

Manufactured Housing in Rural America:

*How States are Supporting Energy
Efficient Homes and Reducing
Energy Costs for Residents*

April 2021



*National Association of
State Energy Officials*

Acknowledgements

The National Association of State Energy Officials (NASEO) prepared this document to assist members of the Rural Energy Task Force in their efforts to develop effective policies and programming to support rural communities.

The primary author of this report was Dylan Tucker, a NASEO Program Manager. NASEO would like to thank the many State Energy Directors and State Energy Office staff that contributed to the development of this report. We would also like to thank the following NASEO contributors: Ed Carley, Rodney Sobin, Cassie Powers, and David Terry.

NASEO would like to thank the staff of the U.S. Department of Energy and the U.S. Environmental Protection Agency's ENERGY STAR Program, who were both instrumental to the development of this report.

Abstract: *Manufactured homes are a key segment of the housing sector comprising 10 percent of new detached home sales annually. It is a particularly important housing option for low-income, rural Americans. While the low up-front costs of manufactured homes provide initial savings, residents generally pay significantly higher energy bills throughout the lifetime of the home due to the broad use of manufactured housing energy efficiency standards that were last updated by the Federal Government in 1994. As a result, many states are working to save residents money by enhancing the energy performance of homes, through retrofits of existing homes, encouraging the purchase of ENERGY STAR certified manufactured homes and home appliances, and in some cases supporting a low-cost alternative of modular housing.*

Introduction

Manufactured homes have an enormous impact throughout the United States, providing low-cost housing to over 22 million Americans, supporting 129 manufacturing plants, and accounting for about 10 percent of new detached homes sales nationally.¹ Because components are produced on a mass scale, manufactured homes achieve an average cost per square foot less than half the price of site-built homes, \$55 per square foot and \$114 per square foot respectively.² With these lower costs, manufactured homes are an attractive option for low income home buyers: in 2018, median household income for manufactured home residents was \$30,000 compared to \$64,000 nationally.³ Manufactured housing is also more common in rural communities, accounting for 15 percent of rural housing and only three percent of urban housing.⁴

While manufactured homes offer large up-front cost savings, they remain outside the jurisdiction of state and local building codes and are not subject to the same energy efficiency standards as site-built homes, leading to higher average energy bills throughout the lifetime of the home. Thus, millions of residents of non-ENERGY STAR certified manufactured homes are living with air leakage, inefficient appliances and home systems, and energy performance that most states have independently deemed unacceptable. The American Council for an Energy-Efficient Economy (ACEEE) examined data from the Energy Information Administration and found that energy costs per square foot in manufactured homes is nearly twice that of site-built homes: \$1.38/square foot, and \$0.74/square foot respectively.⁵ This consistently high energy consumption from rural homes contributes to a higher “rural energy burden,” the percentage of income spent on energy services. The rural energy burden term has become popular after ACEEE demonstrated that low-income rural residents spend nearly nine percent of income on

¹ Manufactured Housing Institute. “2020 Manufactured Housing Facts: Industry Overview.” May 2020. <<https://www.manufacturedhousing.org/wp-content/uploads/2020/07/2020-MHI-Quick-Facts-updated-05-2020.pdf>>.

² *Id.*

³ National Association of State Energy Officials. “NASEO Input on DOE’s Request for Information – Docket EERE-2009-BT-BC-0021.” September 2018. <https://www.naseo.org/Data/Sites/1/naseo_input_on_doe_request_for_information_-_docket_eere-2009-bt-bc-0021_91718%5b1%5d.pdf>.

⁴ Prosperity Now. “Facts About Manufactured Housing 2019.” <<https://prosperitynow.org/sites/default/files/PDFs/Affordable%20Homeownership/T%27M%20HOME/Facts%20About%20Manufactured%20Housing%20-%20202019.pdf>>.

⁵ Talbot, Jacob. “Mobilizing Energy Efficiency in the Manufactured Housing Sector.” July 2012. American Council for an Energy-Efficient Economy. <<https://www.aceee.org/sites/default/files/publications/researchreports/a124.pdf>>.

energy services, compared to just over three percent of income nationally.⁶ This stark difference in energy spending leads to a higher cost “burden.”

As State Energy Offices examine ways to support rural communities and reduce their high energy burden, improving the energy efficiency of the manufactured housing stock is a promising opportunity to address several state goals simultaneously. First, reducing costs for residents; a study of energy efficiency retrofits in Minnesota found residents could save an average of \$450 per manufactured home annually through energy efficiency retrofits.⁷ Second, reducing energy demand benefits electric and natural gas ratepayers by reducing peak demand and enabling smaller, more efficient energy infrastructure. Third, states provide direct financial support to qualified low-income residents through the Weatherization Assistance Program (WAP) and Low-Income Home Energy Assistance Program (LIHEAP), so reducing the energy burden of these communities would allow WAP and LIHEAP funds to be spent elsewhere or saved. Furthermore, reduced energy demand leads to avoided air pollution, providing local health benefits, and climate benefits. Finally, supporting the economy through the production of manufactured homes and related supply chains, which accounted for 40,000 jobs nationally in 2017.⁸ State actions to incentivize and promote more efficient home systems and appliances, weatherized building envelopes, and education on in-home energy saving behaviors can have widespread benefits while targeting at-risk communities. This report will review regulations for the manufactured housing industry, examine the energy and economic implications of these regulations, and explore state-led efforts to improve the efficiency of existing and new manufactured homes, and to support energy-efficient home building with competitive prices.

