Executive Summary

Cold Climate Air-Source Heat Pumps Have Arrived

Residential air-source heat pumps (ASHP) offer a major opportunity for homes across the Northeast/ Mid-Atlantic region to reduce home heating energy consumption, costs and greenhouse gas (GHG) emissions, and for States to meet energy policy goals to achieve all cost-effective energy efficiency. This report characterizes that opportunity, identifies market barriers to the broad adoption of ASHP systems, and recommends near-term and long-term program, industry and policy strategies to realize the important potential for energy and cost savings as well as for avoided GHG emissions offered by home ASHP systems.

Residential ASHP are HVAC products that use electricity to provide space heating and, in many instances, space cooling to homes by extracting latent heat in ambient air from one location and transferring it to another. Recent advances in heat pump technology have improved ASHP performance levels, specifically under cold weather conditions, to the point that now, for the first time, ASHPs offer a legitimate space heating system alternative for the Northeast/Mid-Atlantic region which is otherwise largely served by the traditional heating fuels of natural gas, oil and propane and electric resistance. Compared to the traditional heating systems, ASHP's offer superior efficiency performance and provide both home heating and cooling through a single system.

Historically, ASHPs have been inadequate for home heating in the colder climates typical of the Northeast / Mid-Atlantic region. The key issue is that older, conventional ASHP's do not have the capacity or efficiency to sufficiently perform during very cold weather, resulting in heavy reliance on inefficient backup resistance heating systems at freezing temperatures. However, today's high efficiency, high performing ASHP systems (ductless "mini-split" systems being today's most common configuration) can perform at a high level of efficiency even at very low ambient temperatures. As a result, new ASHP's offer an exciting pathway to reduce home heating energy use and costs while reducing associated greenhouse gas emissions.

In recent years, HVAC manufacturers have introduced an exciting range of new ASHPs products to United States' markets. Many of these ASHP products use variable-speed compressors which significantly improve overall system efficiency and performance. Some of these systems perform well at low outdoor temperatures (near or below 0°F). In this report, we refer to these latter systems as cold-

climate air-source heat pumps (ccASHPs). They are appropriate in the colder portions of Northeast region (typically IECC climate zones 5, 6 and possibly 7).

Our assessment of the market potential for ASHP systems in the Northeast/Mid-Atlantic region suggests very large opportunities to reduce home heating energy consumption and costs. For example, existing housing data suggests potential ASHP retrofit opportunities for approximately 7.7 million existing low rise homes that currently use electricity, oil or propane to space heat. Adoption of ASHPs in homes that currently heat with electric resistance could provide annual energy cost savings of approximately $1.2 Billion and avoid over 7 million metric tons of annual carbon emissions (equivalent to the annual carbon emissions associated with the energy used by nearly 350,000 homes). Similarly, adoption of ASHP to displace home oil heating could save $1 Billion in annual energy cost and avoid 1.1 million metric tons of annual carbon emissions. New home construction is another attractive market for ASHPs, especially in highly efficient homes with low heating loads or building locations without access to natural gas.

A key barrier to the rapid market introduction of this new generation of high performing ASHP products is lack of well documented energy/cost/peak demand impacts of ASHP installations in scenarios that involve some form of fuel switching (e.g., from heating oil or propane to ASHP) or fuel displacement (e.g., to displace burning of heating oil, propane or natural gas). Such installations are likely to be common in the Northeast/Mid-Atlantic region. Other key barriers include; lack of standardized metrics that describe ASHP capabilities to operate effectively and efficiently at low temperatures typical of the region, lack of consumer and installer awareness of the latest technology, effective controls to manage multiple heating systems, high upfront costs and lack of policy level awareness/support.

To enhance the likelihood of long term market success in the region, NEEP convened a regional collaborative process to develop recommended market strategies to overcome the barriers to broad market adoption of residential ASHP systems. In the spring of 2013, NEEP assembled a Leadership Advisory Committee (LAC) of ASHP stakeholders. The LAC included manufacturers, regulators, utilities, program administrators, engineers, consultants and other contractors. Over the course of several months, the LAC identified barriers and developed strategies to realize increased benefits of residential ASHPs in NEEP's territory, which includes the Northeast and Mid-Atlantic regions.

The strategies represent a combination of existing strategies already being successfully implemented, in and outside of the region, and a collection of new strategies informed by the LAC. While the recommended strategies reflect the region's current understanding of the market and potential implications of broader ASHP penetration, the report identifies a number of data gaps that further research and analysis will be necessary to fill in order to make an even stronger program and policy case for their extensive deployment.

Table ES-1 below summarizes the market strategy areas that respond directly to the critical barriers identified by the Leadership Advisory Committee. More detailed activities are presented in the Regional Strategy Section of the report.

Table ES-1: Recommended Market Strategies to Accelerate Market Adoption of Residential Air-Source Heat Pumps
Near-Term 2014-2015 **Regional Stakeholders work through coordinated efforts to:**
1. Develop more accurate tools to predict energy and cost savings associated with ASHP installations, through collection of real world performance data
2. Develop standardized Metrics for Cold Climate ASHP Performance
3. Increase Consumer Awareness and Education
4. Expand HVAC Contractor Awareness and Education
5. Improve Integration of ASHPs with Other Heating Systems
6. Provide ASHPs at Affordable Costs to Consumers
7. Characterize policy implications of large scale deployment of ASHPs
Long-Term 2016-2018 **Regional Stakeholders work through coordinated efforts to:**
8. Clarify the policy case for broad-scale deployment of ASHPs
9. Support federal appliance efficiency standards that incorporate improved cold climate performance metrics
10. Support International Code Council recognition of ASHP in model energy codes

We urge states, efficiency program administrators and industry to work together to achieve thoughtful and coordinated implementation of the strategies presented herein to achieve the large potential for energy and costs savings offered by the broad adoption of ASHP systems across the Northeast/Mid-Atlantic region. NEEP stands ready to assist those efforts to build regional-scale momentum through strategic regional coordination of these strategies with regular updates to this strategy to keep current with relevant product, market, program and policy developments.