Technology Innovation Project *Project Brief*

TIP 292: Advanced Heat Pump Water Heater Research

Context

The 6th Power Plan calls for a 50% penetration of heat pump water heaters in the Pacific Northwest Region (PNWR) by 2030. According to BPA, 40% of the region's residences have electric water heaters. The U.S. census says 40% of owner-occupied, single family homes in Idaho, Montana, Oregon and Washington equal approximately 1,300,000. Of this number, approximately half are served by BPA customers; using the assumption that in areas served by these utilities the penetration of electric resistance space and water heating is higher, this totals approximately 650,000 single-family, owner-occupied homes. In this sample alone, the 6th Plan is looking to put heat pump water heaters in 325,000 residences. Some utilities interested in this technology have expressed concerns about homeowner comfort when installations are inside the conditioned space, and so are especially interested in split systems.

Description

Washington State University Energy Program (WSUEP), in partnership with Avista, Energy Trust of Oregon, Northwest Energy Efficiency Alliance (NEEA), Ravalli Electric Co-op and Tacoma Public Utilities, will research and demonstrate the capabilities of high-performance, next-generation heat pump water heaters in the laboratory and the three main heating climate zones of the Pacific Northwest.

The project brings a split system, carbon dioxide (CO2) heat pump water heater with a dedicated, variable-speed outdoor compressor, to the Pacific Northwest, where it will be subjected to the same lab and field tests as the integrated heat pump water heaters already marketed in the region. The research will take place over two years. In the first year the equipment will be imported and lab tested. In the second year it will be field tested in all three of the region's heating zones.

The equipment under study in this proposal directly addresses the variable speed compressor option and solves the issue of increasing the space-heating load of residences served by the water heater. This CO2 technology promises to provide cost-effective high performance over a wide range of temperatures, representing a significant increase in heat pump water heater performance over existing technology.

This important research project has potentially significant consequences. It is designed by utilities very interested in the technology. At least two of them have declared they do not support the installation of the current market heat pump water heaters in their service areas. They want to see how this technology works in their climates before they commit to installations in their service territories. Even utilities that serve the warmer part of the region are very interested in CO2 split systems and want to participate in field tests on their grids.

The specific tasks involved in this project are as follows:

1. Select and import four split system CO2 heat pump water heaters.
2. Conduct lab tests to national and regional protocols.
3. Select field sites, obtain permits or waivers, and execute homeowner agreements.
4. Conduct field tests to regional protocols, analyze and report.

Why It Matters

It is crucial to not delay the introduction of what may be an important technology for heat pump water heaters. The PNWR stands at a crossroads. It is currently heavily invested in integrated heat pump water heater technology with single speed compressors, limited to a rated Coefficient of Performance (COP) of 2 to 2.5. WSUEP proposes to introduce a variable speed split system with a COP rated greater than 3 in normal conditions, and a COP of 2 in temperatures as low as 17° F. The probability of success is high with the partnership that has come together for this project.

Assuming an average annual hot water load of 3,300 kWh and an average annual COP of 3, the annual savings would be approximately 2,200 kWh. This system does not add to the space heat load of the home to which it supplies hot water.

Goals and Objectives

This is a low-cost research project with potentially significant ramifications. It will bring a CO2 split system dedicated heat pump water heater to the Pacific Northwest and subject it to all the tests that current integrated systems have undergone. This will allow necessary comparisons to be made.

WSUEP's long-term strategy is to find a supplier for this project who is also interested in developing a cost-effective carbon dioxide refrigerant heat pump water heater. This was part of the qualifications explored when WSUEP and its Project Advisory Task Force chose a manufacturer.

TIP 292: Advanced Heat Pump Water Heater Research

Project Start Date: December 7, 2012

Project End Date: September 30, 2015

Reports & References (Optional)

Links (Optional)

Funding

Total Project Cost:	$720,001
BPA Share:	$360,000
External Share:	$360,001
BPA FY2014 Budget:	$140,000

For More Information Contact:

BPA Project Manager:
Kacie Bedney, kcbedney@bpa.gov

Participating Organizations

Washington State University Energy Program
Avista Corporation
The Energy Trust of Oregon
Northwest Energy Efficiency Alliance
Ravalli Electric Co-op
Tacoma Public Utilities