Federal Manufactured Housing Standards and Resources

Manufactured homes are built entirely in factories, transported to sites, and installed on prepared lots. At the end of 2018, there were 6.7 million manufactured homes around the country, accounting for 7.5 percent of the nation’s single-family homes.⁹ Manufactured homes also represent a growing market, accounting for 13 percent of single-family home sales in 2018.

Defining Different Housing Types

- **Manufactured Homes:** factory-produced homes built since 1976, to comply with the original nationwide HUD Code, or subsequent updates.
- **Mobile Homes:** produced before 1976, before the development of the HUD Code.
- **Modular Homes:** major components are factory built, with the home assembled on-site. This on-site assembly means that local codes apply, instead of the nationwide HUD Code.

⁶ American Council for an Energy-Efficient Economy. “The High Cost of Energy in Rural America.” July 2018. <<https://www.aceee.org/sites/default/files/publications/researchreports/u1806.pdf>>.

⁷ Minnesota Department of Commerce. “Minnesota Manufactured Homes Characterization and Performance Baseline Survey.” October 2016. Division of Energy Resources. <https://mn.gov/commerce-stat/pdfs/card-report-seventhwave_2016.pdf>.

⁸ Manufactured Housing Institute. “2018 Manufactured Housing Facts: Industry Overview.” May 2018.

⁹ Neal, Michael, Laurie Goodman, and Caitlin Young. “Housing Supply Chartbook.” The Urban Institute. January 2020. <https://www.urban.org/sites/default/files/publication/101553/housing_supply_chartbook_1.pdf>.

Because manufactured homes are built and distributed nationwide, their construction is regulated at the federal level through a code produced by the U.S. Department of Housing and Urban Development (HUD Code), rather than using the state and local codes which apply to site-built homes.¹⁰ Exemption from local building codes has made this housing stock among the least energy-efficient in the country. Exact trends are specific to the region and climate, making it difficult to draw conclusions about the country broadly, but the EIA estimates that older manufactured homes use 70 percent more energy per square foot than the average site-built home.¹¹

The HUD code was instituted to regulate “housing design and construction, strength and durability, transportability, fire resistance, energy efficiency and quality” as well as setting “performance standards for the heating, plumbing, air conditioning, thermal and electric systems.”¹² The HUD code breaks the country into three thermal zones based on climate, and three additional wind zones to protect from natural disasters.¹³ These zones help account for differences in heating and cooling needs, so they are based on the location of the installation, rather than production. However, the last update to the HUD Code was published in 1994, 27 years ago; for comparison, the International Energy Conservation Code (IECC) which many states use for their building codes has been updated eight times since 1994 to reflect advances in building practices and materials.

Key Data Points on Manufactured Homes and their Residents

Demographics

- 22 million Americans lived in manufactured homes in 2019, about 7 percent of the country;
- Median household income of \$30,000 in 2018, less than half the national median;
- There are 6.7 million manufactured homes in the United States, accounting for nearly 7.5 percent of single-family units;
- 40,000 land-lease communities host 37 percent of the nation’s manufactured housing;
- 28 percent of residents self-report as “unable to work, disabled, or retired;”
- Manufactured homes makeup 15 percent of the rural housing stock, and only three percent of the urban housing stock.

Economics

- Energy bills per square foot are 60-70 percent higher than site-built homes;
- 129 manufactured housing plants produced nearly 95,000 units in 2019;
- Manufacturing these homes accounted for 40,000 jobs in 2017 and \$3 billion in national GDP;
- Production is concentrated in the Southeast, with Texas, Alabama, and Tennessee accounting for about half of new units shipped in 2019;
- From 2015-2019, the average sales price of a manufactured home has increased 20 percent (from \$68.1k to \$81.6k) and 34 percent more units were produced.

¹⁰ Manufactured Housing Institute. “Understanding Today’s Manufactured Housing.” October 2017.

<<https://www.manufacturedhousing.org/wp-content/uploads/2017/10/Understanding-Manufactured-Housing.pdf>>.

¹¹ Energy Trust of Oregon. “Manufactured Home Replacement Pilot Fact Sheet.” August 2017.

<https://www.energytrust.org/wp-content/uploads/2017/08/ManufacturedHome_FS_2017.pdf>.

¹² *Id.* Page 3.

¹³ Code of Federal Regulations. Title 24B.XX.3280. “Part 3280—Manufactured Home Construction and Safety Standards.” Accessed June 4, 2020. <<https://www.ecfr.gov/cgi-bin/text-idx?SID=a2c5655a37054c584f7dd6a0ed240fb8&node=pt24.5.3280&rgn=div5>>.

