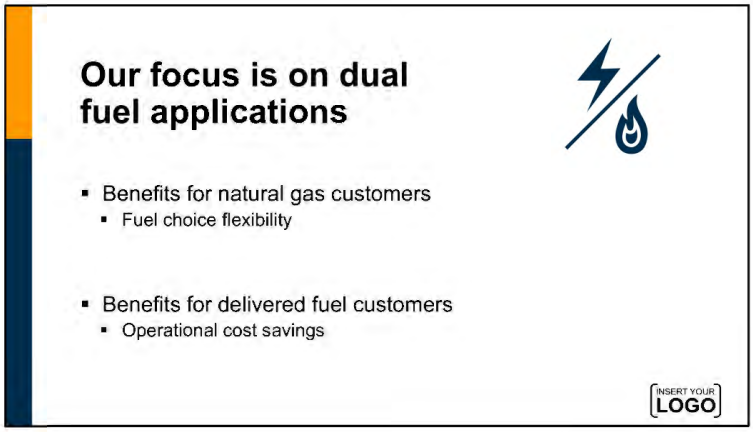
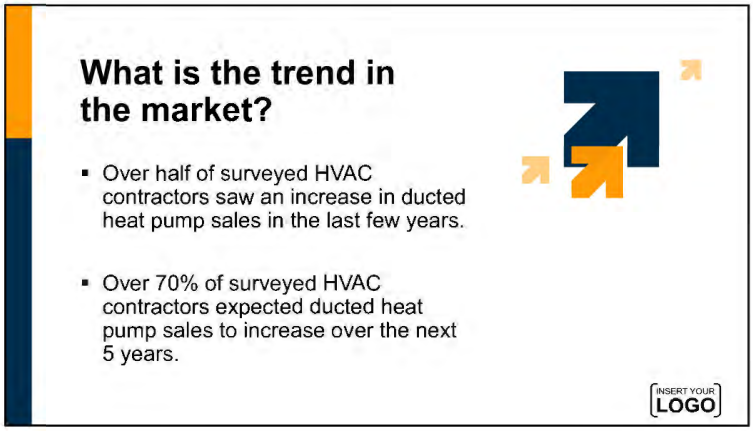
Welcome

	Facilitator	Notes
Slide 6		
Slide 7		
Slide 8		

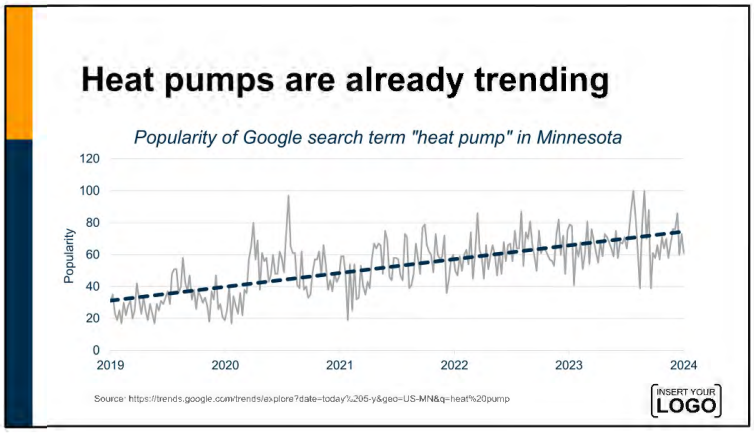
Welcome

	Facilitator	Notes
Slide 9		
Slide 10		
Slide 11		

Welcome

	Facilitator	Notes
Slide 12		
Slide 13		
Slide 14		

Welcome

	Facilitator	Notes
Slide 15		
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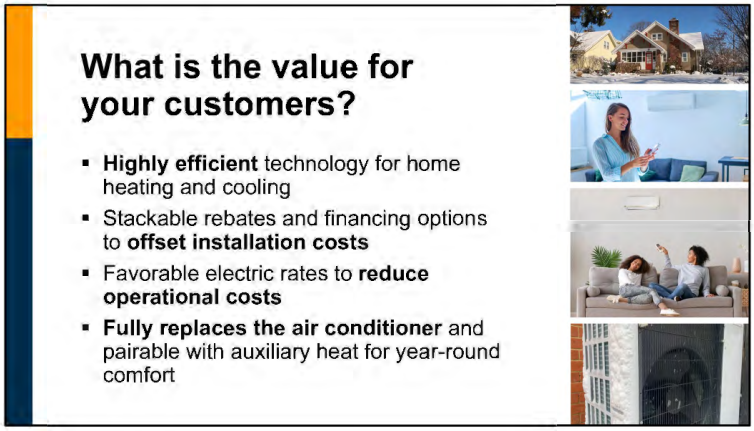
Slide 17		

Welcome

	Facilitator	Notes
Slide 18		
Slide 19		
	Transition to Incentive Sources & Minimizing Operational Costs	

Incentive Sources & Minimizing Operational Costs

Goal

Show where to find, and then explain the basics of available utility rebates & rates for the customer

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

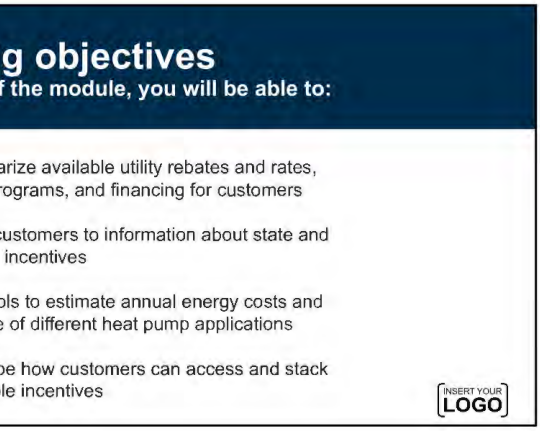
Overview

- **Summarize available utility rebates and rates, local programs, and financing for customers**
- **Refer customers to information about state and federal incentives**
- **Use tools to estimate annual energy costs and runtime of different heat pump applications**
- **Describe how customers can access and stack available incentives**

Materials Needed

- Technology and Room Set-up
- Handouts
- PPT Presentation

Present

Facilitator	Notes
Cumulative time: 0 hours, 15 minutes Time to complete this lesson: 30 minutes.	
Slide 20 	
Slide 21 	

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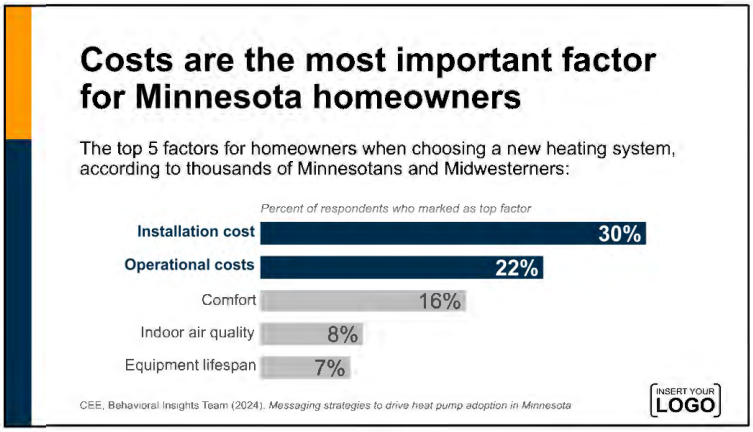
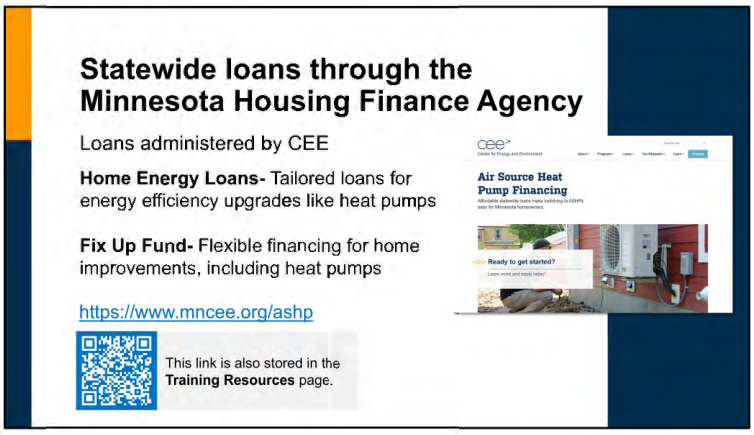
	Facilitator	Notes
Slide 22		■ Randomized controlled trial completed in 2024 ■ Sample size – thousands of Minnesotans and Midwesterners were surveyed
Slide 23		
Slide 24		

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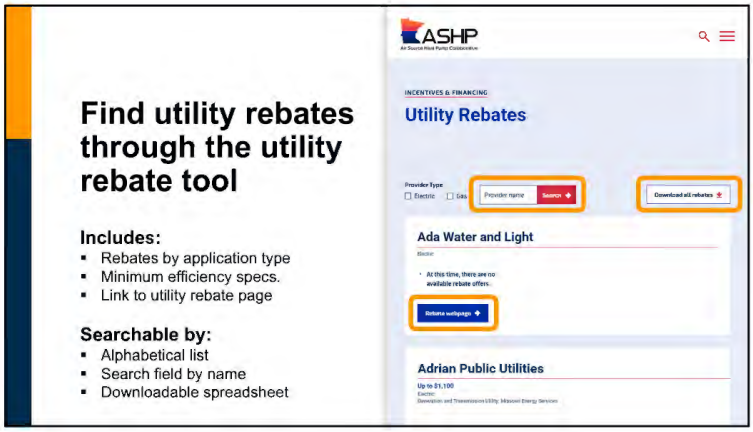
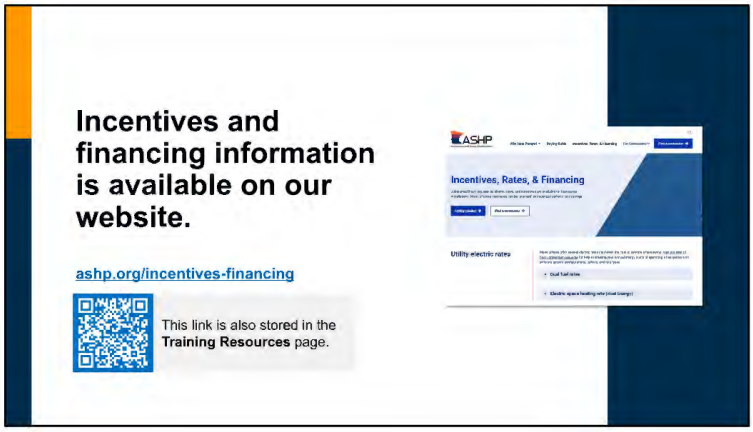
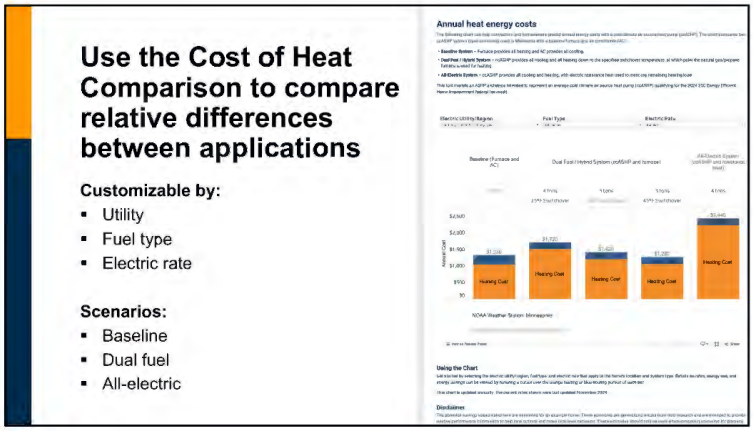
Slide 25		
Slide 26		-
Slide 27		

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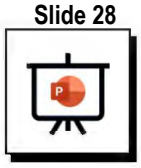
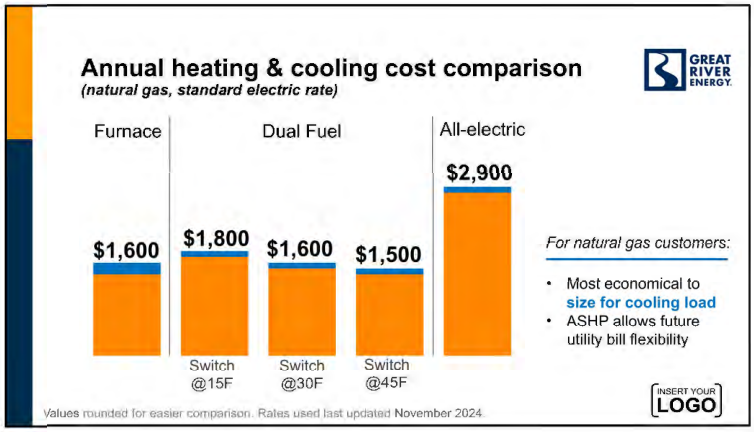
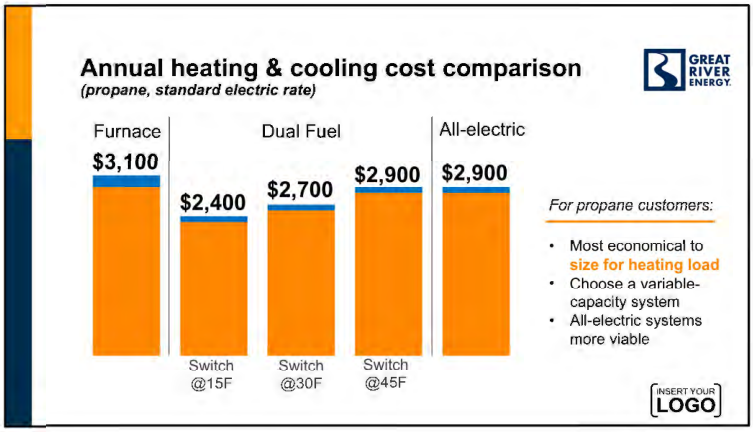
Slide 28  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

Present

Slide 29

Facilitator	Notes
	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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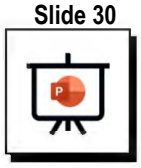
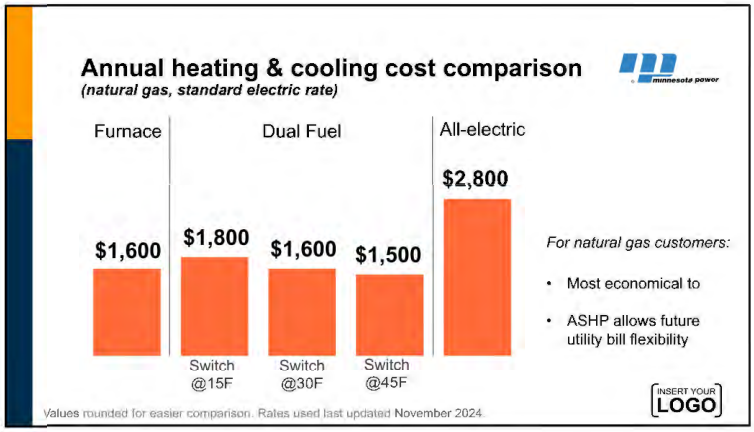
Slide 30  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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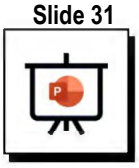
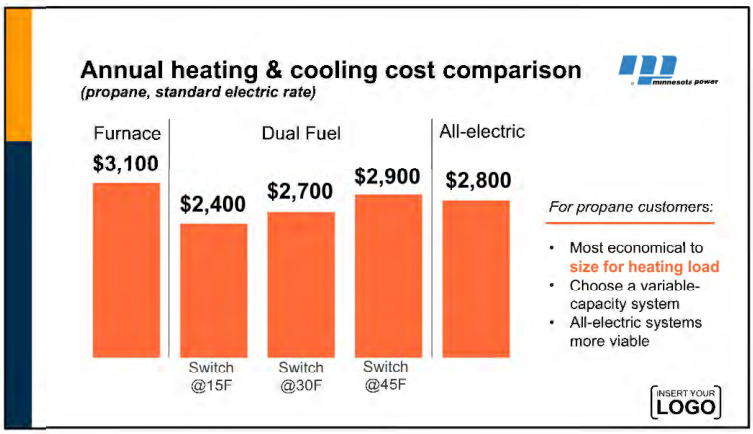
Slide 31  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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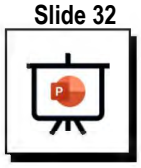
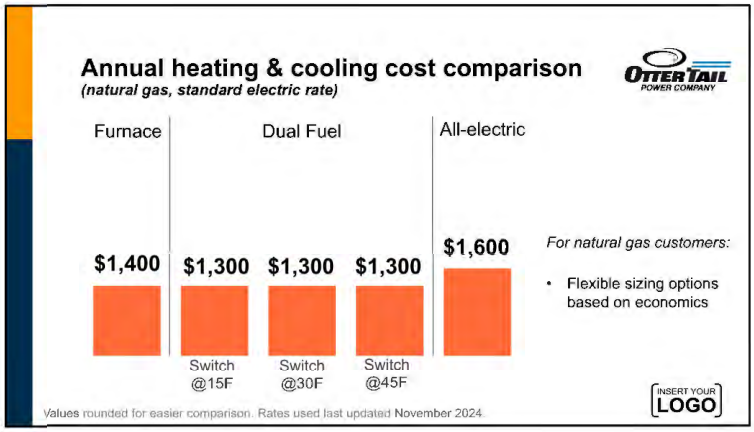
Slide 32  	OTP also has a $1000 incentive that will reimburse customers for purchasing a dual fuel meter, which can decrease payback times. If I were an OTP customer buying a new system, I'd likely explore a system that can cover more of the heating load (per these economics), get a dual fuel meter, and take advantage of their tonnage based rebate, which further incentives sizing for heating. ■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The

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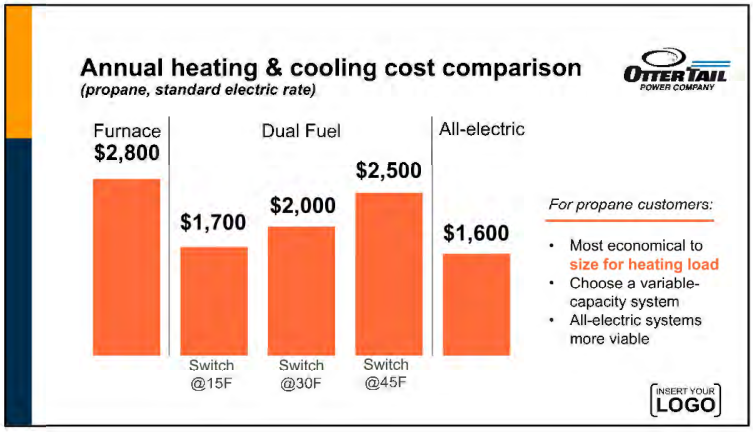
Slide 33  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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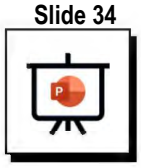
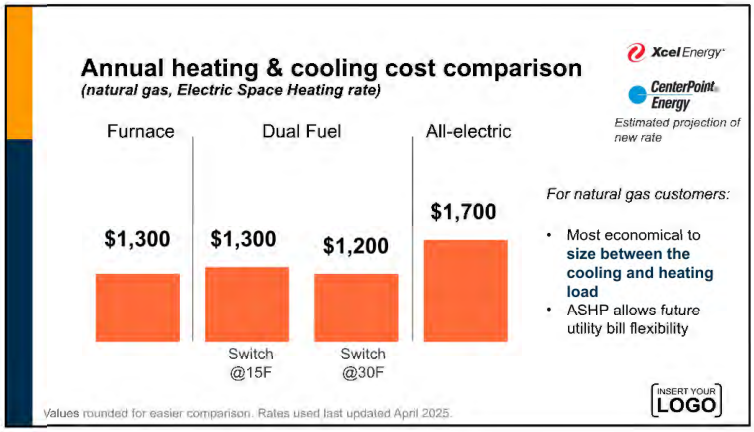
Slide 34  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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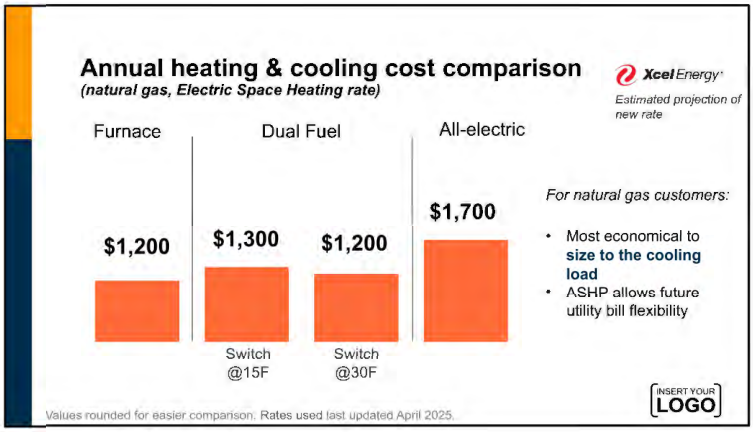	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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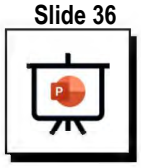
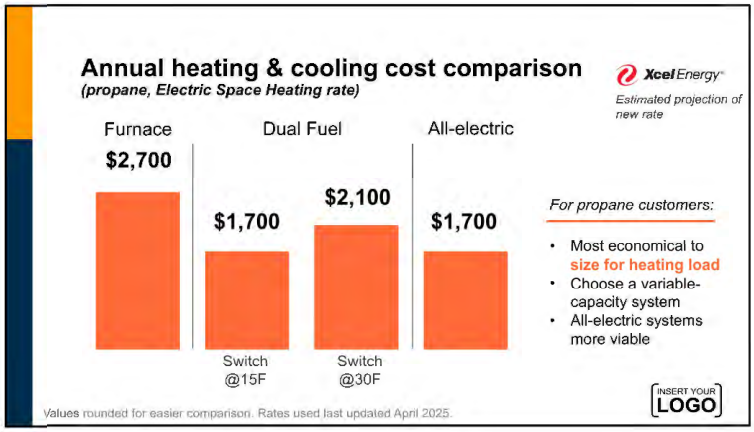
Slide 36  	■ Standard Electric Rate ($/kWh): $0.14 (June-September: $0.15) ■ Dual Fuel Electric Rate ($/kWh): $0.07 ■ Natural Gas Rate ($/therm): $1.06 ■ Propane Rate ($/gal): $2.03 ■ Rates are inclusive of any riders or fuel cost adjustments, but not base rates as we are only modeling cost of heating/cooling. ■ All of the GRE modeled rates are statewide averages, with Rodney providing the modeled dual fuel rate. The natural gas rate is a HDD weighted statewide average using St. Cloud as the weather station.

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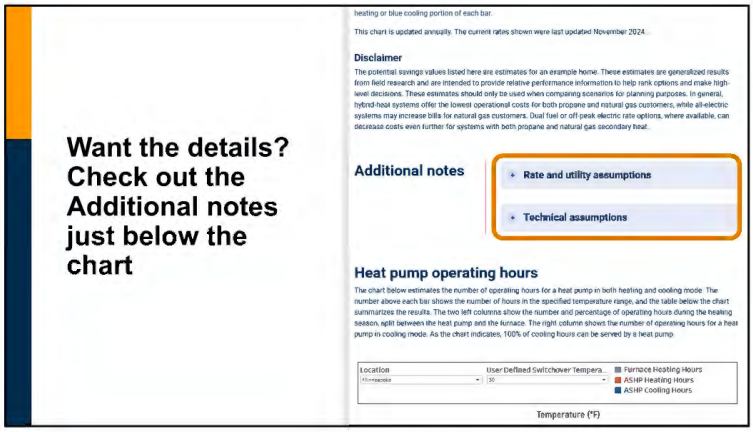
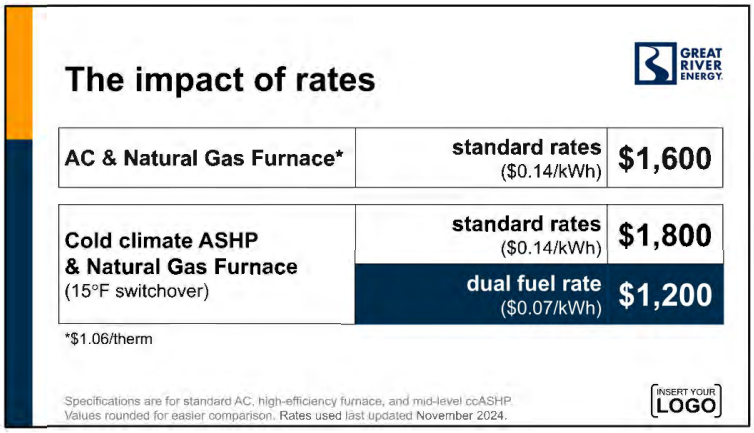
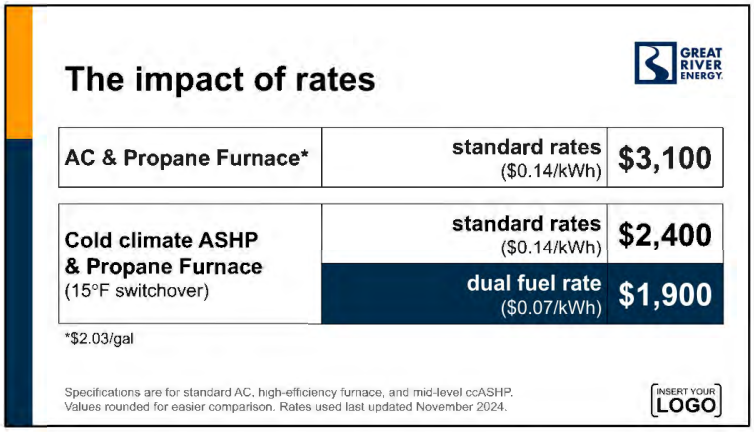
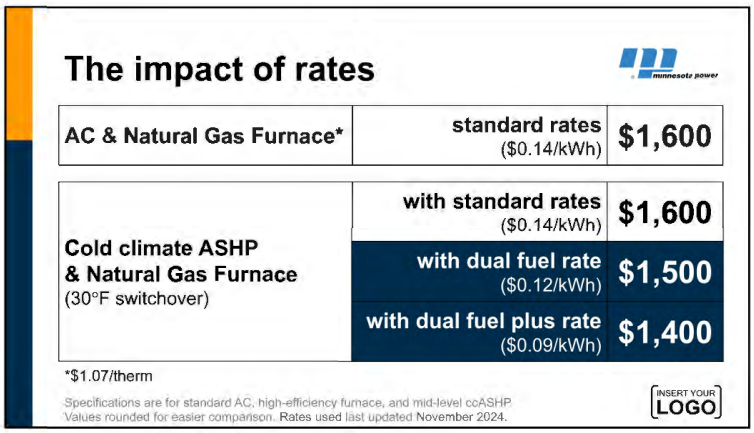
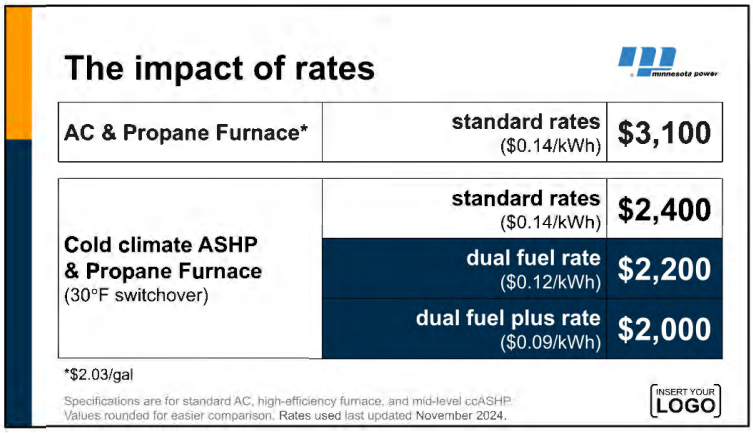
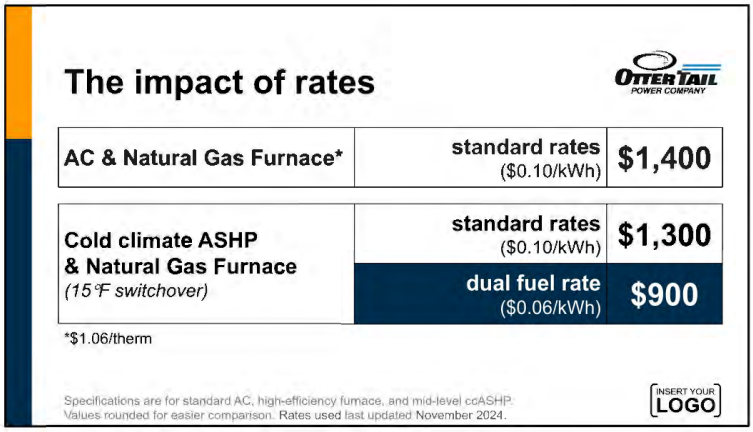
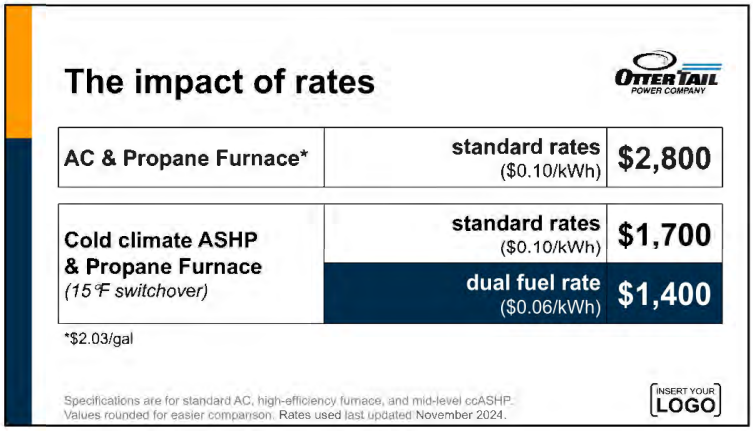
Slide 37		-
Slide 38		
Slide 39		

