Built in 1915, this two-story, three-bedroom home with an unfinished basement and 2,600 ft² of living space is typical of many older homes found in eastern Washington. Through the U.S. Department of Energy’s Building America program, researchers from the Pacific Northwest National Laboratory worked with local energy rater Energy Incentives, Inc., to assist the home owners in cost-effectively reducing their energy use by over 50%. The researchers used Energy Gauge USA simulation software to model retrofit packages and predict the most cost-effective retrofit measures within the homeowner’s budget.

The presence of asbestos insulation on the boiler made it more cost-effective to pursue efficiency measures that left the boiler in place to avoid the additional costs of disposal. Major energy and cost savings were achieved by installing a multi-headed ductless heat pump to complement the existing hydronic heating system, leaving the boiler to provide supplemental heating during times of exceptionally cold weather. The homeowners are also considering further improving energy efficiency and thermal comfort by insulating and air sealing the building envelope.

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PNNL will meter and collect data on the electricity and fuel consumption of the heating systems and major appliances in this home, as well as temperature and relative humidity in several locations. This information will allow PNNL researchers to fully characterize the energy and comfort performance of the dual heating systems and monitor the impact of any addition insulation and air sealing work as it occurs.

**Lessons Learned**

- The key to cost-effective retrofits in this classic historic house was to avoid unnecessary replacement and upgrading costs by leaving the asbestos-encapsulated boiler intact.

- Fuel cost and availability was a key consideration when selecting the best heating system for this home. Natural gas was not available and Washington state code prevents propane systems from being installed in the basement. Switching to an efficient heat pump with zonal controls was the best solution to save energy and reduce expensive diesel fuel costs.

- The scope and timeline of retrofits are often dictated by capital cost and available budget when retrofits are financed by homeowners. In this case, measures were prioritized based on energy savings potential and cost-effectiveness. Implementaiton will occur over time.

- "While the ductless heat pumps heat differently, it’s a pleasant surprise when we pay our utility bill!"

  _Judy Robertus, homeowner_

This chart shows the projected site energy savings resulting from the heat pump installation, as modeled in Energy Gauge.