Across all climates, manufactured homes encounter similar problems with energy efficiency. Key piping and ductwork is often exposed to ambient temperatures underneath the home, increasing the energy use required to maintain a consistent indoor temperature.¹⁴ Poor insulation and air leakage from walls, windows, and building envelopes is another common issue, further increasing the burden on heating and cooling systems.¹⁵ Furnaces and cooling systems are also often less efficient than those mandated in site-built homes, requiring more energy to achieve the same temperature levels.¹⁶ Finally, because the optimal temperature often cannot be reached with the existing systems, residents of manufactured homes are often reliant on electric space heating and cooling, which is much less efficient than heating and cooling systems for the entire home.¹⁷ Combining all these factors leads to significantly higher energy use in manufactured homes.

In 2007, Congress passed the bipartisan *Energy Independence and Security Act*, which included sections on manufactured housing codes. Section 413 requires the U.S. Department of Energy (U.S. DOE) to set a new manufactured housing energy efficiency standard within four years of enactment (2011) based on the then most recent IECC and directs revision of the standard within one year of each revision of the IECC.¹⁸ Still, as of April 2021 the 1994 HUD code remains in place.

Federal Resources

While standards at the federal level have remained stagnant, there are a number of helpful resources and programs dedicated to enhancing the energy performance of manufactured housing. The WAP and the LIHEAP Programs are run by the U.S. DOE and the Department of Health and Human Services respectively, and support energy efficiency investments in low-income housing. WAP provides funding through state agencies for the weatherization of homes, by providing loans and funding to enhance the energy efficiency of low-income homes. To provide technical support for the retrofit of manufactured homes through this program, the National Renewable Energy Laboratory developed the online Manufactured Home Energy Audit tool ([MHEA](#)), which facilitates remote energy audits for manufactured units based on their designs. This tool is now managed by Oak Ridge National Laboratory and is free for public use, with designs of common manufactured homes preloaded in order to facilitate simple energy audits and identify common solutions. The Weatherization and Intergovernmental Programs Office, within the U.S. DOE Office of Energy Efficiency and Renewable Energy has also developed a training series for Weatherization Installers or Technicians for Mobile Homes, in

¹⁴ Office of Energy Efficiency and Renewable Energy. “Notice of Proposed Rulemaking and Public Meeting.” Docket EERE-2009-BT-BC-0021-0140, Section 460.102. Accessed November 10, 2020. <<https://beta.regulations.gov/document/EERE-2009-BT-BC-0021-0140>>

¹⁵ *Id.* Sections 460.103-104.

¹⁶ *Id.* Section 460.202.

¹⁷ Office of Energy Efficiency and Renewable Energy. “Energy Saver: Energy-Efficient Manufactured Homes.” U.S. Department of Energy. Accessed July 27, 2020. <<https://www.energy.gov/energysaver/types-homes/energy-efficient-manufactured-homes>>.

¹⁸ Energy Independence and Security Act of 2007. Public Law 110-140, December 19, 2007. §413: Energy Code Improvements Applicable to Manufactured Housing. <<https://www.govinfo.gov/content/pkg/PLAW-110publ140/pdf/PLAW-110publ140.pdf>>.

order to support efficiency efforts in these homes.¹⁹ Several states have worked with the National Renewable Energy Laboratory to tailor these weatherization guides for manufactured homes to conditions and programs within their state, such as Maryland and Texas, to produce local retrofit field guides.²⁰ LIHEAP offers block grants to make home energy bills more affordable for low-income households, with a particular focus on energy for heating and cooling.²¹

The U.S. Department of Agriculture (USDA) also has available funding for manufactured homes in rural communities through the Rural Energy Savings Program (RESP). RESP offers low-interest, long-term loans, but to qualify applicants must live in a rural-designated census tract and own their home as well as the land. Starting in 2018, the retrofit or full replacement of manufactured homes was added as an eligible project for a RESP loan. Based off an initial audit and assessment, the USDA will determine if retrofits or a full home replacement is more cost-effective over the period of the loan.²²

Finally, in 2005, the U.S. Environmental Protection Agency (EPA) established efficiency requirements specifically for manufactured homes to earn ENERGY STAR certification.²³ Through this program, manufacturing plants work with ENERGY STAR Quality Assurance Providers to review architectural designs, manufacturing processes, and conduct site evaluations of manufacturing plants and at least 2 percent of completed homes to ensure homes consistently meet higher levels of energy efficiency during operation. The ENERGY STAR program requirements for manufactured homes were recently updated, with Version 2 specifications taking effect for homes manufactured on or after June 1, 2020.

The Version 2 ENERGY STAR program requirements for manufactured homes are tailored to the thermal zone where the home is manufactured, and allow for several different approaches to reduce energy consumption, with a primary focus on air conditioning, heating, and envelope improvements. While actual combination of energy saving strategies will depend on the manufacturer's decisions and the thermal zone, EPA's cost modeling estimates that the collective package of efficiency improvements will achieve monthly energy bill savings between \$15 and \$137 per unit.²⁴ These monthly savings are achieved with up-front cost premiums between \$1,037 and \$3,968. The higher up-front costs and lower monthly savings were associated with

¹⁹ Office of Energy Efficiency and Renewable Energy. "Weatherization Installer/Technician Mobile Homes Curriculum." U.S. Department of Energy. <<https://www.energy.gov/eere/wap/weatherization-standardized-curricula/weatherization-installer-technician-mobile-homes>>.

