Heat Pump Market:
Latest Trends and How to Engage Customers

Green Energy Contractor Conference

November 29, 2018

Overview

Theme of the day:

strategic electrification

Discussion:

- CT's heat pump market
- Technical perspective
- Regional overview
- Financing & engagement opportunities

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Empowering you to make smart energy choices

Heat Pump Trends & Consumer Engagement

EVERSOURCE UI SCG CNG

Deep Decarbonization

Public Act 08-98 – An Act Concerning Global Warming Solutions

Reduce statewide GHG emissions by 80% below 2001 levels by 2050

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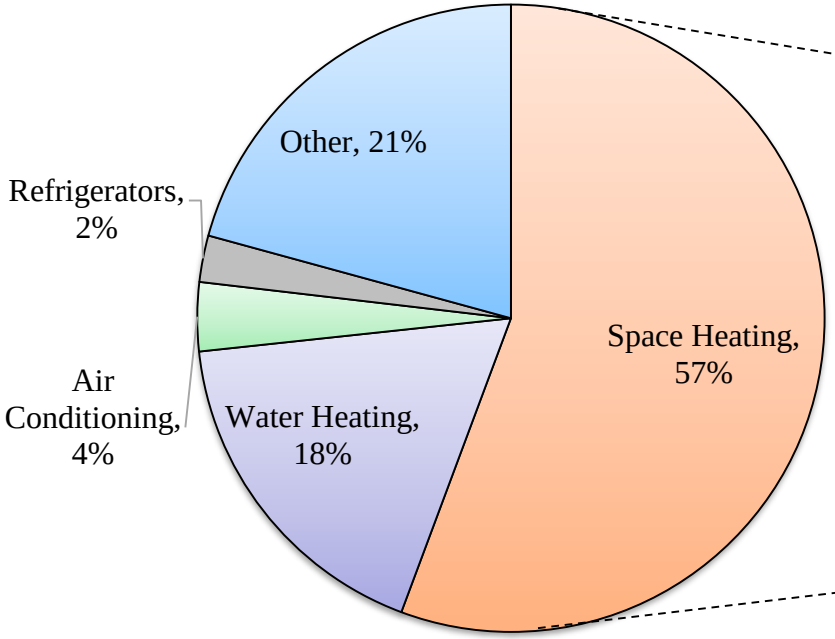
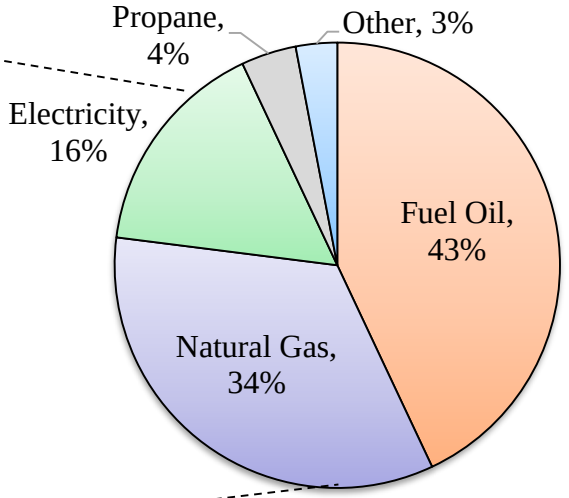
Home Energy Consumption: A Primer

Average Northeast Household Energy Consumption by End-Use



Primary Energy Source for Space Heating by % of Total Households



Source (1): 2015 RECS Survey Data, EIA, Northeast Average Site Energy Consumption (MMBTU/Household)
Source (2): 2018 CT Comprehensive Energy Strategy, *Figure B4*, p. 68

Three Key Strategies for Strategic Electrification

Advanced Electric Technologies

- Electric Vehicles (EV)
- Air-Source Heat Pumps (Ducted & Ductless)
- Ground-Source Heat Pumps (GSHP)
- Variable Refrigerant Flow (VRF)

Deep Energy Efficiency

- Passive Design principles
- Air-tight thermal envelope
- Well-insulated/Minimal thermal bridging
- DHW & HVAC systems suited for smaller energy loads

Grid Integration

- Control strategies to allow for demand response and load shifting capabilities
- Grid-responsive building design to maintain thermal comfort while shifting operational loads and run-times

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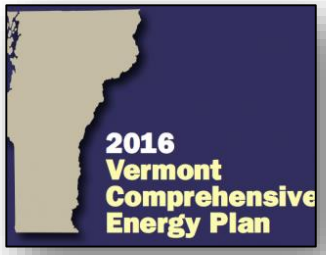
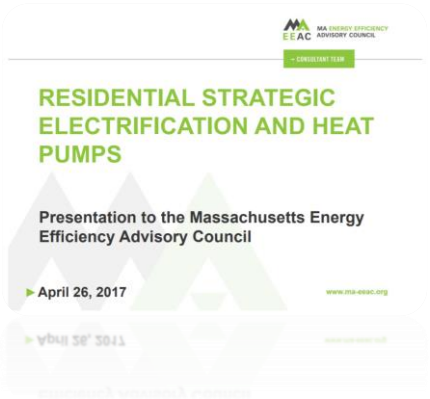
Regional Efforts: Strategic Electrification & Heat Pumps

2016

VT integrates strategic electrification into statewide *Comprehensive Energy Plan*



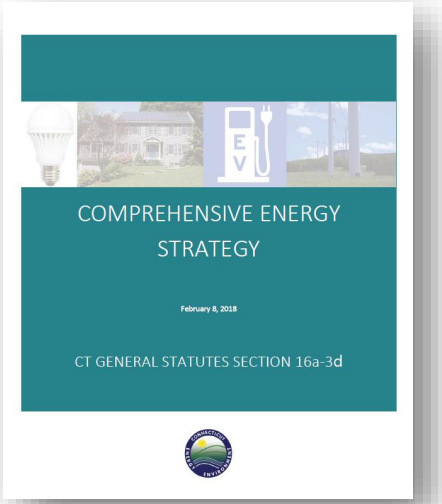


2017

MA Energy Efficiency Advisory Council presentation *Residential Strategic Electrification & Heat Pumps*

2018

CT DEEP publishes *Comprehensive Energy Strategy* (CES) with plans to transition to cleaner thermal fuels and technologies through strategic electrification



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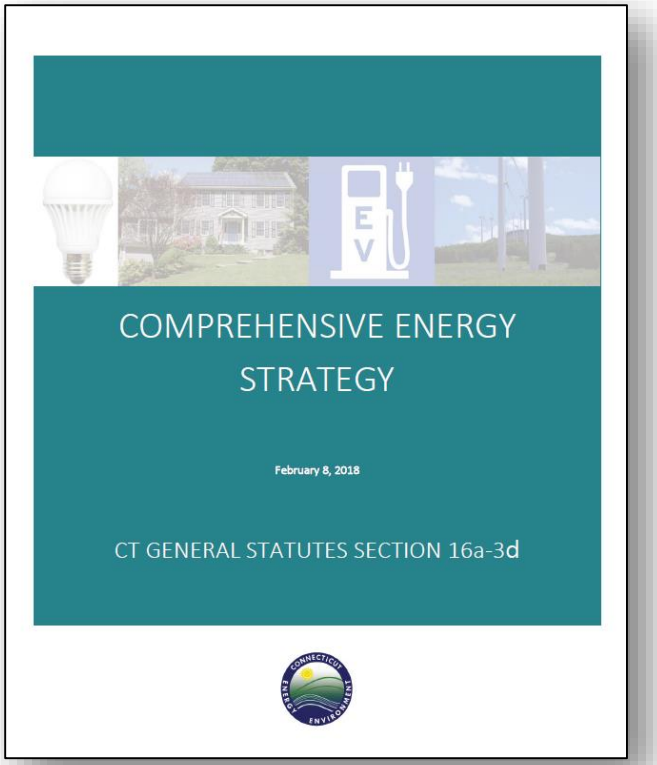
Policy Support for Heat Pumps: CT Comprehensive Energy Strategy

Transition to cleaner thermal fuels and technologies

- To continue the state's progress toward meeting Global Warming Solutions Act goals and improve air quality, decarbonization of thermal systems is necessary.

- DEEP recommends encouragement of renewable thermal technologies (RTT), and in particular heat pumps, that in the summer can provide efficient cooling and in the winter can cost-effectively displace conventional heating fuels/sources



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Strategic Electrification of Homes

Key Concepts

- Decarbonization
- Strategic Electrification

Key Strategies

- Fuel switching to displace or replace fossil fuel heating
- Low heating loads make heat pumps more advantageous
- Enhanced incentives for “all-electric” EE homes

Key Technologies

- Heat Pumps (Air-Source, Ground-Source, Water Heaters)
- High Performance Building Envelope
- Balanced Mechanical Ventilation (HRV/ERV) Systems

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CT Ductless Heat Pump Program

- In 2017, Energize CT transitioned to offering instant discount rebates to qualifying DSHPs through participating HVAC Distributors.
- In 2018, the program has 57 active Memorandums of Understanding
  - Equipment installation information required.
- Field support reps “circuit riders” provide training to sales associates and store managers about program guidelines
- Energize CT has partnered with manufacturers and Distributors to promote the installation of ductless heat pump systems via training to installation contractors.

Equipment Type	Qualification Criteria	Incentive Amount
Ductless Heat Pump	ENERGY STAR certified Single Indoor Unit: 20 SEER, 12.5 EER, 10 HSPF	A $300 instant discount to licensed contractors at participating distributor locations
Ductless Heat Pump	ENERGY STAR certified Multi-Indoor Unit: 18 SEER, 12.5 EER, 9 HSPF	A $500 instant discount to licensed contractors at participating distributor locations
Central Air Source Heat Pump System	16 SEER, 12.5 EER, 10 HSPF ENERGY STAR and AHRI certified	$500 mail-in rebate per system

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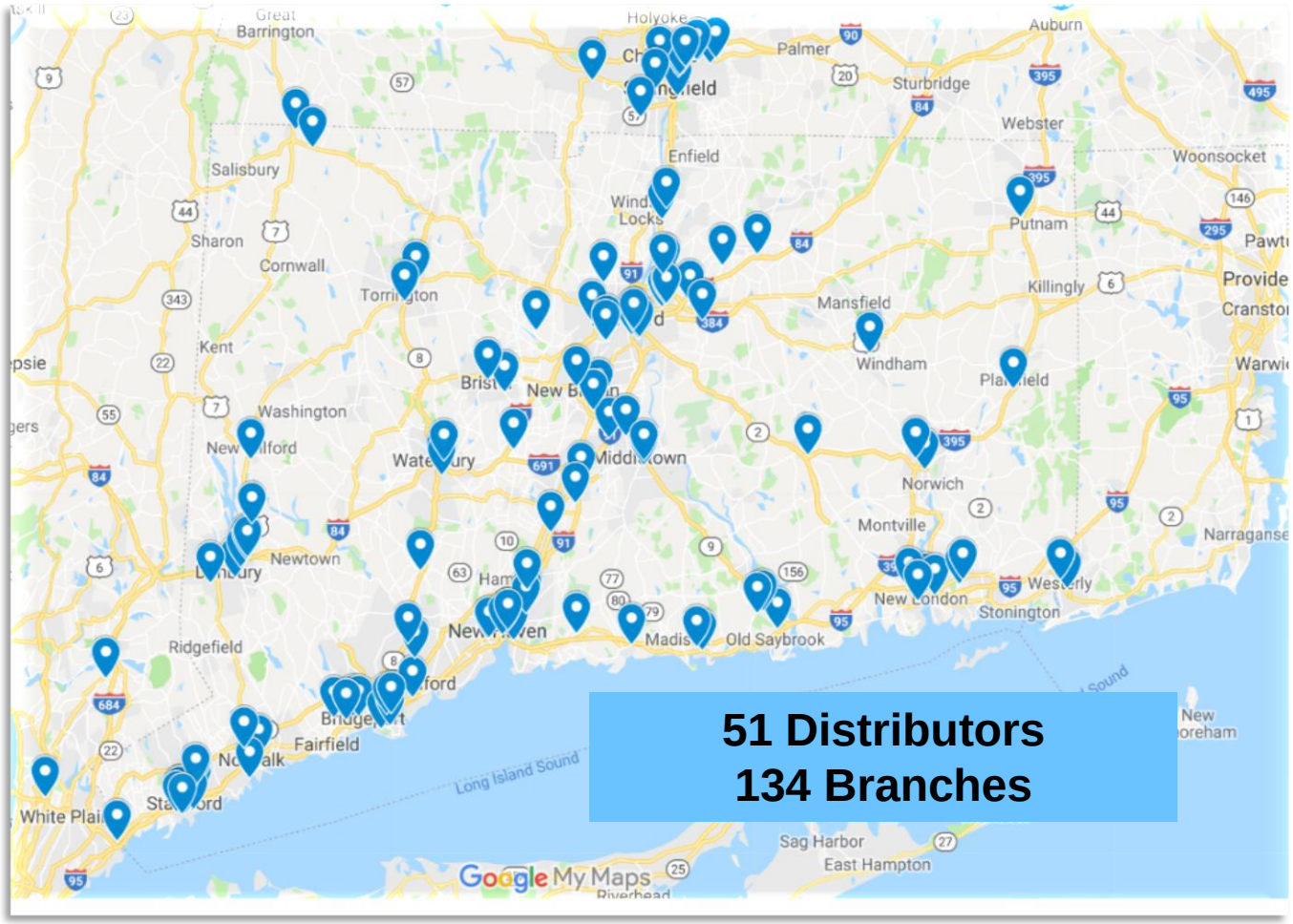
Distributor Participation



