MICHIGAN

Residential Energy Efficiency Potential

Cost-effective package savings potential in Michigan single-family homes

- **2.3 billion** dollars per year utility bill savings
- **109.8 trillion** Btu per year gas, propane, and fuel oil savings
- **8.2 billion** kWh per year electricity savings
- **2.7 million** cars of pollution reduction

25% Energy used by Michigan single-family homes that can be saved through cost-effective improvements

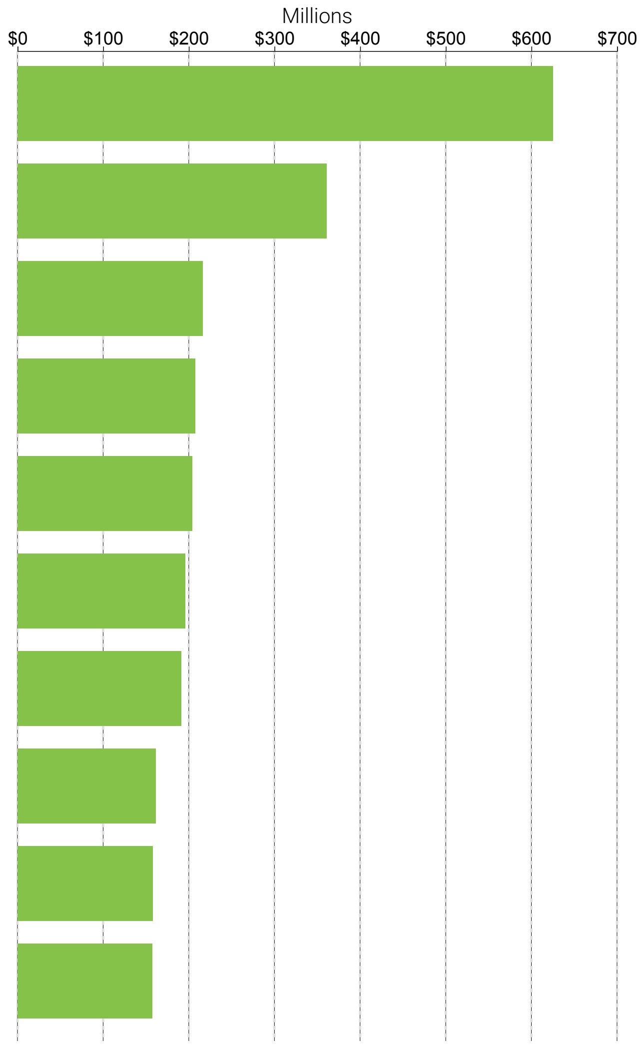
87,013 Michigan existing jobs in energy efficiency (2016)[1]

Michigan Top 10 Improvements

Michigan Utility Bill Savings (electricity, gas, propane, and fuel oil)

* Pays back in less than 5 years for most households

		Average Annual Savings per Household
Enclosure	Drill-and-fill wall cavity insulation	$414
Enclosure	R-10 basement wall insulation	$201
HVAC	Smart thermostat *	$99
Lighting	LED lighting *	$145
HVAC	High-efficiency heat pump (replace electric furnace at wear out) *	$2,125
Enclosure	R-5 insulated wall sheathing (at siding replacement)	$336
Enclosure	R-60 attic insulation	$145
HVAC	Duct sealing & insulating	$130
Enclosure	Low-E storm windows (DIY install)	$142
Enclosure	Air sealing	$75



[1]U.S. Department of Energy. January 2017. *U.S. Energy and Employment Report*

An interactive version of this factsheet is available at resstock.nrel.gov.

Analysis approach and input assumptions are listed on the reverse side. For full details, see Wilson, E., et al. *Energy Efficiency Potential in the U.S. Single-Family Housing Stock*. NREL/TP-5500-68670, 2017. http://www.nrel.gov/docs/fy18osti/68670.pdf

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Analysis approach and input assumptions

The analysis results presented here used the following assumptions. Differences in assumptions or format of results may make comparisons to other efficiency potential analyses invalid. More details on the methodology and assumptions can be found in the NREL technical report, **Energy Efficiency Potential in the U.S. Single-Family Housing Stock**.

