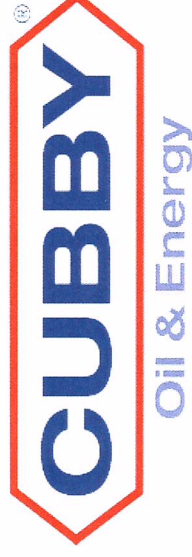




Case Study
Massachusetts Air-Source Heat Pump Installations 2014-2019

Report Prepared For:



November 19th, 2019

*Materials contained in this document are intended for Cubby Oil.
These perspectives are private and confidential.*

■ Disclaimer

This study was created by Diversified Energy Specialists for Cubby Oil. All data was obtained from the Massachusetts Clean Energy Center and the Massachusetts Department of Energy Resources through a public records request filed by Diversified Energy Specialists on October 18th, 2019.

All data collected by the Massachusetts Clean Energy Center was obtained from applications for rebates. All data was self reported.

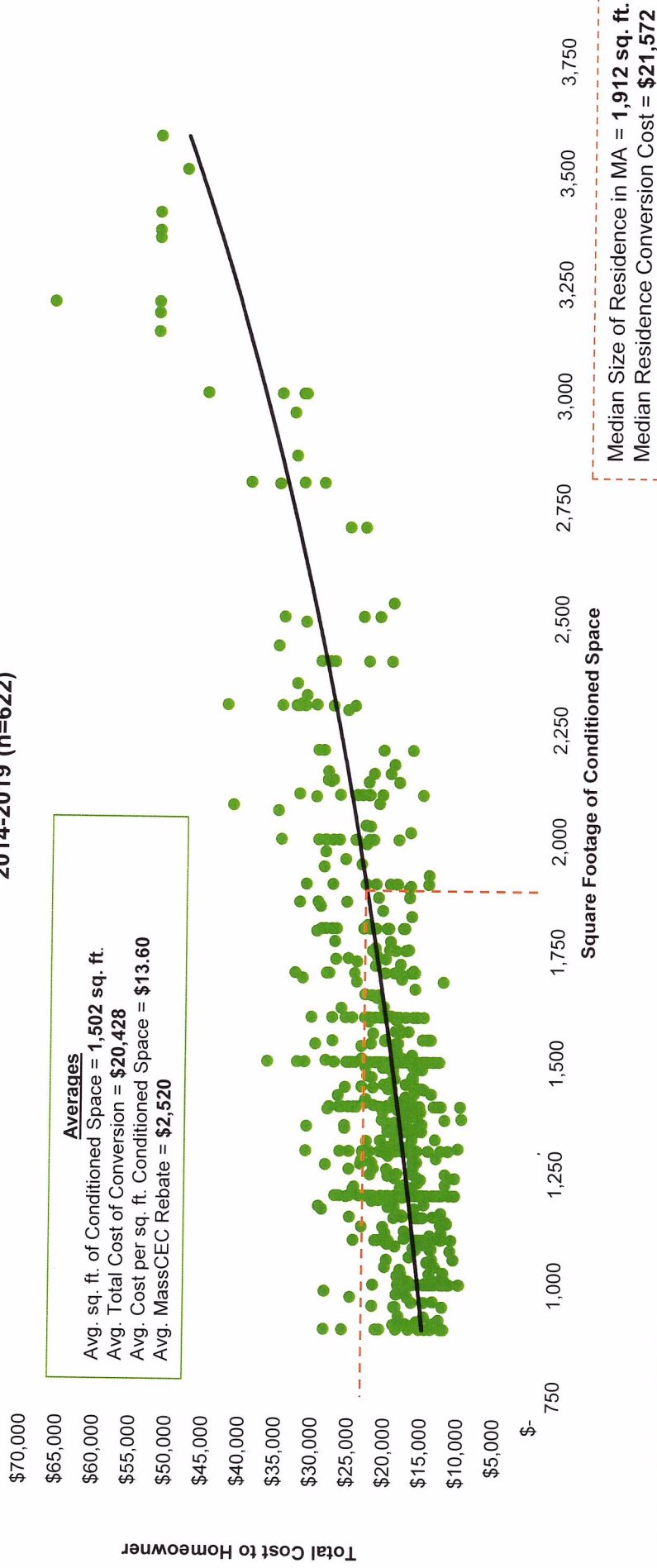
All data collected by the Massachusetts Department of Energy Resources was obtained from applications for the Massachusetts Alternative and Renewable Energy Portfolio Standards. All data was self reported.

This presentation is up to date as of November 19th, 2019.