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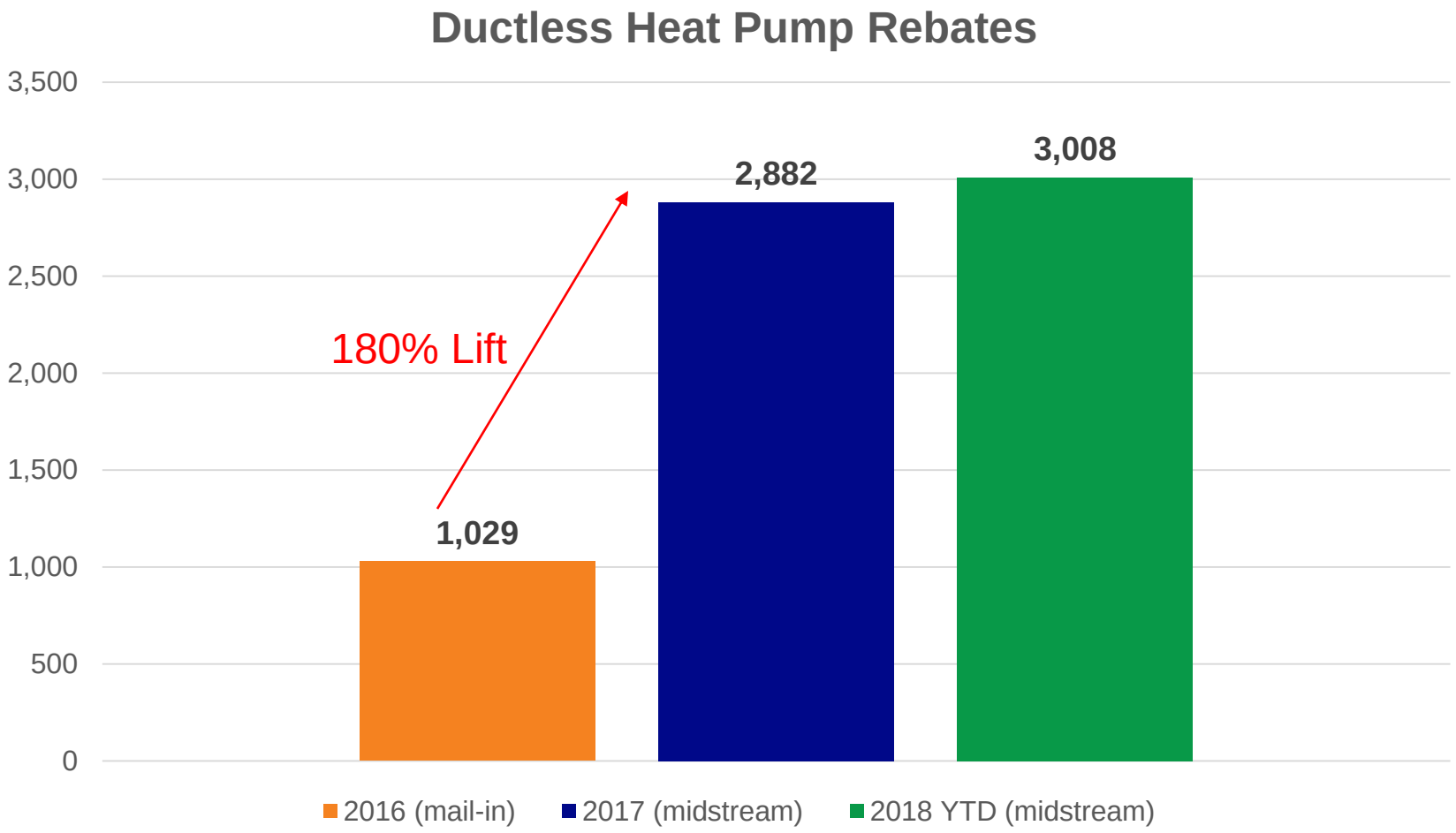
Ductless Heat Pump Results



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HEAT PUMP TRENDS
&
HOW TO EDUCATE CUSTOMERS

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Bordering CT

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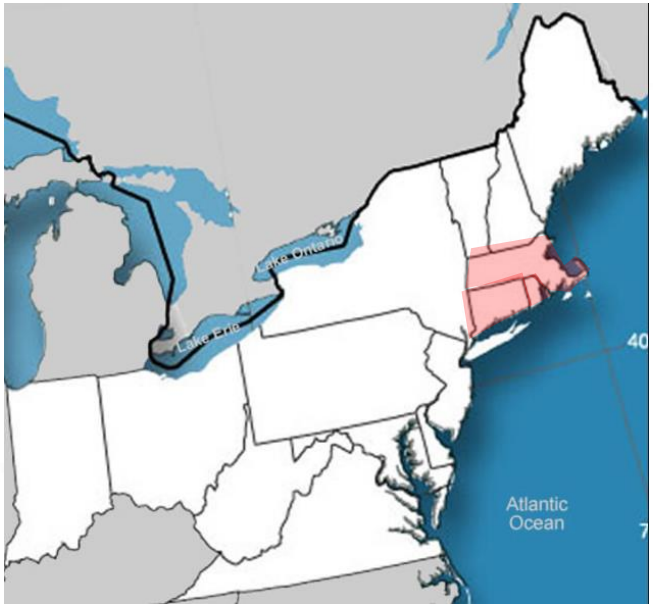
Energize CT
$300/home – 20/12.5/10 - single
$500/home – 18/12.5/9 – multi
*$700 bonus for electric heat
** Upstream starting 1/17

Smart E-Loan
4.99% for 5/7 or 10 year term



Rhode Island
$300 per – 20 SEER/12 HSPF
$100 per – 18 SEER/10 HSPF

Mass Save
$300 per – 20 SEER/12 HSPF
$100 per – 18 SEER/10 HSPF
* Stay tuned for Central HP

Heat Loan
0% Loan/7 years

MassCEC
$500/system ccASHP – Single
$500/ton ccASHP – Multi

Muni-Helps
$250 18 SEER/9 HSPF

* Ashburnham, Boylston, Chicopee, Holden, Hull, Ipswich, Marblehead, Peabody, Princeton, Russell, Shrewsbury, South Hadley, Sterling, Templeton, West Boylston

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New York

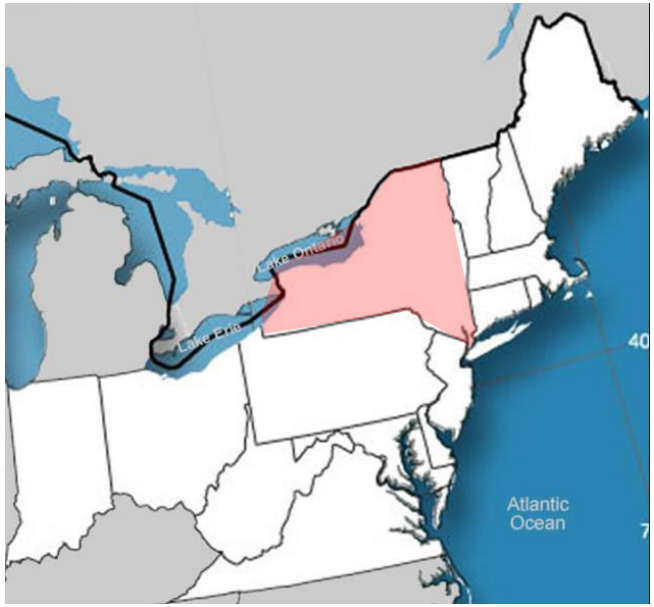
FOCUS INVEST ACHIEVE

NYSERDA

Announced: Aug 17, 2017

$500 Contractor rebate

- ccASHP in any home.
- Entire state except Long Island
- Contractors must sign up to participate.
- Marketing available in September ($50k per contractor or distributor, cost share)



Participating Utilities

- Central Hudson Gas & Electric Corporation
- Con Edison
- National Fuel
- National Grid -Niagara Mohawk Power
- National Grid-Long Island (KeySpan Gas East Corporation)
- National Grid New York (Brooklyn Union Gas Company)
- NYSEG (New York State Electric and Gas Corporation)
- Orange and Rockland Utilities, Inc.
- RG&E (Rochester Gas and Electric Corporation

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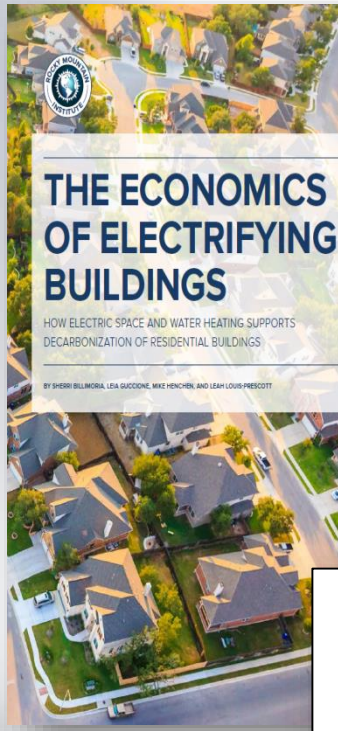

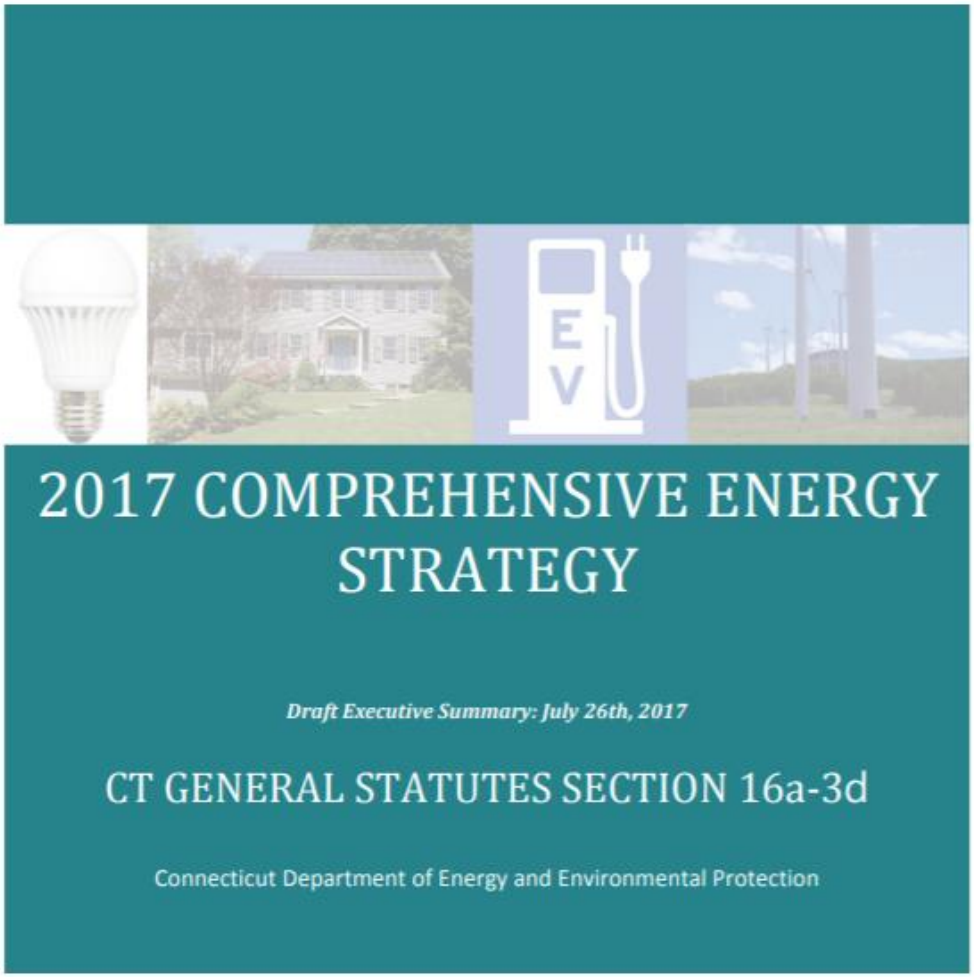

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Strategic Electrification – Only works with this

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WORLDWIDE USAGE – HUGE OPPORTUNITY