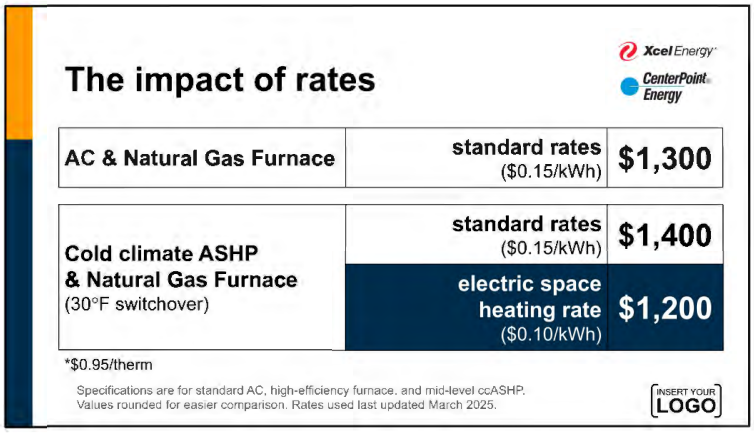
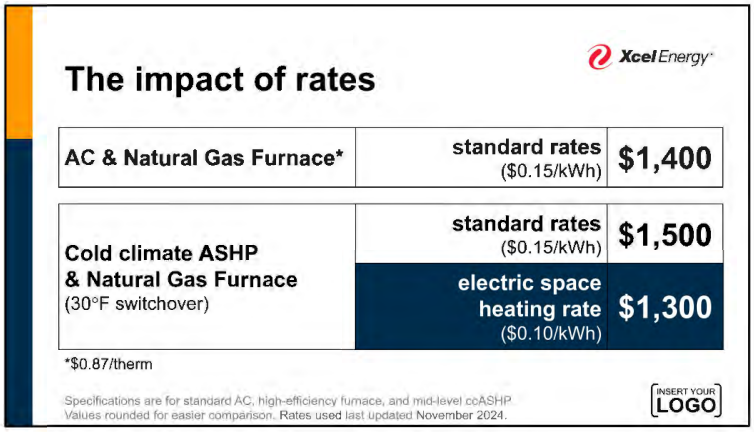
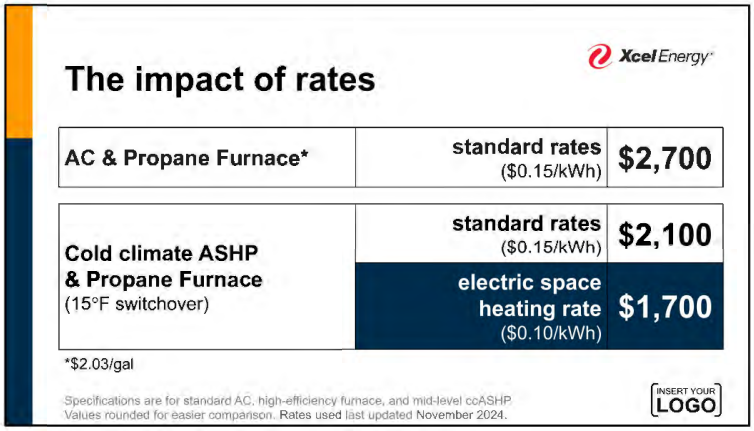
Present

	Facilitator	Notes
Slide 40		OTP: Nat gas
Slide 41		OTP: Nat gas
Slide 42		OTP: Nat gas

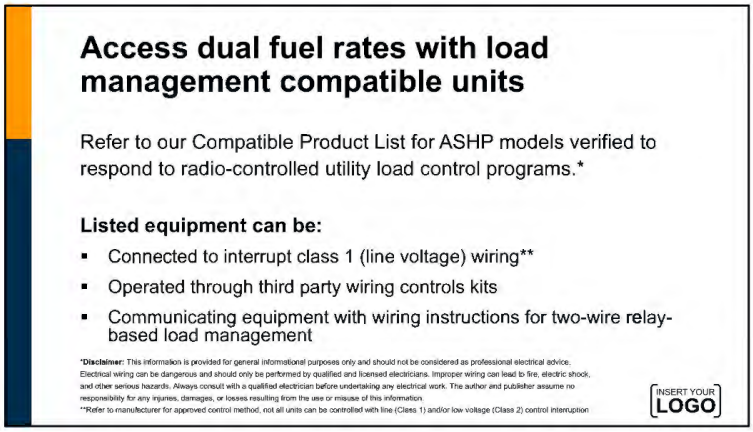
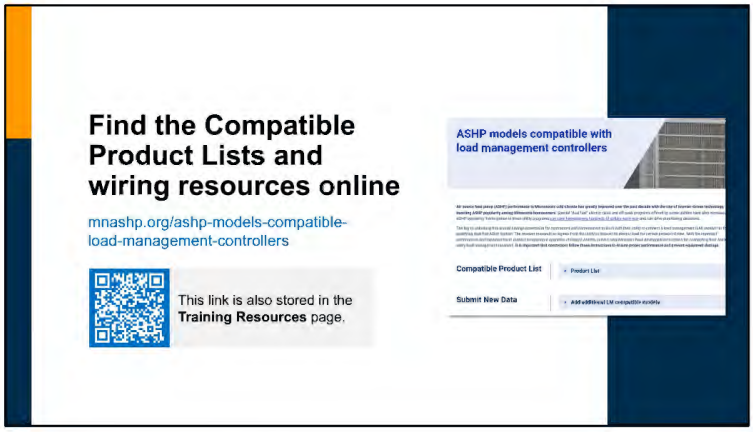
Present

	Facilitator	Notes
Slide 43		OTP: Nat gas
Slide 44		OTP: Nat gas
Slide 45		OTP: Nat gas

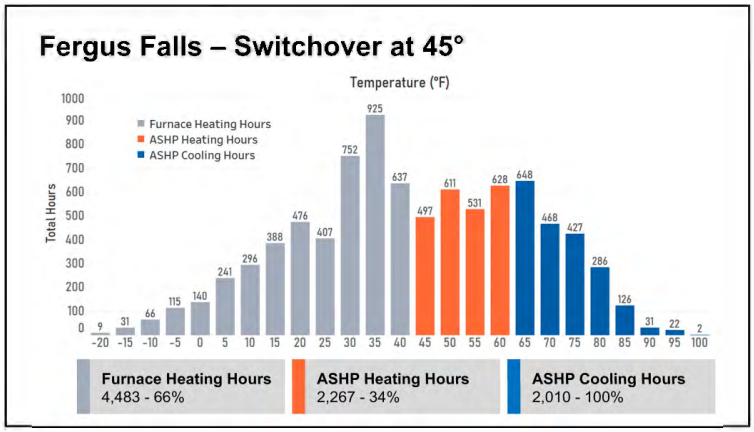
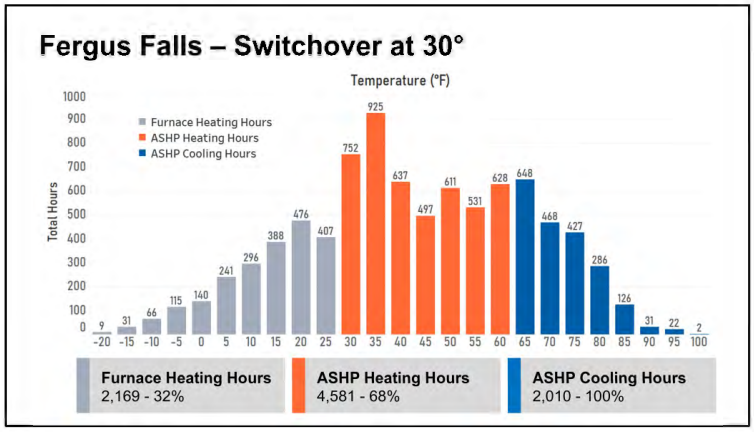
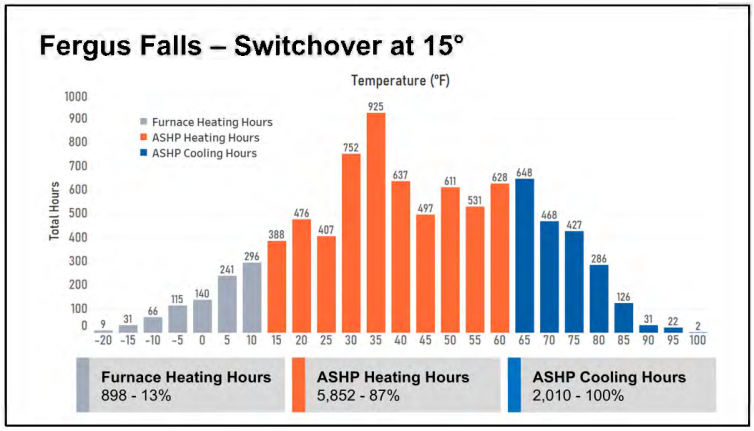
Present

	Facilitator	Notes
Slide 46		OTP: Nat gas
Slide 47		OTP: Nat gas
Slide 48		OTP: Nat gas

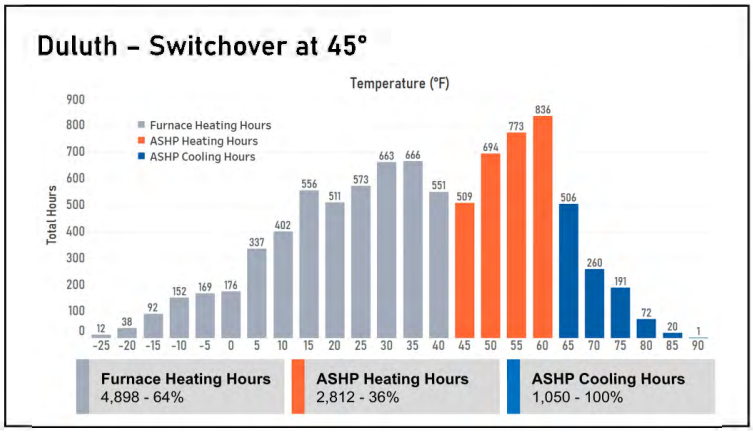
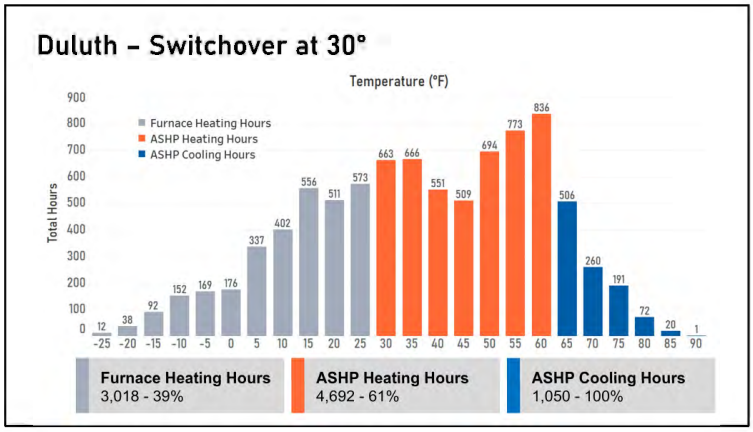
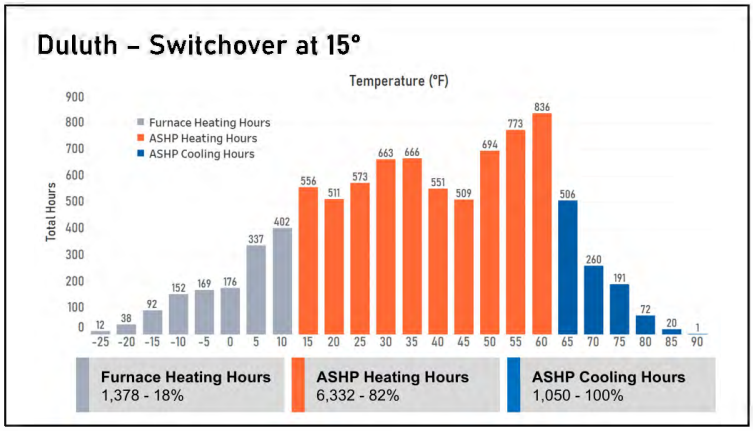
Present

	Facilitator	Notes
Slide 49		
Slide 50		-
Slide 51		

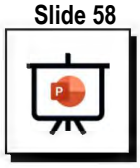
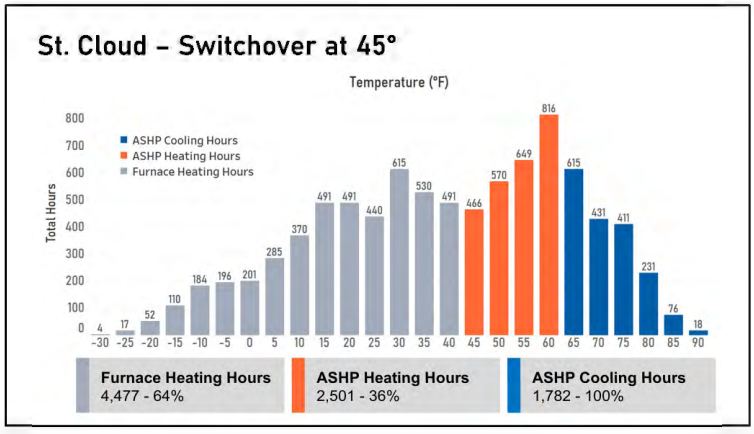
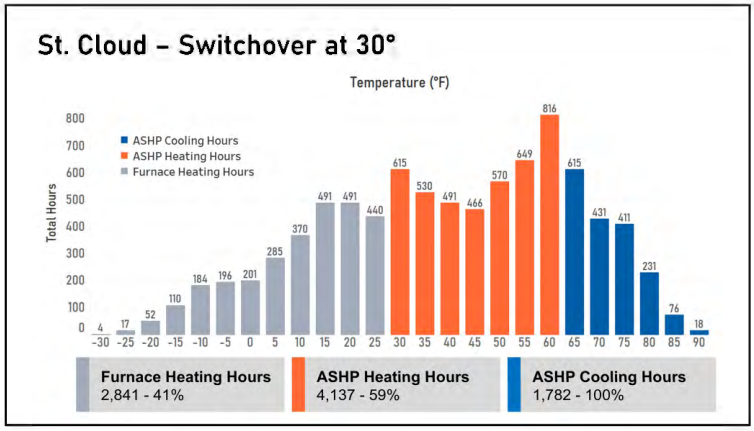
Present

	Facilitator	Notes
Slide 52		
Slide 53		
Slide 54		

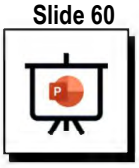
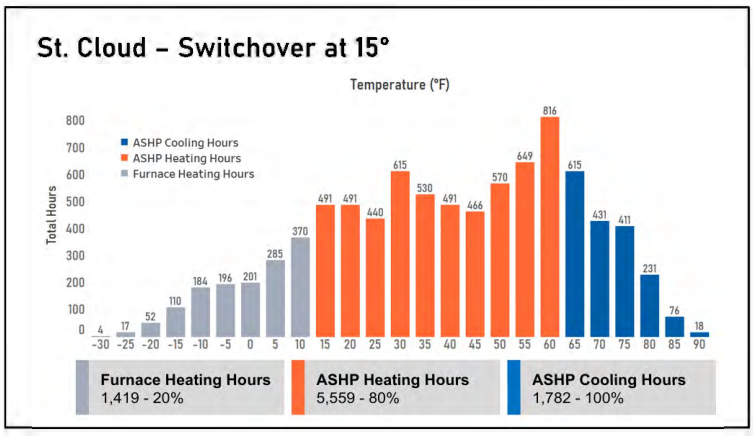
Present

	Facilitator	Notes
Slide 55		
Slide 56		
Slide 57		

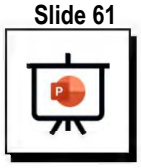
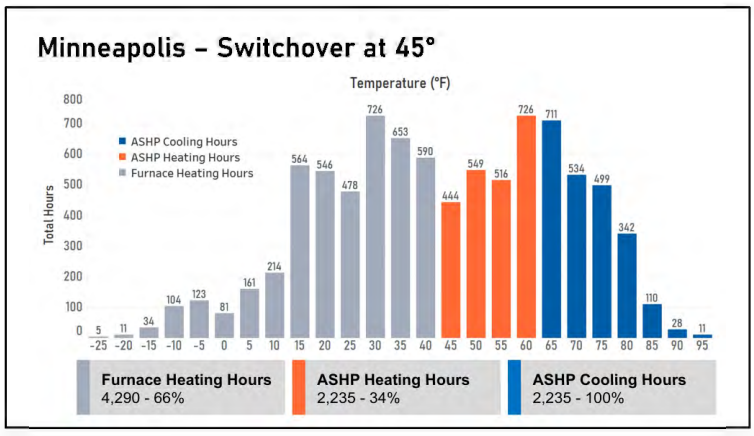
Present

Facilitator	Notes
Slide 58  	Percentage of ASHP heating hours in St. Cloud by switchover temp: 45 degrees = 36% 30 degrees = 59% 15 degrees = 80% 5 degrees = 89%
Slide 59  	Percentage of ASHP heating hours in St. Cloud by switchover temp: 45 degrees = 36% 30 degrees = 59% 15 degrees = 80% 5 degrees = 89%

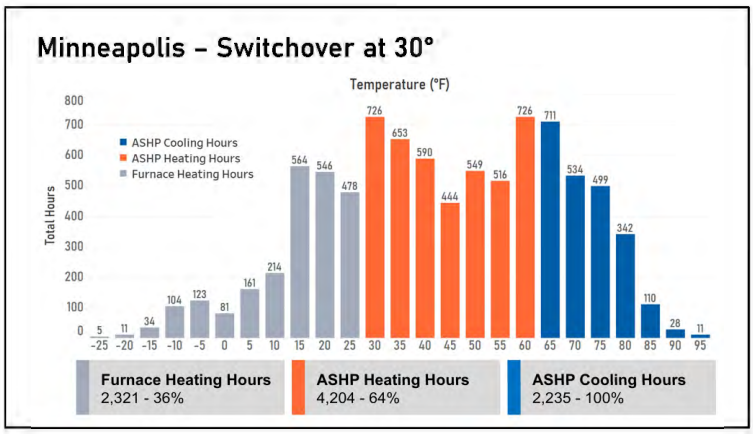
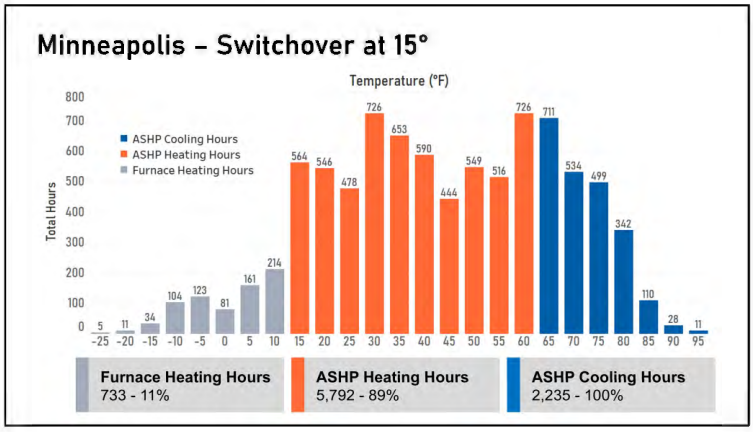
Present

Facilitator	Notes
Slide 60  	Percentage of ASHP heating hours in St. Cloud by switchover temp: 45 degrees = 36% 30 degrees = 59% 15 degrees = 80% 5 degrees = 89%

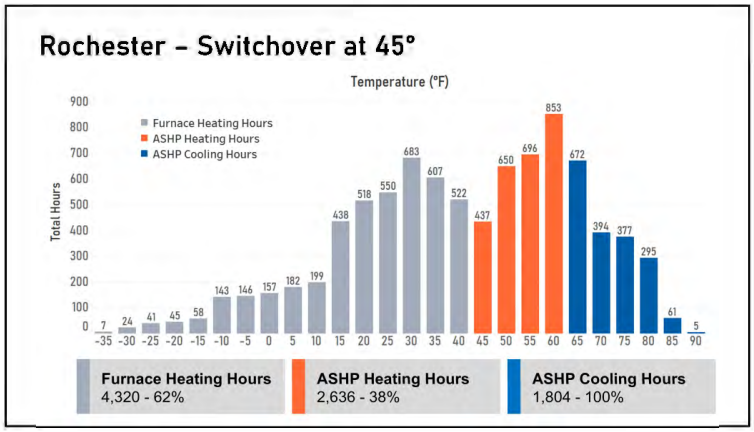
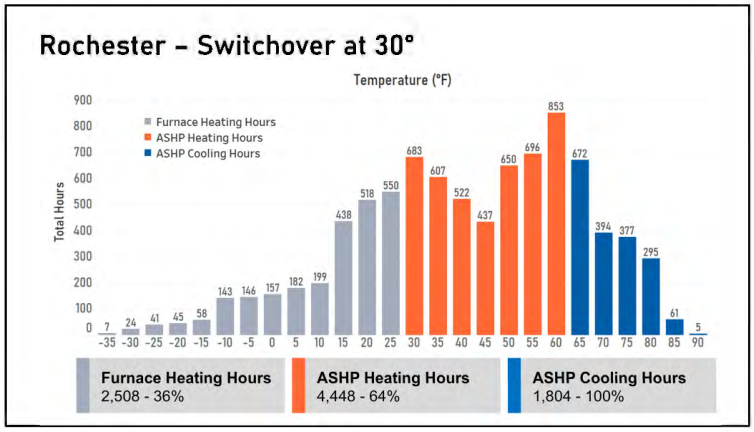
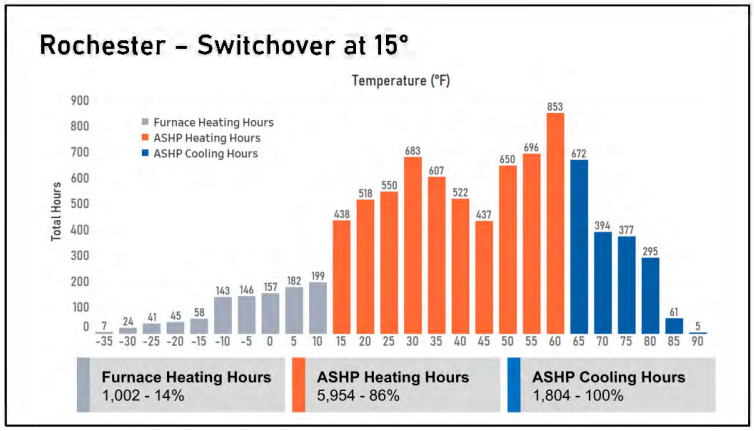
Present

Facilitator	Notes
Slide 61  	■ This is estimating heating hours, not heating load (make sure to clarify when presenting) – Load weighted hours are available in the NEEP Size for Heating tool ■ Set of 3 bin hour slides to be changed depending on location of training (whichever is most relevant) Percentage of ASHP heating hours in Minneapolis by switchover temp: 45 degrees = 34% 30 degrees = 64% 15 degrees = 89% 5 degrees = 95%

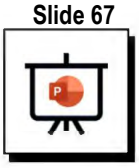
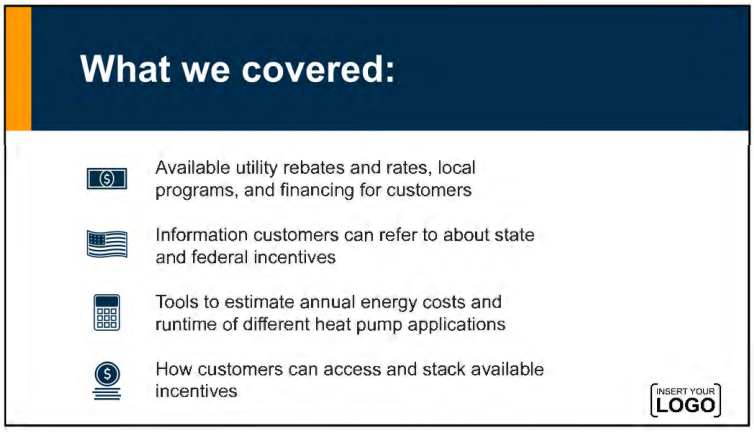
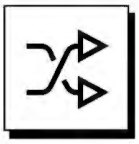
Present

	Facilitator	Notes
Slide 62		Percentage of ASHP heating hours in Minneapolis by switchover temp: 45 degrees = 34% 30 degrees = 64% 15 degrees = 89% 5 degrees = 95%
Slide 63		Percentage of ASHP heating hours in Minneapolis by switchover temp: 45 degrees = 34% 30 degrees = 64% 15 degrees = 89% 5 degrees = 95%

Present

	Facilitator	Notes
Slide 64		
Slide 65		
Slide 66		

Present

Facilitator	Notes
Slide 67  	
 **Transition to Homeowner Education**	

Homeowner Education

Goal

Share high priority topics to discuss with homeowner and tips on how to provide a high level of customer care to assure comfort and positive outcomes.

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

Overview

- **Recognize different customer perceptions and priorities**
- **Use survey data and messaging guides to build customer confidence in heat pumps**
- **Build trust in your expertise by addressing key items throughout the sales and installation process**
- **Give your customers valuable education so they become comfortable and satisfied heat pump owners**

Materials Needed

- Technology and Room Set-up
- Activity Handouts
- PPT Presentation

Present

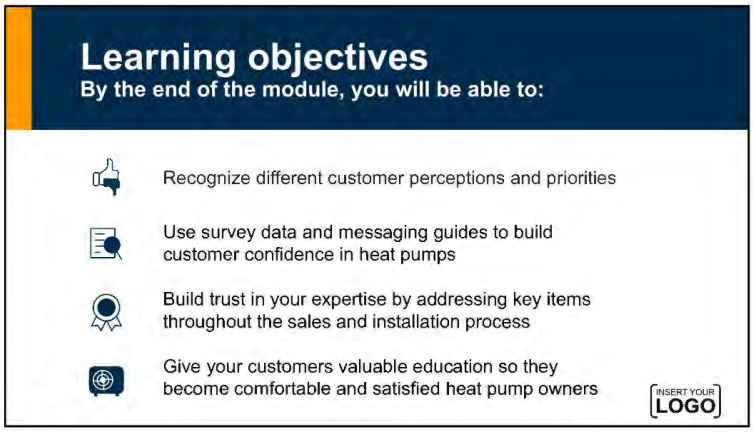
Facilitator	Notes

Cumulative time: 0 hours, 45 minutes

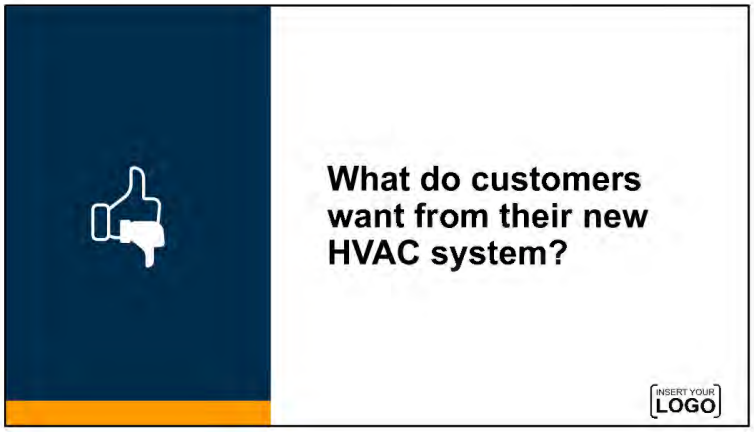
Time to complete this lesson: 30 minutes.