²⁰ Maryland Department of Housing and Community Development. "Retrofitting Maryland – 2018 MH: Standard Work Specifications Field Guide." 2018. <<https://dhcd.maryland.gov/Residents/Documents/wap/RetrofittingMaryland-2018MH.pdf>>; Texas Department of Housing and Community Affairs. "Retrofitting Texas – Manufactured Housing 2018: Standard Work Specification Field Guide." 2018. <<https://www.tdhca.state.tx.us/community-affairs/wap/docs/MH-SWS-Guide.pdf>>.

²¹ LIHEAP 101, March 2014, <https://liheapch.acf.hhs.gov/pubs/LCIssueBriefs/FinalLIHEAPPrimer.pdf>

²² Coates, Bob. "The USDA Rural Energy Savings Program (RESP): Overview and Update." Presentation given October 31, 2018. <<https://www.naseo.org/Data/Sites/1/resp-basic-presentation-10-31-2018-coates.pdf>>.

²³ U.S. Environmental Protection Agency. "ENERGY STAR Qualified Manufactured Homes: Design, Manufacturing, Installation, and Certification Procedures." November 2005. <https://www.energystar.gov/ia/partners/downloads/manufactured_procedures.pdf>.

²⁴ ENERGY STAR. "Cost & Savings Estimates: ENERGY STAR Certified Manufactured Homes, Version 2." May 2020. <<https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Manufactured%20Homes%20Version%20%20Cost%20Savings%20Summary.pdf>>.

the warmer thermal zones, with more cost-effective efficiency measures available in cooler climate zones.²⁵

Economic Impact of Manufactured Housing

While this paper focuses on the energy and energy cost impact of manufactured housing as a significant portion of the U.S. housing stock, the manufactured housing sector can greatly impact state economies. First and foremost, it provides an affordable and stable housing option for millions of Americans. In 2017, there were 37.8 million renters and homeowners that were cost-burdened by their housing, down slightly from peaking in 2010.²⁶ Furthermore, the number of low-rent housing units has fallen by over four million units since 2011.²⁷ While manufactured home sales peaked in the 1970s before the original HUD code was enacted, over 90,000 units shipped annually from 2017-2019.²⁸ Thus they represent one of the only growing options for low-income housing.

Beyond providing housing, there is significant economic benefit that can be realized from the production of new manufactured units and servicing existing units. In 2019, every single state installed new manufactured homes, and more than half of the states hosted a plant that manufactured new homes.²⁹ Texas leads the industry, manufacturing the most homes, and in 2017 Texas installed as many new manufactured homes as the next top three states combined (Alabama, Florida, and Louisiana).³⁰ Even states without a large section of the industry feel its impact. In 2020, the Wisconsin Housing Alliance examined the economic impact of manufactured and modular housing. For reference, in 2019 Wisconsin hosted two manufacturing plants and installed 657 new manufactured homes, compared to 22 plants and 15,866 new homes in Texas in 2019.³¹ The study found that the manufacturing of new homes in Wisconsin generated an economic value of \$185.9 million, supporting 1,115 jobs and providing nearly \$50 million in wages.³² Beyond the direct economic value of constructing new homes, the sector impacted the economy through real estate management and services, complementary manufacturing and construction, and sales and services. These three factors added an additional \$456.4 million in economic impact, supporting 2,884 jobs and \$85.7 million in wages.³³

²⁵ *Id.*

²⁶ Joint Center for Housing Studies. “The State of the Nation’s Housing 2019 – Report Charts.” Harvard University. Slides 38-39. <<https://www.jchs.harvard.edu/state-nations-housing-2019>>. “Cost Burdened” is defined as spending more than 30 percent of income on housing.

²⁷ *Id.* Slide 5.

²⁸ Manufactured Home Survey. “Shipments of New Manufactured Homes.” U.S. Census Bureau. Updated June 10, 2020. <<https://www.census.gov/data/tables/time-series/econ/mhs/shipments.html>>.

²⁹ *Id.* and [Manufactured Housing Institute](#), 2020.

³⁰ Jones, Jonathan. “A New Home for \$70k? The American Dream get a Remodel.” *Construction Coverage*. January 16, 2019. <<https://constructioncoverage.com/research/rise-in-manufactured-housing-by-state>>.

³¹ 2020 Manufactured Home Survey, and Manufactured Housing Institute, 2020.

³² Wisconsin Housing Alliance. “The Economic Impact of Manufactured Home Manufacturing.” University of Wisconsin-Whitewater, Fiscal & Economic Research Center. January 2020. <https://housingalliance.us/wp-content/uploads/MH-Economic-Impact-Study.pdf>.

³³ *Id.* Page 2. This equates to an average income of \$29,715, about ten percent lower than Wisconsin’s 2019 per capita income, \$33,375, as reported by the U.S. Census Bureau.

