NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Evaluating Energy Efficiency Potential in Low-Income Households

New ResStock™ capabilities unlock county-level efficiency potential estimates for various ranges of household income.

ResStock

Energy efficiency programs designed to help low-income customers save energy and money on their utility bills are some of the most widespread and successful programs.[1] But exactly how much energy and money could be saved? Are some states or utilities missing out on cost-effective savings opportunities? Are there some customers—such as renters or those with moderate incomes—who have significant savings potential and are falling between the cracks of existing energy efficiency programs?

Key Research Result

Achievement

ResStock enhancements enable estimating the energy efficiency potential for various ranges of household income (e.g., <80% of area median income or <200% of federal poverty level).

Key Result

Dynamic visualizations transform the outputs of millions of simulations into meaningful and actionable results on a county-by-county basis.

Potential Impact

States, utilities, and locally-operated weatherization programs will be able to better understand the savings potential from energy efficiency in low-income communities.

These are some of the questions that can be addressed using new capabilities added to ResStock, an open-source software tool for modeling energy efficiency potential across the diversity of the U.S. housing stock. Thanks to support from the U.S. Environmental Protection Agency (Regions 8 and 10) and the U.S. Department of Energy Office of Energy Policy and Systems Analysis, ResStock has been enhanced with the ability to estimate energy efficiency potential for various ranges of household income (e.g., <80% of *area median income* or <200% of *federal poverty level*), as well as the ability to get results at a county-level in addition to state-level results.[2]

Identifying Housing Characteristics Correlated with Household Income

Statistical analysis determined which energy-related housing characteristics are most correlated with household income. Initially focusing on single-family detached housing, the most important characteristics include a home's size, location, vintage, whether or not it has central air conditioning, use of window air conditioners, and air tightness. Conditional probability distributions capturing the relationship between these parameters were derived from several high-resolution datasets, including the U.S. Census Bureau American Community Survey, the U.S. Census Bureau American Housing Survey, and the U.S. Energy Information Administration Residential Energy Consumption Survey.

Enhanced Geographic Resolution

While previous results from ResStock analyses were only available for states or similarly sized geographic areas, these new capabilities enable confidence in results at the county level. This is particularly helpful for locally-operated weatherization programs interested in understanding the savings potential specific to their county, which, for example, may look quite different in a rural county with older housing stock and predominantly propane heating compared to a suburban county with newer housing stock and natural gas available for space and water heating.

Visualization of Results

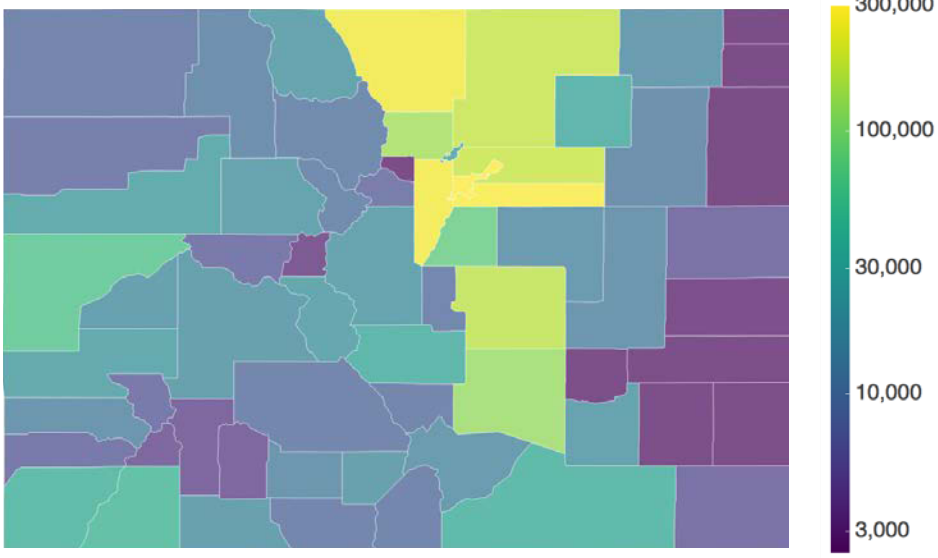
Dynamic visualizations transform the outputs of millions of simulations into meaningful and actionable results. In the state of Colorado, for example, the savings potential is largest in the most highly populated counties along the Front Range urban corridor, as shown in the figures on the back. However,

[1] Tonn, Bruce Edward; Carroll, David; Pigg, Scott; Blasnik, Michael; Dalhoff, Greg; Berger, Jacqueline; M. Rose, Erin; et al. 2015. Weatherization Works--Summary of Findings from the Retrospective Evaluation of the US DOE's Weatherization Assistance Program. Oak Ridge, Tennessee. Oak Ridge National Laboratory. ORNL/TM--2014/338.