Slide 68

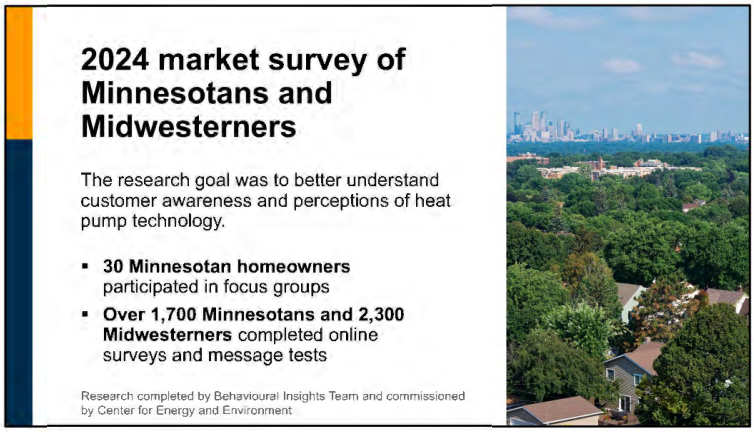
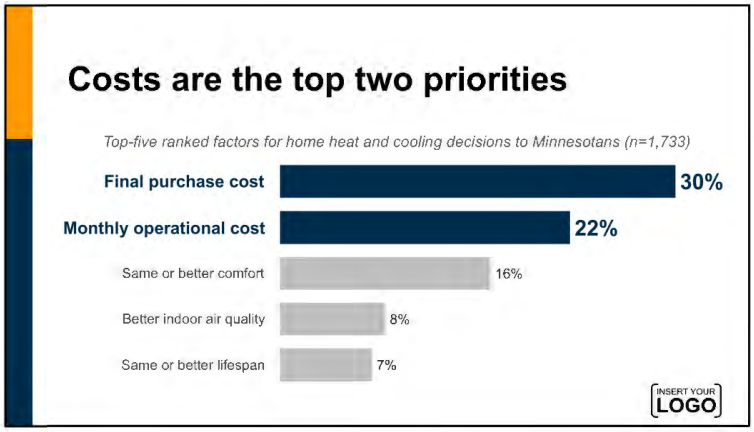
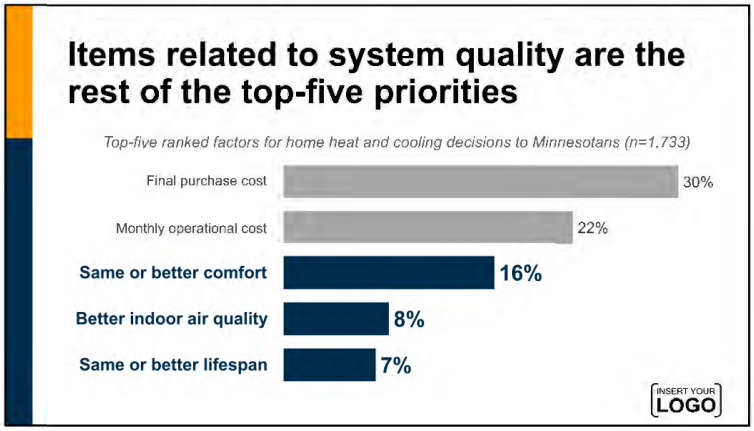
Slide 69



Slide 70



Present

	Facilitator	Notes
Slide 71		
Slide 72		
Slide 73		

Present

	Facilitator	Notes
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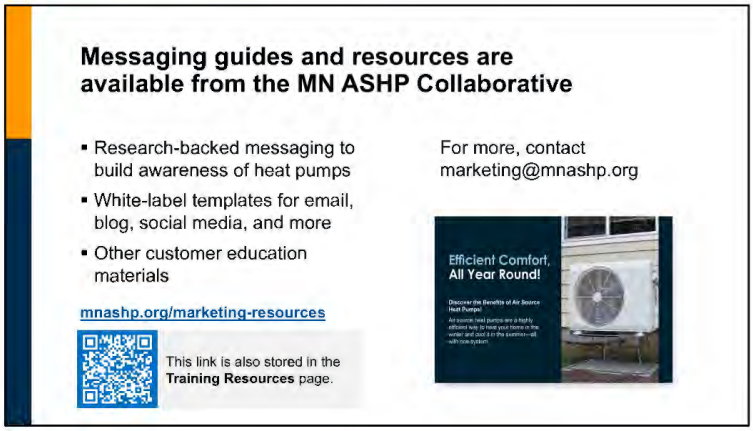
Slide 75		
Slide 76		

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	Facilitator	Notes
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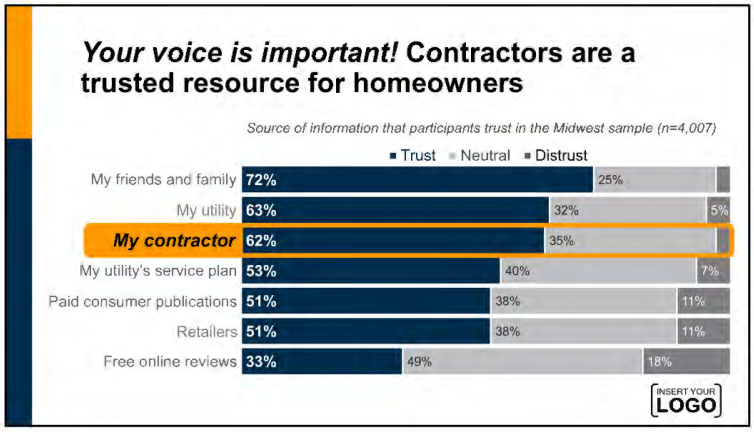
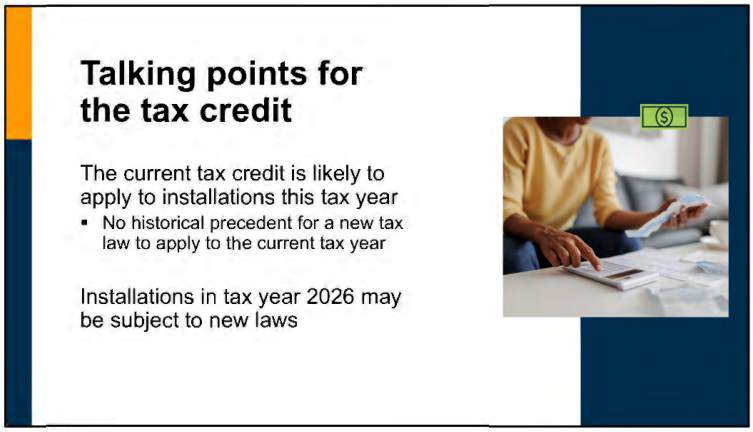
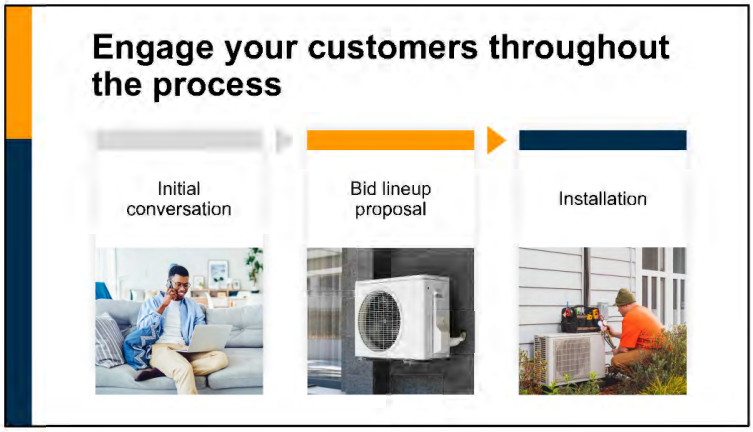
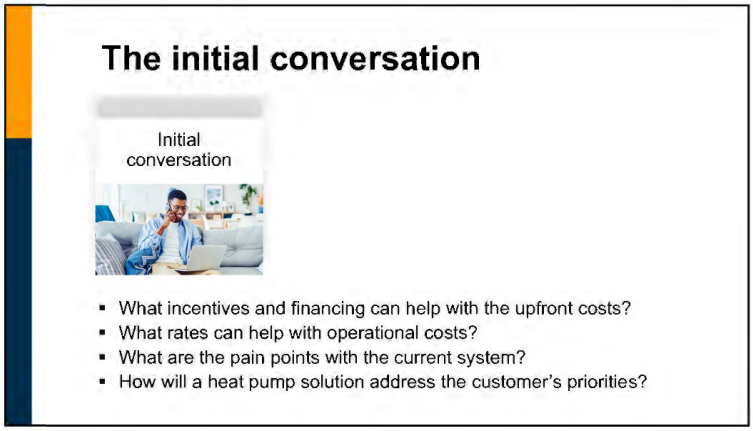
Slide 78		
Slide 79		

Present

	Facilitator	Notes
Slide 80		
Slide 81		
Slide 82		

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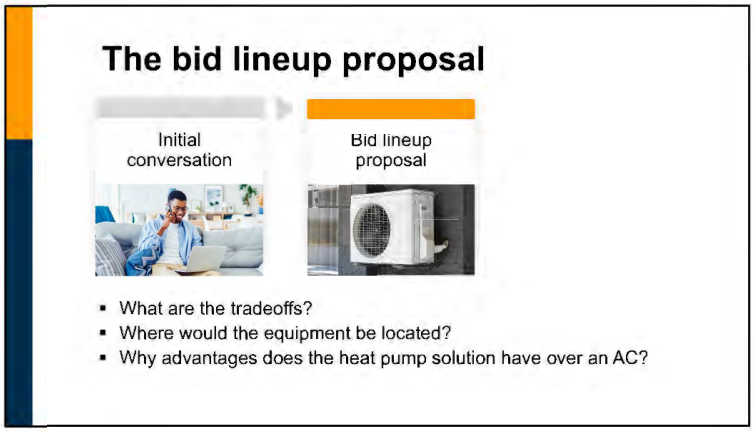
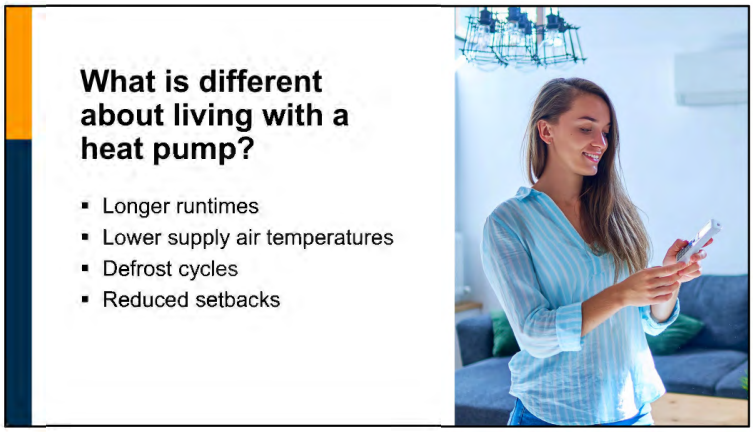
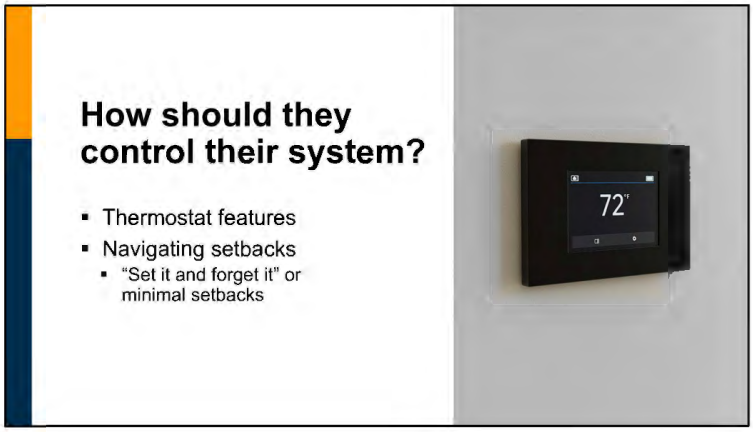
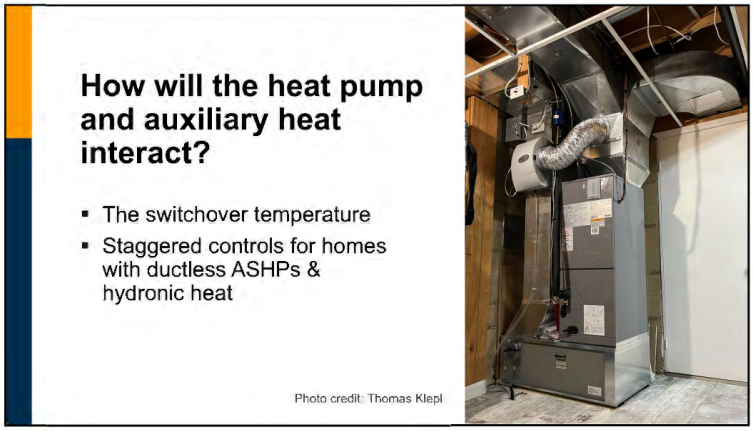
	Facilitator	Notes
Slide 83		
Slide 84		
Slide 85		

Present

	Facilitator	Notes
Slide 86		
Slide 87		
Slide 88		

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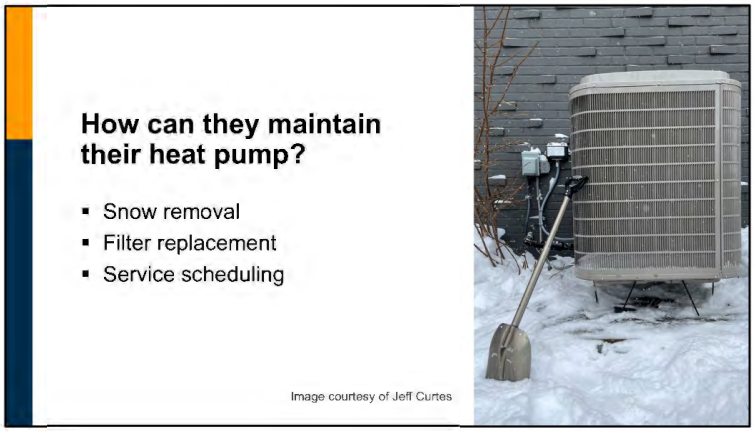
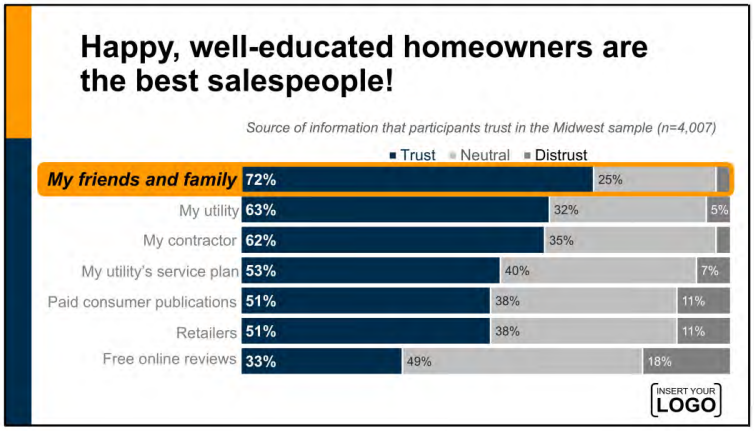
	Facilitator	Notes
Slide 89		
Slide 90		
Slide 91		

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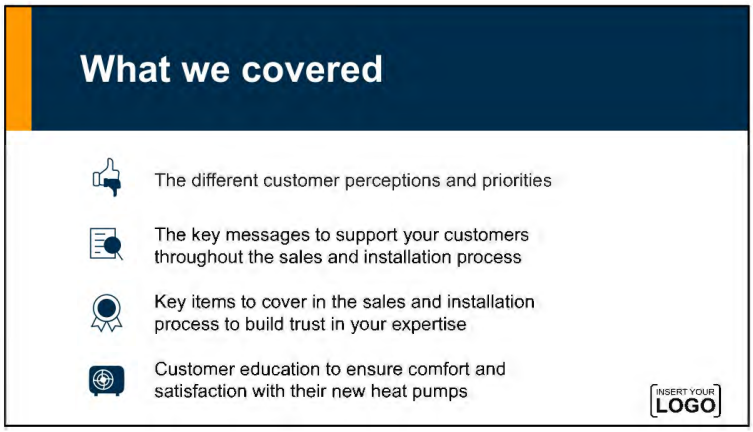
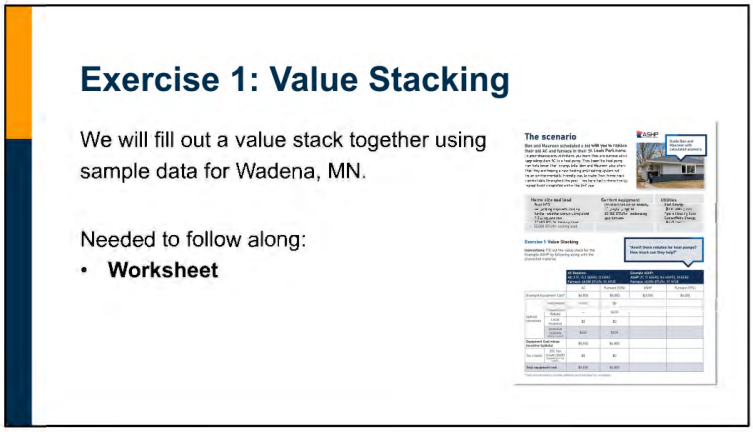
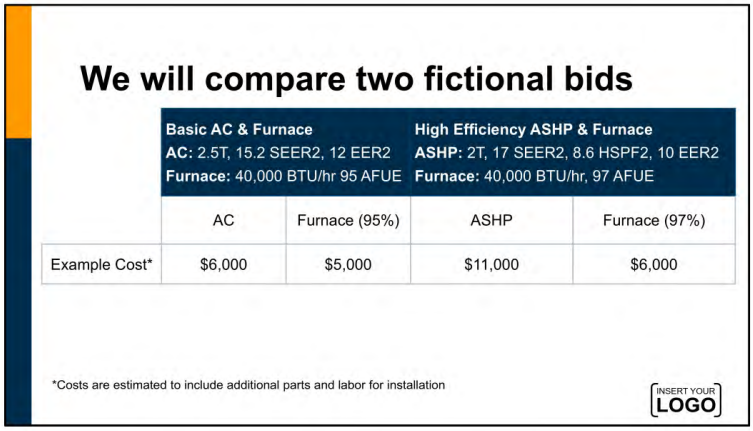
	Facilitator	Notes
Slide 92		
Slide 93		
Slide 94		

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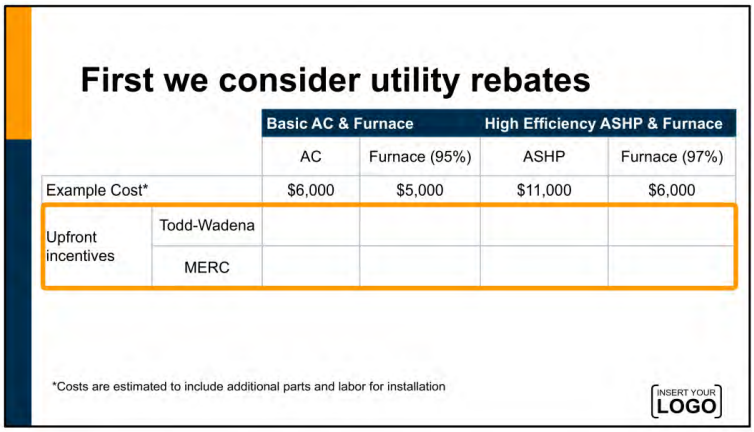
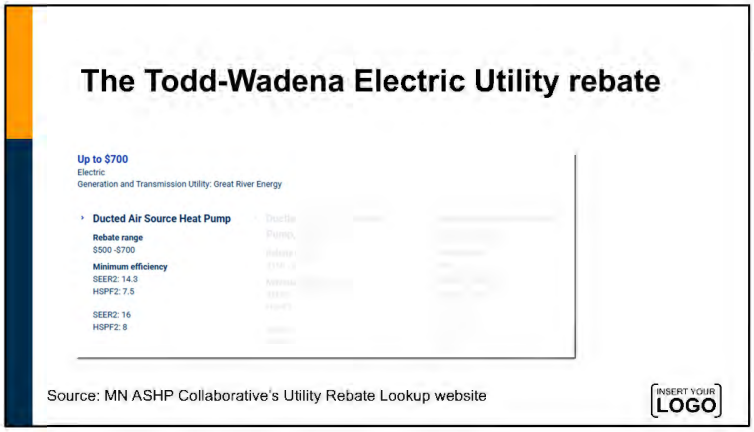
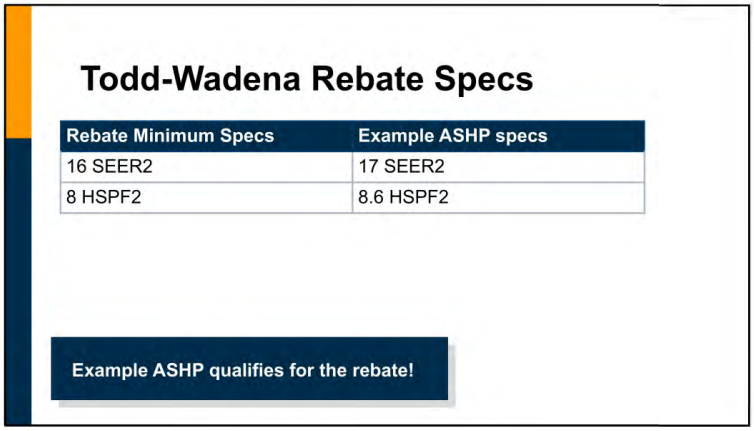
	Facilitator	Notes
Slide 95		
Slide 96		
Slide 97		

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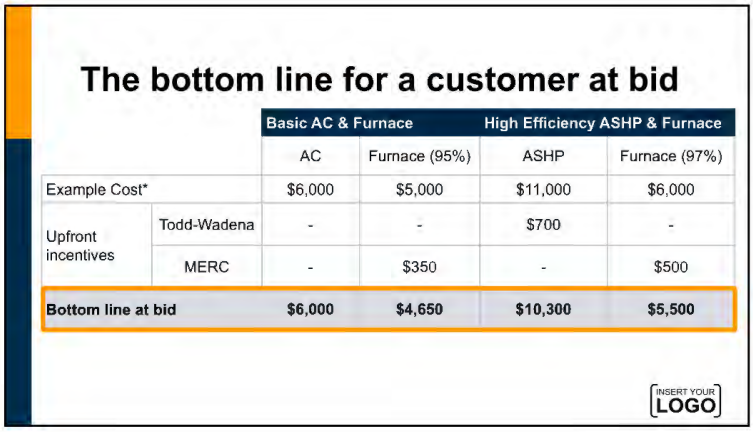
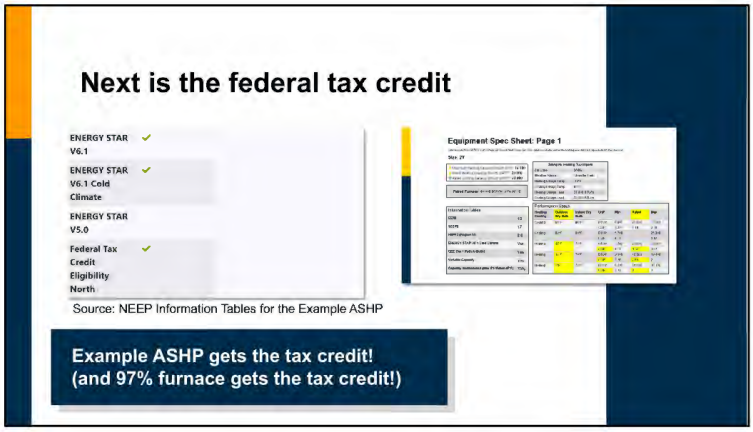
Facilitator	Notes

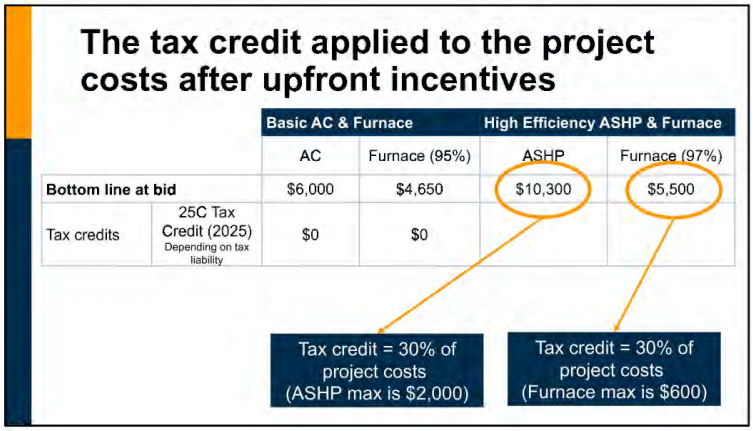
Slide 98



Slide 99



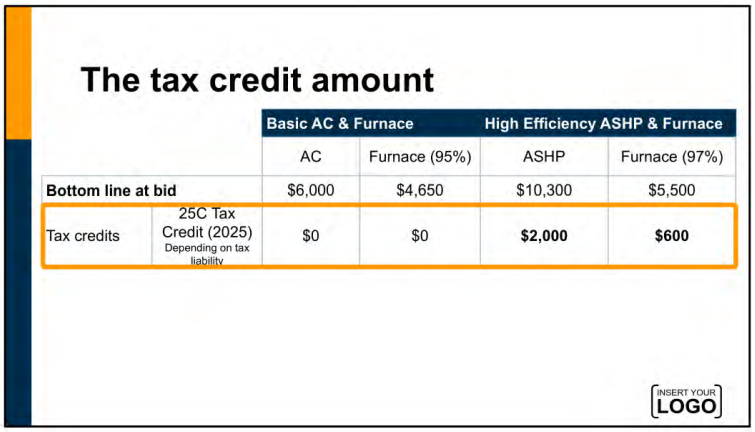
Slide 100



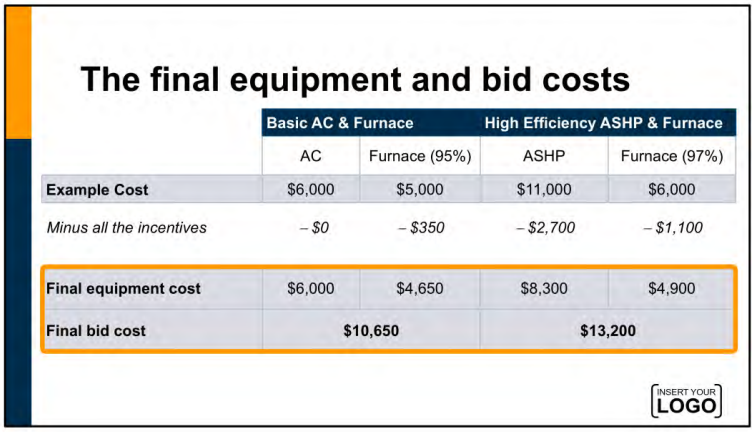
Present

	Facilitator	Notes

Slide 101



Slide 102



Transition to Best Practices for Sizing & Load Calculations

Best Practices for Sizing & Load Calculations

Goal

Identify the various sizing methods that are recommended in completing high-accuracy load calculations (Manual J or equivalent).

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

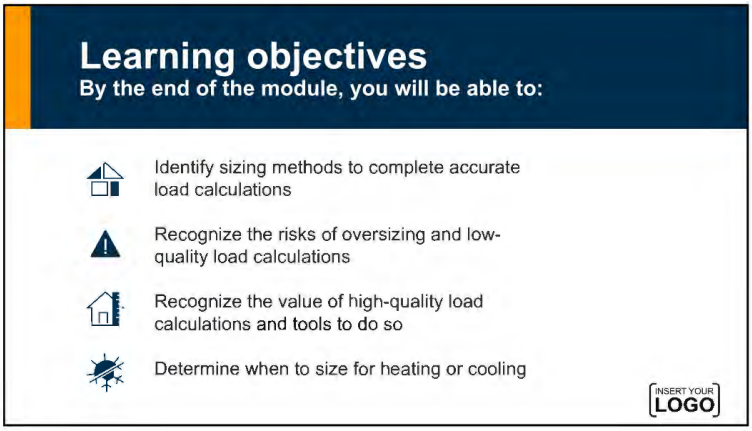
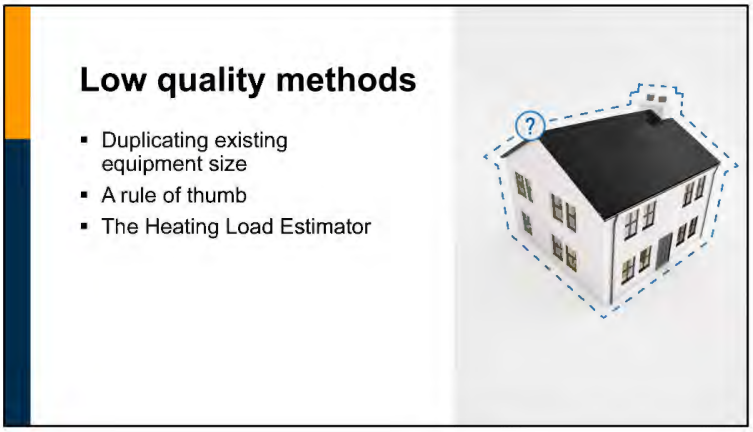
Overview

- **Identify sizing methods to complete accurate load calculations**
- **Recognize the risks of oversizing and low-quality load calculations**
- **Recognize the value of high-quality load calculations and tools to do so**
- **Determine when to size for heating or cooling**

Materials Needed

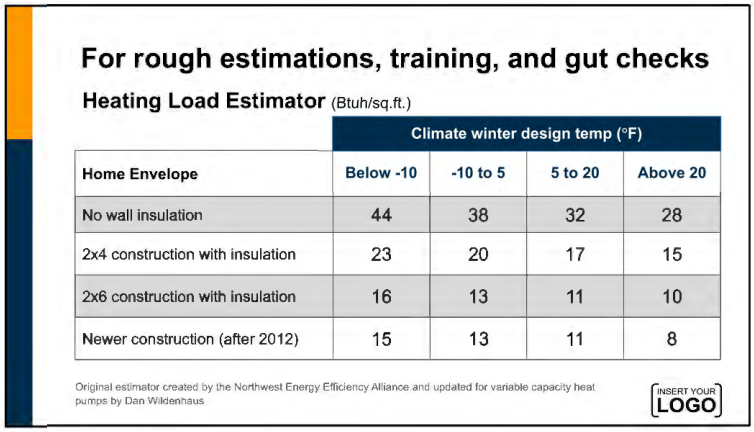
- Technology and Room Set-up
- Handouts
- PPT Presentation

Present

Facilitator	Notes
Cumulative time: 1 hour, 15 minutes Time to complete this lesson: 30 minutes.	
Slide 103 	
Slide 104 	■ Acknowledge the market barrier (more effort, uncertain bid) ■ Mention tools to help
Slide 105 	- 3T AC previously installed, simply install a 3T ASHP without completing a new load calculation

Present

Slide 106



For rough estimations, training, and gut checks

Heating Load Estimator (Btuh/sq.ft.)