States Actions to Enhance Manufactured Housing

States have an important opportunity to support the manufactured housing market; despite the federal preemption of building standards, improvements can be made to support rural economies, enhance energy efficiency, and reduce air pollution. After decades of stagnant federal codes, several states have already taken action to support the residents of manufactured housing and meet their energy needs at lower cost. The following sections will cover three major ways that states are working to meet these needs: retrofitting and enhancing the existing manufactured housing stock, improving the efficiency of new manufactured homes, and supporting alternative housing options to service the same market segment.

Enhancing Existing Homes

Retrofitting existing manufactured homes presents several unique challenges to states. Because manufactured homes are often located in rural areas, and in many cases are owned by low- or moderate-income households, this housing stock limits access to financing for housing improvements, and lower customer density making in-person actions like energy audits, home assessments, and the actual installation of energy-efficient solutions more costly. Some states have worked directly with their utilities to encourage efficiency upgrades. Since 2012 Arkansas has approved Entergy Arkansas to use ratepayer funds from an Energy Efficiency Recovery Rider to reinvest in the efficiency of manufactured housing. The program allows any resident of a manufactured home, or owners/managers of manufactured housing parks to receive energy audits and efficiency upgrades. Initially the program covered LED light bulbs, efficient faucets and showerheads, and advanced power strips. In 2015 the state approved an expansion of the program to include sealing, duct work, and air conditioning.³⁴ To achieve this Entergy worked with local companies to conduct the retrofits, and offered them compensation based on the kWh saved through their enhancements. These changes have helped make the program much more cost effective: in 2015 with a \$872,388 budget the program achieved 0.084 MW in peak demand savings and 6,495 MWh of lifetime energy savings; in 2017 with a \$1 million budget the program achieved 1.083 MW of peak demand reductions and 74,732 MWh of lifetime energy savings.³⁵ The 2017 energy savings were achieved through engaging 641 participants, compared to 687 in 2015, demonstrating the impact of incorporating air leakage solutions.

Minnesota administered a “Characterization and Performance Baseline Survey” of manufactured housing to better understand the unique energy needs of manufactured housing and developed a five-pronged strategy to address these needs. The baseline assessment found that manufactured homes in the state could theoretically achieve cost-effective energy savings of 25 percent with \$450 saved annually on energy bills.³⁶ The report also included five key strategies to reach these communities with efficiency programs:

³⁴ Entergy Arkansas. “Entergy Solutions: Manufactured Homes Program.” Accessed July 27, 2020. <https://www.entergy-arkansas.com/your_home/save_money/ee/manufactured/>.

³⁵ Nowack, Seth, Martin Kushler, and Patti White. “The New Leaders of the Pack: ACEEE’s Fourth National Review of Exemplary Energy Efficiency Programs.” American Council for an Energy-Efficient Economy. January 2019. Pages 44-45. <<https://www.aceee.org/sites/default/files/publications/researchreports/u1901.pdf>>.

³⁶ Minnesota Department of Commerce. “Minnesota Manufactured Homes Characterization and Performance Baseline Survey.” October 2016. Division of Energy Resources. <https://mn.gov/commerce-stat/pdfs/card-report-seventhwave_2016.pdf>.

1. Work with the state's WAP agency, as "about half of all households living in manufactured homes appear to be eligible for WAP services."³⁷ One potential issue is that many of these homes are in rural electric coop territory, who may not have the individual resources to carry out widespread efficiency programs. Here, Minnesota references a successful program in Iowa that aggregates an efficiency surcharge on ratepayers' bills, and allows the Iowa WAP office to address coop customers collectively.
2. Work with WAP to identify manufactured homes on private property. These homes tend to be about 30 percent larger than manufactured homes in parks, allowing for greater savings potential per home.
3. Engage with manufactured home parks to conduct a "blitz" type program to target many homes in a park simultaneously.
4. Collaborate with utilities to address the high use of inefficient electric space heaters.
5. Expand the scope of existing utility programs for new homes to incentivize the use of ENERGY STAR manufactured homes.

Based on the findings of this report, follow-up programs have been crafted to target energy efficiency in manufactured homes. In 2021, Minnesota Energy Resources launched a "Low-Income Community Blitz" to share educational resources on energy efficiency, local trainings, and Do-It-Yourself kits to enhance the energy efficiency of manufactured homes.³⁸ Through this program, Minnesota Energy Resources is working with manufactured home park managers, electric utilities and cooperatives, and resident organizations in order to reach these communities and provide resources to build local capacity and save these communities money on energy bills.

Efficiency in New Homes

Another key reason for this higher energy use in manufactured housing is the age of the homes. A 2017 study by the Energy Trust of Oregon, and corresponding pilot program to increase housing efficiency, found that nearly two-thirds of their manufactured housing stock was built before 1995.³⁹ Thus, even the most recent HUD efficiency standards did not apply. In these cases, it was determined that efficiency upgrades were not worth the investment, as the value of the house often did not justify the cost of enhancements, or there wasn't enough time left of the home's useful life to pay back investments. To reflect this, the program provided incentives to fully replace pre-1995 homes with new energy-efficient models, rather than spending on retrofits. Since, this pilot, the Energy Trust of Oregon has expanded their financial incentives, providing additional funds for more energy-efficient models, the installation of heat pumps, and \$300 incentive for retailers or sales representatives involved in the purchase.⁴⁰

³⁷ *Id.* Page 84.