Conversion: Cost

The cost of converting to an electric air-source heat pump system in Massachusetts is substantial and isn't affordable for most low- and middle-class residents

Massachusetts Heat Pump Conversion Cost
2014-2019 (n=622)



Assumptions

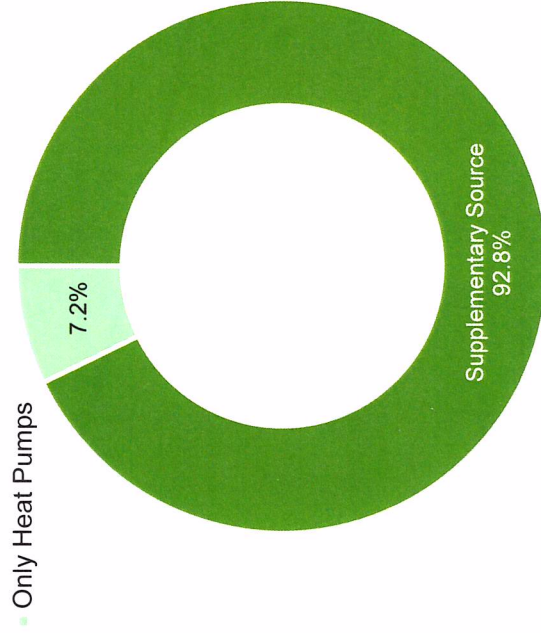
- ✓ Applications that reported a contained space under 900 square feet were excluded
- ✓ Applications that reported the installed heat pump capacity at 5° F (Btu) could not sufficiently provide heat for a minimum of 80% of the residences heat load were excluded. This calculation was based on a 40 Btu per square foot requirement
- ✓ Applications that reported the project as new-build construction or an addition were excluded. Only reports of "existing home" or "retrofit" were included
- ✓ Applications that reported heat pumps as a supplemental heat source were excluded
- ✓ Only applications within 2 standard deviations of the mean were included
- ✓ Any application that did not report square footage of conditioned space, any cost metric, installed capacity at 5° F (Btu), or number of heat pumps were excluded

Source: Diversified Energy Specialists Research & Analysis; MassCEC; MA DOER

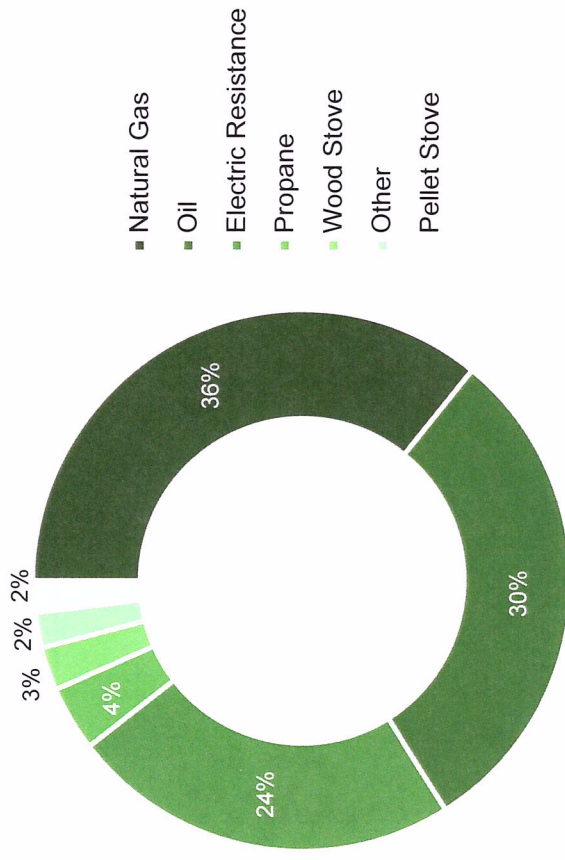
Conversion: Supplementary Heat Source

In addition to the high cost of conversion to air-source heat pumps, most installers recommend retaining a supplementary source of heat due to the heat pump systems inability to sufficiently heat residences in the cold Massachusetts winters

Percent of Conversions Retaining a Supplementary Heat Source (n=622)



Supplementary Heat Source (n=571)