	Climate winter design temp (°F)			
Home Envelope	Below -10	-10 to 5	5 to 20	Above 20
No wall insulation	44	38	32	28
2x4 construction with insulation	23	20	17	15
2x6 construction with insulation	16	13	11	10
Newer construction (after 2012)	15	13	11	8

Original estimator created by the Northwest Energy Efficiency Alliance and updated for variable capacity heat pumps by Dan Wildenhaus

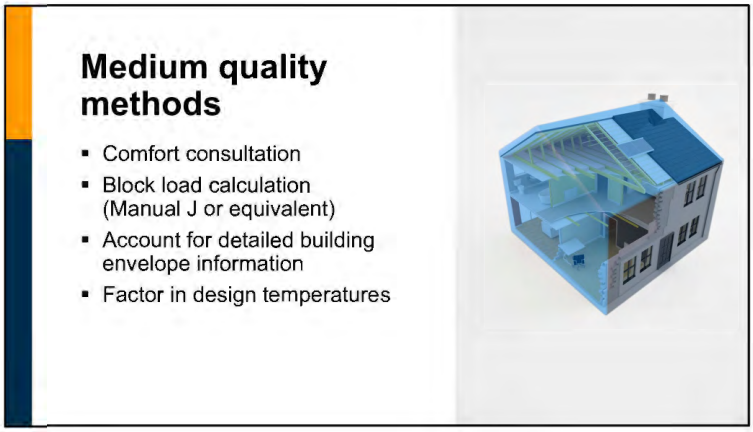
INSERT YOUR LOGO

Facilitator	Notes
	■ If you are going to use a Rule of Thumb, we recommend enhanced rules of thumb that add context of both home insulation levels and climate zone. ■ This tool should be used for "gut checking" an existing system or your own calculated heating load. ■ If time constraints don't allow for a full Manual J calculation, this table can be very helpful to verify that you're in the correct load range for block load calculations ■ (original graph noted climate winter design temp @ 99% for dual fuel, and @ 99.6% for all-electric)

Present

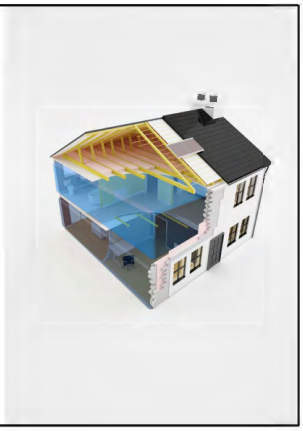
Facilitator	Notes

Slide 107

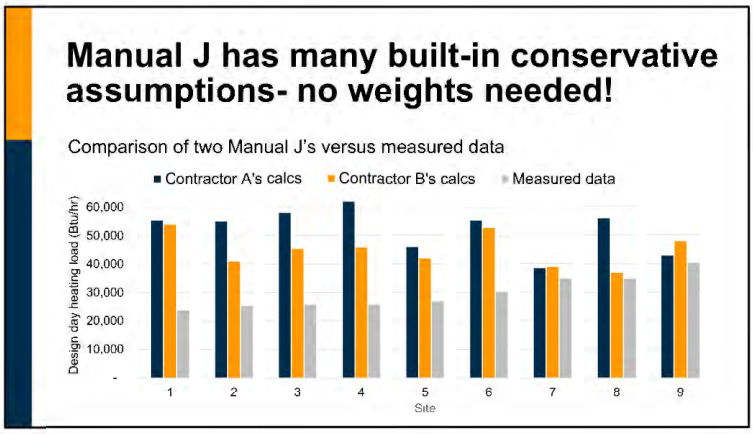


- Comfort consult – talk to the customer and understand what they like/don't like about their current HVAC system
  - Too hot/cold in any particular area of the home, lack of dehumidification in the summer, etc.
- Run time/utility bills – this can be time consuming, but is very helpful to understand if the system is oversized based on runtimes and expected vs actual utility costs with current equipment size
  - Example: can use an ecobee to get runtime data

Present

	Facilitator	Notes
Slide 108	**High quality methods** ▪ Comfort consultation ▪ Room-by-room Manual J or equivalent ▪ Account for detailed building envelope information ▪ Factor in design temperatures ▪ Factoring in existing equipment's run time or customer's utility bills 	- Taking into account the building envelope is critical in achieving a higher accuracy load calculation
Slide 109	**Design temperatures** There are multiple design temp values depending on the source! • For example, ASHRAE, Manual J, NEEP Sizing for Heating tool, etc. **Best practice is to use the MN Mechanical Code** consistently across different tools and calculation methods. INSERT YOUR LOGO	ASHRAE – science/engineering based values for design temps Be on the lookout for tools that auto-populate design temps, like the NEEP Sizing for Heating tool.
Slide 110	**Using ASHRAE look up for most accurate design temps** MINNEAPOLIS-ST PAUL, MN, USA (WMO: 726580) Heating DB: 99.6% = -23.6; 99% = -21.1 Cooling DB/MCWB: 0.4% DB 32.7 / MCWB 23.0; 1% DB 31.1 / MCWB 22.2; 2% DB 29.5 / MCWB 21.3 https://ashrae-meteo.info/v2.0/index.php?lat=39.833&lng=-104.658&place=%27%27&wmo=725650 INSERT YOUR LOGO	Animated.

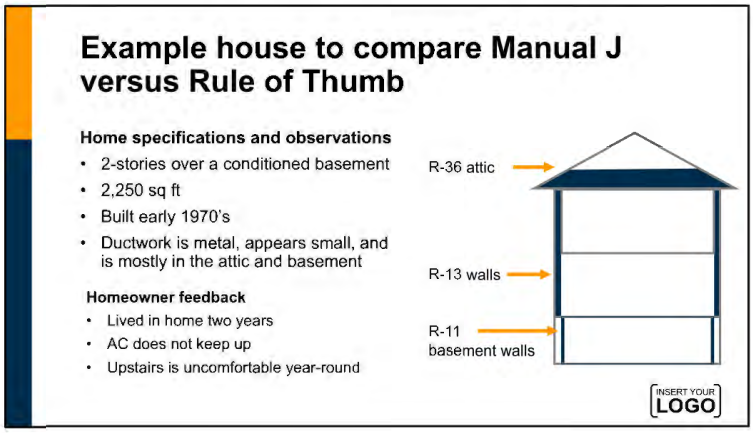
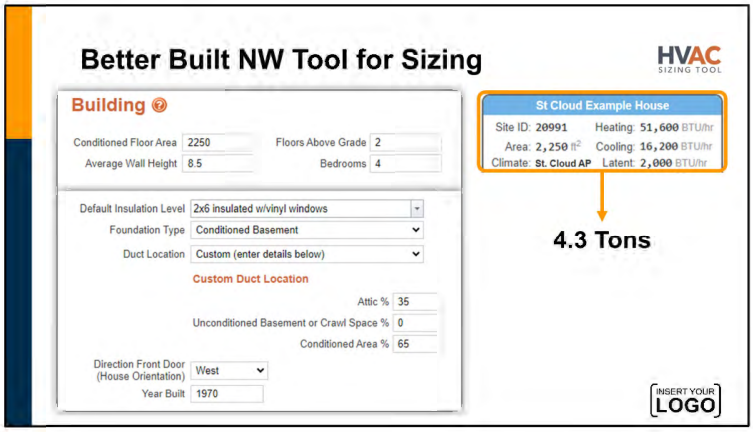
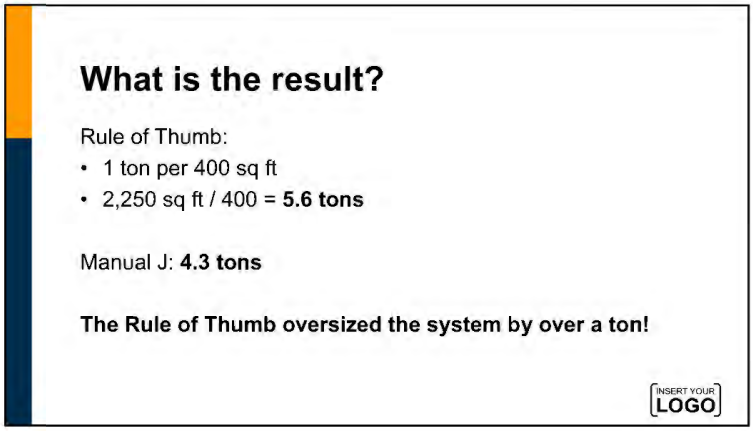
Present

	Facilitator	Notes
Slide 111		
Slide 112		Has anyone in here thought that Manual J does not have buffers in place for sizing? Research background: ■ Conducted by CEE for a gas boiler program that was run in 2017 ■ Two different contractors who were told we would be reviewing their manual J calculations ■ Key takeaways – Manual J calcs were mostly much higher than the actual measured heating load needed for the homes – Differences between contractor A and B can be due to different

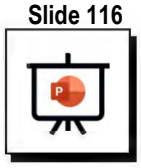
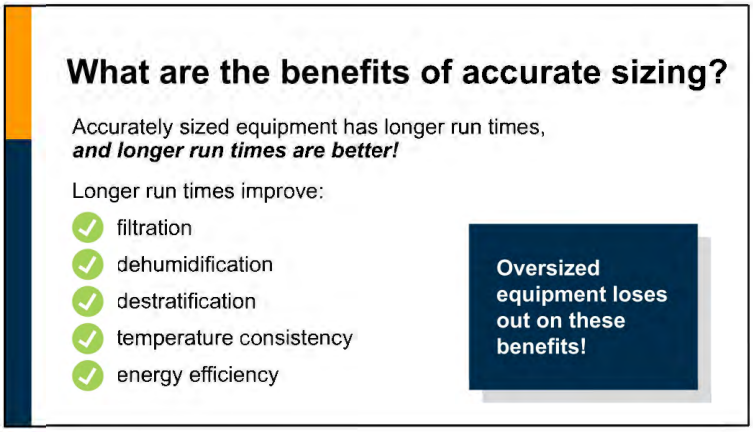
Present

Facilitator	Notes
	software used, different assumptions, discrepancies in building envelope assessments, etc. – Shows that Manual J has a lot of built-in conservative assumptions • If rules of thumb are oversizing compared to Manual J and Manual J is oversizing vs measured loads, we can see how likely it is to end up with oversized loads and equipment • Sizing to meet Manual J load calcs is still a safe/conservative way to meet the heating and cooling needs of the home

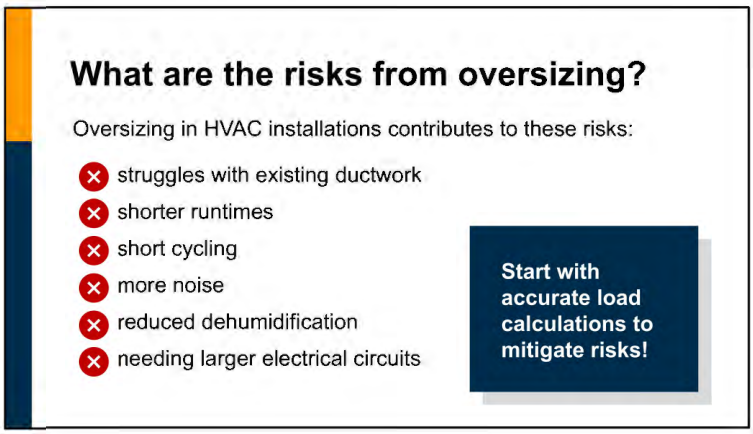
Present

	Facilitator	Notes
Slide 113		
Slide 114		Note that this house is larger, but has a lower BTU/sq ft.
Slide 115		

Present

Facilitator	Notes
Slide 116  	■ Longer run times are good for all types of equipment, but they especially optimize performance of cold climate, variable speed heat pumps ■ If the customer has shared dissatisfaction with their current HVAC system around inconsistent temperatures, lack of dehumidification, and/or IAQ, promoting the benefits of longer run times can be a very valuable sales tool

Present

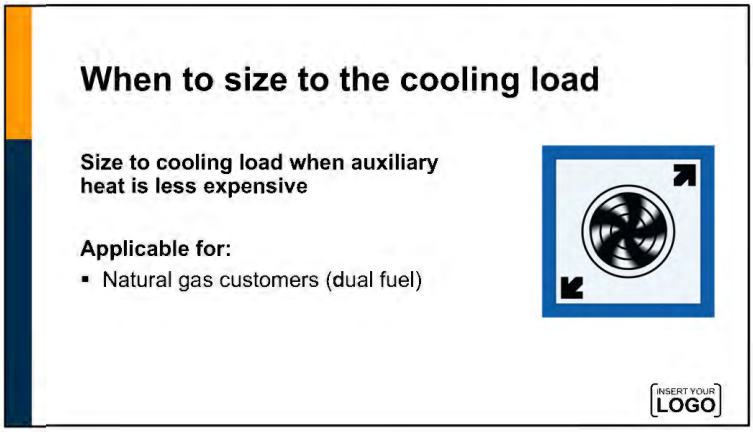
Facilitator	Notes
Slide 117  	■ Struggles with existing ductwork – Lack of delivered air; customer is not getting the capacity they paid for – Results in system working harder than it needs to; increased noise, more frequent fan motor replacement, risk of coils freezing, etc. – Shorter runtimes, short cycling, less dehumidification ■ Larger systems require larger electrical circuits – Potential to increase installation costs, overall electric usage

Present

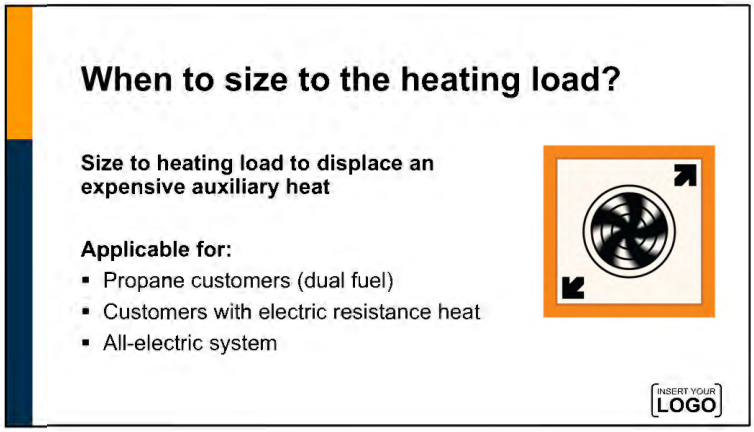
	Facilitator	Notes
Slide 118	**Is the homeowner planning to have any weatherization work done?** Why this is a valuable question to ask before installation: • Future weatherization will change the home loads • Weatherization contractors can be a valuable partner in your design process  INSERT YOUR LOGO	
Slide 119	**Possible responses to plans around weatherization** INSERT YOUR LOGO	

Is the homeowner considering future weatherization?	How could you respond?
Yes	Recommend installing a heat pump at the same time or after the weatherization project occurs
No	Recommend installing a heat pump that is flexible for lower loads in the future
Not sure	Introduce the homeowner to a weatherization service!

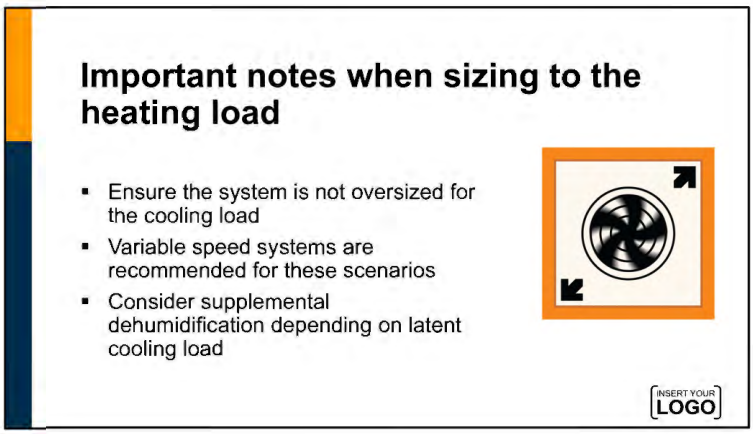
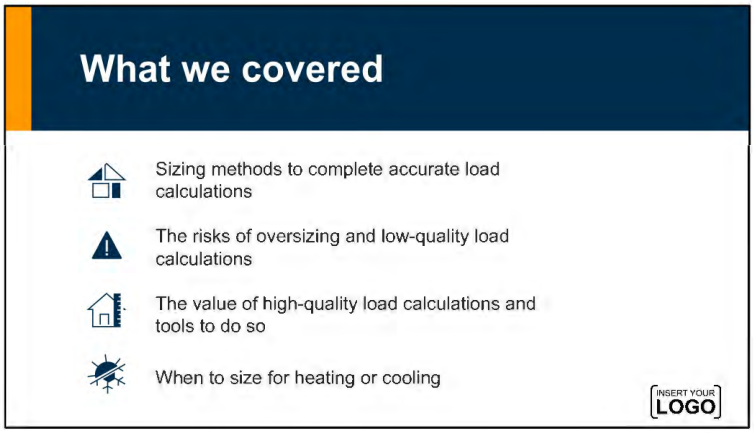
Present

Facilitator	Notes
Slide 120  	■ If a customer has natural gas for their auxiliary heat, we can size the heat pump closer to the cooling load ■ Since natural gas is cheap compared to electric, it's not often beneficial for the heat pump to take a larger portion of the heating load.

Present

Facilitator	Notes
Slide 121  	■ If a customer has propane or electric resistance auxiliary heat, it's almost always going to be more economical to heat the home with a heat pump ■ Size to the heating load as much as possible without being oversized for cooling to maximize operational cost savings for the customer – Being oversized for the cooling load can result in frequent low-load cycling and reducing all benefits of longer runtimes in the cooling season (dehumidification, air filtration/IAQ, destratification, etc.)

Present

	Facilitator	Notes
Slide 122		Don't oversize for cooling – can result in the following negative results: compressor short cycling, negative impact to system longevity, lack of dehumidification, lose many benefits that come with longer run times - Variable speed systems are the best solution – allows for the heat pump to be sized to take on more of the heating load in winter; can modulate down to a lower operating mode/fan speed in summer to maintain benefits of longer runtimes without as much risk of short cycling
Slide 123		

Present

Facilitator	Notes
Transition to Ductwork & Airflow	

Ductwork & Airflow

Goal

Reveal the importance of ductwork assessment with high level steps. Identify the risks and impacts to system operation as a result of ductwork being improperly sized or maintained.

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

Overview

- **Recognize the importance of a ductwork assessment**
- **Assess the ductwork in three steps: Compare airflow requirements, interview the homeowner, and evaluate**
- **Diagnose any ductwork issues and resolve through feasible modifications or replacement**

Materials Needed

- Technology and Room Set-up
- Handouts
- PPT Presentation

Present

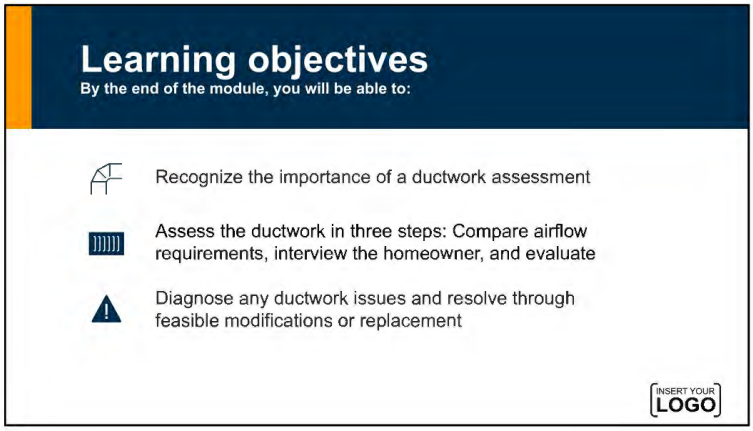
Facilitator	Notes

Cumulative time: 1 hour, 45 minutes

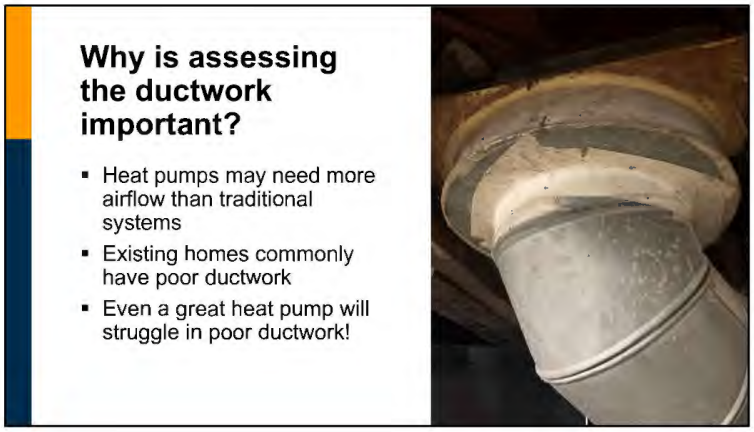
Time to complete this lesson: 30 minutes.

Slide 124

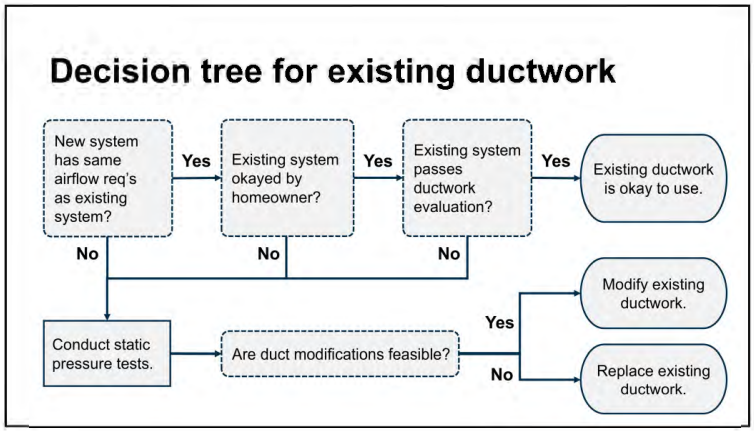
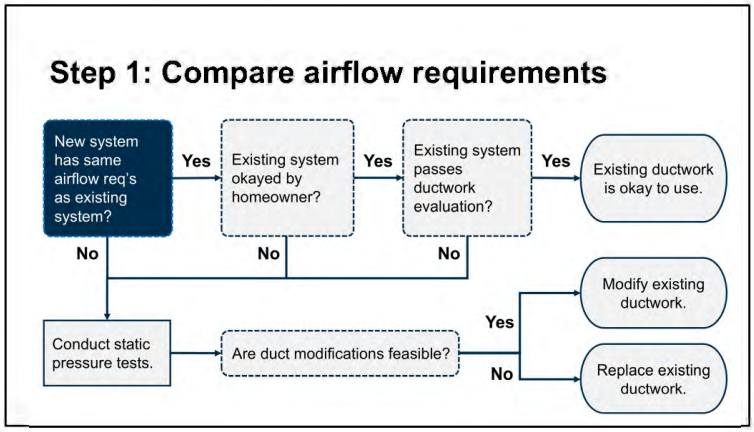
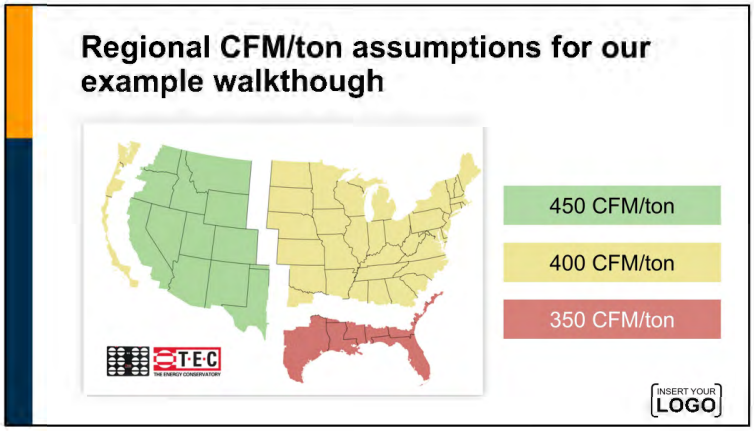
Slide 125



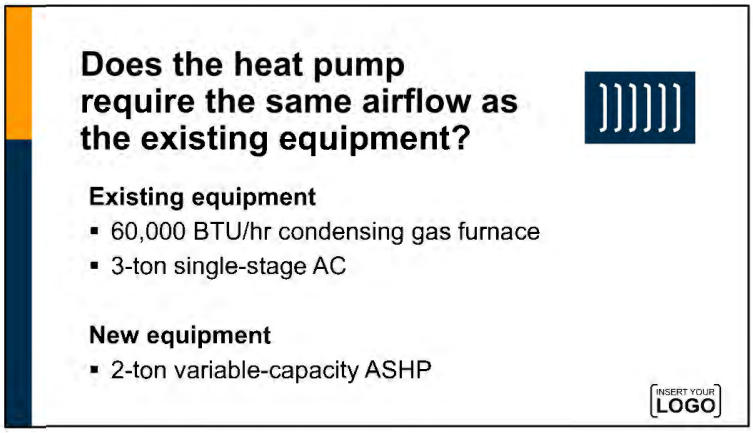
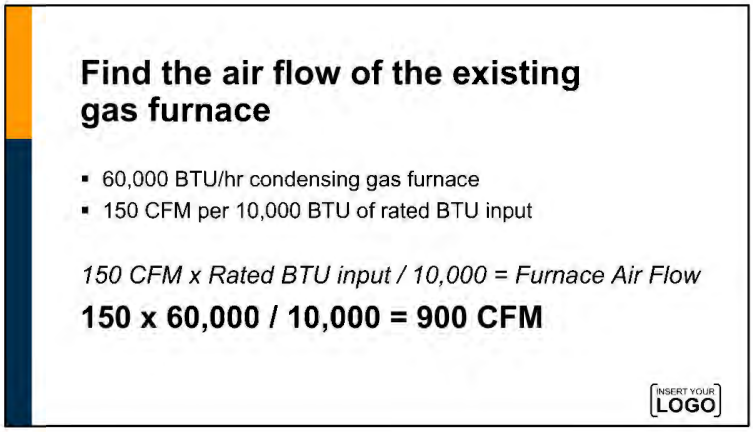
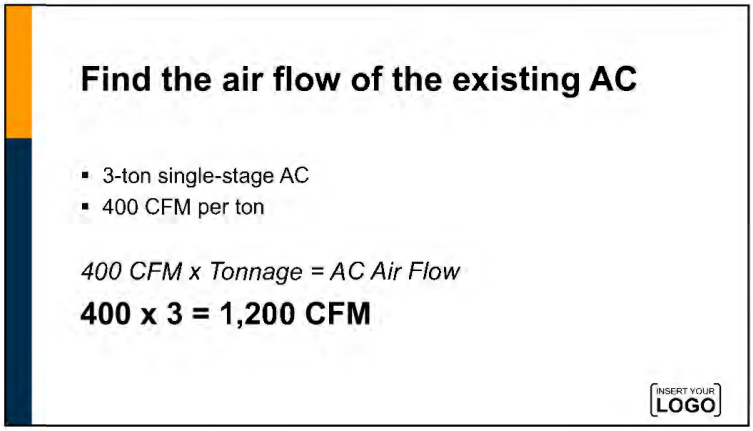
Slide 126



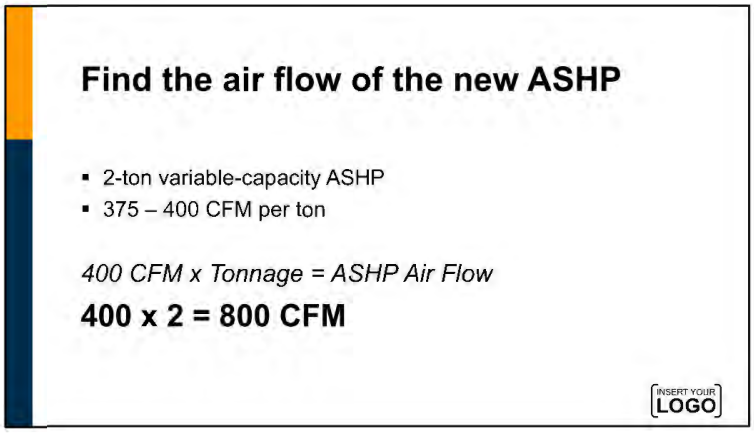
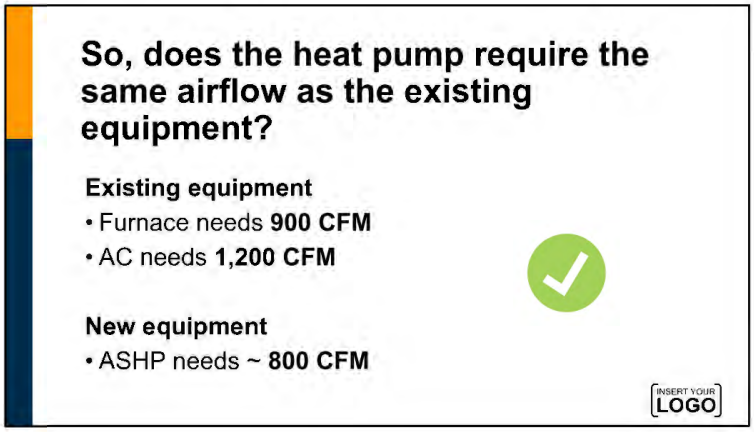
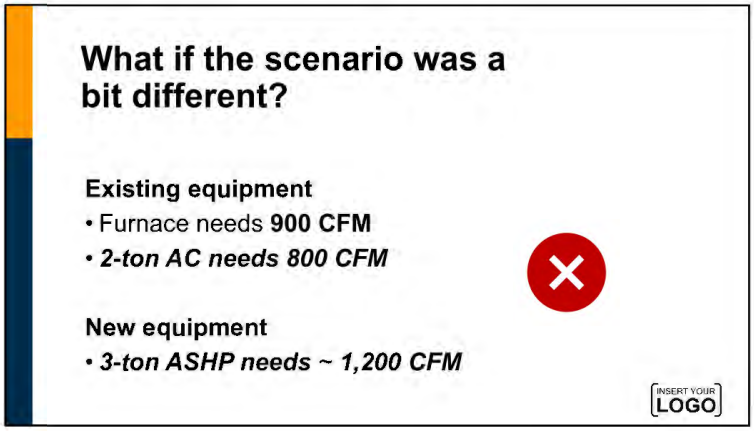
Present