³⁸ Correspondence with Minnesota Department of Commerce, Division of Energy Resources. January 25, 2021.

³⁹ Energy Trust of Oregon. "Manufactured Home Replacement Pilot Fact Sheet." August 2017. <https://www.energytrust.org/wp-content/uploads/2017/08/ManufacturedHome_FS_2017.pdf>.

⁴⁰ Energy Trust of Oregon. "New Manufactured Home Incentives for Retailers and Homebuyers." September 6, 2019. <<https://insider.energytrust.org/new-manufactured-homes-incentives-for-retailers-and-homebuyers/>>.

A small number of states have also worked to incentivize higher adoption of ENERGY STAR certified manufactured homes and appliances to increase energy efficiency in newly installed homes. In 2010, the North Carolina Energy Office began offering a rebate on ENERGY STAR certified manufactured homes. This offer was coupled with a utility side incentive, which offered five percent reductions on the utility bills. In 2011 the state-funded rebate was tripled to \$1,500.⁴¹ Today, instead of a rebate for the full home, North Carolina offers incentives to enhance ENERGY STAR certified manufactured homes with efficient heat pumps, rather than standard electric furnaces through the Upgrade and Save Program. This program was initially funded with \$100,000 from the state and matching funds from the program administrator, East Carolina University with operations beginning in 2012. After its successful implementation the program was refunded for another year, through summer 2020. Upgrade and Save works with 29 local retailers of manufactured housing and provides a \$400 rebate for every unit they install with a heat pump. The state estimates that a heat pump can save the average home \$630 in utility bills each year, paying off in less than one year with an estimated lifetime benefit of \$12,600 offsetting the up-front \$400 investment. Since Eastern Carolina University's contract began in August 2018, 583 efficient units have been installed.⁴²

Beyond the federal ENERGY STAR program, states and private firms are leveraging other strategies to encourage higher efficiency in new homes. The Northwest Energy Efficient Manufactured Housing Program (NEEM) is a partnership between manufactured home builders and energy efficiency advocates, and is one of two ENERGY STAR Quality Assurance Providers recognized by EPA to certify manufacturing plants to produce manufactured homes that earn ENERGY STAR. They also offer a [NEEM+ Certification](#) which is even more stringent than ENERGY STAR, with requirements for ENERGY STAR appliances, LED light bulbs, and even more efficient heating and cooling equipment. NEEM+ homes are built for the climate conditions of the Northwestern United States, and NEEM has partnered with over 85 utilities in the region to offer rebates on NEEM+ homes.⁴³ On average, these homes achieve 38 percent energy savings, worth \$620 in avoided utility bills annually.

Finally, other organizations have worked on customer awareness and engagement to encourage energy-efficient purchases and financing options up front. In 2011, Kentucky received funds under the Tennessee Valley Authority Clean Air Act Settlement, for the purpose of investing in energy projects that “reduce pollution, save energy and protect public health and the environment.”⁴⁴ One of the activities funded was a partnership between the Kentucky Housing Corporation with Next Step Kentucky, to provide rebates for the purchase and siting of new ENERGY STAR certified manufactured homes for low-income families. Uptake at the time was challenging, as manufactured home vendors were not eager to take on the role of hosting and

⁴¹ WRAL. “NC Offers Rebate on ENERGY STAR Manufactured Homes.” August 2011. <https://www.wral.com/news/local/story/9946980/>.

⁴² Interview with Russell Duncan, Energy Assurance Program Manager, North Carolina Department of Environmental Quality. August 3, 2020.

⁴³ Northwest Energy Efficient Manufactured Housing Program. “Why Choose ENERGY STAR.” <https://static1.squarespace.com/static/5b10a91989c172d4391ab016/t/5d56e3ffd1b997000154f594/1565975555345/NEEM-TriFold-r8.pdf>.

⁴⁴ U.S. Environmental Protection Agency. “TVA Clean Air Act Settlement.” April 14, 2011. <https://www.epa.gov/enforcement/tennessee-valley-authority-clean-air-act-settlement#mitigation>.

showing model homes for prospective buyers.⁴⁵ However, the program sparked enough interest for Next Step Kentucky to continue their focus on “building relationships between the factory-built housing industry, housing developers, affordable housing advocates, lenders and other key stakeholders to deliver factory-built homes.”⁴⁶ In 2016 Next Step began their SmartMH program in collaboration with Freddie Mac, which connects potential home-buyers to a network of lending institutions and retailers of ENERGY STAR certified manufactured homes. SmartMH also offers educational resources on the process of buying a home, credit-building, financial literacy, and manufactured housing options. In 2019, Next Step and Freddie Mac announced that they would expand this partnership to support residents of Texas and Arkansas.⁴⁷

Modular Homes

While manufactured homes and modular homes are both built in factories, the two housing types have significant differences. Modular homes have major sections built in factories that are assembled on-site, offering a market alternative to manufactured housing while adhering to and benefitting from local building codes. This on-site construction means that construction is more tailored to specific needs than fully prefabricated manufactured homes, but at slightly higher average up-front prices of \$50-80 per square foot for basic units.⁴⁸ However, by complying with local building codes up front, residents can save a great deal on their energy costs. By U.S. DOE estimates, the IECC Building Code updates from 2006 to 2012 only included efficiency measures that paid off in one to two years. In fact, that difference is so large between those codes, that homebuyers at the 2006 IECC code level are locking themselves in “to pay 50 percent more to heat, light, and cool their homes” than if they have met the 2012 code.⁴⁹ That difference was made by two updates to building codes and advances in supporting technologies. Thus, savings achieved from updating the 1994 HUD code could be much higher.