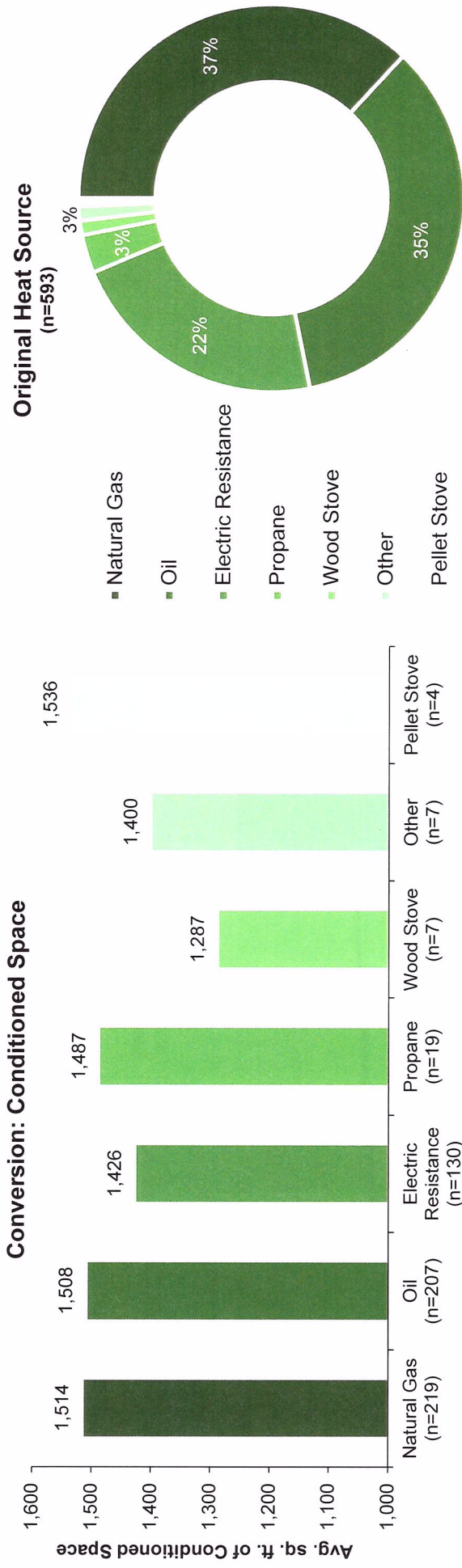
Assumptions

- ✓ Applications that self-reported whether a backup source of home heating would be used were included
- ✓ For applications that failed to report whether a backup source of home heating was used, DES used their self-reported installed capacity at 5° F (Btu) to determine if the heat pump system could sufficiently provide heat for greater than 90% of the residence's heat load. The determination was made based on a 40 Btu per square foot requirement. If the system could not provide sufficient heat for 90% or more of the residences heat load, DES made the assumption that a supplementary heat source was used

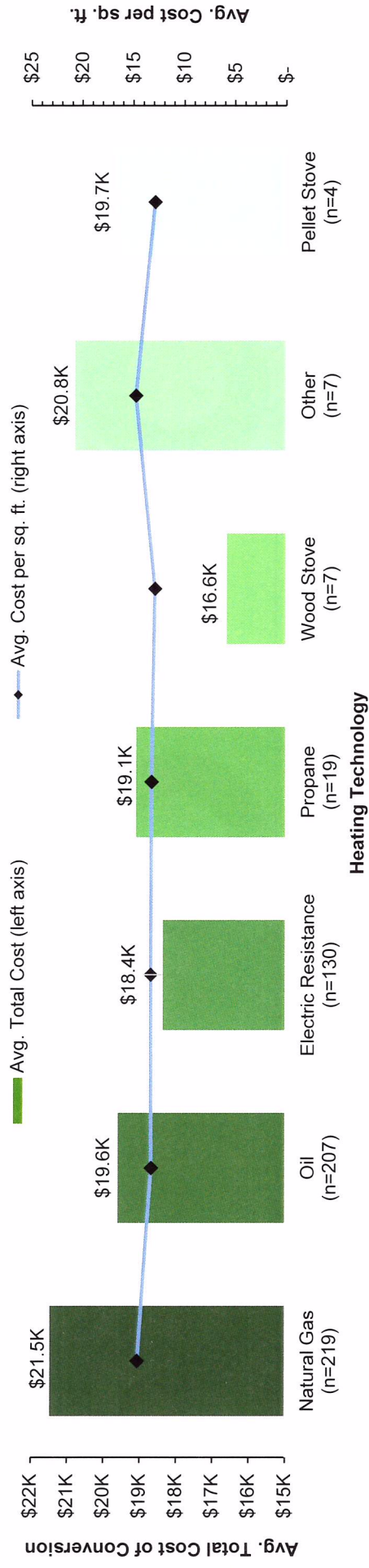
Source: Diversified Energy Specialists Research & Analysis; MassCEC; MA DOER