	Facilitator	Notes
Slide 127		
Slide 128		
Slide 129		

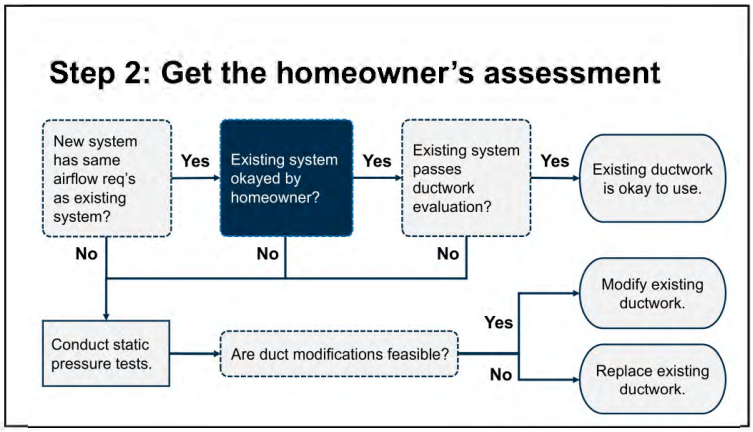
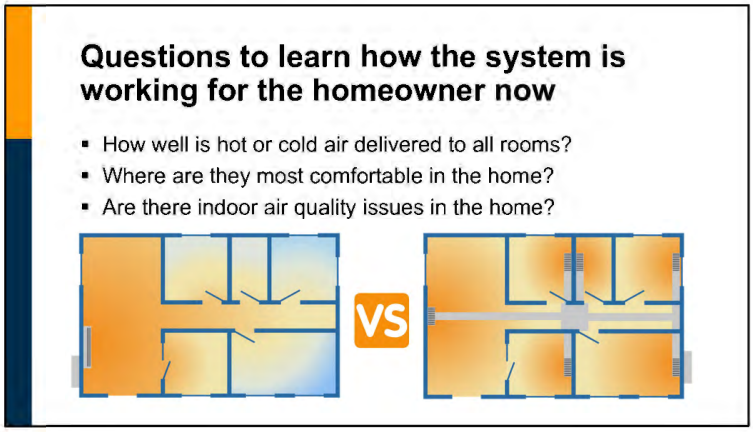
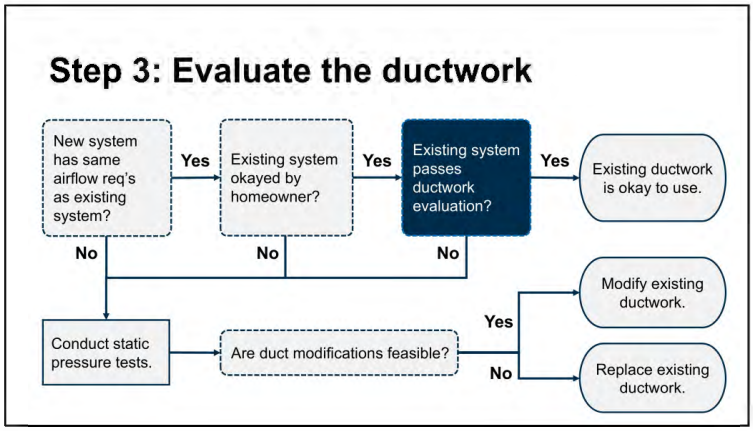
Present

	Facilitator	Notes
Slide 130		
Slide 131		
Slide 132		

Present

	Facilitator	Notes
Slide 133		
Slide 134		
Slide 135		

Present

	Facilitator	Notes
Slide 136		
Slide 137		
Slide 138		

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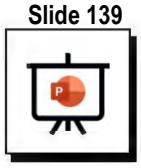
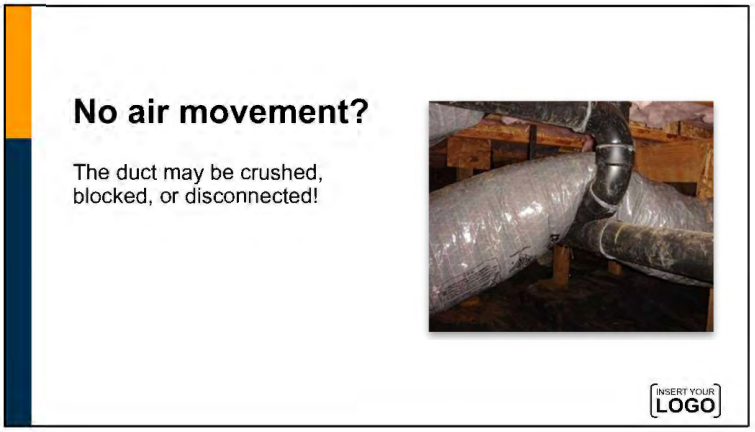
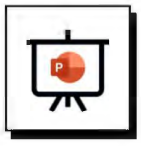
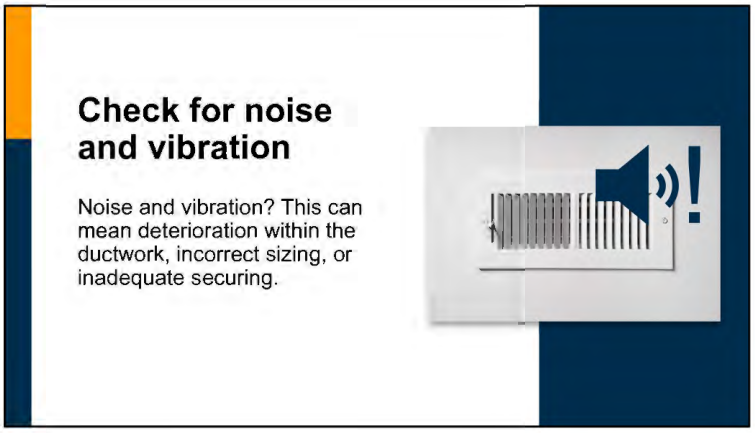
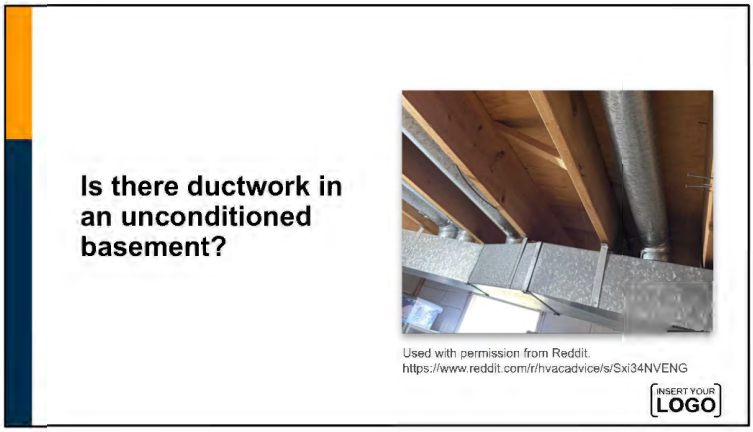
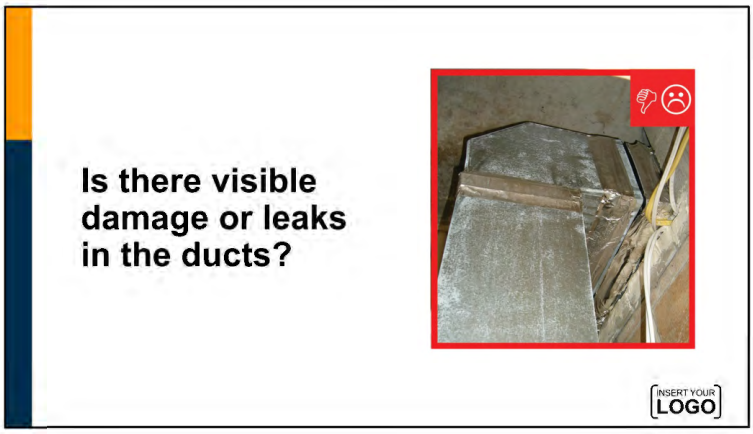
Facilitator	Notes
Slide 139  	Both images from the Building America Solution Center – free to use! https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A114&page=2
Slide 140  	Both images from the Building America Solution Center – free to use! https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A114&page=2
Slide 141  	Both images from the Building America Solution Center – free to use! https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A114&page=2

Present

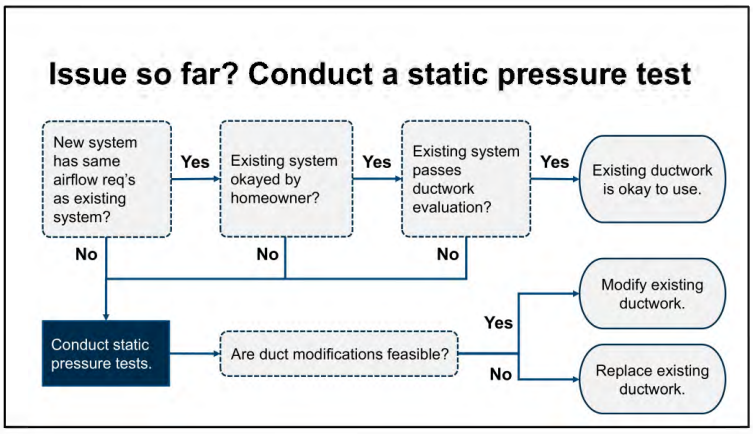
	Facilitator	Notes
Slide 142		
Slide 143		■ Image from BASC: https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A114&page=1 ■ Check accessible ducts for any visible gaps or tears in insulation ■ Trace each branch checking for compressed ducts and sharp bends or kinks

Present

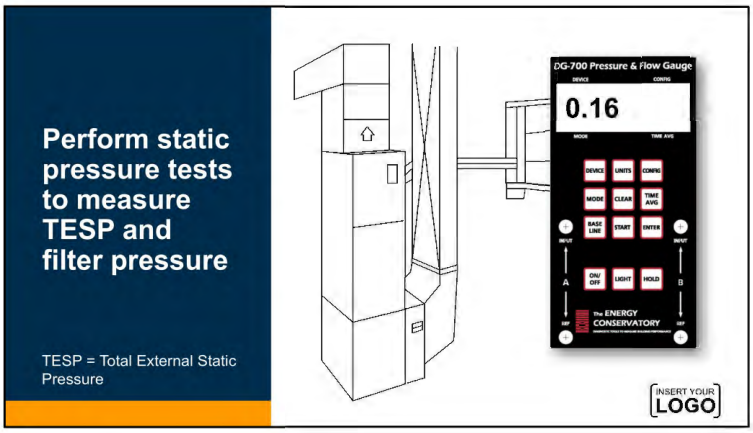
Facilitator	Notes

Slide 144

Slide 145



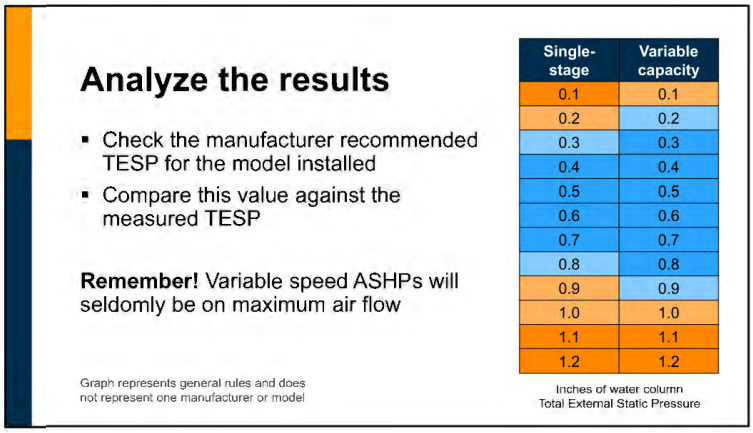
Slide 146



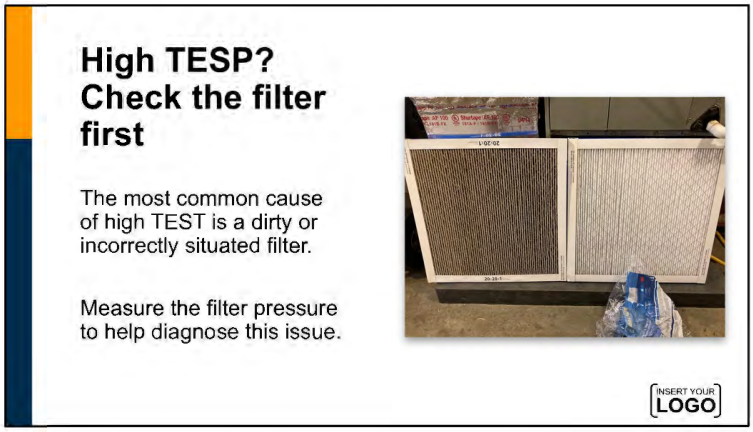
Present

Facilitator	Notes

Slide 147



Slide 148



Filter pressure – important to understand filter impact to TESP, especially if filter is dirty and in need of replacement

Image source: https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A120

Slide 149

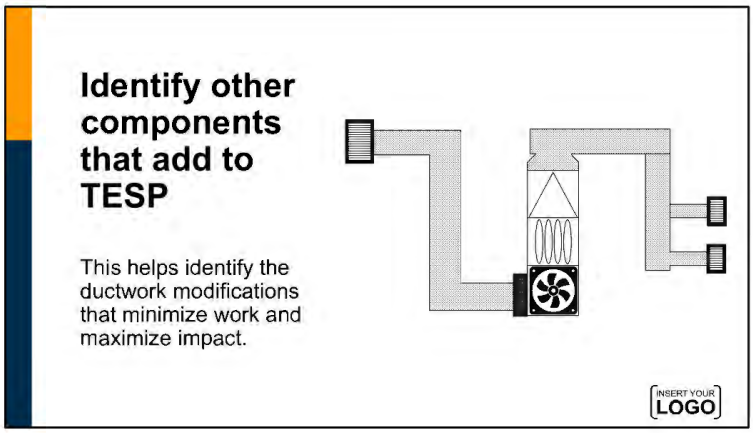
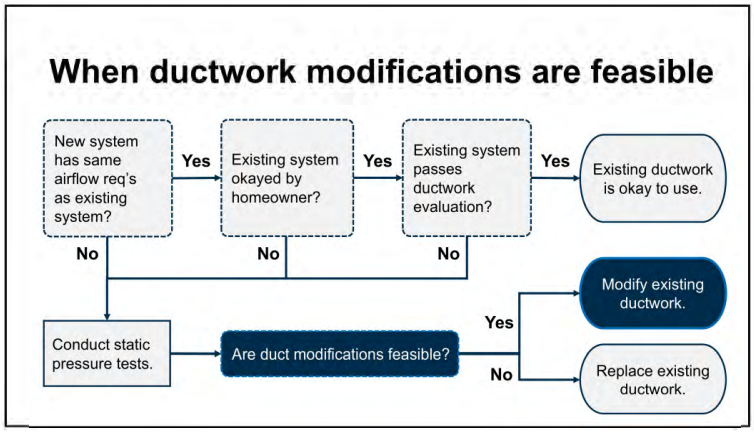
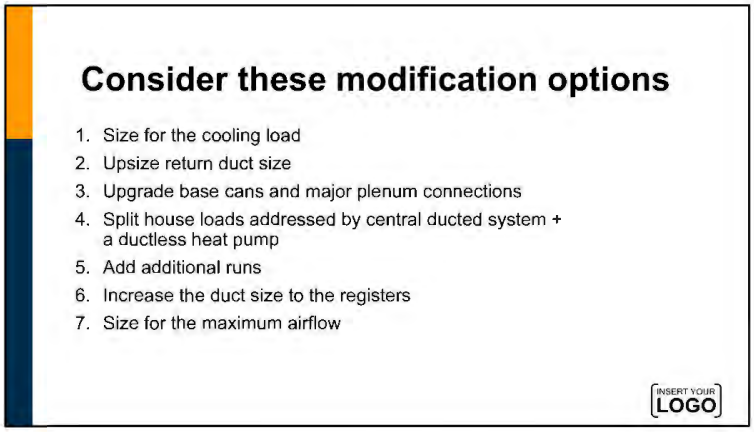
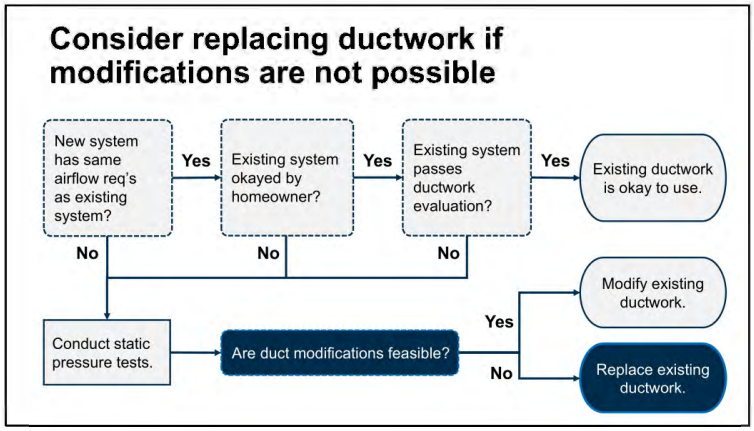
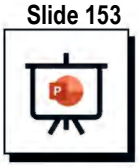
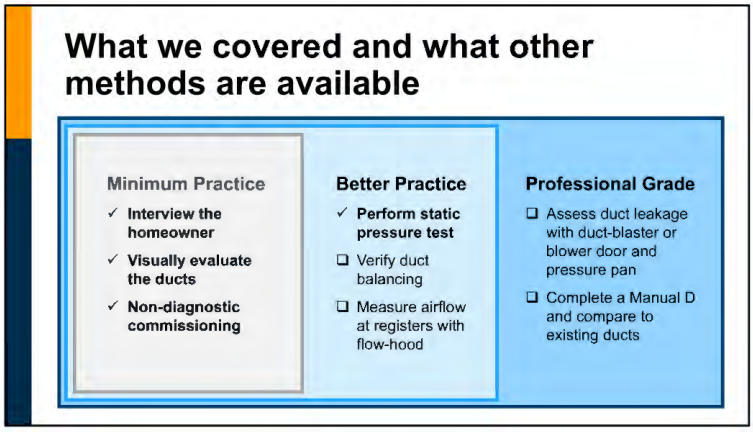
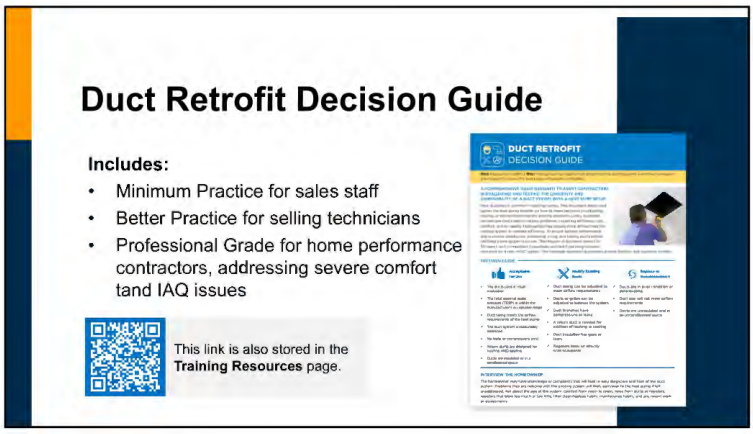


Image source: https://basc.pnnl.gov/images?f%5B0%5D=basc_keywords%3A120

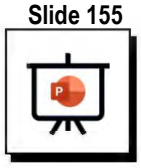
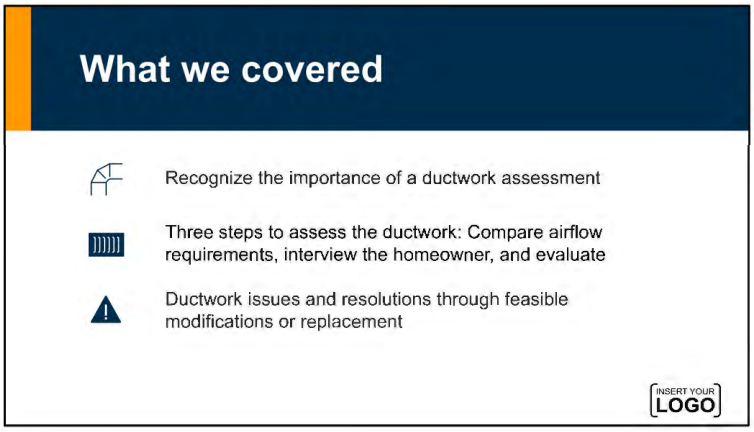
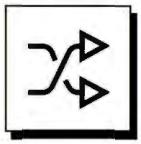
Present

	Facilitator	Notes
Slide 150		
Slide 151		Caution: When potential asbestos-containing materials are present, refer to a remediation specialist.
Slide 152		

Present

Facilitator	Notes
Slide 153  	https://cee1.org/images/pdf/CEE_Duct_Retrofit_Decision_Guide_TRC_01.16.24.pdf
Slide 154  	All of these installation considerations and more can be found through our ASHP Installation Best Practices Guide, which can be found on our website. Following these best practices and using the proper tools are some of the best ways to ensure an installation delivers on the projected performance.

Present

Facilitator	Notes
Slide 155  	Acknowledge the market barrier (more effort, uncertain bid) Mention tools to help
 **Transition to Control Strategies**	

Control Strategies

Goal

Identify controls strategies for dual fuel heat pump systems; and apply them based on the selected thermostat and customer priorities.

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

Overview

- **Summarize best practices for selecting thermostats- especially for dual fuel systems**
- **Describe how to identify balance points and select switchover temperatures**
- **Apply additional control strategies for auxiliary heat**

Materials Needed

- Technology and Room Set-up
- Handouts
- PPT Presentation

Present

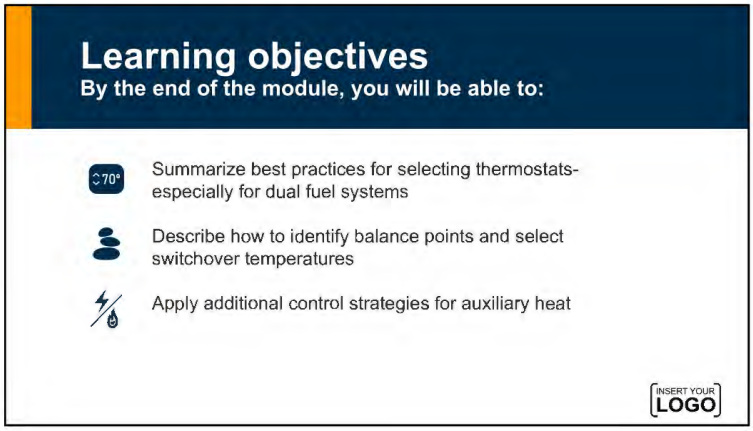
Facilitator	Notes

Cumulative time: 2 hours, 15 minutes

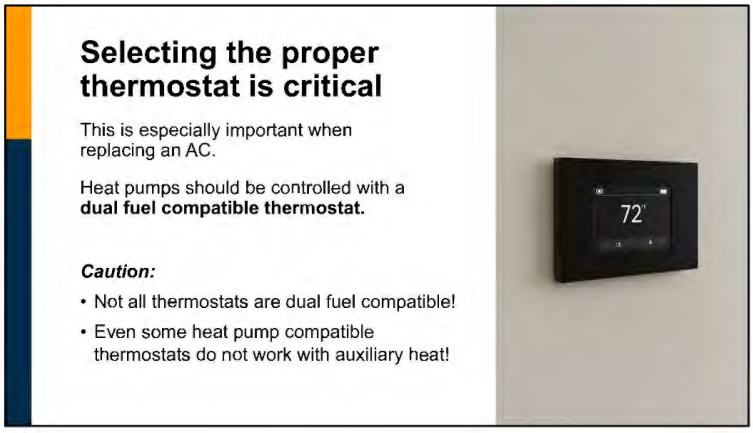
Time to complete this lesson: 30 minutes.

Slide 156

Slide 157



Slide 158

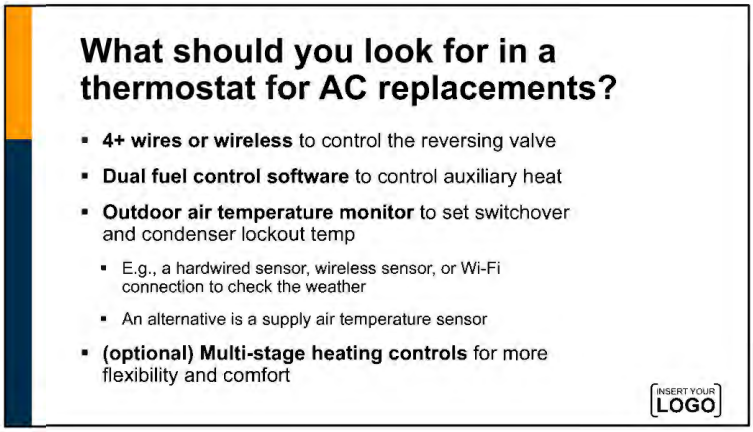


The last major difference between HPs and AC installations is the thermostat. While you can install most any HP and control it as an AC, The magic happens when you

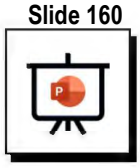
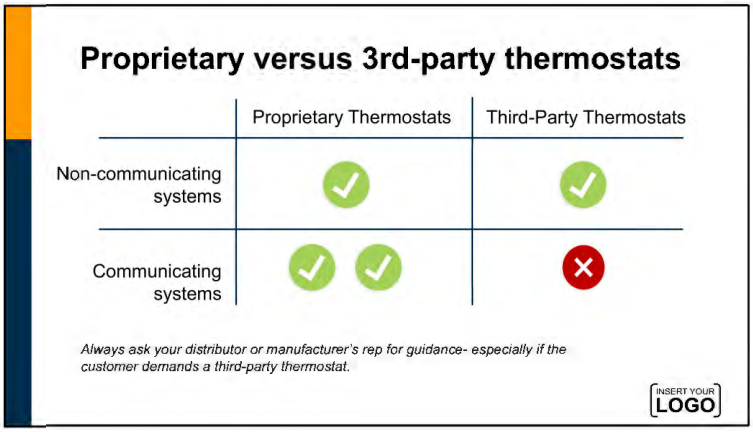
Present

Facilitator	Notes
	control it with a dual fuel capable thermostat Especially with coil-only VSHPs, manufacturers often do not require a particular thermostat, due to their interest in highlighting the drop-in nature of their product. However, we have found in the field that not all thermostats are dual fuel compatible, and even some HP compatible thermostats cannot be configured to run with a backup heat source should the HP not be able to meet the full heating load of the home. This is why proper thermostat selection and configuration is an important aspect of a quality HP installation in MN, especially for AC replacements, where you may not be installing brand-matched equipment and may want to use the existing thermostat.

Present

Facilitator	Notes
Slide 159  	Dual fuel controls software - If separate systems, stagger thermostats by 2-3°F o what makes for a good thermostat for HPs installed as AC replacements? There are 4 things to look for. Multiple stage heating controls is not really required, but it provides a lot of flexibility in how the system is operated.

