Technology Innovation Project

TIP 318: Enhanced Residential Efficiency Analysis Tools for the Pacific Northwest

Context

Predictions from energy analysis tools play an integral role in identifying and evaluating cost-effective energy efficiency. They are most effective for deep energy retrofits for existing homes and zero net energy solutions for residential new construction in the Pacific Northwest (PNW) region. Tools should be robust, accurate and flexible enough to evaluate innovative and emerging technologies in the context of whole-building simulations. Building simulations should be based on a suitable number of archetypes with characteristics representative of PNW homes, and aggregated results should be weighted by the number of archetype homes in different climates throughout the region.

The PNW currently uses a small number of prototype residential buildings to evaluate energy savings of efficiency measures. These buildings have continued to be used for historical reasons and were not specifically developed to represent the PNW housing stock. Without a suitable number of building archetypes weighted to reflect the number of homes in different climates throughout the region, aggregate energy savings estimates lack the comprehensiveness and granularity required for utility/regional programs.

Description

EnergyPlus is a sophisticated whole-building energy simulation program that engineers, architects, and researchers use to model heating, cooling, lighting, ventilation, other energy flows, and water use. EnergyPlus includes many innovative simulation capabilities: time-steps less than an hour, modular systems and plant integrated with heat balance-based zone simulation, multi-zone air flow, thermal comfort, water use, natural ventilation, and photovoltaic systems. The Building Envelope Optimization (BEopt) tool has been developed by NREL in support of the U. S. Department of Energy Building America program goal to develop market-ready energy solutions for new and existing homes. The BEopt software, now incorporated with Open Studio, utilizes the EnergyPlus simulation engine to provide capabilities to evaluate residential building designs and identify cost-optimal efficiency packages at various levels of whole-house energy savings along the path to zero net energy.

This project builds on the DOE funded development of ResStock, a software framework for enhanced national scale residential efficiency analysis.

The tool is tailored for the PNW thru: 1) an enhanced residential building energy analysis tool that identifies cost-optimal efficiency packages and 2) Residental Building Stock Assessment (RBSA) data calibrated to optimize simulations for PNW region residential efficiency analysis and assessing residential building energy conservation potential.

The tools and processes detailed above comprise a proven toolkit for identifying optimal combinations of energy efficiency technologies and operating strategies, in both design of new construction homes and retrofit packages for existing homes.

Benefits

This project successfully demonstrated that sophisticated yet easy-to-use residential analysis tools can quickly identify least-cost efficiency measures/packages on the path to zero net energy for targeted residential markets. These tools, tailored for the PNW and built upon DOE's flagship open-source EnergyPlus simulation engine, leverage proven software platforms that have been used nation-wide to provide robust, reproducible, and accurate analysis under local conditions. The project also made use of these tools to identify optimized, least-cost, efficiency packages and to produce detailed regional efficiency potential. Public availability of these tools allows adaptation of these analyses as the residential building landscape changes over time.

Compared to current practice, use of EnergyPlus will result in increased accuracy, transparency, leveraged funding/support, and more widespread adoption. Use of the regional tool will extend the granularity and accuracy of conservation potential assessments.

Accomplishments

The BPA/DOE partnership to further development in ResStock-PNW produced a new, open-source framework for assessing regional efficiency technologies in the residential housing stock. In addition, a comparison study between the EnergyPlus simulation program and the PNW modeling program, Simple Energy and Enthalpy Model (SEEM) showed that Energy Plus is a suitable simulation engine for

PNW residential buildings. It also delivered a cloud based tool that can be used to identify cost-optimal efficiency packages.

Thru this project, the ResStock platform now has a solid foundation, and nationally other entities are investing in the tools functionality and interface. These partners are leveraging BPA investments and producing additional value for the PNW.

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Project Start Date: October 1, 2014

Project End Date: September 30, 2016

Funding

Total Project Cost: $870,000

Deliverables

As a result of this project, the following major outcomes were achieved:

Final Report: TIP 318: ResStock-PNW Regional Tool

1. New BEopt and EnergyPlus software versions are publically available with enhanced modeling capabilities.
2. A technical report has been published: *EnergyPlus and SEEM Modeling Enhancements via Software-to-Software Comparison Using NREL's BEopt Test Suite*.
3. An OpenStudio framework for ResStock-PNW has been developed on top of DOE's OpenStudio, allowing analysis of user-defined efficiency measures/packages.
4. A successful demonstration of the framework was conducted on Amazon cloud computing, including initial model validation to RBSA consumption data.

For More Information Contact:

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Participating Organizations

National Renewable Energy Laboratory (NREL)
U.S. Department of Energy – Buildings Technology Office
Ecotope, Inc.

Links, Reports & References

Related Projects

1. Advanced Ductless Heat Pump Modeling.
2. SEEM Calibration Review

Closing Project Brief - 2016