Conversion: Original Heat Source

The heating technology that is being converted to heat pumps slightly affects the price of conversion



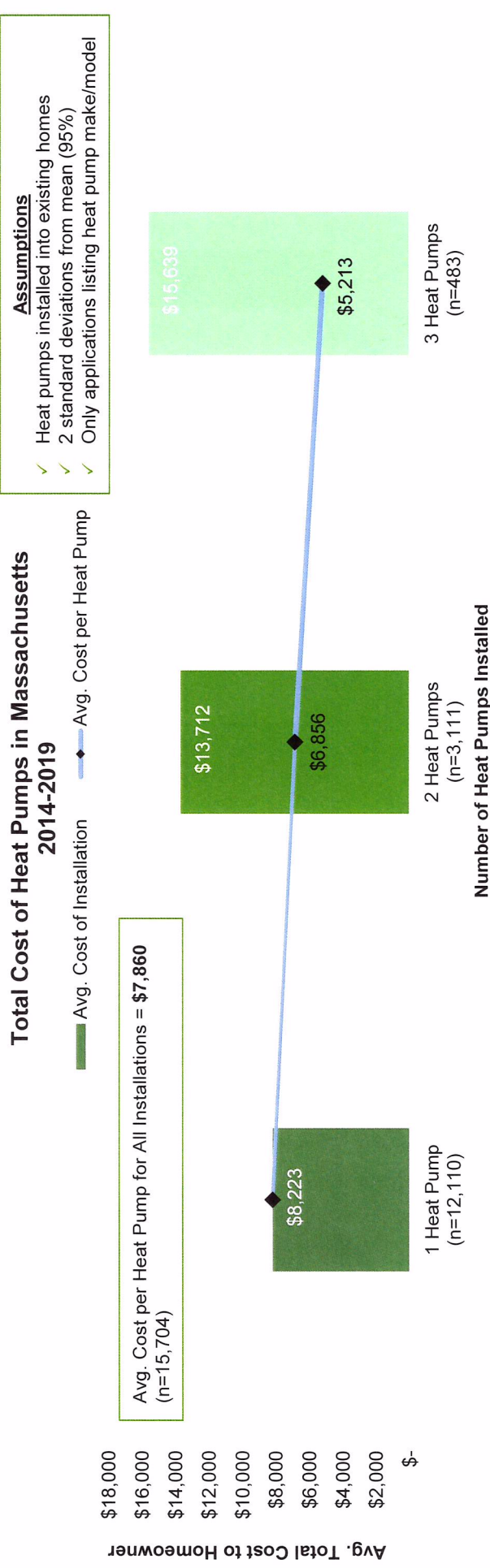
Conversion Cost to Heat Pumps by Original Heating Technology



Source: Diversified Energy Specialists Research & Analysis; MassCEC; MA DOER

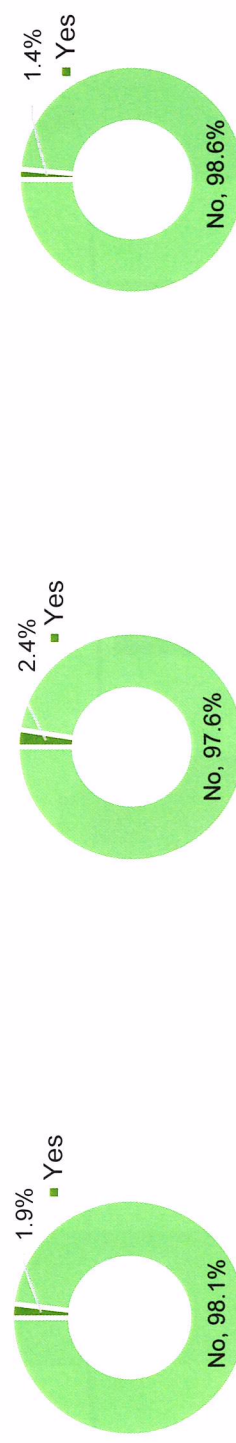
Supplemental Heat Source: Cost

DES estimates that 96%* of the data from the MassCEC rebate program from construction in existing homes was from single or multi-room systems that did not provide sufficient heat for the entire home



Percent of MassCEC Applications Self-Reported to Provide Entire Heat Load

Q: Do your heat pump(s) provide the entire heat load for your residence?



