Dear Ms. Cushman,

I appreciate the opportunity to submit comments in response to Efficiency Maine Trust's Beneficial Electrification Study.

I am a Maine resident, and an energy efficiency consultant, but am submitting comments representing my own views, not on behalf of my employer or any clients.

Regrading my professional background, I have a Bachelor of Science in mechanical engineering, and currently work at ICF providing consulting services for a range of clients. My primary work is supporting EPA's ENERGY STAR Certified Homes program, providing technical, analytical, and outreach support (e.g., developing program specifications and documents, conducting building energy modeling, analyzing energy code changes). Additionally, I support various state and local governments develop and implement energy efficiency policies. Most applicable to this study is my current work as part of a team supporting New York City's 80 x 50 goal to reduce greenhouse gasses 80 percent by 2050; I focus on analyzing and modeling the impacts of significant efficiency improvements and electrification of buildings. Part of this is to also identify technical barriers that could limit the adoption of electrification technologies (primarily heat pumps). Prior to ICF, I worked at Navigant and supported DOE in developing appliance and equipment energy conservations standards and test procedures including compressors and electric motors.

I believe my professional background and being a Maine resident allows to me provide valuable input to this study, that I think can help plan for and address climate change in Maine.

Thank you,

Michael Brown
Energy Efficiency Consultant and Maine Resident
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Responses:

Overarching Comments

Refrigerant Leakage
The adoption of heat pump technologies can lead to increased unintended leakage or refrigerants used in these systems. These refrigerants have extremely high global warming potential. Project Drawdown lists refrigerant management as the top solution for emissions reduction. [1] The Trust should consider the impact of additional refrigerant leakage that could offset part of the emissions reductions resulting from the beneficial electrification of heating and hot water end-uses.

Most refrigerant leakage occurs at disposal, so robust systems and a properly trained workforce should be developed to manage increased need for refrigerant disposal. Leakage can also occur during routine maintenance when a contractor connects and disconnects gauges to measure refrigerant line pressure. To reduce maintenance leakage, non-invasive procedures can be used by contractors to check refrigerant charge in lieu of connecting gauges. Currently *BSR/RESNET/ACCA 310-201x, Standard for Grading the Installation of HVAC Systems*, is under development, and non-invasive procedures from this standard could be adopted by contractors to reduce leakage during maintenance. [2]

Refrigerant leakage should be considered a barrier towards emissions reductions and a potential topic for future analysis.

5.2.1 Heat Pumps for Smaller Buildings

Heating Remote / Small Rooms
Many residential heat pumps in Maine are ductless mini-splits, which work well for open spaces. However, in existing homes some layouts may present challenges with remote or small rooms. Some approaches to address these rooms would be using multiple indoor units, but generally the smallest available capacity of indoor units is about ½ Ton of cooling, which can be too large for small rooms (e.g., bathrooms). Another approach would be to install short duct runs from the unit to rooms, which can add costs and architectural challenges. A third approach is to use small 'transfer fans' which move air from a room with the indoor unit to other rooms. Similar to ducting, this can add cost and can present architectural challenges.

Building layout and remote and small rooms should be considered a potential barrier towards heat pump adoption. It can add cost and potentially give homeowners a negative perception of the technology if they find their homes have cold spots after installing heat pumps.

Increased Cooling Use
Many homes in Maine do not have any cooling, or simply one or two window air conditioners in primary living areas. Increased adoption of heat pumps could lead to increased cooling energy use, for both temperature control and dehumidification. Increased cooling could offset some of the emissions reductions seen from electrification of heating.

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[1] https://www.drawdown.org/solutions-summary-by-rank

[2] https://www.resnet.us/about/standards/resnet-ansi/draft-pds-01-bsr-resnet-acca-310-201x-standard-for-grading-the-installation-of-hvac-systems/

The potential increase in cooling can be seen as a benefit for many consumers, but should be considered in any future analysis to quantify the total emissions impact of heat pump adoption.

5.2.2 VRF Heat Pump Systems for Larger Buildings

Safety

In confined spaces refrigerant leakage can pose a safety threat for individuals. While the risk of significant leakage is rare, designers should take care to ensure that relevant safety standards are met (e.g., ASHRAE Standard 15 and 34 [3]). In older and larger buildings this could pose a challenge if there is a central refrigeration plant leading to many indoor units and limited confined spaces for distribution lines. While likely able to be overcome, this may cause slight design challenges in some buildings and should be considered as a potential barrier.

5.2.3 HPWHs

HPWH Dehumidification

Heat pump water heaters are proven technologies which can effectively electrify domestic hot water heating. In addition to heating water, they also cool and dehumidify surrounding spaces. In most single-family homes it's likely that the water heater will be in the basement, meaning that the HPWH will cool and dehumidify the basement. The impact of this should be taken into consideration in any future analysis.

In the summer, this is a benefit and an opportunity to reduce the need for a stand-alone dehumidifier in the basement, which is common in many homes in Maine. Any future analysis should also consider the dehumidification benefit and potential for reduced energy use from dehumidifiers.

In the winter, cooling and dehumidification from the HPWH can be viewed as a barrier because it will add an additional load that the heating equipment must meet. If the HPWH is in an unconditioned basement this impact may be muted, but should still be accounted for in any future analysis.

[3] https://www.ashrae.org/technical-resources/bookstore/standards-15-34