- **Definition of energy efficiency potential:** The energy efficiency potential is presented as annual energy savings specific to each state, assuming full turnover of the stock of equipment and appliances at wear out, which could take 15–30 years, depending on the type of equipment. Full uptake of applicable and cost-effective enclosure improvements was also assumed. Thus, the savings presented are the economic potential, as opposed to market potential which might be informed by historical adoption rates. Policy and programs could be implemented to lower other market barriers and reduce the difference between market potential and economic potential.
- **Energy savings:** The energy savings estimates were calculated using **ResStock™**, a highly granular model that uses 350,000 physics-based building energy models (**OpenStudio®**/ **EnergyPlus™**) to statistically represent the diversity of the U.S. single-family housing stock (80 million homes) across a range of climates (216 climate regions), vintages, sizes, fuel types, equipment, insulation, occupancy, etc. For heating/cooling equipment and appliance upgrades considered at wear out, only the incremental savings and cost over the reference replacement scenario (e.g., federal minimum standards) is counted. Detailed descriptions of each improvement scenario are provided in the **technical report**. The analysis did not account for state/local codes and standards.
- **Packages/measure interaction:** The statewide savings potential values presented in the upper right box are based on simulated packages of cost-effective improvements, including the state's top 10 improvements listed and other, lower priority, improvements. The packages are tailored to maximize the net present value (NPV) in each of the 350,000 representative home models. The packages account for any diminished returns due to interaction between heating/cooling equipment and enclosure upgrades, as well as the potential for reduced upfront cost through heating/cooling equipment downsizing. The green bar graph shows the statewide economic potential energy savings of the top 10 individual improvements, not accounting for interactions between them.
- **Cost-effectiveness perspective:** The presented energy efficiency potential aggregates savings across all homes in which the improvement or package has a positive NPV, evaluated using costs and benefits from the building owner's perspective rather than a utility or societal perspective. Health and safety benefits were not quantified.
- **Economic assumptions:** For NPV calculations, 30 years of future cash flows (utility bill savings, equipment replacement at end of life, and residual value) are brought to the present using a 3% real discount rate. The **technical report** provides additional results using an alternative (more stringent) cost-effectiveness criterion of simple payback period less than five years.
- **Tenant-occupied homes:** The same economic calculations are used for both owner-occupied and tenant-occupied single-family homes. For tenant-occupied housing, it is assumed that either the building owner pays the utility bills or rent is increased by an amount equal to utility bill savings.
- **Utility prices:** Electricity rates were assumed to be flat volumetric charges ($/kWh), were derived from EIA Form 861 sales and revenue data (2013), assumed $8 per month in fixed customer charges, and were applied at the county level based on utility service territories reported on EIA Form 861. Rates for on-site fuel use were derived from 2015 EIA data (natural gas) and 2010 EIA data (propane and fuel oil), and were applied by state.
- **Improvement costs:** Improvement costs include all material, labor, and overhead costs paid by the building owner. In the case of equipment replaced at wear out, only the incremental cost of the improvement over the reference (e.g., federal minimum standards) is included. As noted above, future replacement costs and residual value at the end of the 30-year cash flow analysis are accounted for. With a few exceptions, the initial costs and lifetimes for each upgrade and reference scenario are national averages sourced from the **National Residential Efficiency Measures Database**.
- **Incentives:** State, utility, and local incentives (e.g., rebates) were not included in the economic analysis, due to the large number of unique incentives that exist. A federal income tax credit for residential energy efficiency was included and assumed to be available in future years (capped at $500 per household). The eligible improvements include high-efficiency heating, cooling, and water heating equipment, as well as insulation and windows upgrades.
- **Sectoral scope:** The analysis covers single-family detached housing only. The housing stock characteristics tool developed for ResStock currently is limited to single-family detached housing and excludes all multifamily buildings (including duplexes and townhomes) as well as mobile homes. Expansion to the multifamily sector is planned in 2018.
- **Geographic scope:** The fact sheets are limited to the 48 contiguous U.S. states. Sources of housing characteristics and consumption data (particularly the Residential Energy Consumption Survey) for Alaska, Hawaii, and U.S. territories tend to have low sample sizes, resulting in high uncertainty in the data.
- **Temporal scope:** House counts and housing characteristics are a snapshot based on circa-2012 data; projections of future construction and changes in housing characteristics were not included in this analysis.

The ResStock software can be used to analyze additional scenarios with different assumptions, for additional technologies, or with additional input data for specific city, state, or utility territories. ResStock is free, open source, and publicly available, with the large-scale simulations running on Amazon cloud computing. See **resstock.nrel.gov** for more information on using the software, and to learn how to partner with NREL or third-party consultants on additional analyses.

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