*The average Btu needed to sufficiently heat a home in Massachusetts is 40 Btu per square foot. Of the 16,572 applications of retrofit construction from existing homes, DES estimates that 622 (3.8%) were full conversions (displayed on slide 3). 2 standard deviations from the mean ensured that the above data contains less than 2% full conversions and displays the price of heating less than 90% of a home. Of the less than 2% self-reported to provide the entire heat load for their home above, DES determined that only 17% were accurate based on their self reported Btu output and square footage of conditioned space (see next slide)

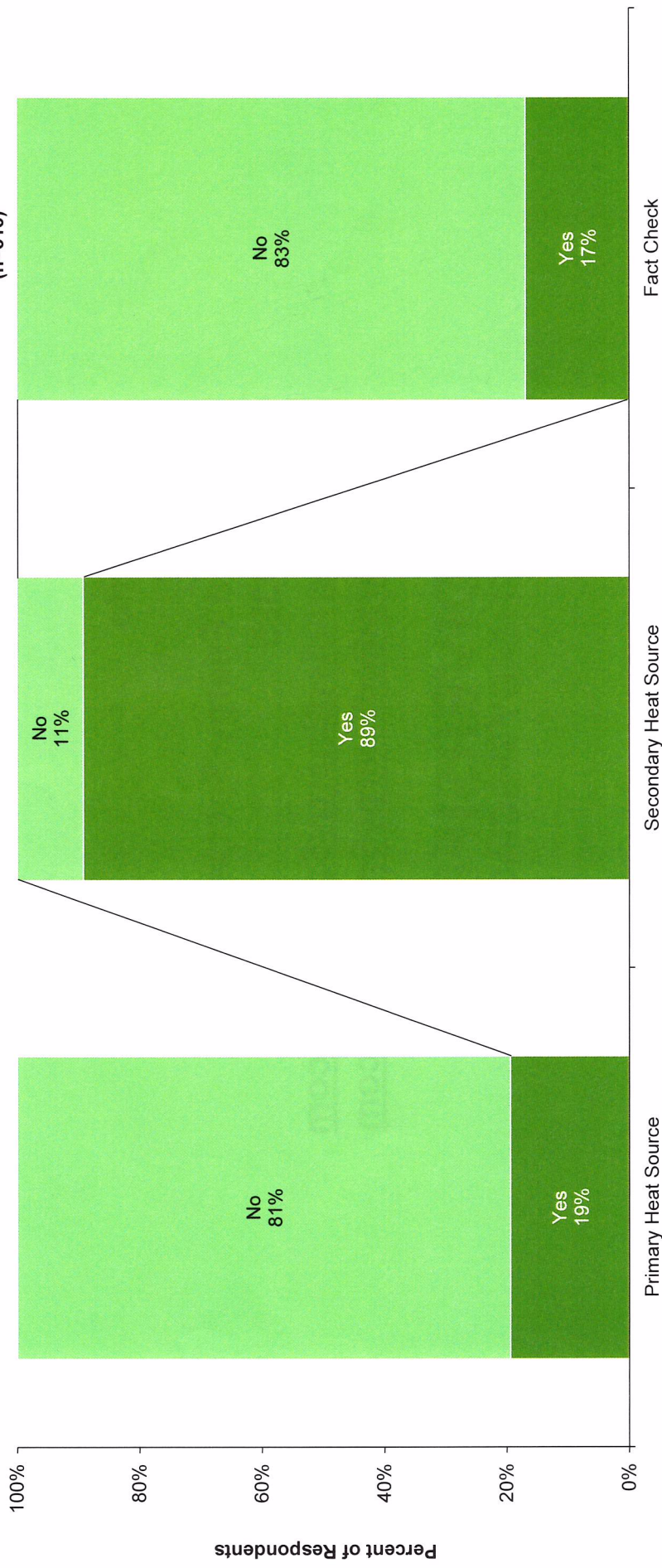
Supplemental Heat Source: Applicable Use

The MassCEC rebate application data shows that air-source heat pumps in Massachusetts are primarily used as a supplemental heat source

Do self-reported heat pump systems without a secondary heat source provide enough Btu of heat to sufficiently heat at least 90% of the self-reported square footage of conditioned space? (n=313)

Q: Are the heat pump(s) the primary source of heat for the home? (n=14,878)

Q: Does the home have another source of heat besides the heat pump(s)? (n=2,881)



Of the applications that self-reported that their heat pump(s) are the residences only source of heat, only 17% reported a Btu output from their heat pump(s) that could provide greater than 90% of their homes heat load. DES fact checked this number using a 40 Btu per square foot requirement

Source: Diversified Energy Specialists Research & Analysis; MassCEC