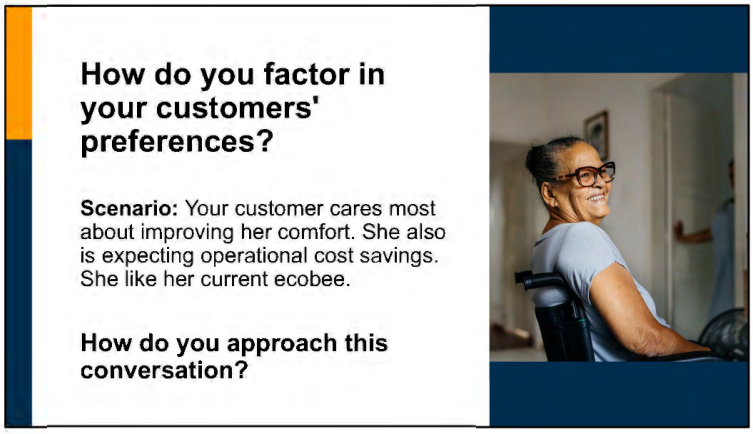
Present

Facilitator	Notes
Slide 160  	- Both solutions work well with non-communicating ASHPs. Make sure to factor in any needs for load control programs. - Proprietary thermostats with variable-capacity systems are the best pairing for optimized efficiency & cost savings. - Third-party thermostats are not recommended for variable-capacity systems: staged, third-party thermostats will limit efficiency

Present

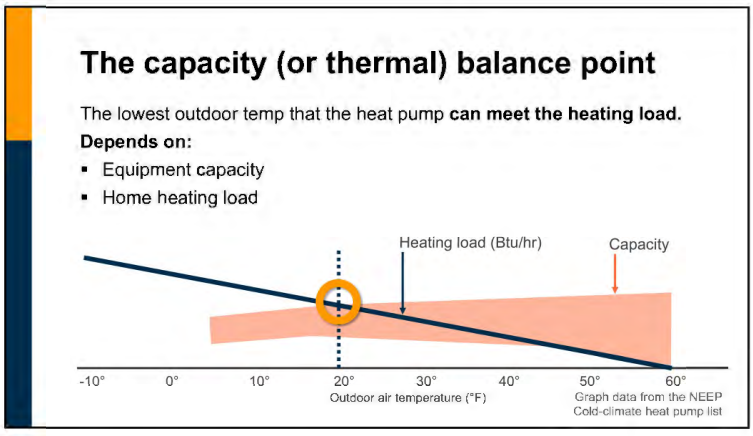
Facilitator	Notes

Slide 161



- Warranty w/proprietary thermostat
- Find out what they like/don't like about current thermostat to better sell the proprietary options
- Opportunities for connected diagnostics and remote servicing, better error code reporting to resolve issues

Slide 162



- Comfort balance point
  - Temperature at or below which the homeowner experiences discomfort
  - Good opportunity for contractors to work with the homeowner and make small changes over time to ensure comfort
    - Increases customer confidence,

Present

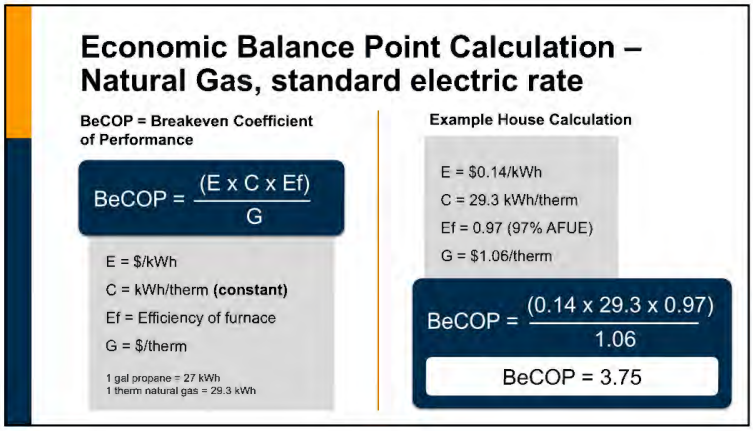
Facilitator	Notes
	shows how much you prioritize their comfort • Opportunity for continued communication to help them adjust to their new heat pump system (can reiterate key customer education points to avoid callbacks) – Can modify the switchover temperature based on outdoor air temp or supply air temp sensor • Without a supply air temp sensor, recommended to set switchover temp a few degrees above the capacity balance point to start and iterate from there • Sensor gives an opportunity to dial in the delivered air temp at which the homeowner

Present

Facilitator	Notes
	feels comfortable

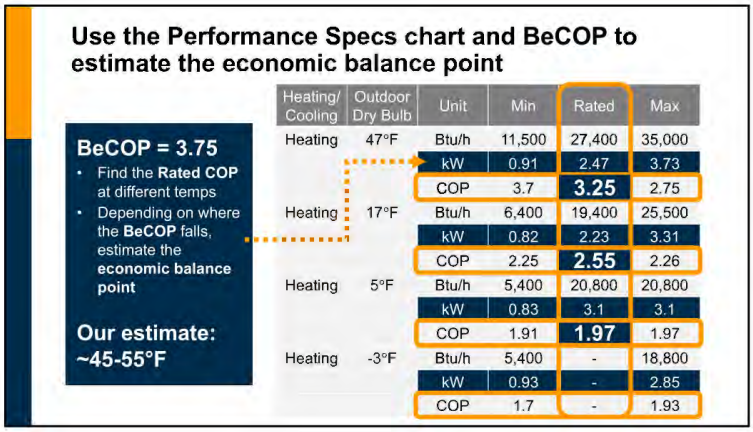
Slide 163

Slide 164

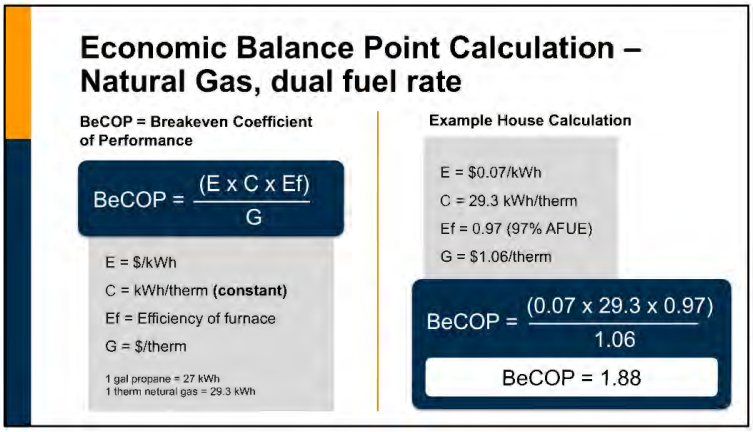
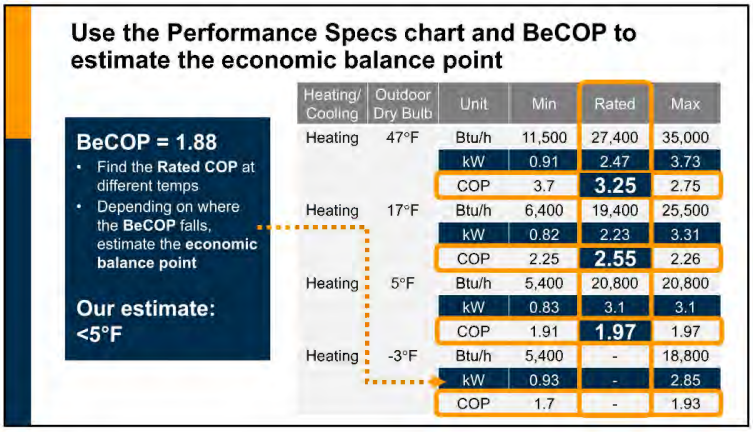
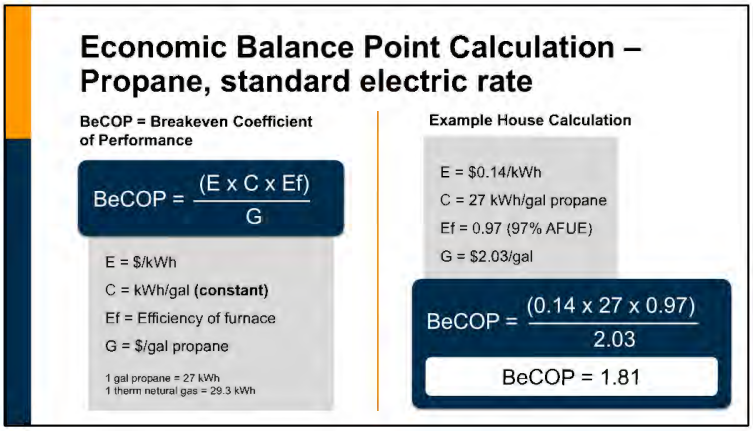


Natural gas – statewide average

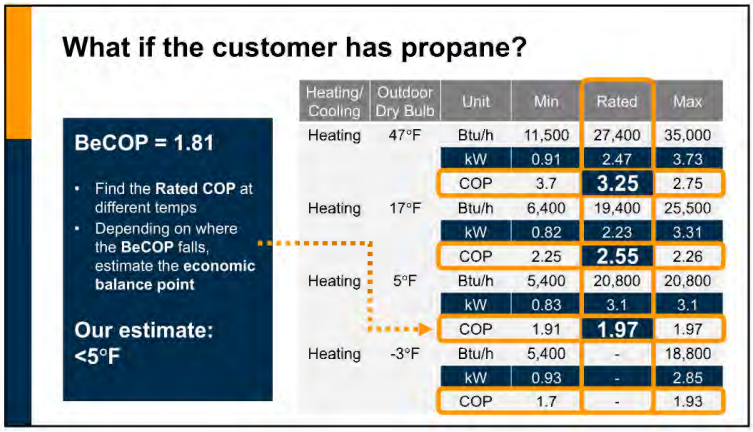
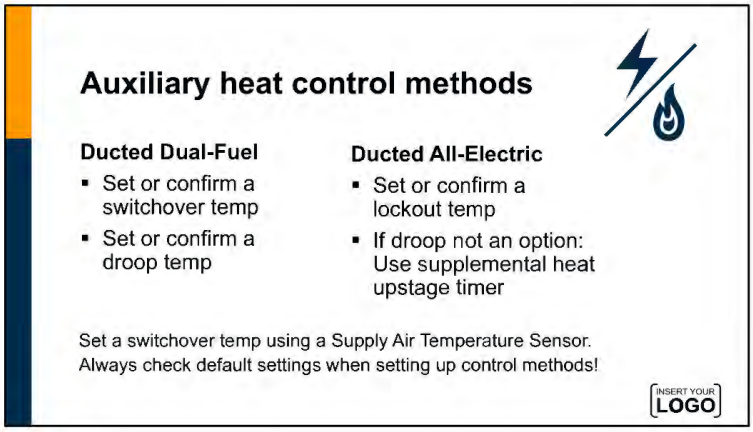
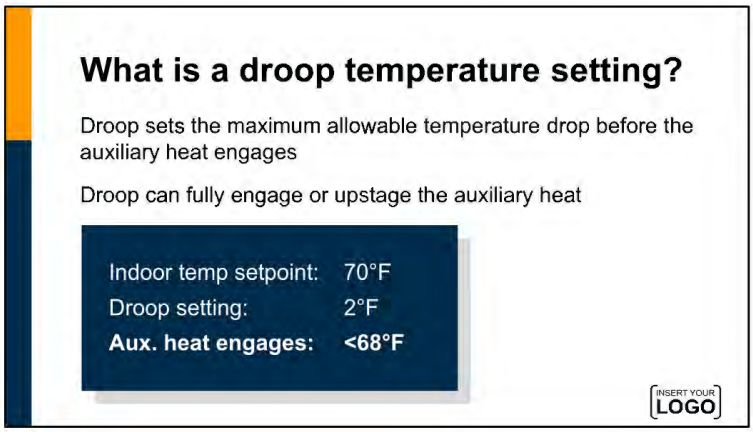
Slide 165



Present

	Facilitator	Notes
Slide 166		
Slide 167		
Slide 168		

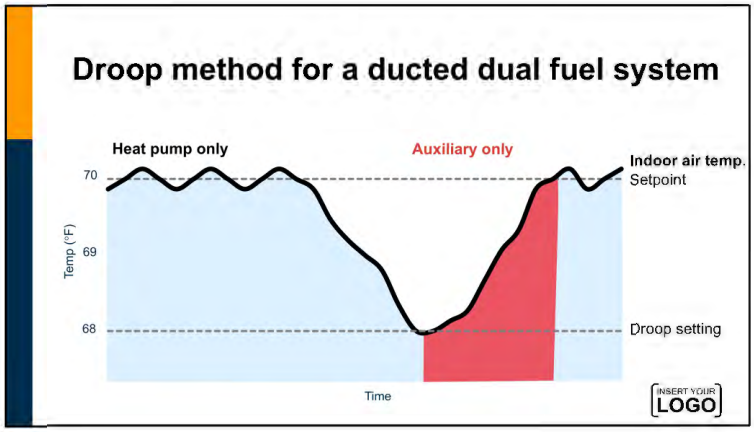
Present

	Facilitator	Notes
Slide 169		
Slide 170		All-electric – system should run as low as possible simultaneously with ER heat – lockout temp can be set with respect to COP (don't switch fully to ER heat unless HP COP is <1)
Slide 171		

Present

Facilitator	Notes

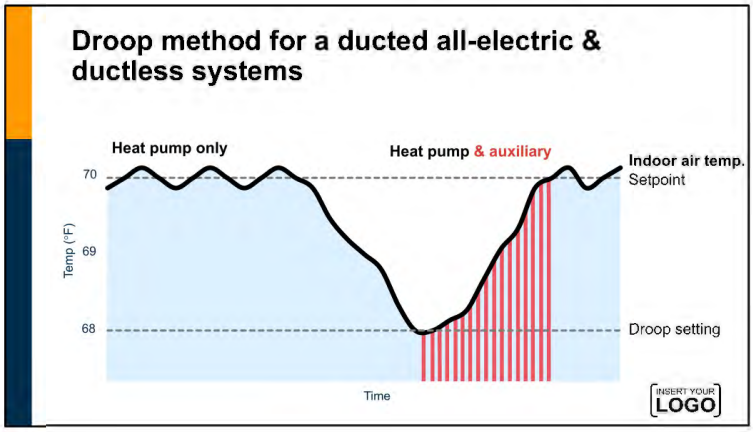
Slide 172



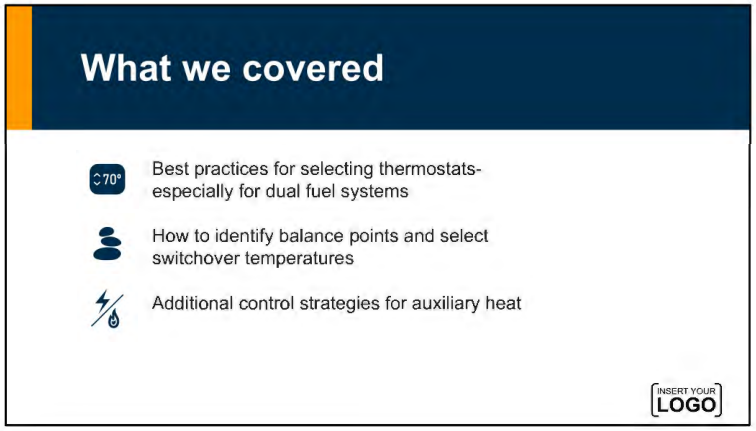
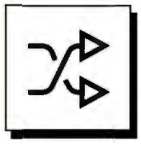
For the droop method, both systems are “on”, and the heat pump essentially never stops supporting space heating. This is accomplished with a two-stage thermostat or sometimes with two separate thermostats. When the indoor air temperature starts to droop, because the heat pump can no longer maintain the indoor air temperature, the backup system triggers, and runs simultaneous to the heat pump until the back-up systems' thermostat is satisfied. This should occur at about the same outdoor condition that defined the balance point.; when the heat pump can no longer keep up with the load.

Back up heat upstage timers are an alternative if the droop setting is not available in the settings menu. This will activate the strip heat during long run time of the heat pump. It is recommended to set this as long as the customer with. The longer the heat pump runs the more even

Present

Facilitator	Notes
	the temperature in the house will be.
Slide 173  	For the droop method, both systems are "on", and the heat pump essentially never stops supporting space heating. This is accomplished with a two-stage thermostat or sometimes with two separate thermostats. When the indoor air temperature starts to droop, because the heat pump can no longer maintain the indoor air temperature, the backup system triggers, and runs simultaneous to the heat pump until the back-up systems' thermostat is satisfied. This should occur at about the same outdoor condition that defined the balance point.; when the heat pump can no longer keep up with the load. Back up heat upstage timers are an alternative if the droop setting is not available in the settings menu. This will activate the strip heat during long run

Present

Facilitator	Notes
	time of the heat pump. It is recommended to set this as long as the customer with. The longer the heat pump runs the more even the temperature in the house will be.
Slide 174  	
 **Transition to Equipment Selection**	

Equipment Selection

Goal

Utilize available equipment selection tools to support the accuracy of your work and increase customer confidence. Apply appropriate Manual S tables.

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

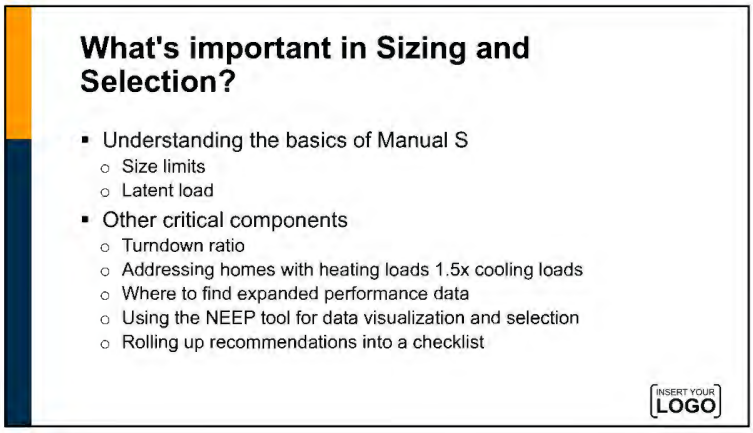
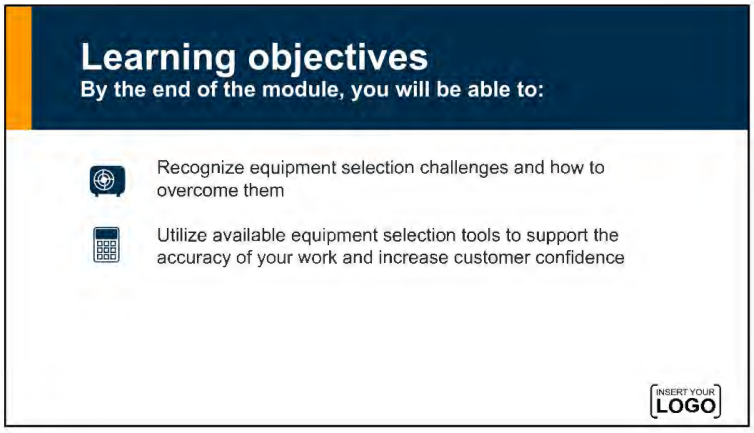
Overview

- **Recognize equipment selection challenges and how to overcome them**
- **Utilize available equipment selection tools to support the accuracy of your work and increase customer confidence**

Materials Needed

- Technology and Room Set-up
- Handouts
- PPT Presentation

Present

Facilitator	Notes
Cumulative time: 2 hours, 45 minutes Time to complete this lesson: 30 minutes.	
Slide 175 	
Slide 176 	
Slide 177 	Acknowledge the market barrier (more effort, uncertain bid) Mention tools to help

Present

Slide 178

Facilitator	Notes
	Determining when to size for heating vs cooling Ensuring the system works well with the existing ductwork (and assessing when ductwork improvements/retrofits are needed) Ideas to expand on Homeowner thermostat preference vs compatibility with possible systems Outdoor unit location options Top discharge vs side discharge – available space, ability to mount above snow line (all this matching up with the capacity needs based on load calcs) Planning around future weatherization (is the system flexible to future lower loads?)

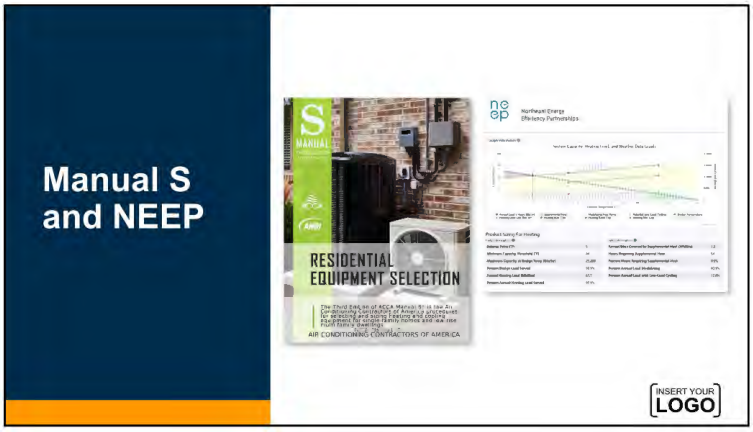
Present

Facilitator	Notes
Slide 179 	Determining when to size for heating vs cooling Ensuring the system works well with the existing ductwork (and assessing when ductwork improvements/retrofits are needed) Ideas to expand on Homeowner thermostat preference vs compatibility with possible systems Outdoor unit location options Top discharge vs side discharge – available space, ability to mount above snow line (all this matching up with the capacity needs based on load calcs) Planning around future weatherization (is the system flexible to future lower loads?)

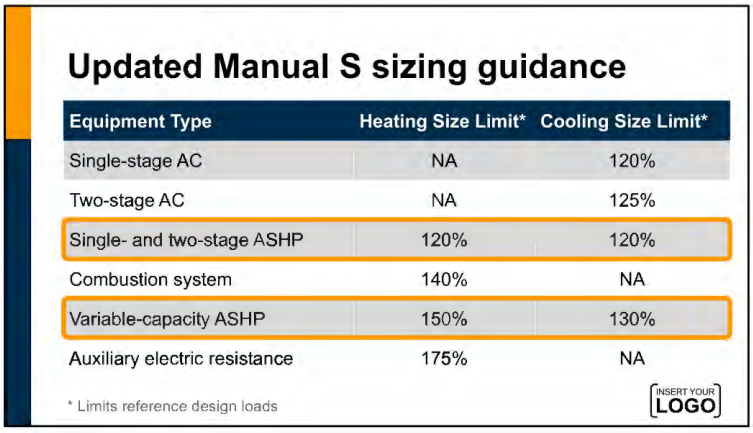
Present

Facilitator	Notes

Slide 180

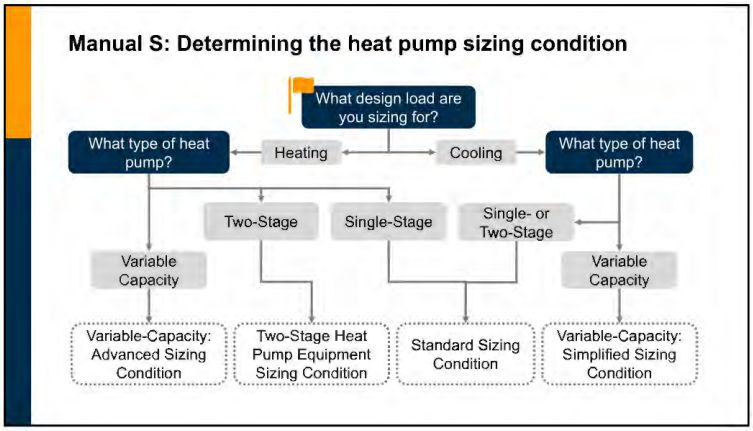


Slide 181



Note, for existing homes in Minnesota that have not been Wx'd, it's very difficult to stay within 130% of the cooling load if attempting to do a large percentage of the heating load!

Slide 182



Present

Facilitator	Notes

Slide 183

Manual S: Equipment selection & sizing procedure

1. **Produce a load calculation.**
2. **When heat pump equipment is used, determine the heat pump sizing condition.**
3. Procure OEM performance data.
4. For forced-air systems, determine the entering air condition for cooling and heating.
5. Determine blower airflow in CFM for cooling and heating.
6. Extract capacity values from performance data. As needed, interpolate OEM capacity values for the operating conditions that apply.
7. **Ensure that the selected equipment conforms to the size limits that apply to the project.**
8. Product a project file that documents the design decisions.

INSERT YOUR LOGO

Slide 184

Key considerations

Manual S is complicated – what are the key areas we can focus on to ensure we're incorporating the most important principles?

- Heating to cooling design load ratios
- How to best use capacity tables
- Sensible vs latent load and "right sizing"

INSERT YOUR LOGO

Slide 185

Heating to cooling design load ratio

Example: 2000 sq ft home in Minneapolis

Outdoor Design Conditions (MN Code)	
Location	Minneapolis
Summer Db	88°
Summer Wb	72°
Winter Db	-15°

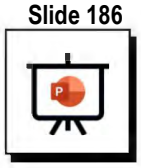
Heating/Cooling Loads	
Heating Load	40,000 BTU/hr
Cooling Load	22,000 BTU/hr
Sensible Load	20,000 BTU/hr
Latent Load	2,000 BTU/hr

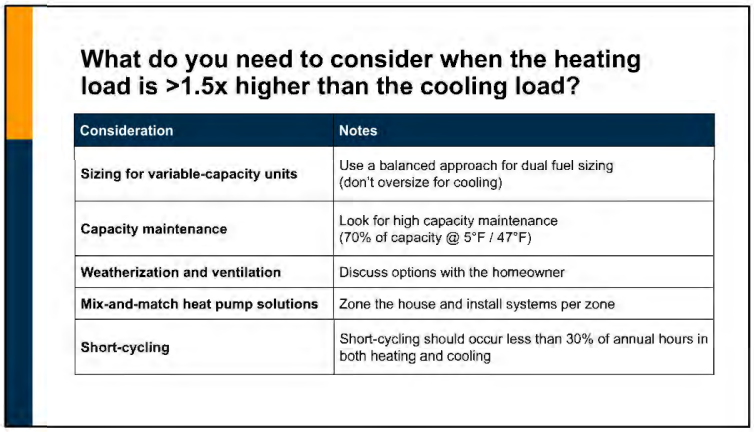
$$Heating\ to\ cooling\ design\ load\ ratio = \frac{Heating\ design\ load}{Cooling\ design\ load}$$

$$\frac{40{,}000\ BTU/hr}{22{,}000\ BTU/hr} = 1.8$$

INSERT YOUR LOGO

Present

Facilitator	Notes
Slide 186 	Animated slide Every heat pump in the database has a heating/cooling capacity graph available. For this instance, we are using it to visualize the turndown ratio It is very helpful in ensuring match loading, particularly at partial heating and partial cooling loads to see the turndown ratio at 47 and 82 degrees.
Slide 187 	Animated



Present

Facilitator	Notes

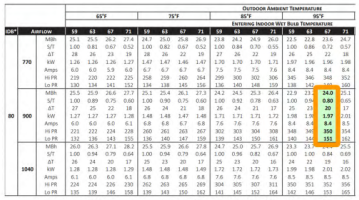
Slide 188

Know where to find capacity tables for selected equipment

The issue: AHRI data simulates a small geographic area.

A solution: Use manufacturer extended performance data.
- More detailed
- Wider variety of results

For easier selection: Narrow down available product lines as you find "best" solutions.



AHRI only uses the highlighted section! It is important to find the correct section for equipment in our specific climate.

INSERT YOUR LOGO

Manufacturer extended performance data can partially be found in the NEEP tool or through manufacturers data through your distributor.

Slide 189

Sensible Heat Fraction (SHF)

Sensible Heat Fraction is the capability of selected equipment
- Acronyms include CSHR or S/T
- Ratio of cooling system sensible heat to total heat removal
- Manufacturer data shows equipment sensible heat fraction as a decimal (S/T) and listed with a total capacity (MBh or TC, depending on the manufacturer)

75°F	MBh	25.8	26.5	26.7
	S/T	0.83	0.69	0.54
	ΔT	19	16	13
	kW	1.72	1.72	1.73
	Amps	7.6	7.6	7.6

INSERT YOUR LOGO

(Animated)

Modern, high SEER2 heat pumps (and ACs) have much higher sensible heat fractions when compared to older systems.

Slide 190

Finding the Sensible Cooling Capacity

This system was "Rated" as a 24,000 BTU/hr cooling heat pump

Total Capacity x Sensible Heat Fraction = Sensible Cooling Capacity

75°F	MBh	25.8	26.5	26.7
	S/T	0.83	0.69	0.54
	ΔT	19	16	13
	kW	1.72	1.72	1.73
	Amps	7.6	7.6	7.6

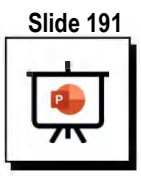
*Total Capacity **(25,800 BTU/hr)** x SHF **(0.83)** = Sensible Cooling Capacity **(21,414 BTU)***

INSERT YOUR LOGO

Present

Facilitator	Notes

Slide 191



Sensible Heat Ratio (JSHR)

The ratio of sensible load to total cooling load from the Manual J load calculation.

Heating/Cooling Loads	
Heating Load	40,000 BTU/hr
Cooling Load	22,000 BTU/hr
Sensible Load	20,000 BTU/hr
Latent Load	2,000 BTU/hr

$$JSHR = \frac{Sensible\ Load\ (\frac{BTU}{hr})}{Cooling\ Load\ (\frac{BTU}{hr})} \qquad JSHR = \frac{20{,}000}{22{,}000} = 0.91$$

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Slide 192

Sensible Heat Fraction vs Sensible Heat Ratio

Sensible Heat Fraction (SHF) = **0.83**
Sensible Heat Ratio (SHR) = **0.91**

Heating/Cooling Loads	
Heating Load	40,000 BTU/hr
Cooling Load	22,000 BTU/hr
Sensible Load	20,000 BTU/hr
Latent Load	2,000 BTU/hr

SHF should be *lower* than the SHR ☑

If SHR if higher than SHR, dehumidification should be considered

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Slide 193

Quick design guidance

Metric	Upper Midwest Goals
Size to	Cooling for natural gas dual fuel; Balanced otherwise
Sensible Heat Fraction (SHF)	At or lower than Sensible Heat Ratio (SHR)
Efficiency guide	COP at Max Capacity at 5°F, 82°F *and* COP at Min Capacity at 17°F, 47°F
Weatherization recommended	Yes, particularly for propane and all-electric systems+
Low-load short cycling	Watch for cooling low-load short cycling
Turndown ratio @ 47°F and 82°F	2.25+ averaged
Dry Mode	Only if SHF is the same or slightly higher than SHR

+ Weatherization is always recommended if heating load to cooling load is 1.5 or more, unless multiple systems are being designed to handle the home

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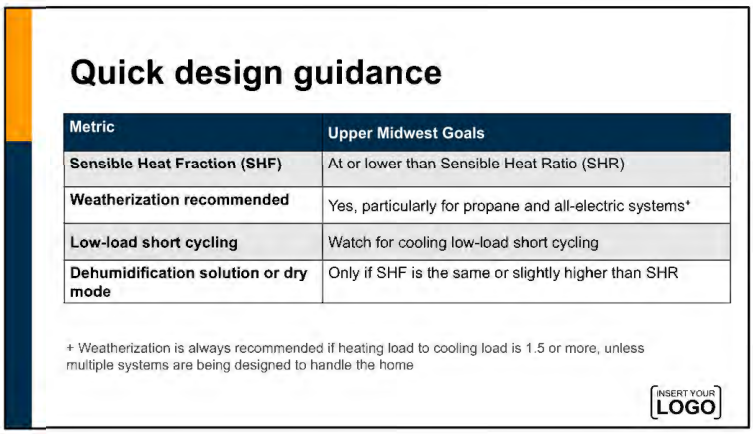
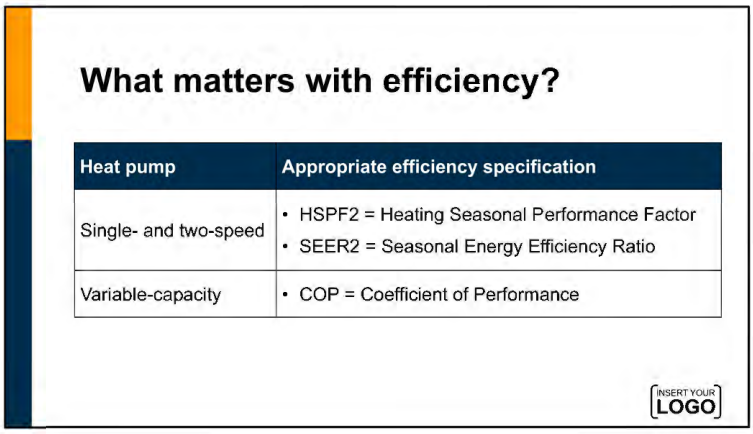
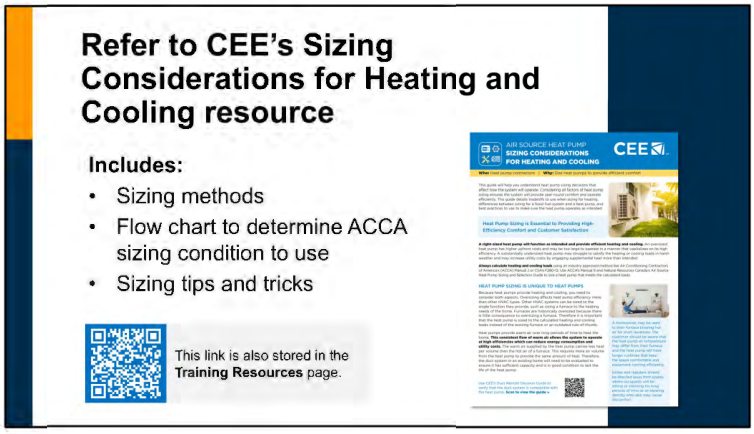
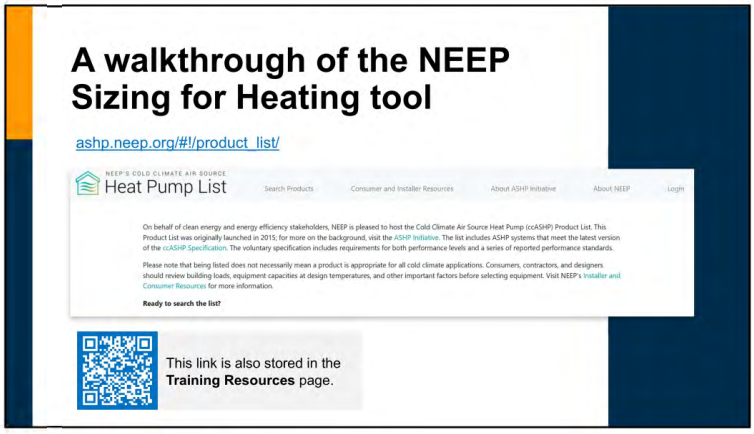
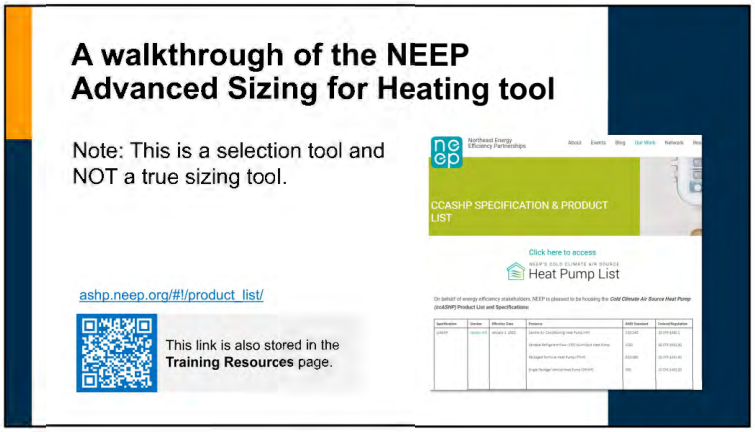
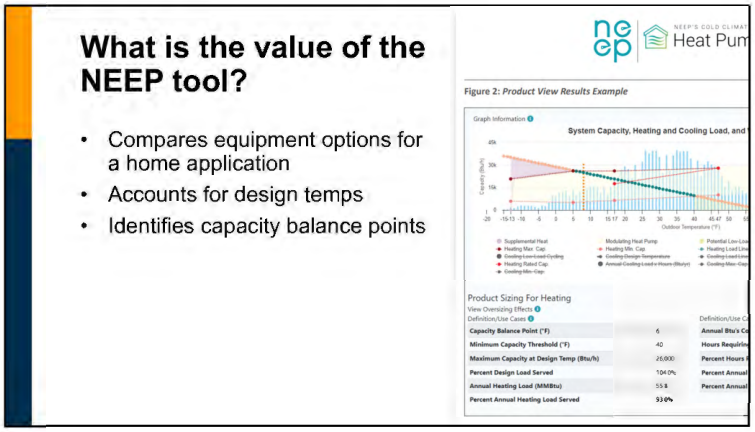
Present

Facilitator	Notes
Slide 194  	
Slide 195  	HSPF and SEER are often needed to ensure equipment qualifies for rebates and incentives. However, these ratings are averaged across seasons and are only at rated capacities. Since inverter heat pumps vary their capacity at different outdoor temperatures, the COP at each temperature is a better indicator of actual efficiency. COP is an instantaneous efficiency at a temperature. Higher COP is better. For variable-capacity heat pumps, it's the COP at various temperatures and capacities that matters!