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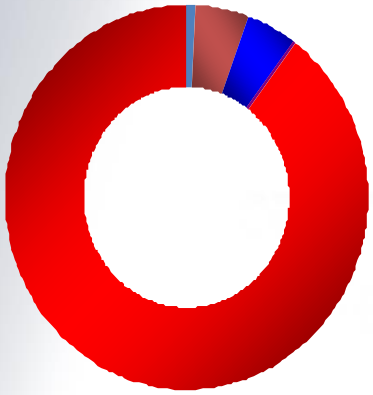
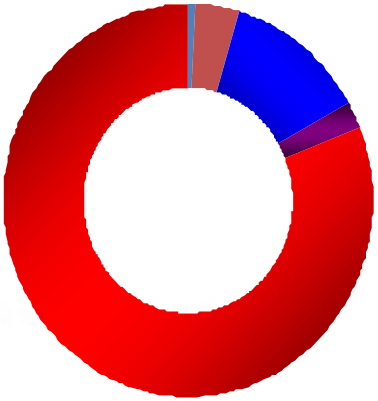
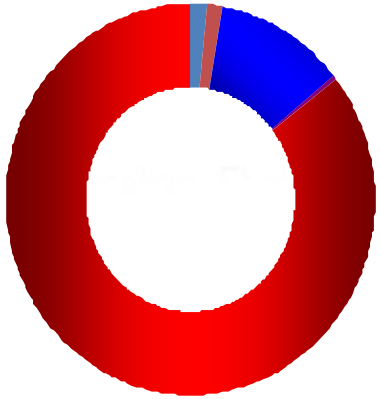


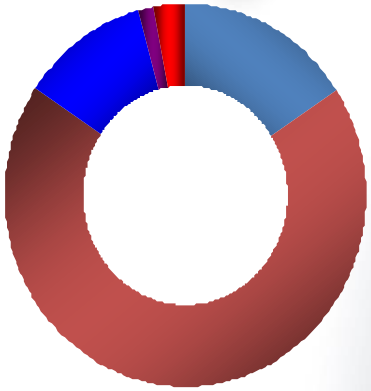
JAPAN
90%
7.2M Systems



CHINA
86%
16.7M Systems



EUROPE
81%
7.6M Systems



USA
8%
0.7M Systems

- Window
- Unitary
- Chillers
- Moveble
- Ductless

Ductless is a small percent of the U.S. HVAC market but current building & energy usage trends indicate **tremendous growth opportunity.**

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Product Life Cycle

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Introduction | Growth | Maturity | Decline

Product Sales

Mass Market

Time

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An Evolution has Occurred

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PAST

1:1 Only
Ductless Only
Spot Cooling Only
Niche Applications
Little Brand Awareness

PRESENT

Multi-Zone
Ducted and Ductless
Zone Comfort Solutions
Whole House Applications
Dominant Brand Awareness

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Conventional Compressor

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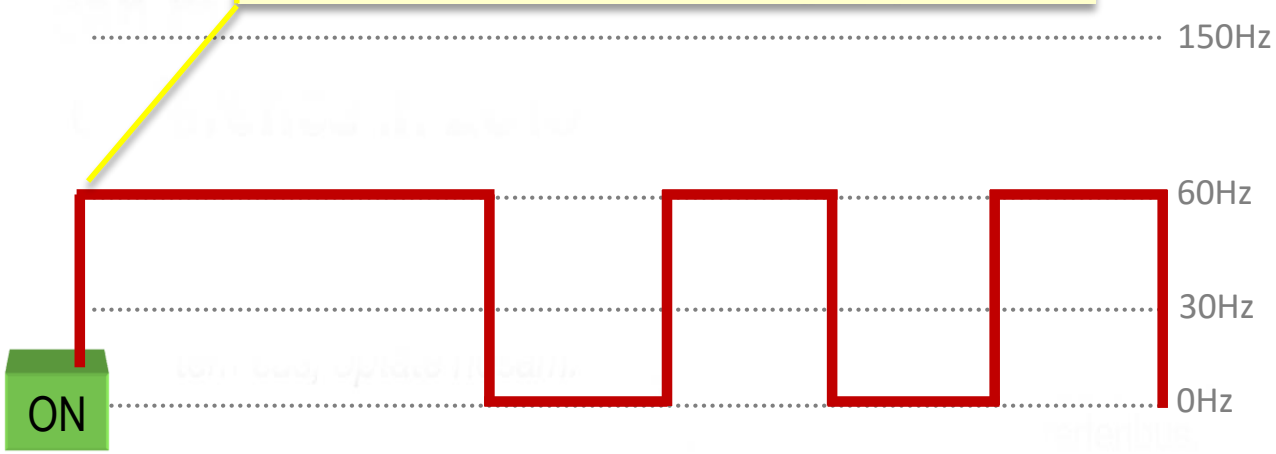
- High starting current results in energy loss
- On/off cycling results in temp fluctuations and lower efficiency
- Additional strain on system
- Noisier



Conventional compressor

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INVERTER Technology

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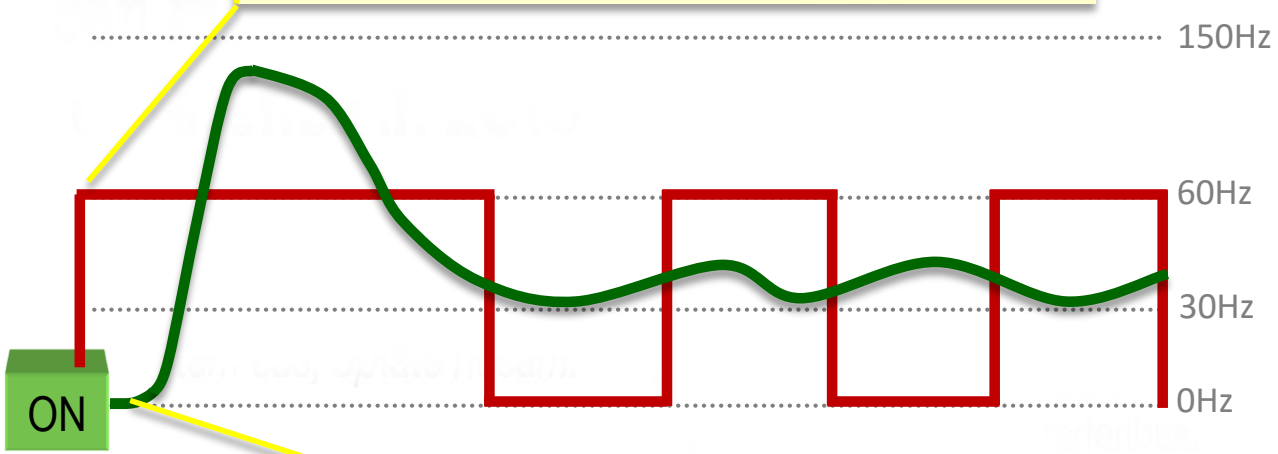

- Starts current at lower level
- Ramps up to high rotation for faster heating/cooling
- Throttles back to maintain temperature
- Energy efficient and quieter

INVERTER compressor

Conventional compressor

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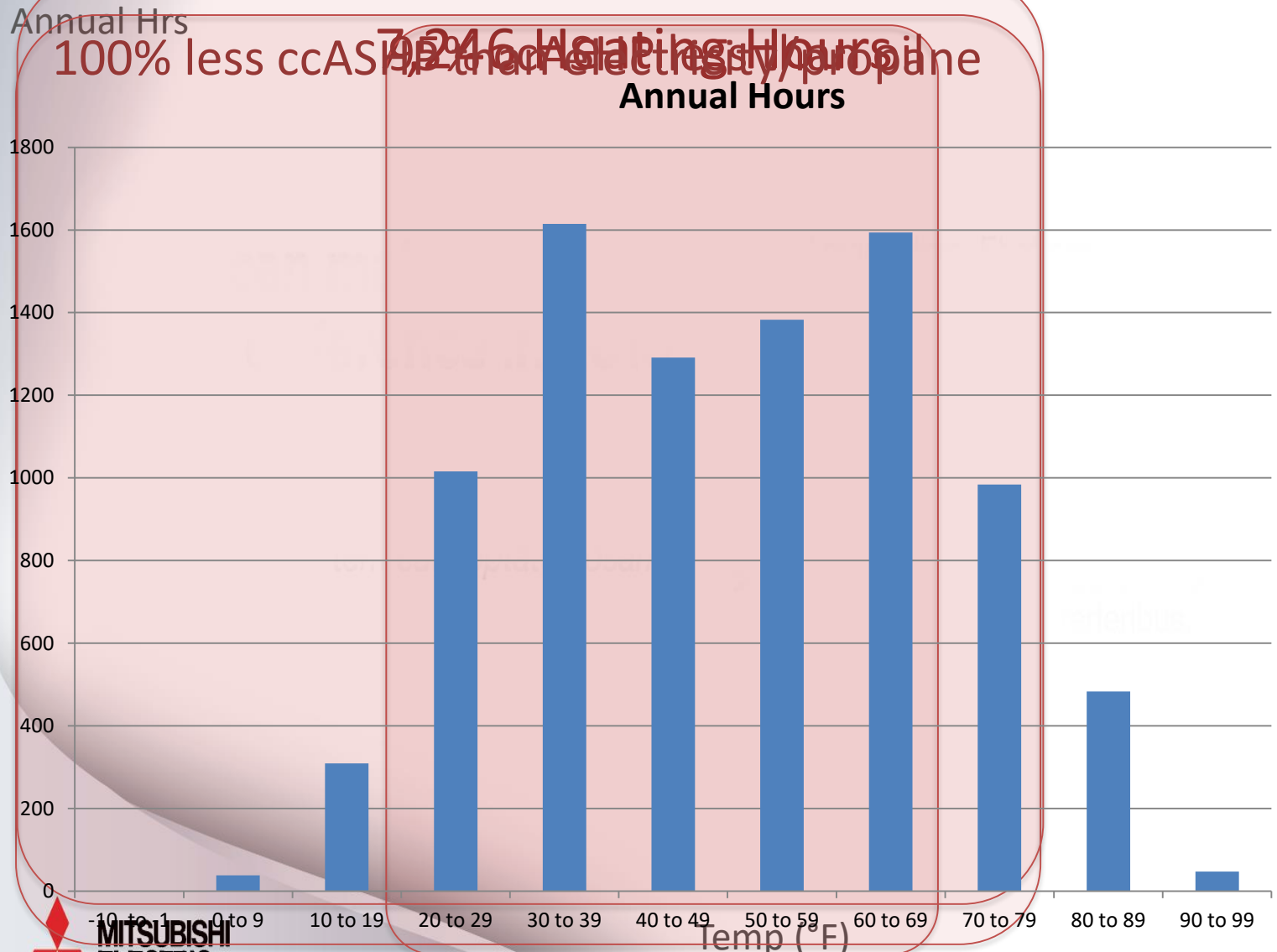
Hartford Heating Season



Source: Engineering Weather Data, Michael Kjelgaard,

ccASHP

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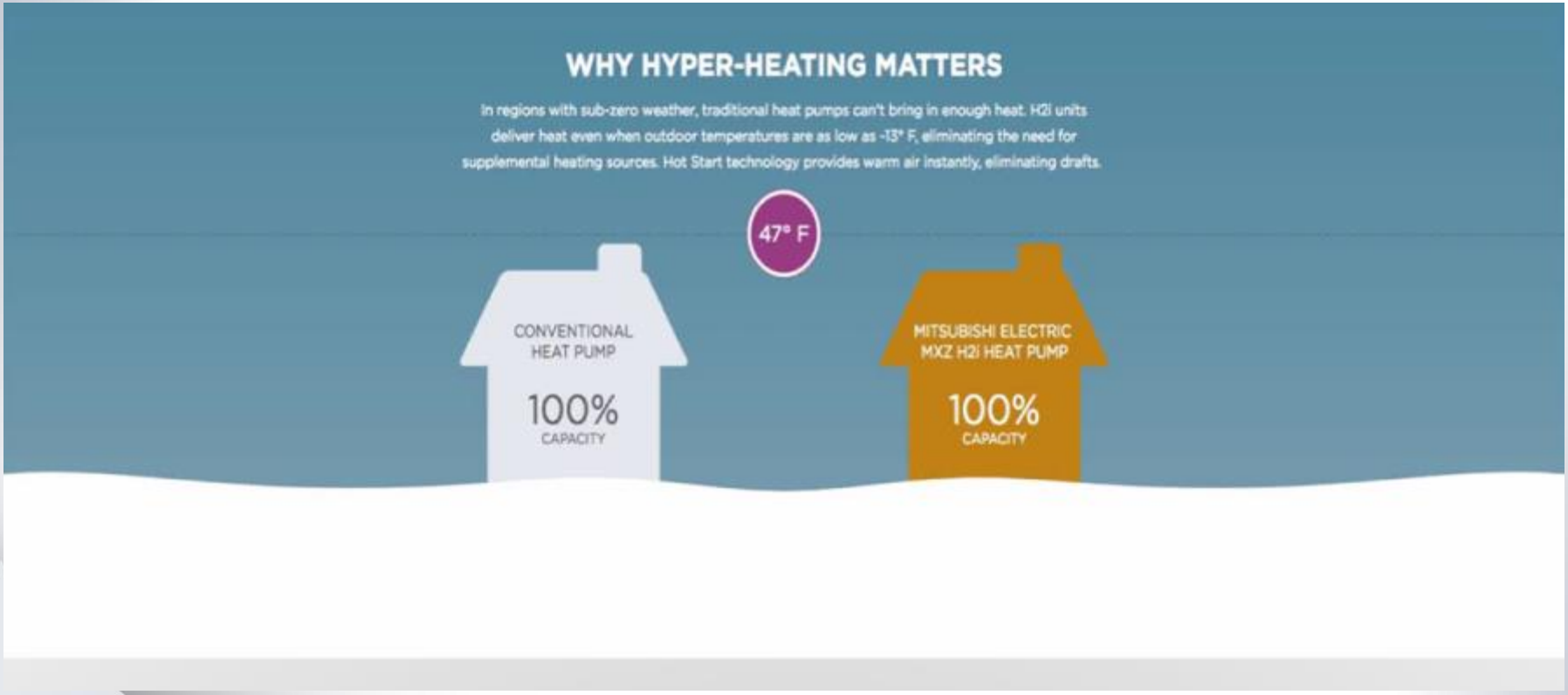