Several states and private firms have supported the development of affordable modular housing that is highly-energy efficient, or even net-zero energy due to on-site renewable production. The Vermont Energy Investment Corporation’s (VEIC) Zero Energy Modular Housing initiative has worked to advance the manufacturing and availability of affordable net-zero energy homes, with a group of partners including local builders, state policymakers, and community organizations. In 2018, the Addison County Community Trust completed a pilot project which redeveloped a defunct mobile home park into the McKnight Lane Development project. The final pilot hosts 14 single-family modular homes available for rent to low-income residents. All the homes are zero-net energy, with on-site solar production, as well as battery systems. Rural energy resiliency emerged as a major issue for Vermonters after Tropical Storm Irene knocked out electric service for much of the state in 2011. The project developers noted that generally, the economic case for adding storage is to encourage faster payback through “behind-the-meter” transactions, storing

⁴⁵ Correspondence with the Kentucky Office of Energy Policy. December 10, 2020.

⁴⁶ Next Step. “About Us” Accessed July 24, 2020. <<https://nextstepus.org/about/>>.

⁴⁷ Beck, Grant. “Next Step and Freddie Mac Expand Manufactured Housing Education and Counseling Program.” September 4, 2019. <<https://nextstepus.org/next-step-freddie-mac-expand-program/>>.

⁴⁸ Home Guide. “Average Modular Home Cost.” Accessed July 23, 2020. <<https://homeguide.com/costs/modular-home-prices>>.

⁴⁹ Environmental and Energy Study Institute. “The Value and Impact of Building Codes.” September 30, 2013. <<https://www.eesi.org/papers/view/the-value-and-impact-of-building-codes>>.

energy while prices are low and selling energy to the grid during peak hours.⁵⁰ However, they determined that “this economic case, which applies in many urban areas, is largely not transferable to rural areas,” as homes are more dispersed. Thus, “rather than relying on behind-the-meter charge management to make the economic case [for storage], the project was installed as a ‘virtual power plant’ with remote dispatch by the utility, Green Mountain Power, or use in reducing capacity and transmission costs.”⁵¹

In 2016, the Delaware Sustainable Energy Utility began a pilot program in collaboration with VEIC in order to develop Zero-Net Energy modular homes tailored to the local climate and building codes, and then install 25 homes over three years. The two firms partnered with local builders and the Milford Housing Development Corporation to operate the program.⁵² The result was the ZeMod Delaware program, not only offering low-cost homes, but homebuyer counseling, low-interest mortgages, and down payment assistance for eligible low-income buyers. The homes are zero-net energy with generation on-site, so buyers can expect to only pay \$30 monthly for energy needs as a utility connection fee.⁵³ An analysis by VEIC shows that when combining monthly energy bill savings with mortgage support, the ZeMod homes provides residents an additional cash flow of \$200-300 per month compared to a new manufactured home.⁵⁴

Finally, KB Homes is based in California and designed a modular home to support energy efficiency and water use concerns. Their Double ZeroHouse is designated by the U.S. DOE as a Zero Energy Ready Certified home, with on-site solar generation achieving higher production that exceeds the home’s energy use,⁵⁵ and home water recycling to use “zero fresh water.”⁵⁶ These homes are much larger than typical modular homes, over 2,500 square feet with five bedrooms.⁵⁷ While certifying the homes as Zero Energy Ready, the U.S. DOE calculated annual electric bill savings at \$2,700 compared to a typical new home. When factoring in water bills, KB Homes estimates annual savings at \$4,300 annually, or “over a 30-year mortgage...enough money to put your children through college.”⁵⁸

⁵⁰Donalds, Samantha, Sarah Galbraith, and Todd Olinsky-Paul. “Resilient Power Project Case Study: McKnight Lane Redevelopment Project.” Clean Energy Group and the Meridian Institute. June 2018. <<https://www.cleanegroup.org/wp-content/uploads/McKnight-Lane-Case-Study-June-2018.pdf>>.

⁵¹ *Id.* Page 6.

⁵² Delaware Sustainable Energy Utility. “Program Portfolio Operating Plan.” January 2017. <http://www.dnrec.delaware.gov/energy/information/otherinfo/Documents/EEAC/5-2017/DESEU%20Program%20Portfolio%20Operating%20Plan_Updated%205-2-2017.pdf>.

⁵³ ZeMod Delaware. “Why ZeMod: Affordable.” Accessed July 28, 2020. <<http://www.zemodelaware.com/why-zemod/affordable/>>.

⁵⁴ Vermont Energy Investment Corporation. “Market Analysis for Zero Net Energy Manufactured Home Replacements in Delaware.” January 2015. <<https://www.veic.org/Media/default/documents/resources/reports/veic-market-analysis-for-net-zero-manufactured-home-replacements-delaware.pdf>>.