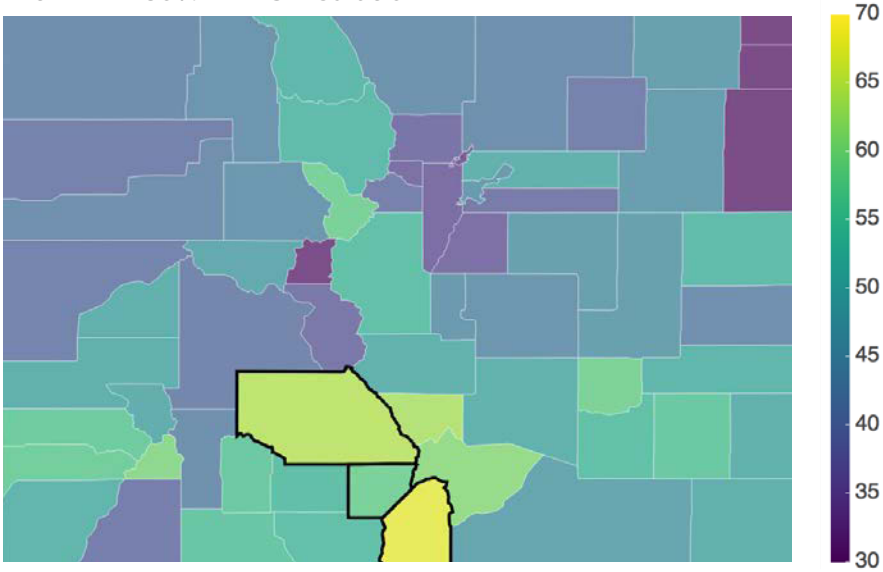
[2] Area median income and federal poverty level are metrics based on a combination of household income and number of household members; they are both developed by the U.S. Census Bureau. Area median income is issued by the U.S. Department of Housing and Urban Development and is specified for counties, except in cities, which are further subdivided. Federal poverty level is issued by the U.S. Department of Health and Human Services and uses the same levels across the continental U.S. Alaska and Hawaii each have different federal poverty level thresholds.

the highest percentages occur in south central Colorado, including the three Colorado counties classified as persistent poverty counties (Alamosa, Costilla, and Saguache).[3] While these counties are not as highly populated as those in the Front Range, efficiency programs implementing wall insulation are likely to have a larger impact on reducing the burden of high energy bills in those counties.

Total Source Energy Savings – R-13 Wall Insulation



Percentage of Total Source Energy Savings in Households with AMI <80% – R-13 Insulation



Counties in the U.S. state of Colorado are colored according to the aggregate primary energy savings potential for insulating empty wall cavities in all households (top) and the fraction of that savings that occurs in households with less than 80% of the area median income (bottom).

The figures show the technical potential savings on a county-by-county basis for the state of Colorado. The top map shows the total source energy savings potential for adding R-13 insulation to empty wall cavities. The bottom map shows the percentage of each county's savings potential that occurs in households making less than 80% of the area median income.

Technical Contact

Reach out to the NREL team to learn how ResStock can benefit your organization.

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ResStock Website: *https://www.nrel.gov/buildings/resstock.html*

Reference(s)

Wilson, E.; Christensen, C.; Horowitz, S.; Robertson, J.; Maguire, J. 2017. Energy Efficiency Potential in the U.S. Single-Family Housing Stock. National Renewable Energy Laboratory. NREL/TP-5500-68670. *http://www.nrel.gov/docs/fy18osti/68670.pdf*.

Applications

ResStock analysis can be used to answer questions for a variety of applications:

Which energy efficiency (EE) upgrades are most cost-effective in each state or county for a particular range of household incomes?

How much utility bill savings can be achieved with cost-effective EE?

What is the potential revenue resulting from cost-effective EE upgrades?

[3] United States Department of Agriculture, Economic Research Service, ERS County Typology Codes, 2015 Edition. https://www.ers.usda.gov/data-products/county-typology-codes/. Accessed 12/20/2017.

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