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ccASHP

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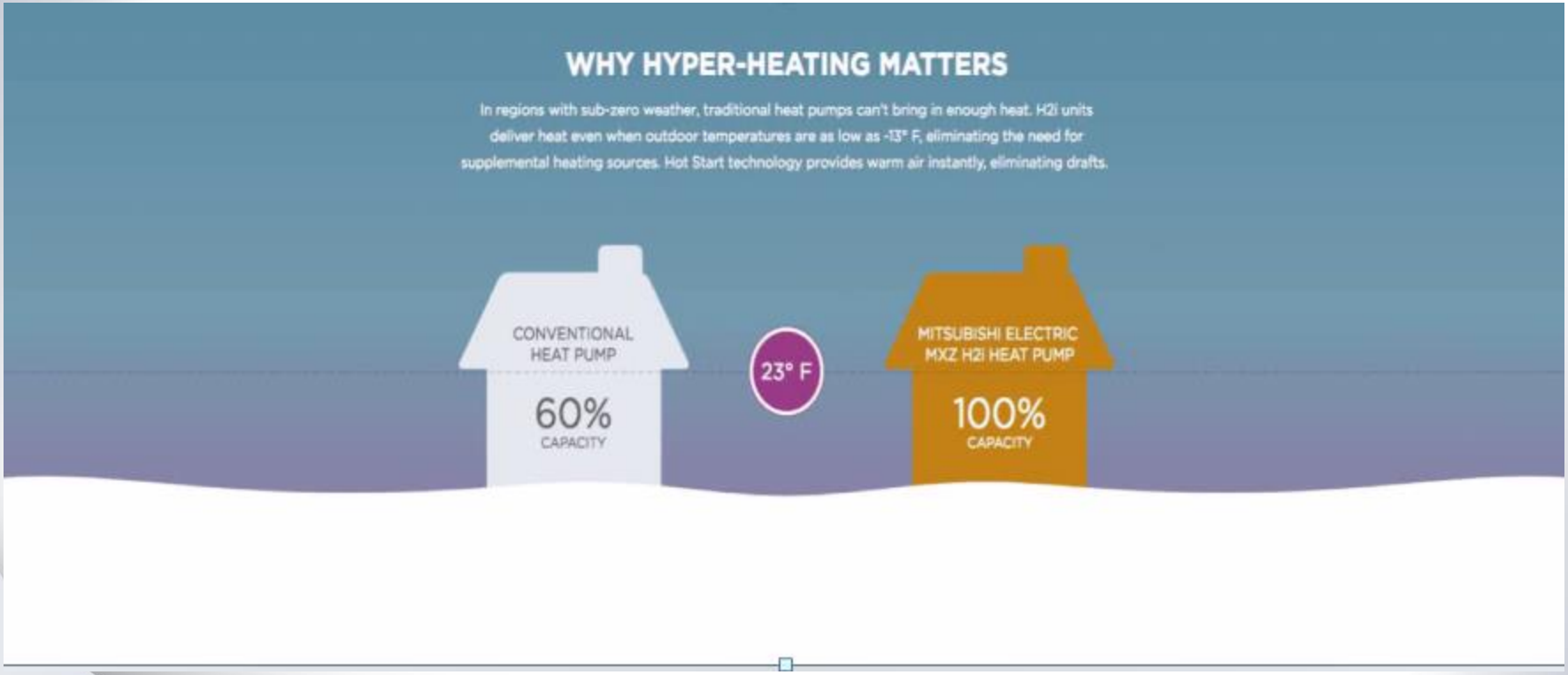

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ccASHP

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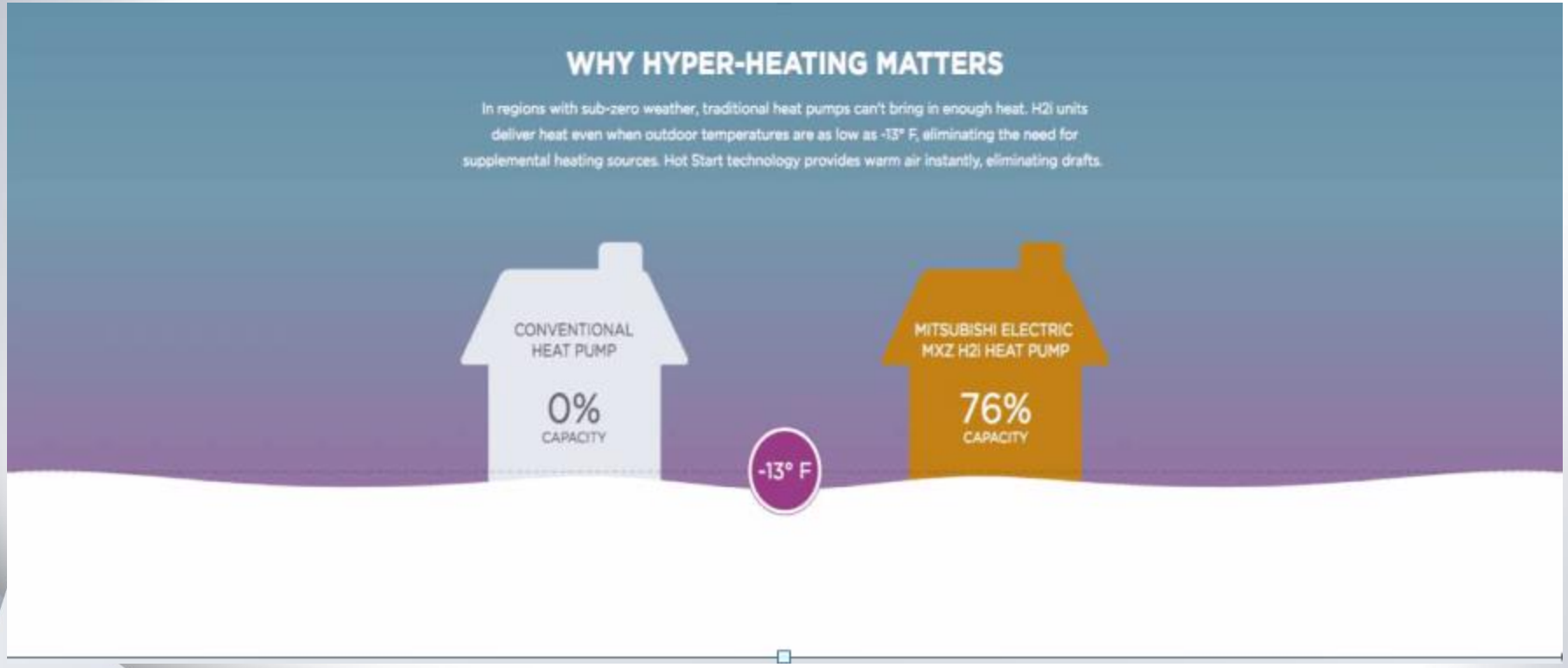

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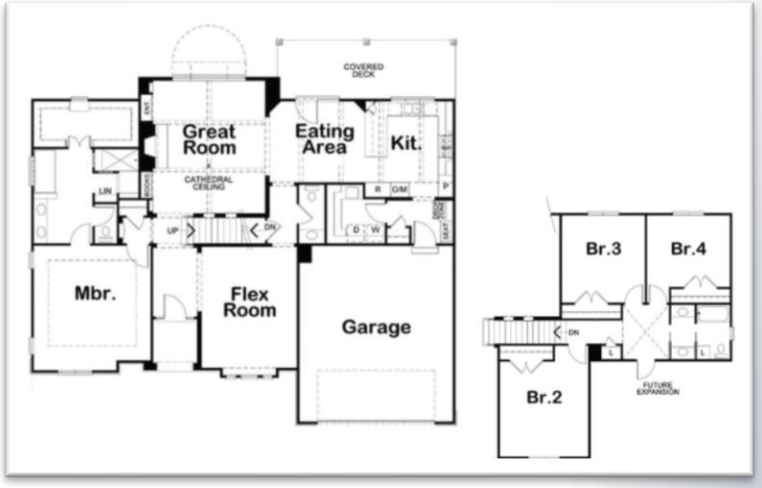
Applications

- Single family homes & condos
- Hot and Cold spots
- Additions & renovations
- New construction



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Solution is an opinion

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Whole Home Solution

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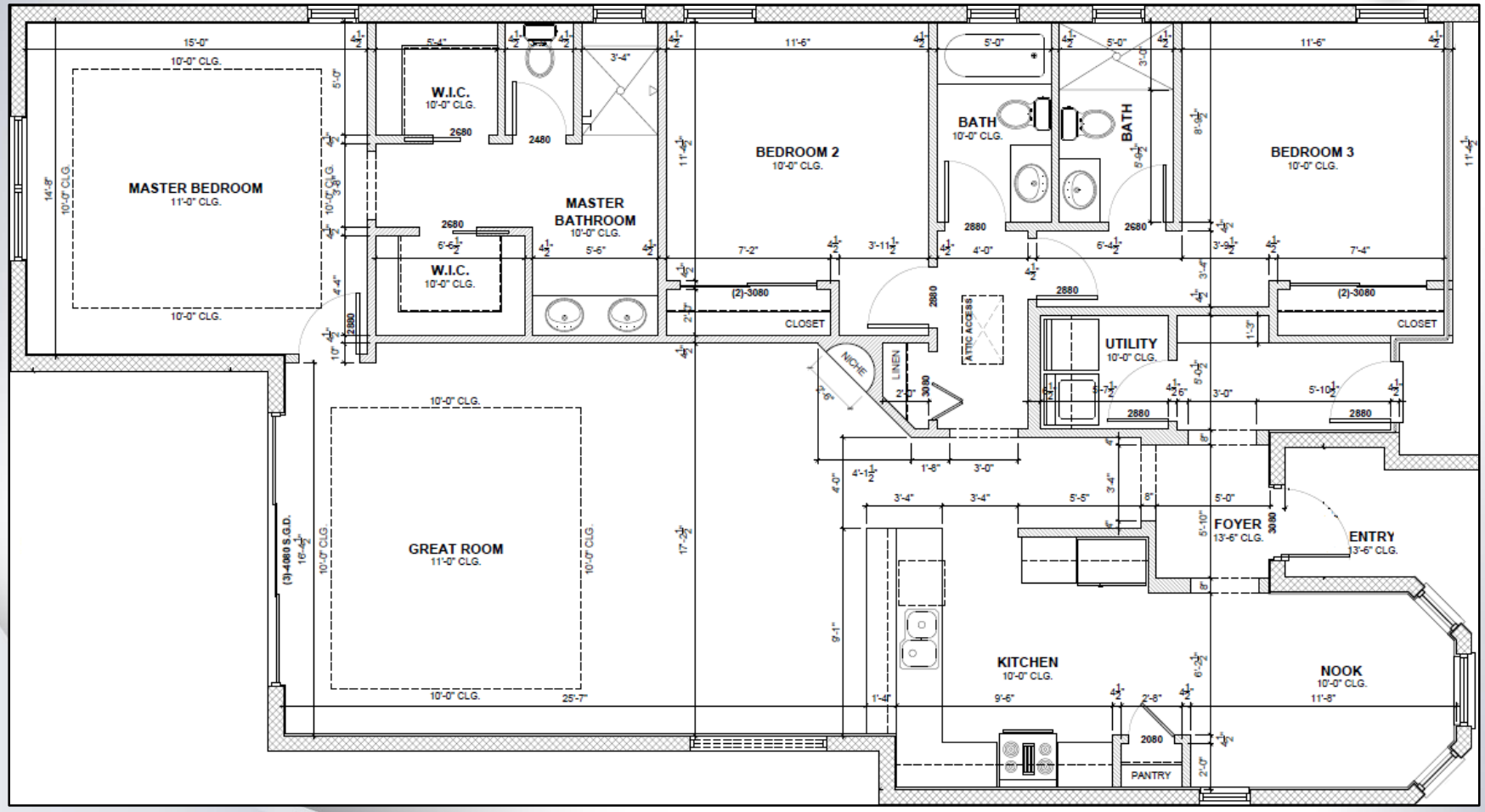