⁵⁵ Zero Energy Project. “Zero Energy Ready Homes.” Accessed July 28, 2020. <<https://zeroenergyproject.org/buy/zero-energy-ready-homes/>>.

⁵⁶ Zero Energy Project. “Case Studies: KB Homes - Los Angeles, CA.” Accessed July 28, 2020. <<https://zeroenergyproject.org/case-studies/hanson-house/kb-homes/>>.

⁵⁷ While prices vary by features and the installation site, prices are around \$100 per square foot. [Urban Land Institute](#).

⁵⁸ Office of Energy Efficiency and Renewable Energy. “DOE Tour of Zero: Double ZeroHouse by KB Home.” U.S. Department of Energy. Accessed July 28, 2020. <<https://www.energy.gov/eere/buildings/doe-tour-zero-double-zerohouse-kb-home>>.

Conclusions

Energy efficiency in manufactured homes is a particularly difficult area for states to address: building standards are set by the Federal Government with no state standard option; residents tend to be low- and moderate-income and are often located in rural areas; and electric service is often provided by smaller, rural cooperatives with less capacity to undertake widespread efficiency programs. Still, many of these factors make manufactured homes perfect targets for state support. An older, inefficient housing stock means that there are greater opportunities for cost-effective efficiency projects. Rural low-income residents pay three times the national average for energy costs as a percentage of income, so there is a need for efficiency gains. Finally, many residents of manufactured homes receive state, federal, or utility financial support for their energy bills, so efficiency measures add greater benefits to taxpayers, rather than simply covering sustained high utility costs.

With such a great need for enhanced efficiency in this housing stock, states, the private sector, non-profits or community organizations, and the federal government have developed a number of supporting programs. States have successfully engaged partners, such as electric utilities or cooperatives to undertake efficiency programs in existing homes or incentivize more efficient new-home purchases. State Energy Offices and other state agencies overseeing WAP funds have leveraged those funds as well as LIHEAP programs to finance efficiency upgrades, as well as U.S. DOE and EPA resources to identify better building or retrofit practices. Community organizations and non-profits have worked to counsel new homebuyers to simplify the process, explain the benefits of energy-efficient purchases, help with financial support, and in some cases directly develop low-energy building developments. Finally, states and private firms are actively working to develop alternatives to manufactured housing, that retain the benefits of low up-front costs, while saving homeowners money for decades through efficiency gains which can drastically reduce utility bills, and in some cases eliminate energy bills and net energy use entirely.

Appendix: Available State-by-State Data on Manufactured Homes

State	Number of Manufactured Homes Produced (2019) ⁵⁹	Average Purchase Price of Single-Wide Home (2019) ⁶⁰
<i>National Average</i>	<i>2,045</i>	<i>\$53,200</i>
Alabama	4,546	\$51,100
Alaska	89	N/A
Arizona	2,402	\$54,600
Arkansas	1,565	\$53,100
California	3,890	\$54,600
Colorado	8,885	\$55,100
Connecticut	100	\$48,900
Delaware	345	\$52,100
Florida	7,819	\$52,800
Georgia	3,649	\$49,300
Hawaii	14	N/A
Idaho	553	\$47,700
Illinois	1,313	\$51,700
Indiana	2,180	\$54,200
Iowa	581	\$55,900
Kansas	860	\$53,300
Kentucky	2,792	\$51,100
Louisiana	4,360	\$53,500
Maine	635	\$83,200
Maryland	128	N/A
Massachusetts	190	N/A
Michigan	4,203	\$51,600
Minnesota	847	\$63,300
Mississippi	3,478	\$51,500
Missouri	1,291	\$55,400
Montana	314	\$107,500
Nebraska	261	\$56,900
Nevada	810	\$53,000
New Hampshire	394	\$61,600
New Jersey	596	\$55,300
New Mexico	1,406	\$49,800
New York	1,610	\$50,100
North Carolina	4,871	\$51,900
North Dakota	298	\$71,200
Ohio	1,828	\$54,900
Oklahoma	1,981	\$57,300
Oregon	1,566	\$48,800
Pennsylvania	1,862	\$54,500
Rhode Island	26	N/A
South Carolina	4,079	\$49,400
South Dakota	238	\$61,300
Tennessee	2,716	\$51,300
Texas	15,866	\$55,300
Utah	342	\$49,100
Vermont	144	\$59,800
Virginia	1,101	\$46,000
Washington	1,331	\$48,600
West Virginia	1,074	\$48,800
Wisconsin	657	\$53,700
Wyoming	143	N/A

⁵⁹ U.S. Census Bureau. “U.S. Manufactured Home Shipments by State: 2019.” Accessed March 2021.

<<https://www2.census.gov/programs-surveys/mhs/visualizations/2019/2019usmapbystate.pdf>>.

⁶⁰ U.S. Census Bureau. “Average Sales Price of New Manufactured Homes Places by Size of Home by State (2014-2019).” Accessed March 2021. <<https://www.census.gov/data/tables/time-series/econ/mhs/annual-data.html>>.