Present

Facilitator	Notes
Slide 196  	All of these installation considerations and more can be found through our ASHP Installation Best Practices Guide, which can be found on our website. Following these best practices and using the proper tools are some of the best ways to ensure an installation delivers on the projected performance.
Slide 197  	Emphasize how helpful it is to compare systems using tools (there can often be more variance than expected in operation of similar equipment models) https://ashp.neep.org/#!/product/78771/7/25000/95/7500/0///0

Present

	Facilitator	Notes
Slide 198		Emphasize how helpful it is to compare systems using tools (there can often be more variance than expected in operation of similar equipment models) https://ashp.neep.org/#!/product/78771/7/25000/95/7500/0///0
Slide 199		Emphasize how helpful it is to compare systems using tools (there can often be more variance than expected in operation of similar equipment models) https://ashp.neep.org/#!/product/78771/7/25000/95/7500/0///0

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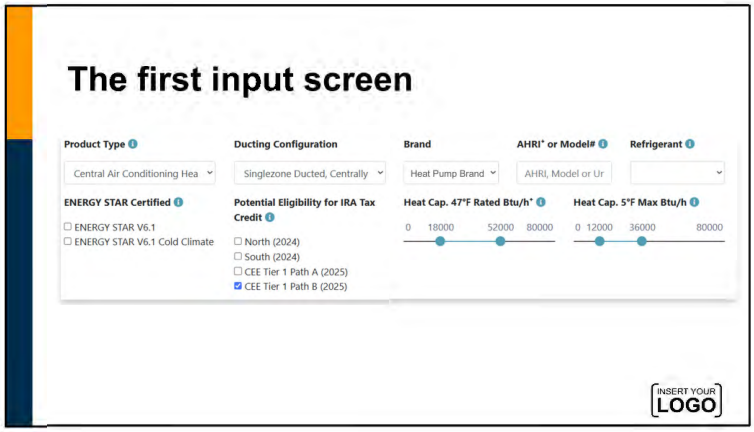
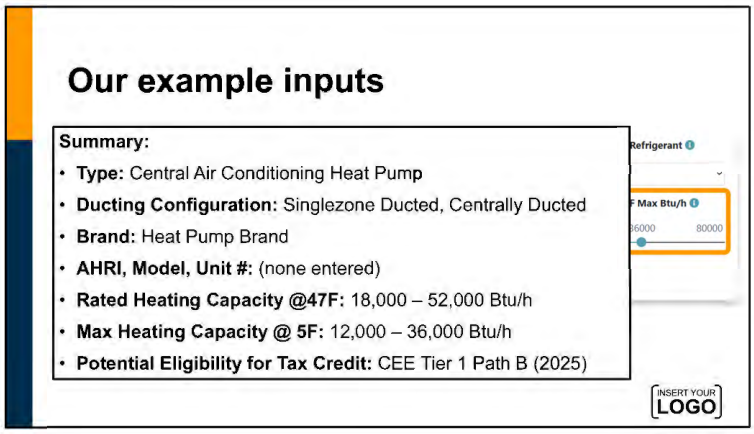
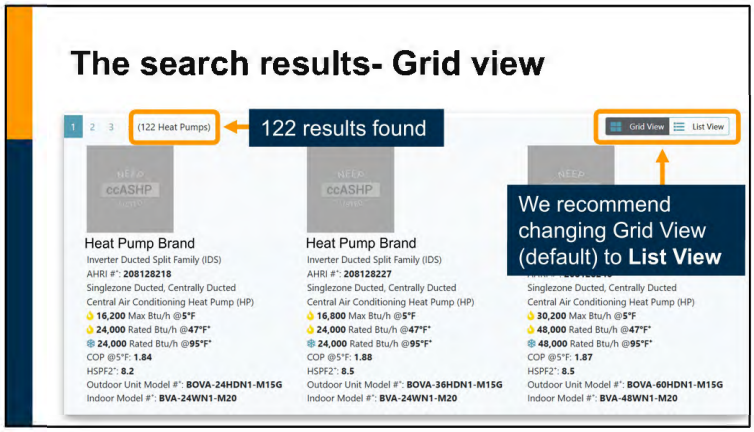
	Facilitator	Notes
Slide 200		
Slide 201		https://ashp.neep.org/#!/product/78771/7/25000/95/7500/0///0 Specifying the brand or searching for a few specific model numbers to compare is a great way to narrow down the search results
Slide 202		

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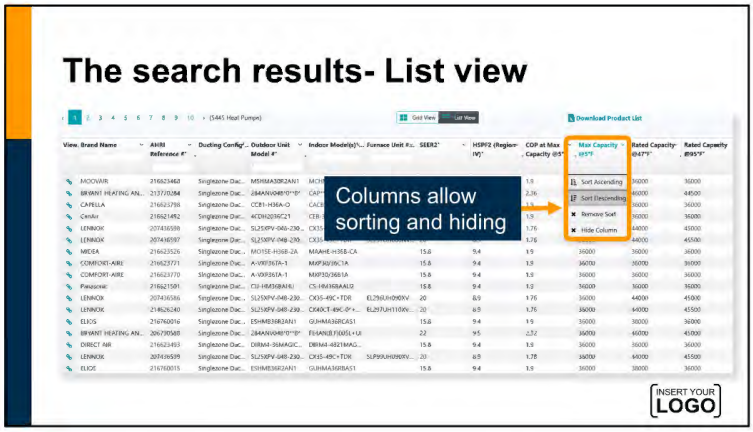
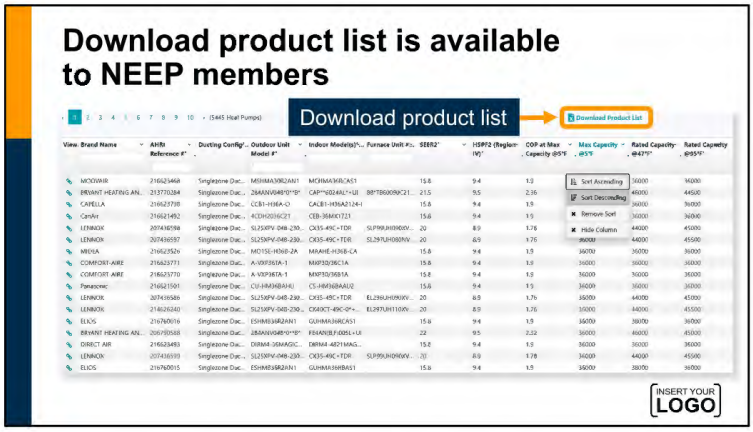
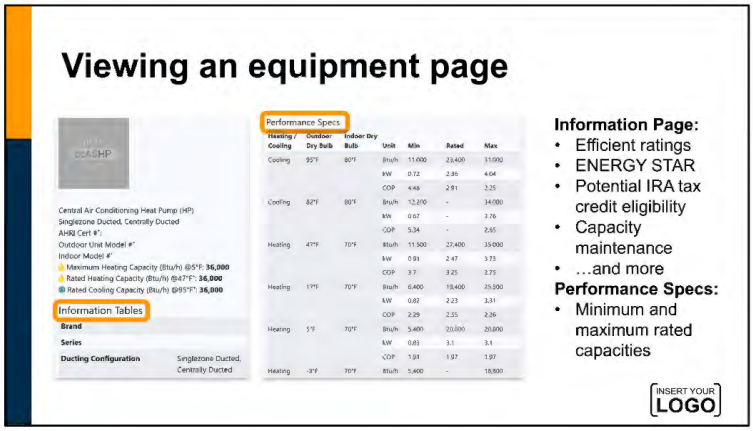
	Facilitator	Notes
Slide 203		
Slide 204		
Slide 205		

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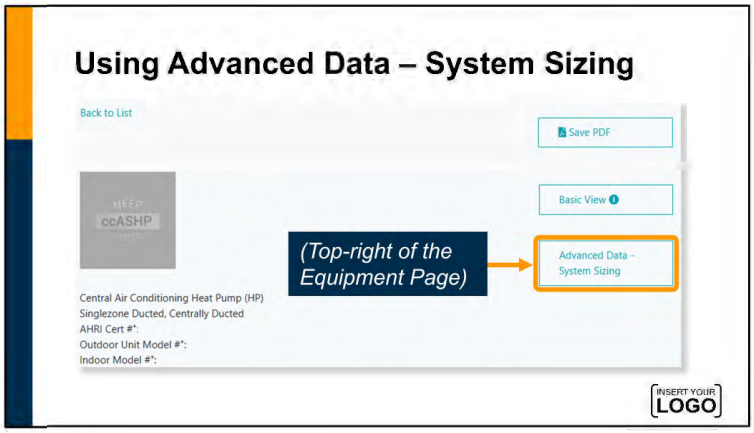
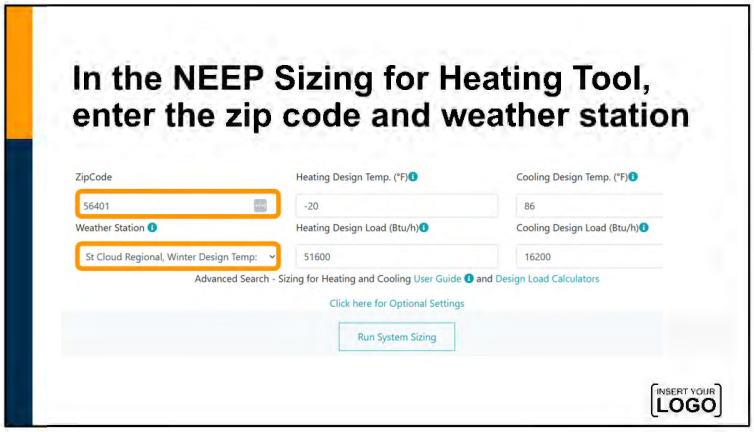
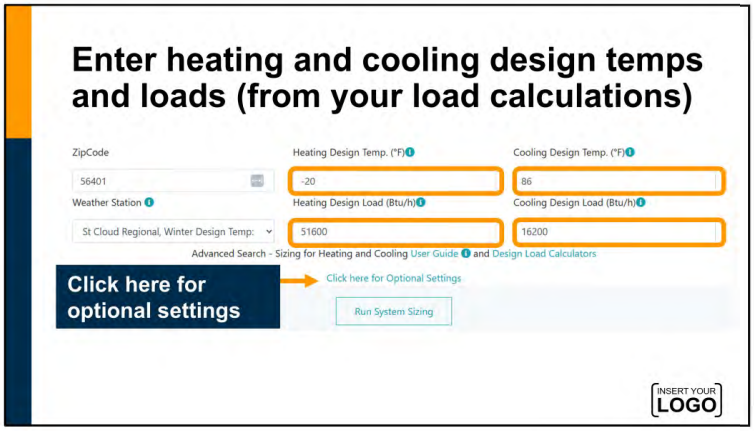
	Facilitator	Notes
Slide 206		
Slide 207		
Slide 208		https://codes.iccsafe.org/content/MNEC2020P1/chapter-4-re-residential-energy-efficiency

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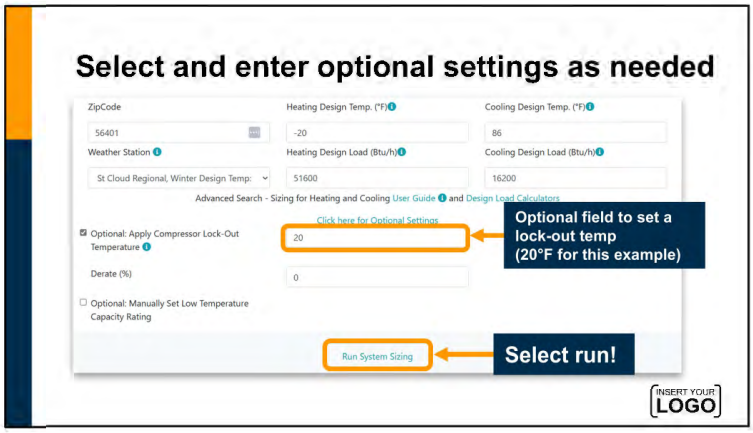
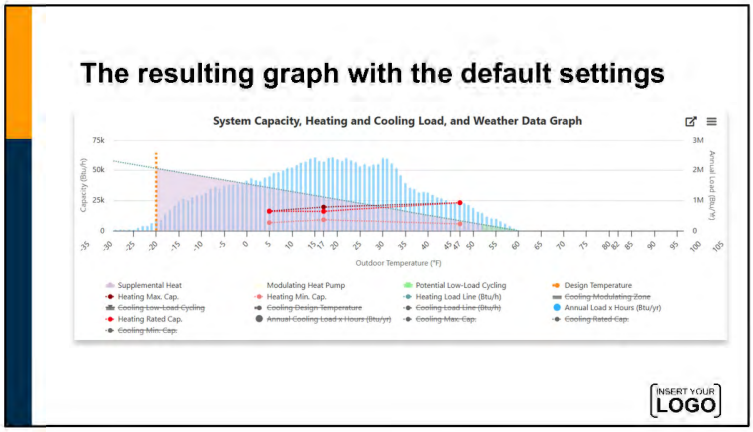
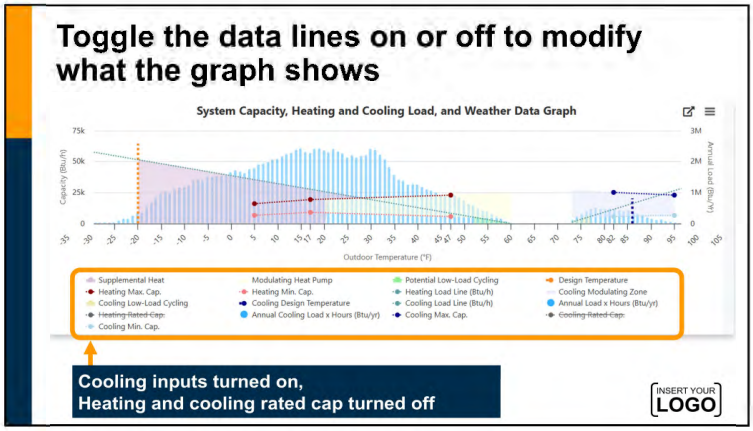
	Facilitator	Notes
Slide 209		
Slide 210		
Slide 211		

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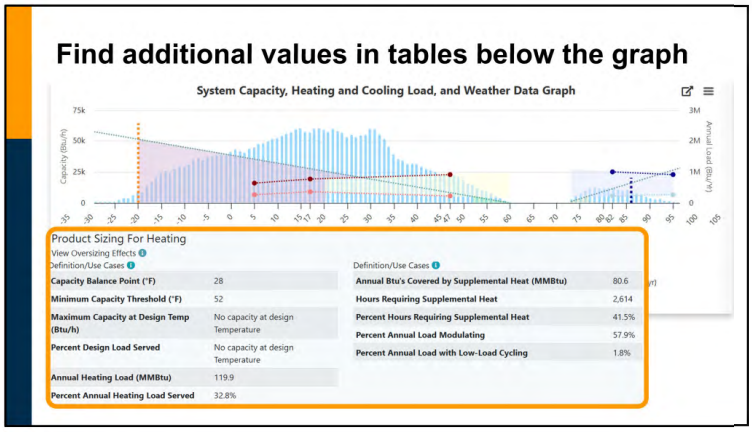
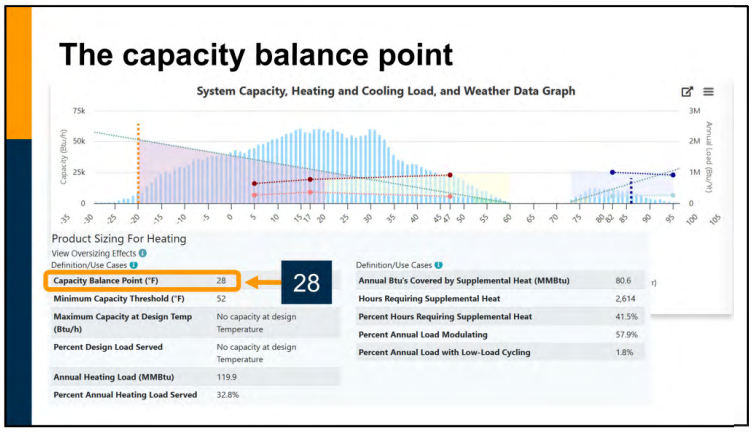
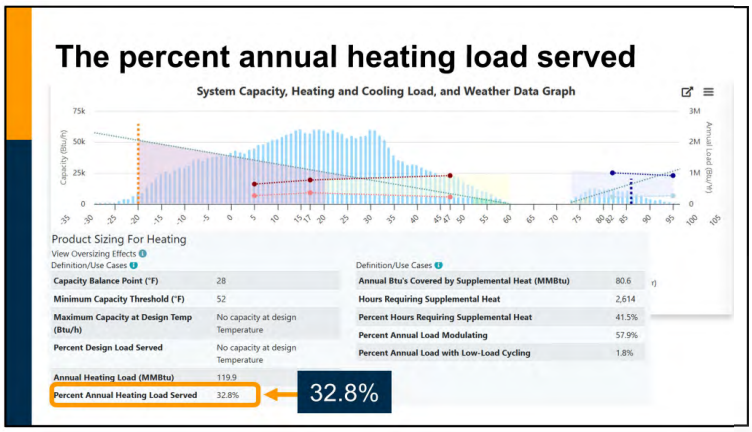
	Facilitator	Notes
Slide 212		
Slide 213		
Slide 214		

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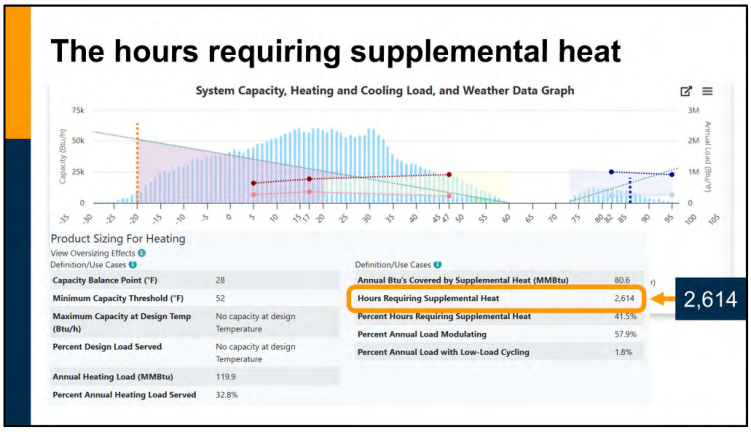
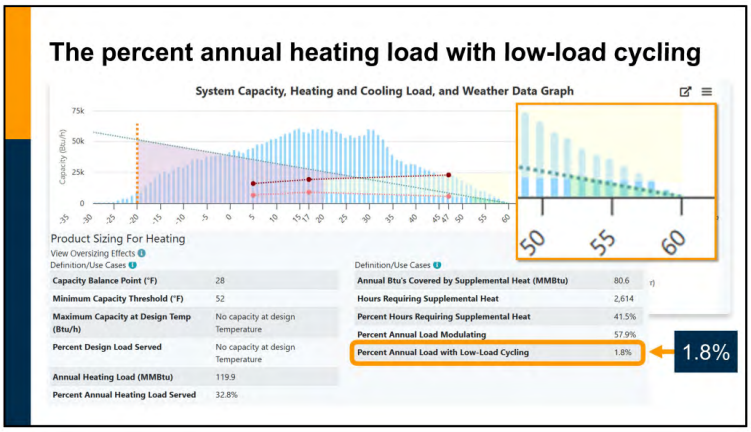
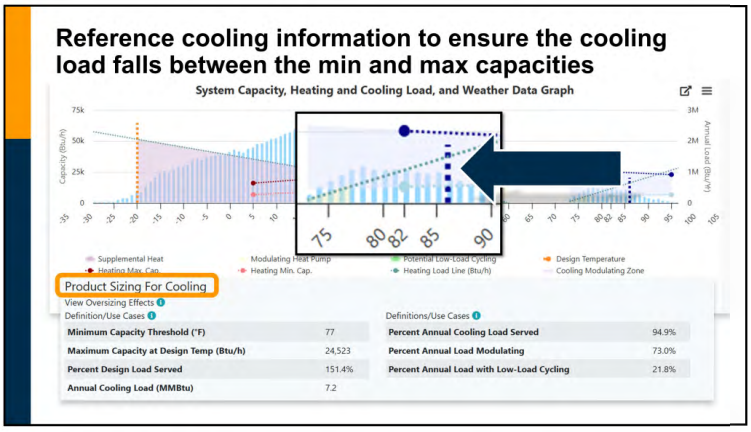
	Facilitator	Notes
Slide 215		
Slide 216		
Slide 217		

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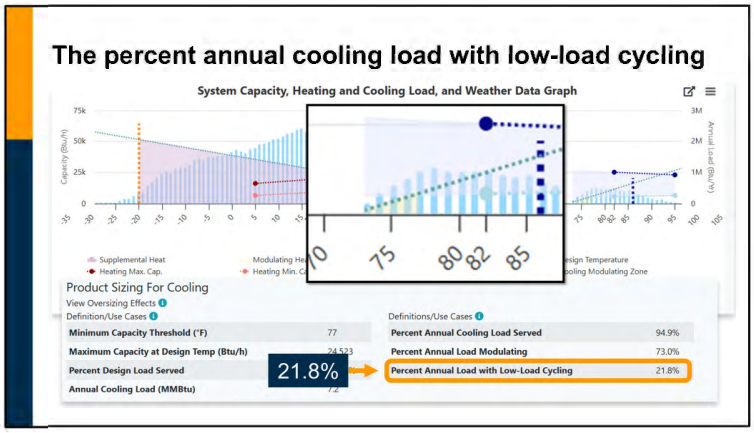
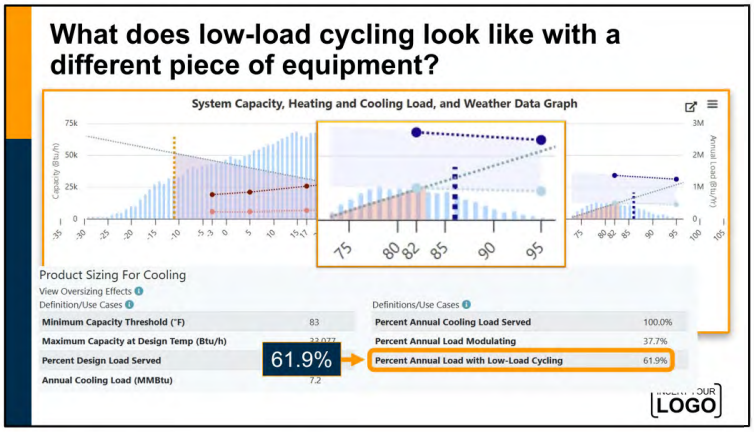
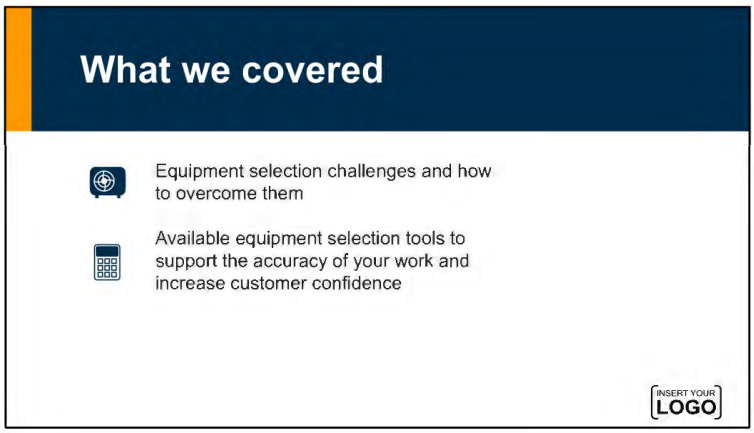
	Facilitator	Notes
Slide 218		
Slide 219		
Slide 220		
	Transition to Installation Best Practices	

Installation Best Practices

Goal

Implement installation best practices for heat pumps moving forward to ensure high quality installations and customer satisfaction.

Time to complete: 0 hours, 30 minutes.

Number of lessons: 1

Overview

- **Implement best practices for outdoor unit placement**
- **Implement best practices for line set routing and insulation**
- **Recognize the value of surge protection**

Materials Needed

- Technology and Room Set-up
- Activity Handouts
- PPT Presentation

Present

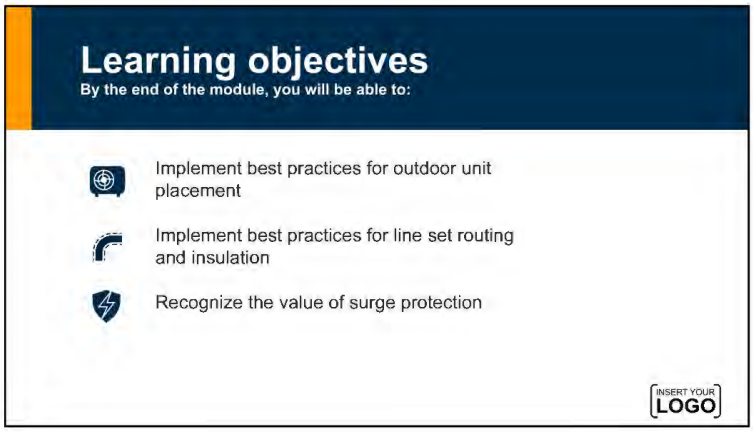
Facilitator	Notes

Cumulative time: 3 hours, 15 minutes

Time to complete this lesson: 30 minutes.

Slide 221

Slide 222



Slide 223

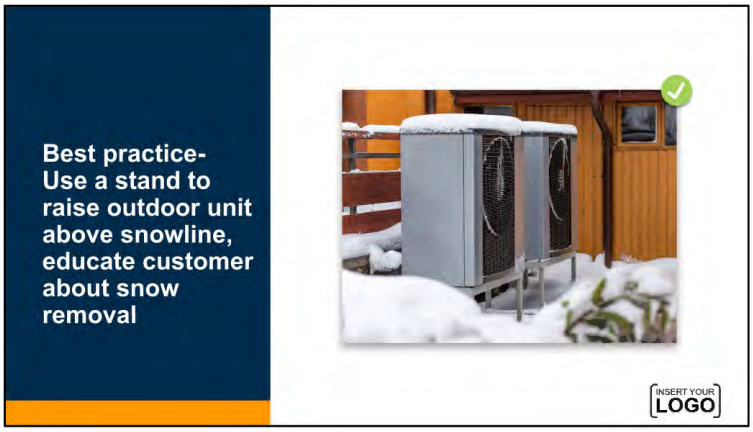
Present

	Facilitator	Notes
Slide 224		Avoid Installing outdoor units on walkways and patios Defrost cycle melt water can re-freeze on ground surfaces and create a dangerous slip hazard.
Slide 225		
Slide 226		Do not install outdoor units under a roof's driplines Rain, ice fall and snow melt from roof overhangs and driplines can re-freeze on the compressor's coil surface and overwhelm the unit's defrost cycle..