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Whole Home Solution
5 single zone systems

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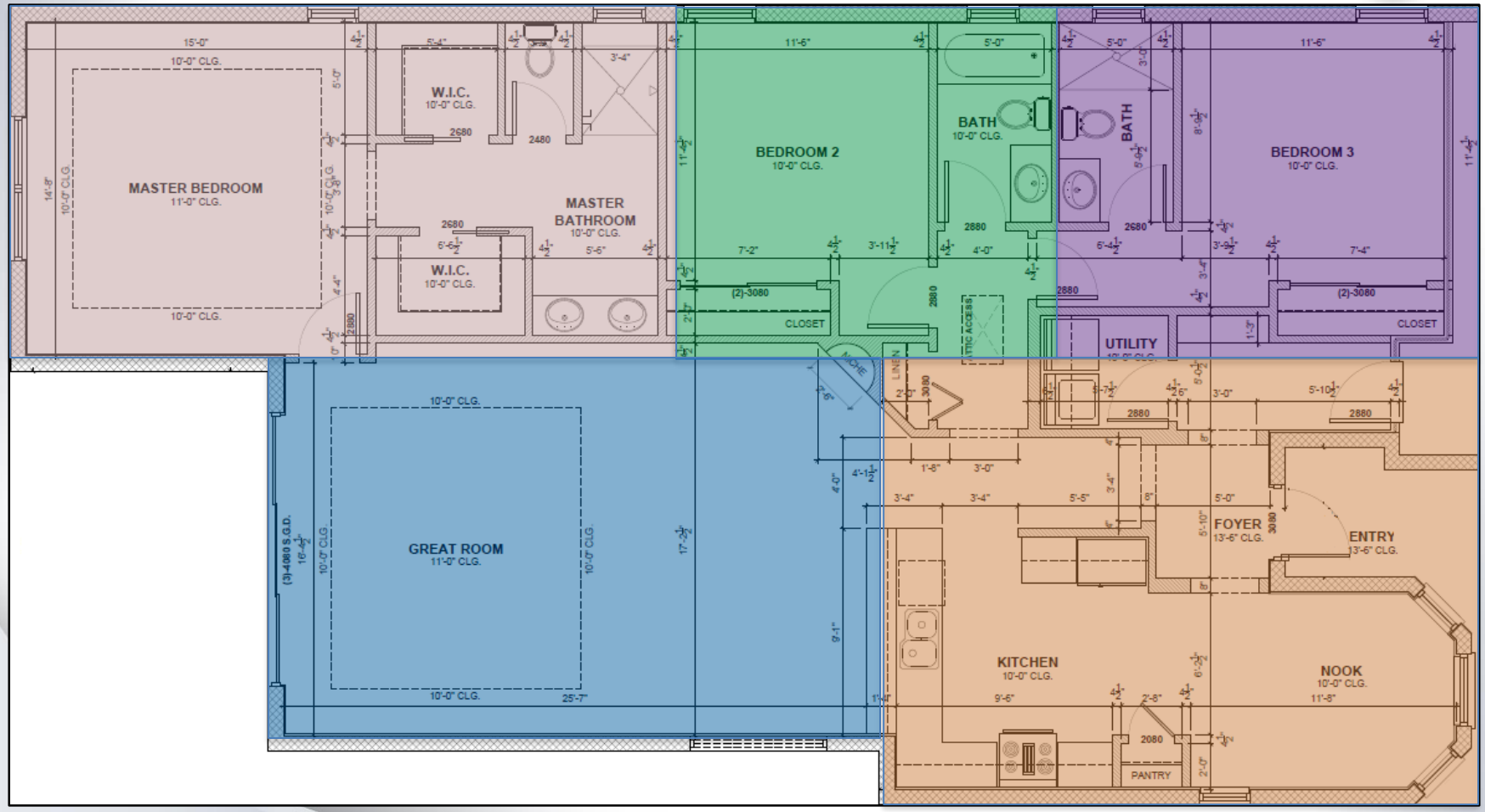

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Whole Home Solution
3 single zone systems

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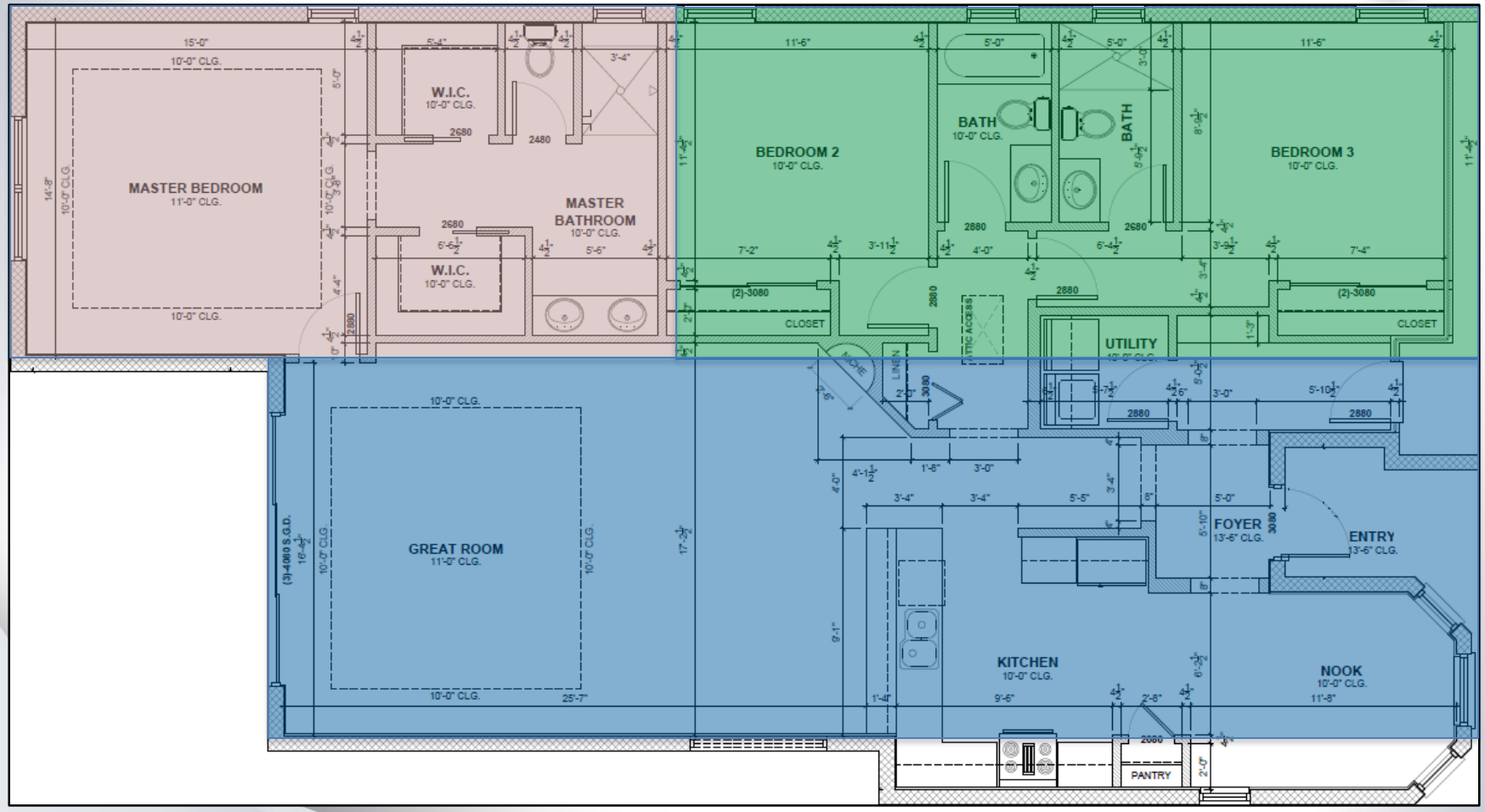

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Whole Home Solution
3 zone system and 2 single zone systems

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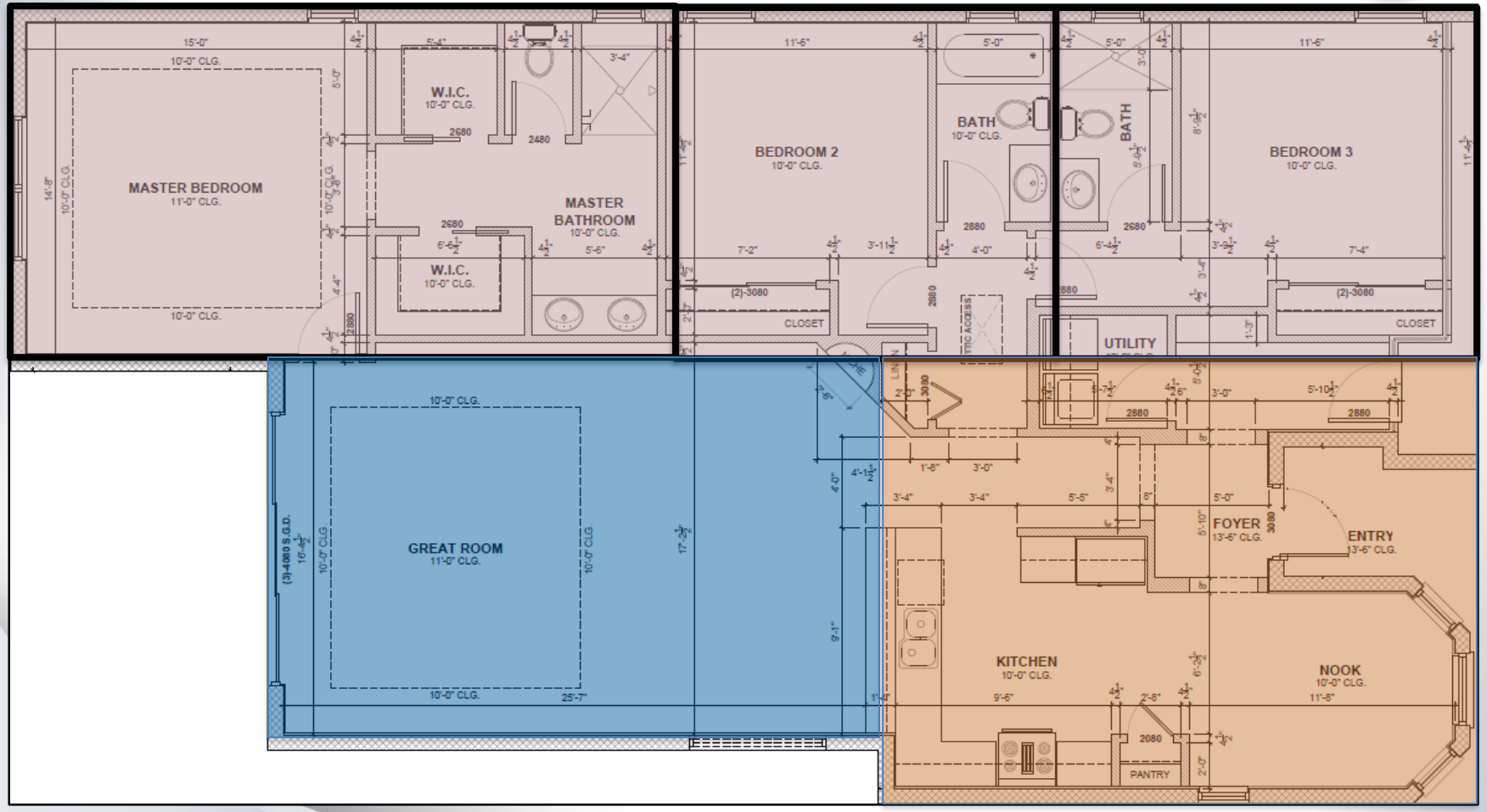

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Whole Home Solution
3 zone system and 2 zone system

