Recalibration of the median building profile and expected energy savings in a Thermalize Campaign

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INTRODUCTION

Thermalize Juneau launched at the beginning of 2021 as a clean energy campaign to facilitate the installation of ductless minisplit heat pumps (DHP) and energy efficiency measures (EEM) in a cohort of 150 homes in Juneau, Alaska. Prior to the launch of the campaign, the team created a model of the median house in Juneau to model the anticipated energy savings and carbon emissions reductions and to develop the package of EEM offered.

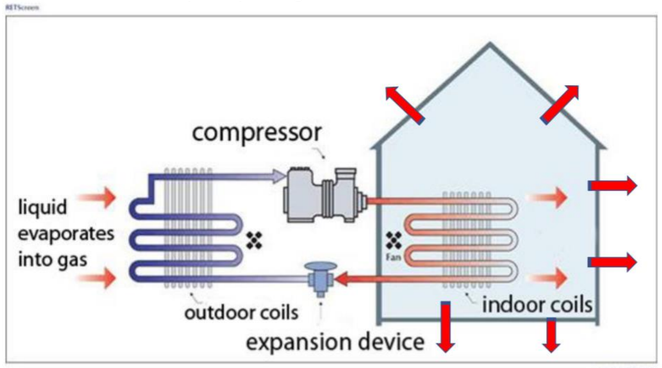

Figure 1: Diagram of how a DHP works courtesy of Retscreen.

What is a DHP?

A DHP is a single head air source heat pump(ASHP) that uses electricity and technology like a refrigerator to heat and/or cool the inside of a home. Because the coefficient of performance (COP) is estimated to be 2.5 in Juneau, they are far more efficient than the other forms of heating currently in use in Juneau and therefore cheaper to use. According to AEL&P, the main energy supplier in Juneau: "AEL&P produces 100 percent of its base-load generation through clean, renewable, and low-cost hydropower," so there are also significant carbon emissions reductions to be seen.

Why model the median home?

The median Juneau home (MJH) was created to inform the Thermalize package and estimate programmatic energy savings. The creation of the median Thermalize home (MTH) is to determine if the MJH was relevant enough to the houses in the campaign and accurate enough that this type of modeling would be useful for future Thermalize campaigns.

MJH

The median Juneau home model was created by the Thermalize team prior to the start of the Thermalize campaign. Built from census data, local government data, and a statewide database of energy audits, this model is representative of the median house in Juneau from size to efficiency.

MTH

The median Thermalize house model created from the 41 currently available AkWarm files of Thermalize homes. This model is based solely on the information in the current AkWarm files and will be updated as more files become available. While based mostly on the R-value of components, the dominant build and insulation is taken into consideration.

Research Questions:

1. How well does the median Juneau house created by the Thermalize Juneau team in Fall 2020 compare to the median Thermalize house?
2. What are the energy savings estimates and carbon reductions for the median Thermalize house installing the full package of energy efficiency options and the single head ductless heat pump?

PROCESS

Literature Review
- To determine the number of Thermalize campaigns that included EEM implementations in the US.
- To understand how previous Thermalize and EEM campaigns were conducted.

Aggregate Data
- Consolidate and evaluate available energy audit and intake survey data.
- Calculate median values for quantitative data and dominant response for qualitative data.

Compare MJH and MTH
- Model MTH in AkWarm to see the expected energy savings and carbon reductions.
- Understand how current model of MTH compares to the MJH.

RESULTS

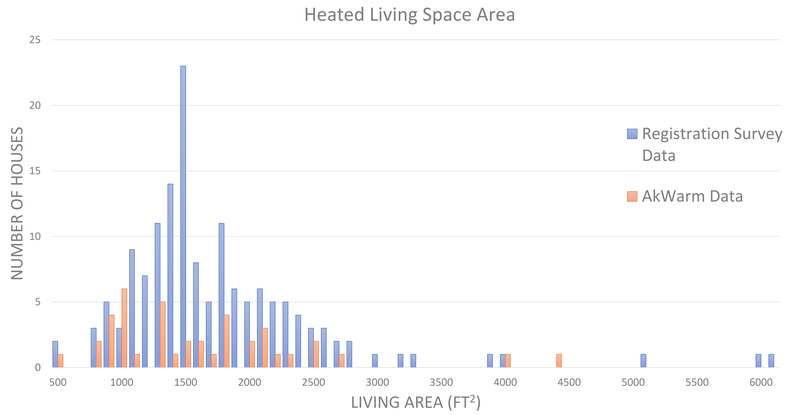

Figure 2: Comparison of living area floor data from survey data and AkWarm information

	Living Area (ft^2)	Wall R-value	Window R-value	Ceiling R-value	ACH @ 50 Pa	Heater Fuel Type	Secondary Fuel Type	Energy Use (MMBTU)	CO_2 Emissions (Lb.)
MJH	1,995	12.2	1.9	27.6	7.93	Fuel Oil #1	None	169	18,878
MTH	1,431	15.4	2.2	30.7	8.10	Fuel Oil #2	Spruce Wood	102.4	9,671

Table 1: Comparison of components from MJH and MTH

	MJH with just DHP(COP of 2.5)	MTH with just DHP(COP of 2.5)	MJH with DHP and EEMs	MTH with DHP and EEMs
% Reduction Energy Use	50.06	45.80	56.74	54.00
Carbon Emissions Avoided (Lb.)	18,556	9,460	18,599	9,492

Table 2: Comparison of MJH and MTH with implementation of a DHP and EEM

DISCUSSION

There have been only a small number of Thermalize Campaigns conducted to date of those:
- One, HeatSmart Tompkins, has done both ASHP installations and EEM.
- One, Emera Maine Heat Pump Pilot Program, looked at real data to evaluate the benefits from the campaign.

As shown in Figure 2, median floor area is 1,500 ft^2 based on registration survey data, but 1,431 ft^2 based on information from the AkWarm files received so far.
- AkWarm files only account for 41 of 150 sites, while registration data is more comprehensive.

- Table 1 lists some of the key differences between the MJH and MTH
  - Most MTH R-values are higher, and component areas are lower
  - MTH Energy use and emissions are lower as well

- Table 2 shows the anticipated reductions in energy use and carbon emissions with the implementations of just the DHP and with the DHP and EEM package.
  - MJH anticipates a larger reduction both in energy use, 57%, and carbon emissions, 18,599 lb. or 98.5%
  - MTH anticipates 54% reduction in energy use and a reduction in carbon emissions of 9,492 lb. or 98.1%

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CONCLUSIONS

MTH appears to be smaller and more energy efficient than the MJH created by the team prior to the start of the campaign. This could be explained by the choice of a DHP for the campaign rather than one that could have multiple heads.

This also explains why the energy savings and carbon emissions reductions are smaller for the MTH than the MJH. It is also interesting to note that the EEM package has more of an impact on the MTH model in conjunction with the DHP than when modeled on the MJH.

FUTURE RESEARCH

The MTH model created will be refined and updated as more energy audits become available.

The MJH and MTH models will be validated against post installation and improvement energy data to determine if this type of modeling is beneficial to future Thermalize campaigns.

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