Present

	Facilitator	Notes
Slide 227		When needed, outdoor units should be installed with drip caps or shields.
Slide 228		In colder climates, defrost cycle and full power operations occur frequently and run at Locate outdoor units where noise will not disturb occupants higher decibels than typical operations
Slide 229		In homes with little or no insulation or single pane windows, full power noise may bother occupants.

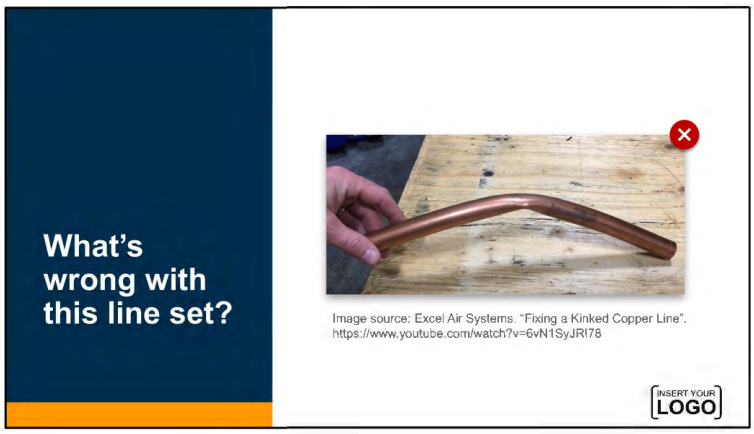
Present

Facilitator	Notes
Slide 230  	■ Install outdoor units above average snowfall depths ■ Outdoor units need free-flowing air at all times. Install using wall brackets or an equipment platform that will raise the outdoor unit
Slide 231  	

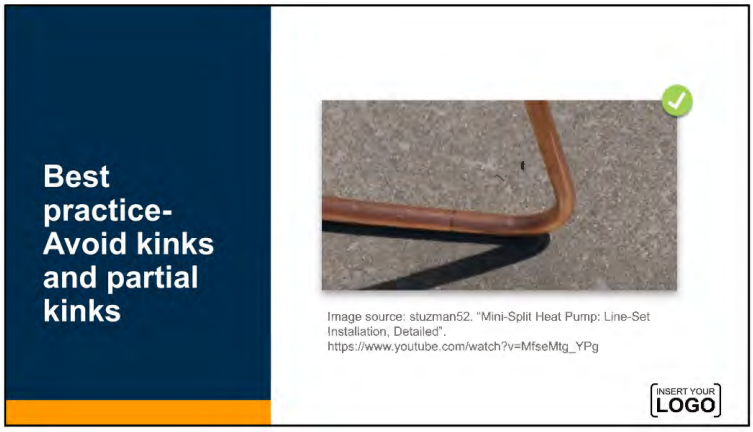
Present

	Facilitator	Notes
Slide 232		Don't install outdoor units facing into the wind If the outdoor unit is facing into dominant wind direction, this could cause counter-rotation of the outdoor fan and lead to failure of the fan motor, fan circuit board or both.
Slide 233		

Present

Facilitator	Notes
Slide 234  	■ Avoid any kinks or partial kinks in the lineset ■ Even a partial kink can result in reduced capacity in low temperatures and may result in a callback. – This can be a very difficult problem to solve. – Adding more refrigerant will only exacerbate the problem. – Locating a kink requires removing the linehide, feeling along the lineset to locate hot spots, and potentially replacing the entire lineset.

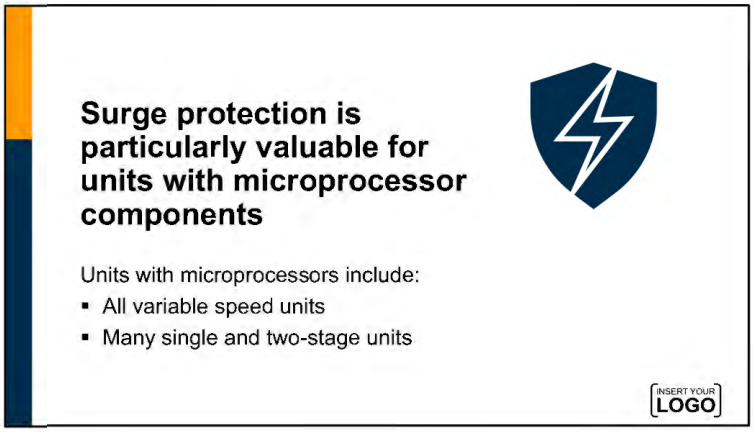
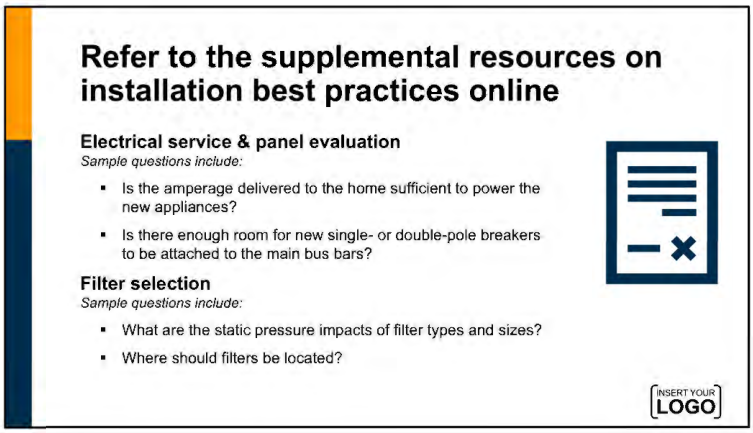
Present

	Facilitator	Notes
Slide 235		- Considering lineset length design, how do 90s contribute to the length of the lineset?
Slide 236		■ Ensure insulation covers the entire lineset including the flare fittings ■ This ensures liquid or frost will not develop under the flare nut and cause cracks. ■ Full insulation coverage also retains heat and improves system efficiency.

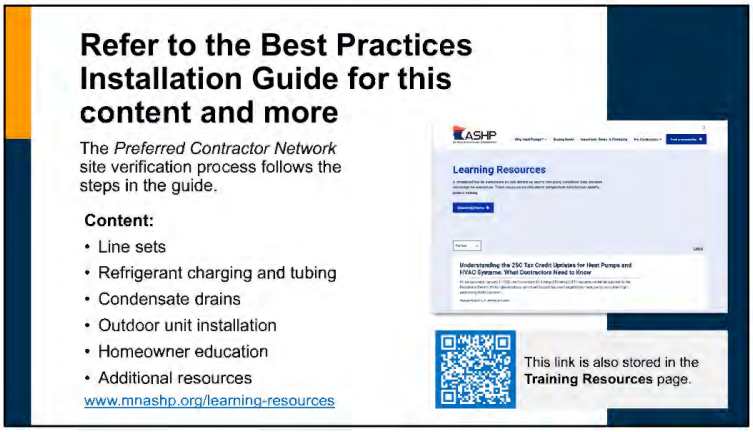
Present

	Facilitator	Notes
Slide 237		- Make sure line set insulation is UV rated
Slide 238		
Slide 239		Some products may only handle one surge, while others can handle multiple surges.

Present

	Facilitator	Notes
Slide 240		
Slide 241		

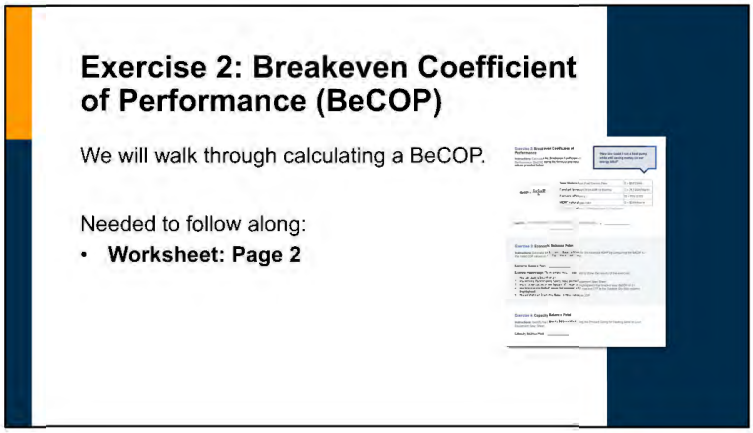
Present

Facilitator	Notes
Slide 242  	All of these installation considerations and more can be found through our ASHP Installation Best Practices Guide, which can be found on our website. Following these best practices and using the proper tools are some of the best ways to ensure an installation delivers on the projected performance.
Slide 243  	

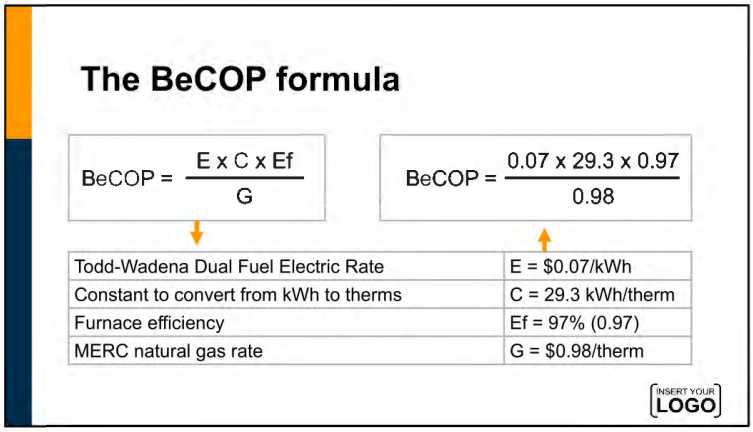
Present

Facilitator	Notes

Slide 244



Slide 245



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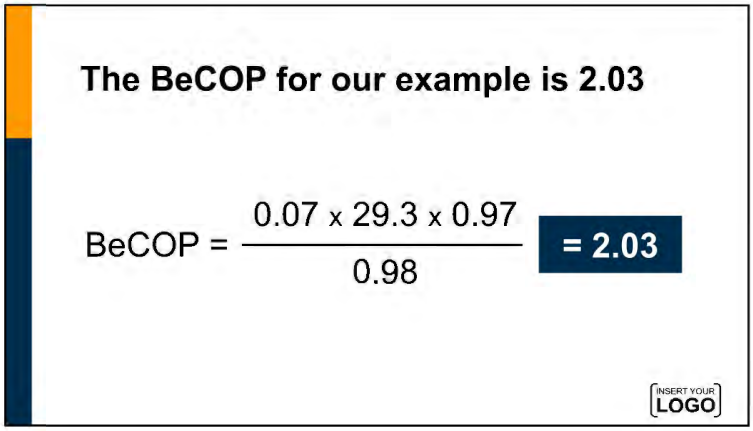

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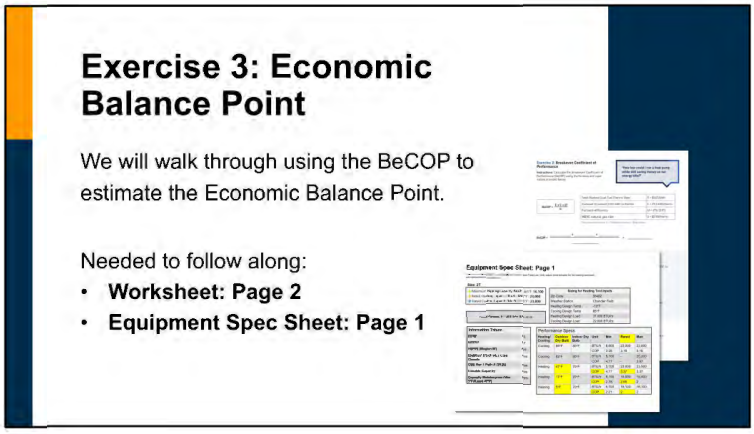
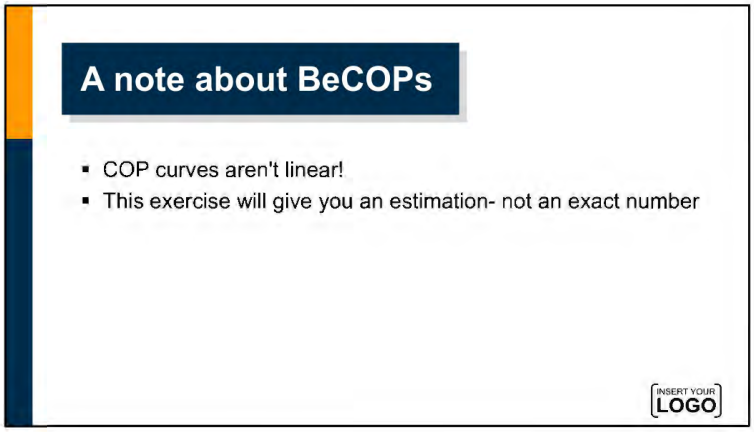
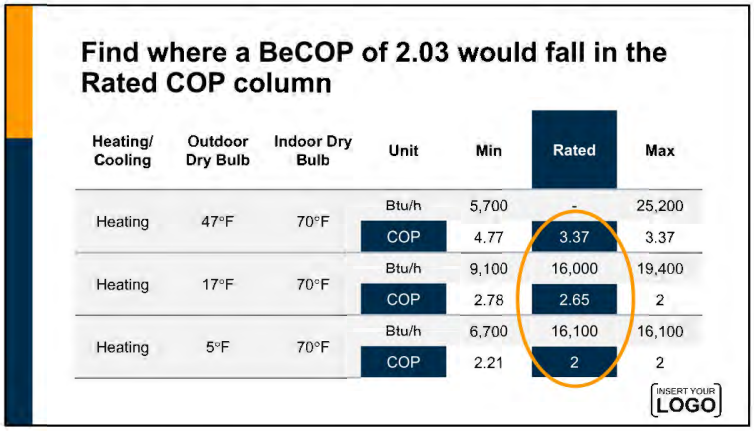
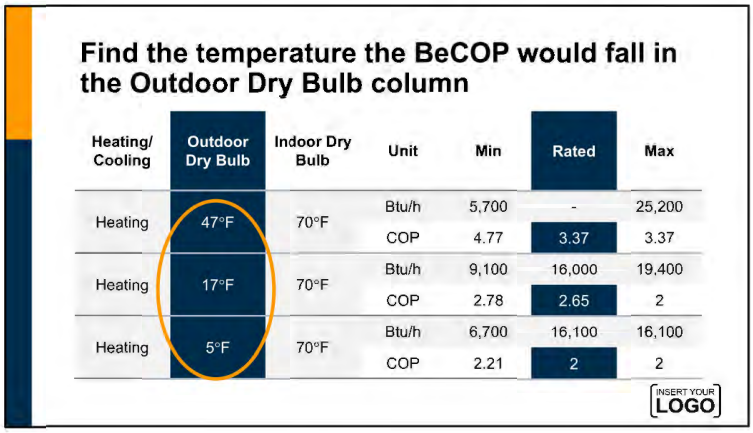
	Facilitator	Notes
Slide 247		
Slide 248		
Slide 249		

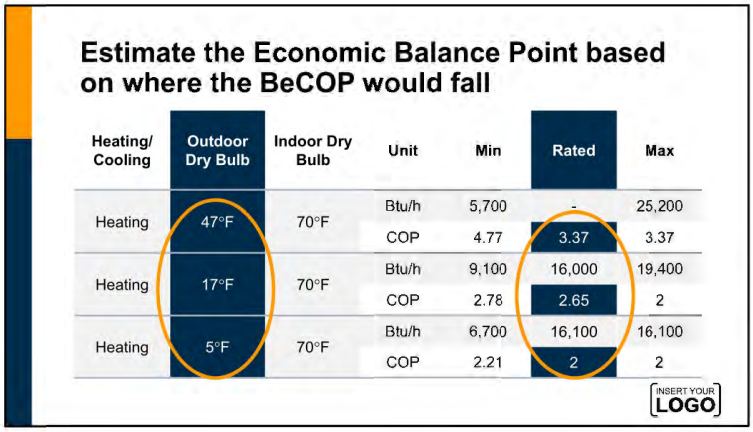
Present

	Facilitator	Notes

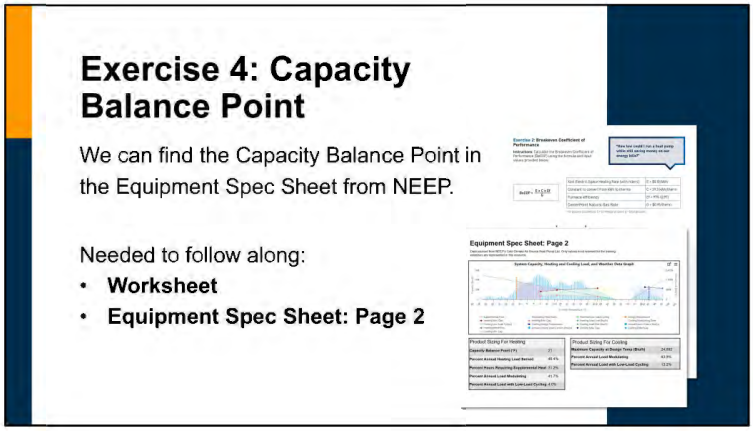
Slide 250



Slide 251



Slide 252



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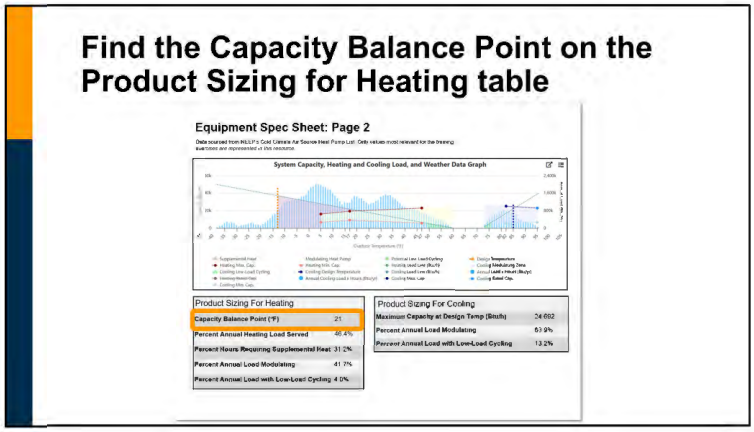
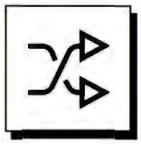
Facilitator	Notes
Slide 253  	
 **Transition to Summary & Closing**	

Summary & Closing

Goal

Review content and provide access to additional resources. Provide time for training evaluation and feedback.

Time to complete: 0 hours, 15 minutes.

Number of lessons: 2

Overview

Summarize content highlights from the day and answer outstanding questions.

Provide access to additional training resources and contact information.

Allow time to give an opportunity for participants to evaluate the training and provide feedback.

Materials Needed

- PPT Slides & AV Equipment
- Evaluation Forms

References and Resources

- MN ASHP Collaborative Preferred Contractor Network mnashp.org/become-preferred-contractor

Review & Evaluation

Facilitator	Notes
Cumulative time: 3 hours, 45 minutes Time to complete this lesson: 10 minutes.	
Slide 254  **Summary & Closing**	
Slide 255  **Next Steps for Contractors** Practice installations at employee homes to gain experience with the technology Leverage and stack financial incentives and lending products Attend ongoing distributor and manufacturer trainings Stay engaged with your utilities on rates and programs INSERT YOUR LOGO	Tip: Installing a heat pump in your own home, if you haven't already, will give you valuable experience and help you connect to all of the considerations needed for quality HP installations. Make sure you are leveraging and stacking financial incentives

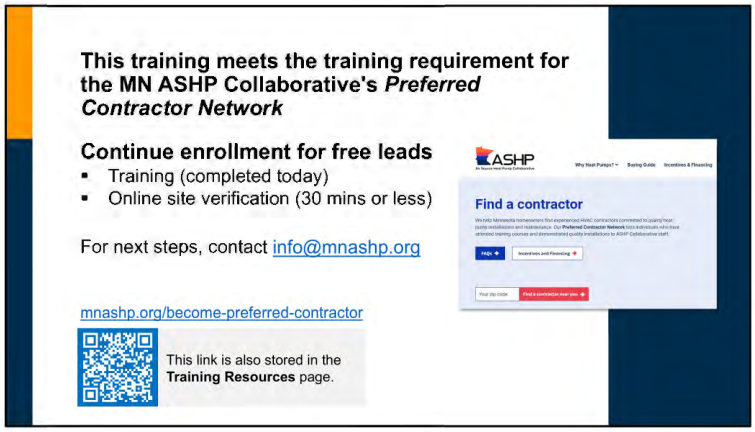
Closing

Facilitator	Notes

Cumulative time: 3 hours, 55 minutes

Time to complete this lesson: 5 minutes.

Slide 256



To wrap up, I wanted to leave you with some more information on the MN ASHP Collaborative's Preferred Contractor Network.

Since you've attended today's training, the only remaining requirements are to fill out some paperwork and complete a site verification for a recent install, which you can easily submit via an online form. You can get started in just a few minutes by filling out a quick intake survey on our website- this QR code will take it straight there, and you can fill it out from your phone in just a few minutes.

Closing

Facilitator	Notes
Slide 257  	Remind audience to complete evaluation and feedback before leaving the training.

APPENDIX A

Sample Documents and Handouts

Introduce this Tool:

Sample Email Communication

Pre-Learning Email

You can find additional sample email communications in the download folder.

Send this to everyone who has signed up about three days ahead of the training, give or take a day if there are weekends or holidays in the way.

Sample Email: Registration Confirmation + Pre-Learning Resource

Subject: You're In! Get Ready for [Training Name]

Header: Your Training is Coming Up—Here's What to Expect

Body:

Thanks for registering for [Training Name]! You're taking a key step toward growing your business with heat pumps. This training will provide you with in-depth technical knowledge, best installation practices, and performance optimization that will set you apart in the market. You'll also gain access to exclusive marketing tools and resources that will help you attract more customers and increase your credibility.

To get the most out of this training, we recommend reviewing our short **Pre-Learning Guide** in advance.

📖 **[Download the Pre-Learning Guide (PDF)]**

🗓️ **Training Details**
Date: [Date]
Time: [Time]
Location: [Address or Virtual Link]

We're looking forward to seeing you there!

Introduce this Tool:

Sample Pre-Learning Document

Give your participants a sense of the main topic areas for the training with some “things to think about” to help make the content more relevant.

You can find a customizable version of the pre-learning document in the download folder.

Leading the Charge –

Why Minnesota is Transforming the HVAC Market with Air Source Heat Pumps

Our next training won't be just about "learning more"- it will also be about leveraging your current expertise.

Things to think about before the training...

- What are best practices to optimize heat pump performance?
- What methods are you already using to ensure high quality ASHP installations?
- What challenges are you currently facing with ASHP installations?

How can you maximize the value of ASHPs for your customers?

- How can you select the best equipment for each customer's home and priorities?
- What important aspects of each customer's home can you factor into your system design?
- How can you factor in available rebates, rates, and financing to maximize cost savings for each customer?

What gets customers interested in heat pumps?

Highly efficient technology to heat and cool your home

You can stack rates, rebates and financing options to offset installation costs

Fully replace your air conditioner for year-round comfort

The energy future is here. Let's turn Minnesota's cold days into hot opportunities!

INSERT YOUR LOGO

Introduce this Tool:

Sample Handouts for Exercises

The scenario

Ben and Maureen scheduled a bid with you to replace their old AC and furnace. In your discussions with them, you learn they are curious about upgrading their AC to a heat pump. They hope the heat pump can help lower their energy bills. Ben and Maureen also share that they are hoping a new heating and cooling system will be an environmentally-friendly way to make their home more comfortable throughout the year.

Home size and load
- Built 1955
- Air sealing improved, but no further weatherization completed
- 2,042 square feet
- 37,000 BTU/hr heating load
- 22,000 BTU/hr cooling load

Current equipment
- Installed before air sealing
- 3T single-stage AC
- 60,000 BTU/hr condensing gas furnace

Utilities
- Todd-Wadena
- Minnesota Energy Resources Corp

Exercise 1: Value Stacking

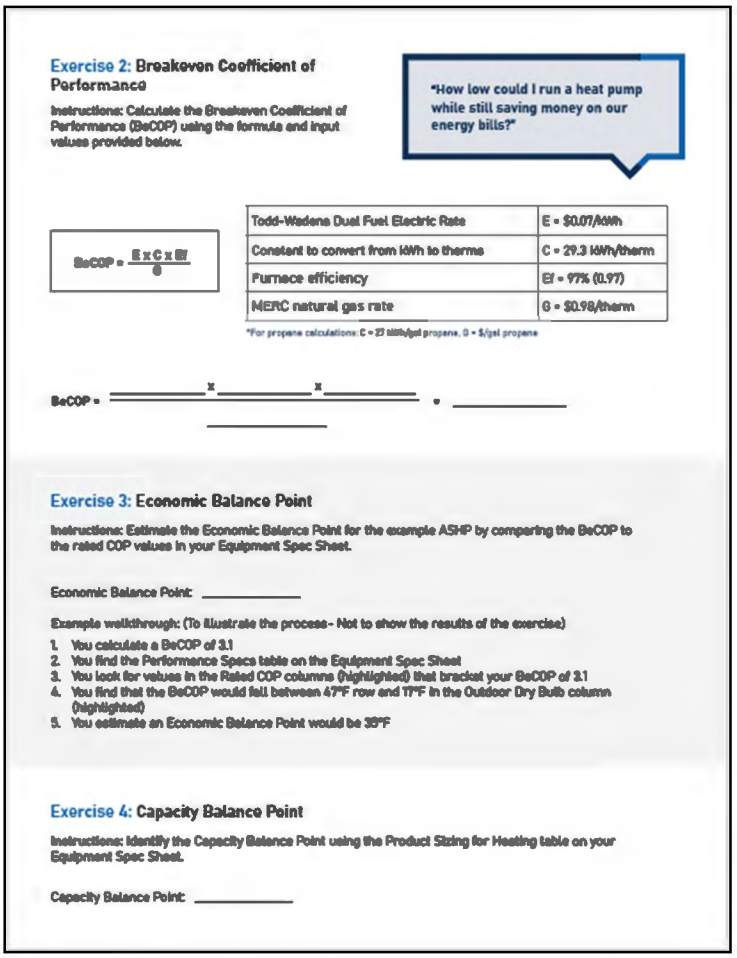
Instructions: Fill out the value stack for the Example ASHP by following along with the presented material.

"Aren't there rebates for heat pumps? How much can they help?"

		Basic AC & Furnace: AC: 2.5T, 15.2 SEER2, 12 EER2 Furnace: 40,000 BTU/hr 95 AFUE		High Efficiency ASHP & Furnace ASHP: 2T, 17 SEER2, 8.6 HSPF2, 10 EER2 Furnace: 40,000 BTU/hr, 97 AFUE	
		AC	Furnace (95%)	ASHP	Furnace (97%)
Example Cost*		$6,000	$5,000	$11,000	$6,000
Upfront Incentives	Todd-Wadena	-	-		-
	MERC	-	$350		
Bottom line at bid (Equipment Cost minus Upfront Incentives)		$6,000	$4,650		
Tax credits	25C Tax Credit (2025) Depending on tax liability	$0	$0		
Final equipment cost		$6,000	$4,650		
Final bid total		$10,650			

*Costs are estimated to include additional parts and labor for installation

You can find a copy of the worksheet in the download folder.



Exercise 2: Breakeven Coefficient of Performance

Instructions: Calculate the Breakeven Coefficient of Performance (BeCOP) using the formula and input values provided below.

"How low could I run a heat pump while still saving money on our energy bills?"

$$BeCOP = \frac{E \times C \times Ef}{G}$$

Todd-Wadena Dual Fuel Electric Rate	E = $0.07/kWh
Constant to convert from kWh to therms	C = 29.3 kWh/therm
Furnace efficiency	Ef = 97% (0.97)
MERC natural gas rate	G = $0.98/therm

*For propane calculations: C = 27 kWh/gal propane, G = $/gal propane

BeCOP = _____ x _____ x _____ / _____ = _____

Exercise 3: Economic Balance Point

Instructions: Estimate the Economic Balance Point for the example ASHP by comparing the BeCOP to the rated COP values in your Equipment Spec Sheet.

Economic Balance Point: _____

Example walkthrough: (To illustrate the process - Not to show the results of the exercise)

1. You calculate a BeCOP of 3.1
2. You find the Performance Specs table on the Equipment Spec Sheet
3. You look for values in the Rated COP columns (highlighted) that bracket your BeCOP of 3.1
4. You find that the BeCOP would fall between 47°F row and 17°F in the Outdoor Dry Bulb column (highlighted)
5. You estimate an Economic Balance Point would be 35°F

Exercise 4: Capacity Balance Point

Instructions: Identify the Capacity Balance Point using the Product Sizing for Heating table on your Equipment Spec Sheet.

Capacity Balance Point: _____

You can find a copy of the worksheet in the download folder.

Introduce this Tool:

Sample Evaluation Form

You can find a customizable version of the Evaluation form in the download folder.

1. What is your role?

☐ Distributor ☐ Contractor ☐ Utility ☐ Sales

☐ Other_____

2. Please share your overall satisfaction with this training. (Choose one)

☐ Very satisfied ☐ Somewhat satisfied ☐ Somewhat dissatisfied ☐ Very dissatisfied

How confident were you in the following?	Not at all confident (1)	(2)	(3)	(4)	Very confident (5)	Not at all confident (1)	(2)	(3)	(4)	Very confident (5)
	BEFORE the training					AFTER the training				
Explaining heat pump benefits to customers	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Implementing design and installation best practices on air source heat pump systems	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Recognizing the priorities and situations of your customers to provide quality heat pump systems	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Helping your customers understand the sources of incentives and how to stack them	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. What would make this training better?

4. Please indicate how confident you were BEFORE and AFTER the training in explaining the following to customers

5. How likely are you to use the skills and concepts you learned today about air source heat pumps in your work? (Choose one)

☐ Very likely ☐ Somewhat likely ☐ Not very likely

6. What impact, if any, will this training have on your thoughts and actions?

A key point I will remember is...

_____

_____

After today, I will likely change the way I....

_____

I'd like to *learn more about*

_____

_____

7. What additional marketing and/or technical resources would you like to see to support air source heat pump installers?