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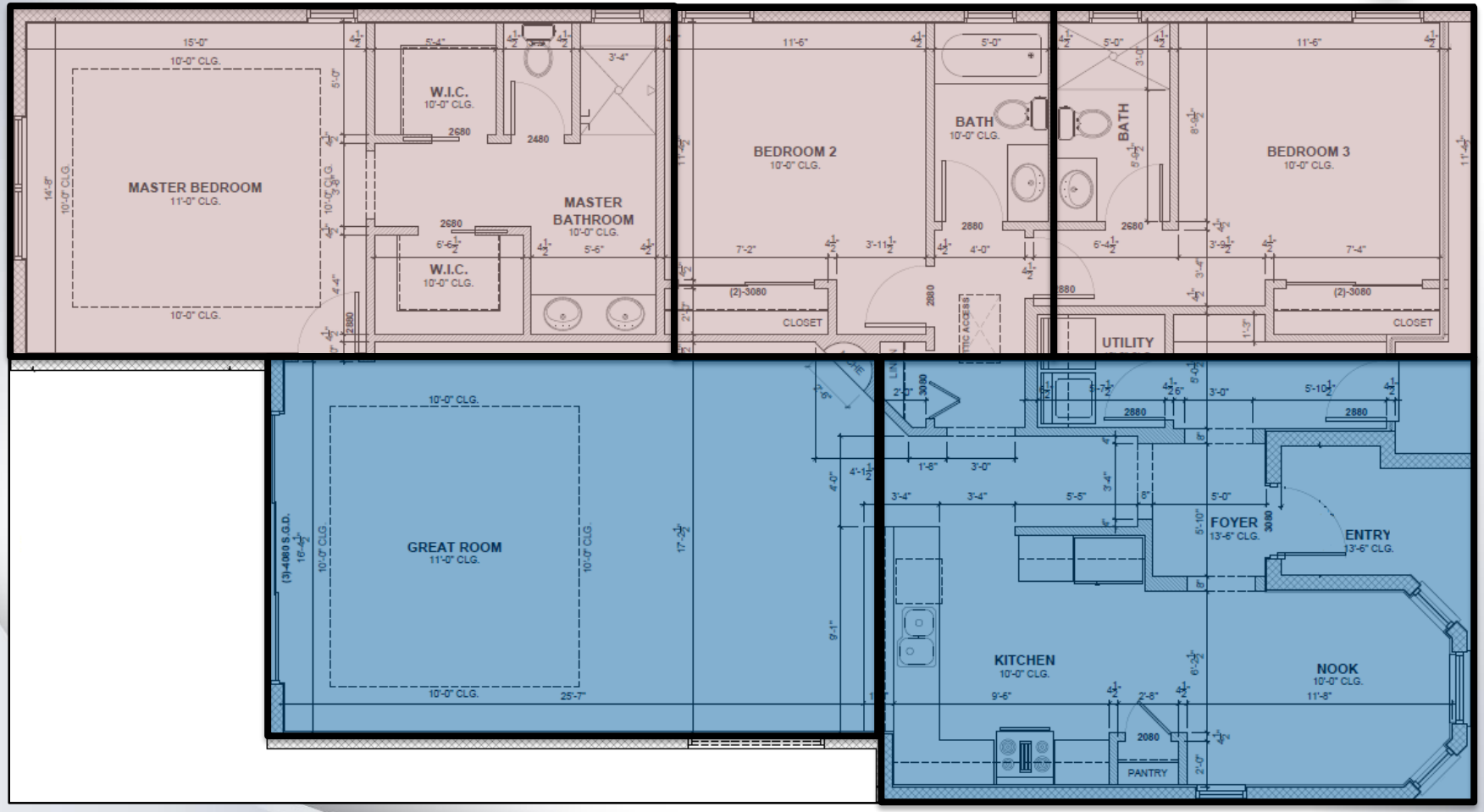

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Whole Home Solution
5 zone system

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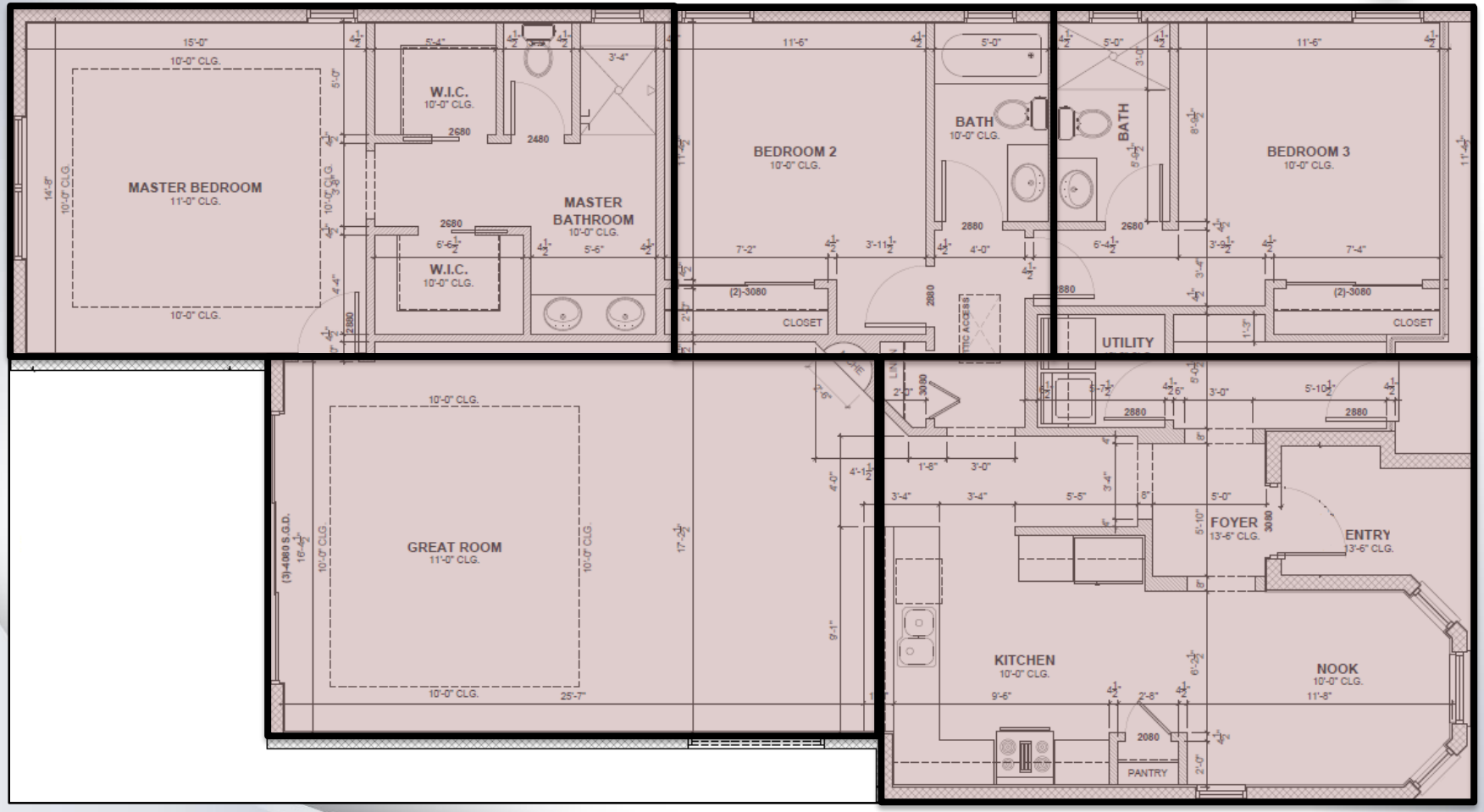

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Whole Home Solution

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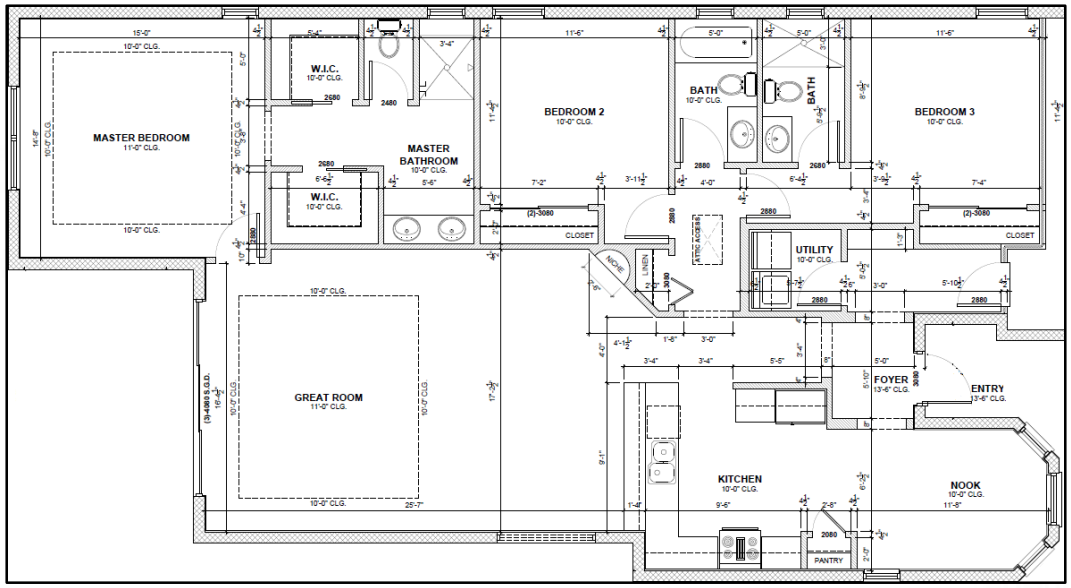

Which solution was right?

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OUR LARGEST DEALERS DO SOMETHING OTHER THAN HVAC

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THANK YOU

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Heat Pump Trends, Strategies and Resources

Dave Lis, Northeast Energy Efficiency Partnerships

November 29, 2018

Northeast Energy Efficiency Partnerships

"Assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption 3% per year and carbon emissions 40% by 2030 (relative to 2001)"

Mission

We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge

THE FUTURE IS ELECTRIC!

Requires massive market transformations

- Assumed Market shares in 2035 according to NEEP's "Plausibly Optimistic" scenario reflects;
  - Residential Heat Pumps-
    - 89% for delivered fuel systems
    - 68% sales share of today's natural gas systems sales
  - Cars and Light trucks-
    - 70% of Sales

NEEP's Regional ASHP Initiative

- Launched in 2013
- Regional ASHP Market Transformation Strategy
- Regional Working Group
- Annual In-person Workshop

ASHP Market Transformation Strategies

1. Increase consumer education and awareness
2. Increase installer/builder awareness of, and confidence in, ASHP through expanded training and education
3. Reduce upfront costs of installed systems through robust and aligned promotional programs and the support of alternative business models
4. Mobilize state and local policymakers to expand support for ASHPs
5. Promote advanced control technologies to allow automated coordination among multiple heating systems
6. Enable the promotion of climate-appropriate ASHPs through improved performance metrics
7. Develop more accurate tools to predict energy, cost and GHG savings associated with ASHP installation through collection and analysis of real world performance data

Highlights of Regional Policy/Program - Buildings

NEW HAMPSHIRE

- Developed first-in-nation **RPS carveout for renewable thermal**
- ASHP and HPWH rebates from individual utilities

MAINE

- Significant uptake in residential ASHP/HPWH through Efficiency Maine rebate and financing programs (**over 20,000 rebates FY14-FY16)**

VERMONT

- Incentives for ASHPs and HPWHs through Efficiency VT and utilities
- **GMP leasing ASHPs and HPWHs for RES** compliance

NEW YORK

- New York REV
- NYSERDA developing rebate program for GSHP; targeting heat pump cost reductions
- NYSERDA Clean Energy Investment Plan

MASSACHUSETTS

- Integrating renewable thermal energy into Alternative Portfolio Standard
- ASHP, GSHP, and HPWH rebates via state and utility programs
- Solarize Mass Plus will include heat pumps, EVs, and storage
- Strategic electrification and DR included in efficiency programs with expanded cost-benefit test.

CONNECTICUT

- Heat pump rebates available through Energize CT

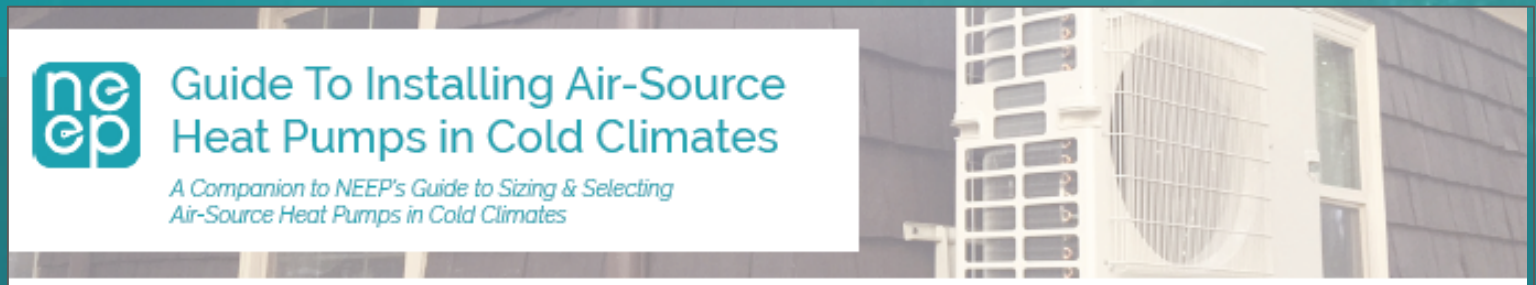
RHODE ISLAND

- Exploring **workforce development programs** to drive heat pump uptake (e.g. engaging delivered fuel dealers)

Key Market Barrier/Opportunities

- Sizing/Installation crucial to system performance.
- New systems, new applications challenge longstanding tools and practices.

Installation Guide



Guide To Installing Air-Source Heat Pumps in Cold Climates

A Companion to NEEP's Guide to Sizing & Selecting Air-Source Heat Pumps in Cold Climates

Introduction

High-quality installations of air-source heat pump (ASHP) systems generate referrals, increase sales, reduce callbacks and improve customer comfort and satisfaction. Installation practices also have a major impact on efficiency and performance of an ASHP system. Efficient ASHPs have seen significant sales growth in colder climates in recent years. The recent generation of cold-climate ASHPs, combined with insights from large-scale installation programs and installers, has led to a better understanding of the full range of practices to ensure maximum system performance and customer satisfaction. This guide provides a list of these best practices, as well as homeowner education and system setup guidance, to help ensure efficient air-source heat pumps and happy customers in cold climates.

Heat pumps should always be installed by licensed, trained professionals. Always follow manufacturer's specification and installation instructions, and all applicable building codes and regulations. All installers should attend a manufacturer's training or preferred installer program.

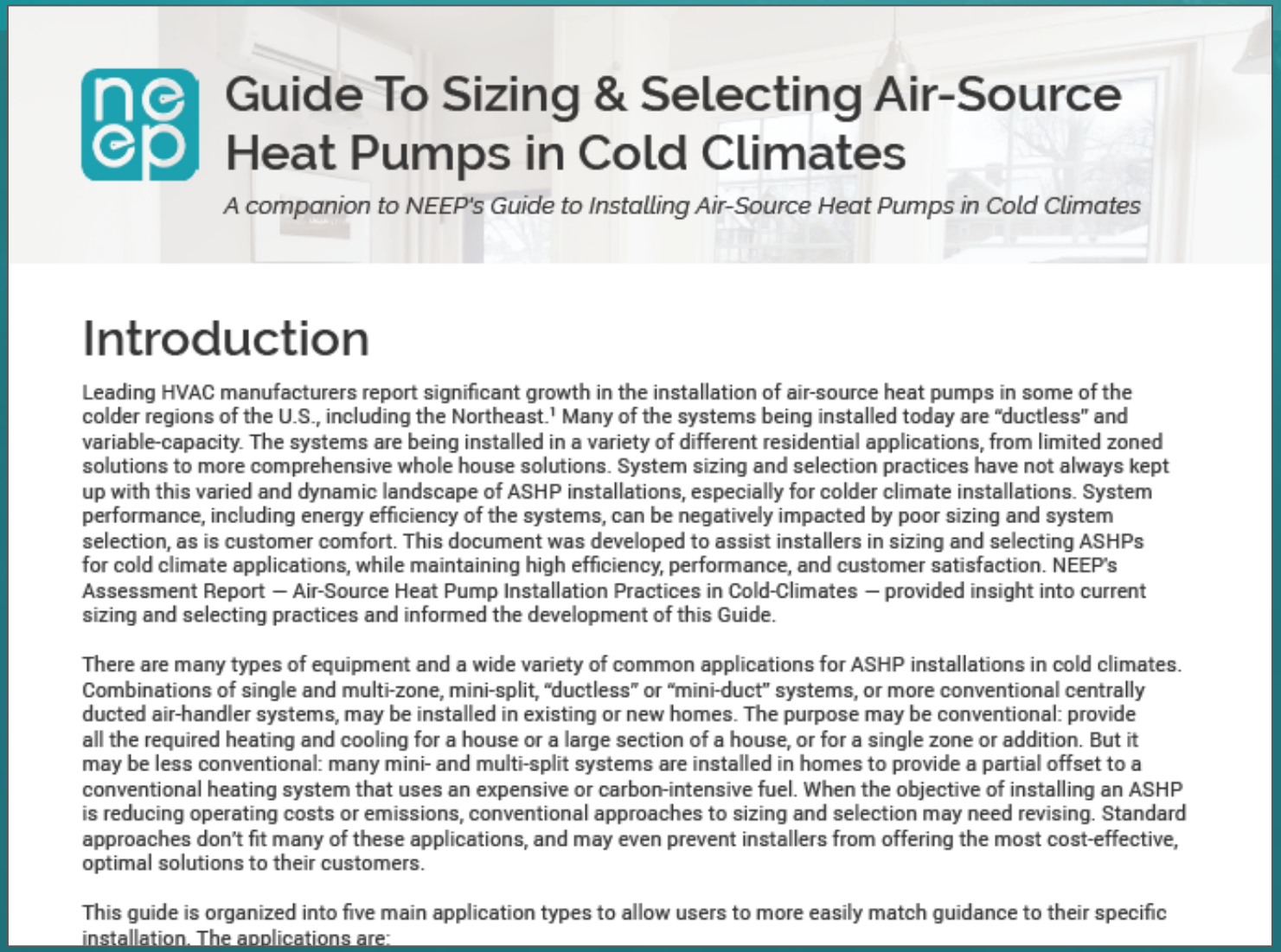
ASHPs come in a number of configurations, and in some cases the following guidance may be specific to one or more of those system types. There are many variations and terms used, but these guidelines will focus on the following broad categories: "ductless ASHP" refers to any non-ducted cassette type indoor unit (including wall-mount air handlers, floor mounted consoles, in-ceiling cassettes, etc.); "mini-duct ASHP" refers to remote air handlers that are typically designed for compact, concealed-ceiling or short-duct configurations; and "centrally ducted ASHP" refers to whole-house systems with central air handlers. The icons shown here are used below to indicate when guidance is specific to a certain system type. All items without icons are generally applicable to all ASHP configurations.

Applies to: Ductless ASHP Mini-Duct ASHP Centrally ducted ASHP

Installation Best Practices: Categories

- Line Set
- Recommended Tools
- Refrigerant Tubing
- Refrigerant Charge
- Condensate Drain
- Outdoor Unit Installation
- Indoor Unit Installation
- Placement of Indoor Unit
- Ducting Considerations

Sizing and Selecting Guide



Guide To Sizing & Selecting Air-Source Heat Pumps in Cold Climates

A companion to NEEP's Guide to Installing Air-Source Heat Pumps in Cold Climates

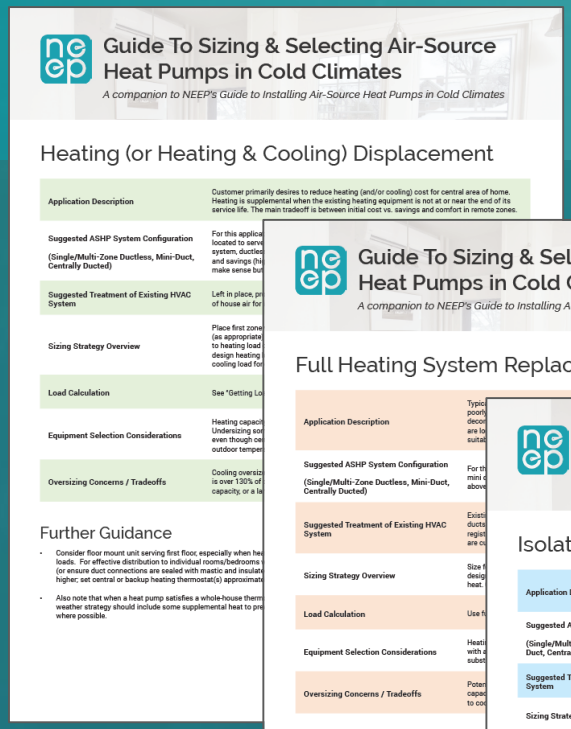
Introduction

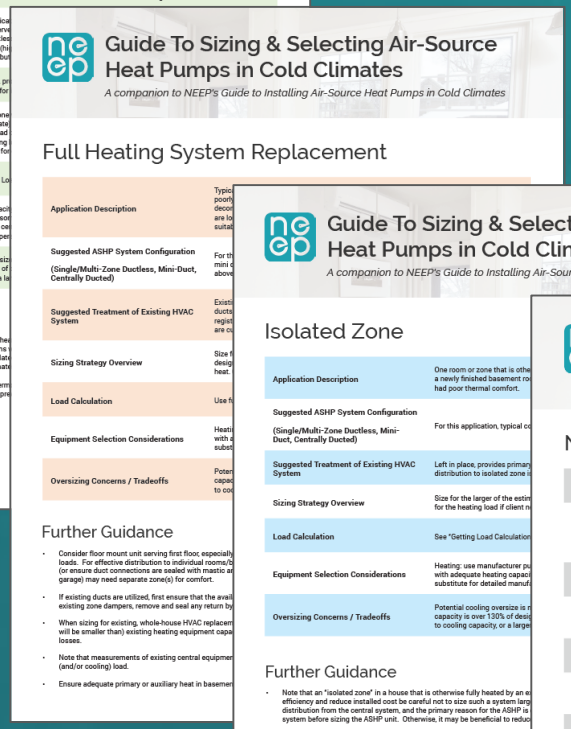
Leading HVAC manufacturers report significant growth in the installation of air-source heat pumps in some of the colder regions of the U.S., including the Northeast.[1] Many of the systems being installed today are "ductless" and variable-capacity. The systems are being installed in a variety of different residential applications, from limited zoned solutions to more comprehensive whole house solutions. System sizing and selection practices have not always kept up with this varied and dynamic landscape of ASHP installations, especially for colder climate installations. System performance, including energy efficiency of the systems, can be negatively impacted by poor sizing and system selection, as is customer comfort. This document was developed to assist installers in sizing and selecting ASHPs for cold climate applications, while maintaining high efficiency, performance, and customer satisfaction. NEEP's Assessment Report — Air-Source Heat Pump Installation Practices in Cold-Climates — provided insight into current sizing and selecting practices and informed the development of this Guide.

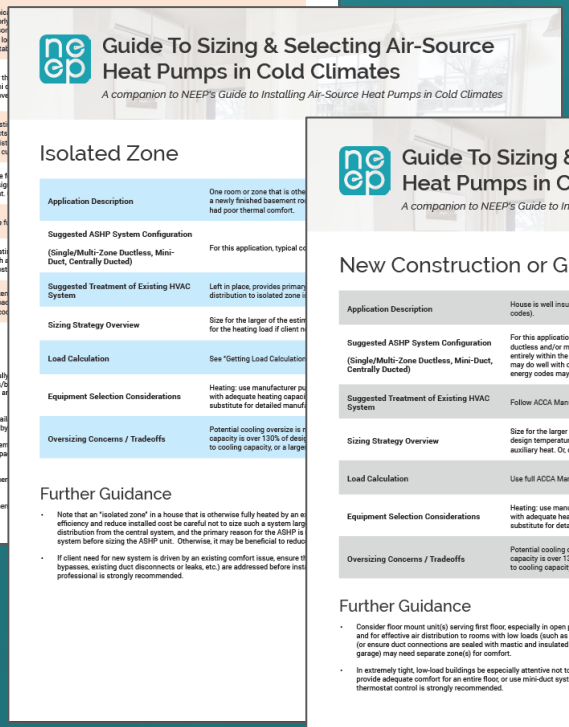
There are many types of equipment and a wide variety of common applications for ASHP installations in cold climates. Combinations of single and multi-zone, mini-split, "ductless" or "mini-duct" systems, or more conventional centrally ducted air-handler systems, may be installed in existing or new homes. The purpose may be conventional: provide all the required heating and cooling for a house or a large section of a house, or for a single zone or addition. But it may be less conventional: many mini- and multi-split systems are installed in homes to provide a partial offset to a conventional heating system that uses an expensive or carbon-intensive fuel. When the objective of installing an ASHP is reducing operating costs or emissions, conventional approaches to sizing and selection may need revising. Standard approaches don't fit many of these applications, and may even prevent installers from offering the most cost-effective, optimal solutions to their customers.

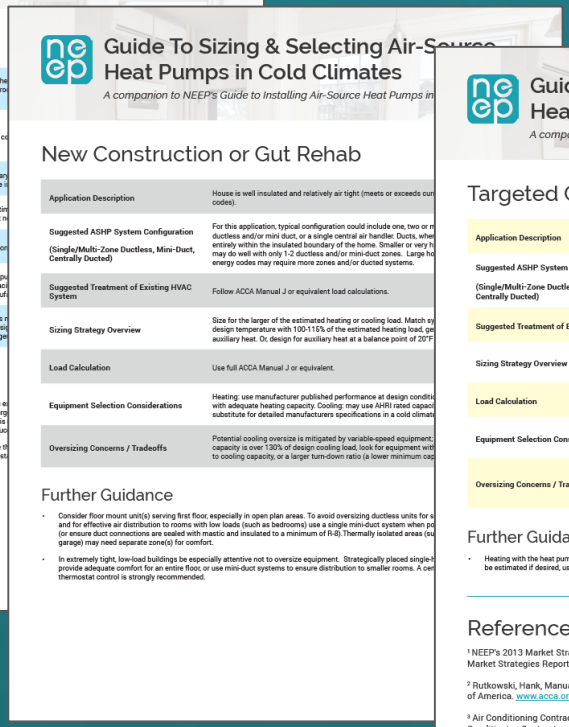
This guide is organized into five main application types to allow users to more easily match guidance to their specific installation. The applications are:

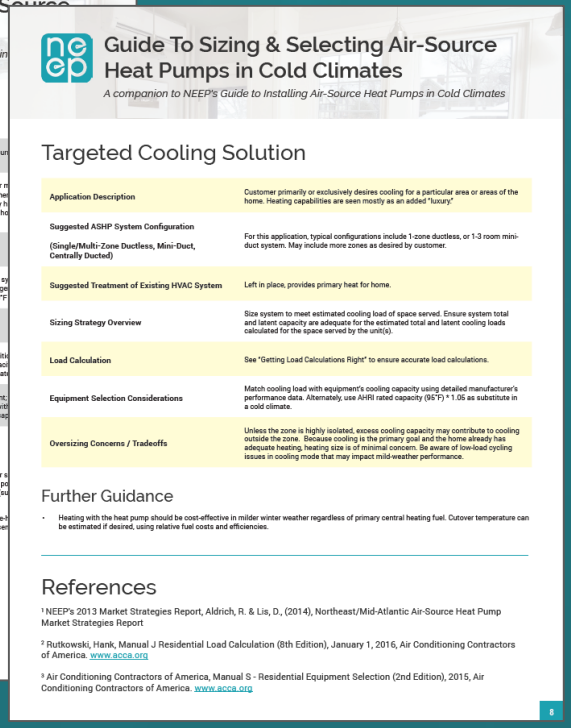
Application Sheets











Heating (or Heating & Cooling) Displacement

Application Description	Customer primarily desires to reduce heating (and/or cooling) cost for central area of home. Heating is supplemental when the existing heating equipment is not at or near the end of its service life. The main tradeoff is between initial cost vs. savings and comfort in remote zones.
Suggested ASHP System Configuration **(Single/Multi-Zone Ductless, Mini-Duct, Centrally Ducted)**	For this application, typical configurations include 1-zone ductless, or 1-3 room mini-duct located to serve central living space (for reduced installed cost). Alternatively, larger 2-5 zone system, ductless and/or mini duct, can be configured to serve home widely for better comfort and savings (higher installed cost). In some cases, a new single-zone central heat pump may make sense but that is more likely a whole-house replacement.
Suggested Treatment of Existing HVAC System	Left in place, provides heat only as needed. A centrally ducted system may also provide mixing of house air for improved comfort.
Sizing Strategy Overview	Place first zone where heat will cover most central living area. Establish any additional zones (as appropriate) to strategically cover key living areas per customer needs. Size each zone to heating load of area(s) to be served (block load): total will be undersized for whole-house design heating load. If cooling comfort is desired by customer, size to larger of heating or cooling load for each zone.
Load Calculation	See “Getting Load Calculations Right” to ensure accurate load calculations.
Equipment Selection Considerations	Heating capacity of system at or near outdoor design temperature is a secondary concern. Undersizing somewhat for heating should improve efficiency and reduce overall heating costs, even though central system may be used slightly more. High efficiency at predominant winter outdoor temperatures will reduce operating cost.
Oversizing Concerns / Tradeoffs	Cooling oversize is mitigated by variable-speed equipment; if minimum speed cooling capacity is over 130% of design cooling load, look for equipment with a higher ratio of heating to cooling capacity, or a larger turn-down ratio (a lower minimum capacity), or both.

NEEP Cold-Climate Specification/ Product List

DISCLAIMER- Some of the performance values reported as part of the Cold-Climate ASHP Specification are NOT derived from industry standard test procedures or third-party tested/verified (i.e. performance values at 5°F).

Products added to list since previous update highlighted in pink

Updated: March 9, 2017

	General Information												Capacity (btu/hr)		
	Manufacturer	Brand (if applicable)	AHRI Certificate No.	Outdoor Unit Model	Indoor Unit Model(s)	HSPF (Region IV):	SEER	EER (@ 95°F)	ENERGY STAR Certifie	Ductless or Ducted	If Ductless, Multi-zone or Single-zone		Minimum Capacity 47°F	Rated Capacity 47°F	Maxim Capac 47°F
7	Daikin		3208521	RXG09HVJU	FTXG09HVJU	11	26.1	15.8	Yes	Ductless	Single-zone		4,668	12,000	18,670
8	Daikin		3208522	RXG12HVJU	FTXG12HVJU	10.55	24.2	14	Yes	Ductless	Single-zone		4,668	16,000	19,130
9	Daikin		3208523	RXG15HVJU	FTXG15HVJU	10	21	12.9	Yes	Ductless	Single-zone		4,668	18,000	21,280
10	Mitsubishi		4217888	MUZ-FE18NA	MSZ-FE18NA	10.3	20.2	14.2	Yes	Ductless	Single-zone		7,500	21,600	29,700
11	Mitsubishi		4908219	MUZ-FE09NA	MSZ-FE09NA	10	26	15.5	Yes	Ductless	Single-zone		3,000	10,900	18,000
12	Mitsubishi		4934170	MUZ-FE12NA	MSZ-FE12NA	10.5	23	12.9	Yes	Ductless	Single-zone		3,000	13,600	21,000
13	Fujitsu		5063325	AOU9RLS2	ASU9RLS2	12.5	27.2	16.1	Yes	Ductless	Single-zone		3,100	12,000	22,000
14	Fujitsu		5063326	AOU12RLS2	ASU12RLS2	12	25	13.8	Yes	Ductless	Single-zone		3,100	16,000	22,110
15	Daikin		5265753	RXS09LVJU	FTXS09LVJU	12.5	24.5	15.3	Yes	Ductless	Single-zone		4,400	12,000	15,600
16	Daikin		5265755	RXS12LVJU	FTXS12LVJU	12.5	23	12.8	Yes	Ductless	Single-zone		4,800	14,400	18,000
17	Daikin		5265756	RXS15LVJU	FTXS15LVJU	11.6	20.6	14.4	Yes	Ductless	Single-zone		5,800	18,000	22,300
18	Daikin		5265757	RXS18LVJU	FTXS18LVJU	11	20.3	12.7	Yes	Ductless	Single-zone		5,800	21,600	26,700
19	Daikin		5265758	RXS24LVJU	FTXS24LVJU	10.6	20	12.5	Yes	Ductless	Single-zone		7,800	25,400	31,400
20	Nortek Global	Maytag	5597453	PSH4BG024K	B6VMAX024K-B	10	19	13.9	Yes	Ducted	N/A		10,200	22,400	24,700
21	Nortek Global	Maytag	5597457	PSH4BG036K	B6VMAX036K-B	10	19	12.9	Yes	Ducted	N/A		16,500	34,400	36,800
22	Fujitsu		5751311	AOU9RLFC	AUU9RLF	13	24	14.5	Yes	Ductless	Single-zone		3,100	12,000	18,000
23	Fujitsu		5751312	AOU9RLFC	ARU9RLF	12.2	21.5	14.5	Yes	Ductless	Single-zone		3,100	12,000	18,000
24	Fujitsu		5751313	AOU12RLFC	AUU12RLF	12.2	21.9	12.8	Yes	Ductless	Single-zone		3,100	16,000	19,400
25	Fujitsu		5751314	AOU12RLFC	ARU12RLF	11.5	20	12.8	Yes	Ductless	Single-zone		3,100	16,000	19,400
26	LG		5859619	LUU187HV	LCN187HV	10.1	20	15	Yes	Ductless	Single-zone		9,300	20,000	22,000
27	LG		6236101	LSU240HSV3	LSN240HSV3	10.2	20	12.5	Yes	Ductless	Single-zone		3,070	27,600	38,900
28	American Standard		6749789	4A6V0024A1	*AM8C0B30V21	10	19.25	13.75	Yes	Ducted	N/A		7,800	20,200	21,900
29	American Standard		6749791	4A6V0048A1	*AM8C0C48V41	10	19.25	12.5	Yes	Ducted	N/A		11,800	42,500	42,600
30	Trane		6749942	4TWV0024A1	*AM8C0B30V21	10	19.25	13.75	Yes	Ducted	N/A		7,800	20,200	21,900
31	Trane		6749944	4TWV0048A1	*AM8C0C48V41	10	19.25	12.5	Yes	Ducted	N/A		11,800	42,500	42,600
32	American Standard		6750232	4A6V8036A1	*AM8C0C36V31	10	18	13	Yes	Ducted	N/A		8,200	32,200	32,200
33	American Standard		6750233	4A6V8048A1	*AM8C0C48V41	10	18	12.5	Yes	Ducted	N/A		11,800	41,000	43,000

Current Product List (3.9.17) | Delisted (on 1.1.17)

New resources

- 2018- Updated Installer Guides
- 2018- New Installer VIDEOS!!
- 2018- New Consumer Operations & Maintenance Guide
- 2019- Consumer Buying Guidance
- 2019- Case Studies of ASHP Installations

With your help…..

To access resources…

- **Link to NEEP's ASHP Website/Resources**
  http://www.neep.org/initiatives/high-efficiency-products/emerging-technologies/ashp
- **Dave Lis, NEEP**
  - **djlis@neep.org**
  - **781-860-9177 (x127)**

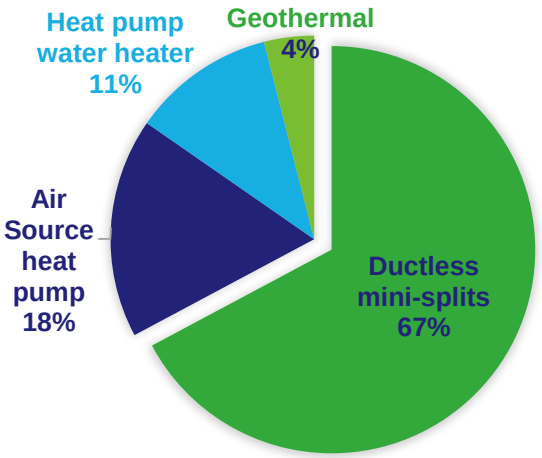
CONNECTICUT GREEN BANK SM

Financing & Customer Engagement

Smart-E Loan Heat Pump Results in Connecticut

CONNECTICUT GREEN BANK

SMART-E LOANS with HEAT PUMPS	
2013-2016	174
2017	400
2018	116



smart-e loan

Solar, heat pump helps couple save money and stay comfortable

- **Ductless mini-splits most common**
  - Then air source heat pumps, heat pump water heaters, and geothermal
- **Heat pumps can sell even when oil prices are low**
  - **Cooling** and comfort are the big customer drivers
- **One third of heat pump projects were part of multi-measure jobs**
  - Heat pumps + solar, insulation or other HVAC

Case Study: Using Special Promotions with CT Market Transformation in Mind

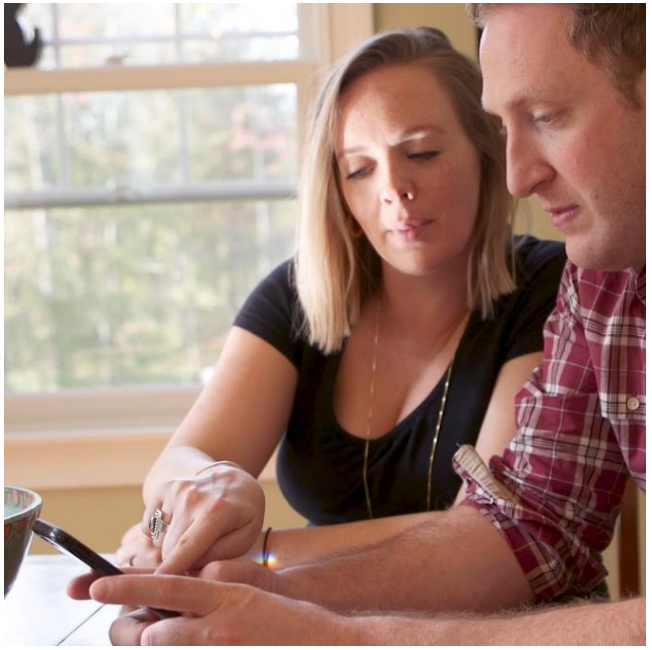
CONNECTICUT GREEN BANK

During 2017 Campaign	After Campaign – 2018

▪ 6x increase in volume – 10x increase in heat pump volume
▪ 54 new contractors
  ▪ Majority of new entrants are HVAC
  ▪ Brought total to 300
▪ 85% of contractors used product during campaign
  ▪ vs. 60% in the year before
	▪ Volume didn't collapse!
	  ▪ 2018 run rate is 3-4x higher than the volume before campaign, including heat pumps
	▪ Continue training contractors
	  ▪ Over 400 now
	  ▪ Majority of new entrants still HVAC
	▪ Some contractors now funding their own buydowns with lenders

Engaging Customers

- Stay engaged with EnergizeCT
  - Rebates, Smart-E Loan, CT Heat Loan
- Building out your company website with informational resources on the technology and available financing
  - What am I buying and how can I pay for it?
- Connect with a Smart-E Lender to promote your business
  - On-site events
  - In-branch displays
- Work with CT Green Bank to co-brand marketing materials



Heat Pump Market:
Discussion