



TEN-YEAR PLAN

Reducing the Energy Burden in Oregon Affordable Housing



GOAL OF THE PLAN

Reduce the energy burden on the low-income population in Oregon, while prioritizing energy efficiency to achieve that reduction.

Acknowledgements

Leadership

Honorable Kate Brown, Governor of the State of Oregon

Built Environment Energy Working Group (BEEWG) Subcommittee 5(B) Members

Oregon Department of Energy (ODOE)

Ruchi Sathir, Associate Director, Strategic Engagement & Development

Warren Cook, Energy Efficiency & Conservation Manager

Blake Shelide, Facilities Engineer

Oregon Housing and Community Services (OHCS)

Dan Elliott, Senior Energy Policy Analyst

Mitchell Hannoosh, Research Analyst

Alexandra Buylova, Hatfield Fellow

Public Utility Commission of Oregon (PUC)

Elaine Prause, Deputy Utility Division Director

Energy Trust of Oregon

Jay Ward, Senior Community Relations Manager

Jake Cullen, Senior Project Manager, Planning

Peter Schaffer, Project Manager, Planning

Bonneville Power Administration (BPA)

Crystal Ball, Oregon Liaison, Intergovernmental Affairs

David Moody, Manager of Efficiency Programs

Prepared by:

Shelley Beaulieu, Senior Program Manager, TRC (consultant)

Alexandra Buylova, Hatfield Fellow, OHCS

Mitchell Hannoosh, Research Associate, OHCS

Peter Schaffer, Project Manager, Planning, Energy Trust

Introduction

On November 6, 2017, Governor Kate Brown signed Executive Order 17-20¹, which contains specific directives to State agencies to improve energy efficiency and support actions to reduce greenhouse gas emissions in the State of Oregon. One of these directives, Section 5(B), specifically addressed affordable housing.

5(B). Prioritizing Energy Efficiency in Affordable Housing to Reduce Utility Bills.

ODOE, PUC, and Oregon Housing and Community Services (OHCS) are directed to work together to assess energy use in all affordable housing stock and develop a ten-year plan for achieving maximum efficiency, as well as a continuum of efficiency levels up to maximum efficiency, in affordable housing across the state by January 1, 2019. As part of the assessment, the agencies shall consider new resources and best practices and shall seek assistance from Energy Trust of Oregon and Bonneville Power Administration. OHCS is directed to expand its existing multi-family energy program and green energy path requirements, including a manufactured home replacement program through pilot programs and initiatives, while considering multiple values from energy efficiency improvement, such as health and habitability.

This document serves to introduce and describe the affordable housing assessment that was developed in response to this directive, as well as to outline the ten-year plan to achieve maximum efficiency in affordable housing across the state.

The Executive Order also directed the development of the multi-agency Built Environment Efficiency Working Group (BEEWG) to implement the directives in the Executive Order. The information contained within this document was developed by the Executive Order 5(B) subcommittee of BEEWG. This subcommittee included members from Oregon Housing and Community Services (OHCS), the Oregon Public Utility Commission (OPUC), the Oregon Department of Energy (ODOE), the Energy Trust of Oregon, and Bonneville Power Administration (BPA).

This subcommittee recognized that while this version of the ten-year plan is vital to start the conversations required to achieve maximum efficiency in affordable housing, it is also important to design it to be a living document. Over the next ten years, markets and technology will evolve and adapt, and this document is designed to be updated as those changes occur. Additionally, there were gaps in available data identified during the creation of the affordable housing assessment, and it is this group's intention to update the plan as more data becomes available.

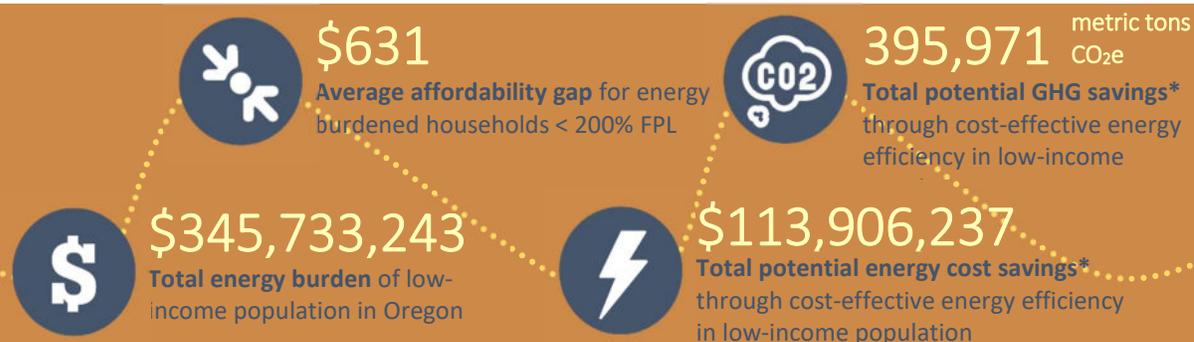
Executive Summary

The Executive Order directed the creation of two main deliverables associated with subsection 5(B) by January 1, 2019 – an affordable housing assessment and a ten-year plan. The affordable housing assessment has been published and is available online at http://bit.ly/OHCS_AHA. This map contains multiple layers of information that can be used to inform efforts in reducing the energy burden on the low-income population in Oregon. Examples of the types of information available include identification of the regions with the greatest need and those with the greatest gaps in existing resources.

This document serves as the second deliverable, the ten-year plan. The first section presents a set of definitions to help readers understand the language used in the plan. Next, it provides details about the development of the assessment, including known limitations and key findings. Lastly, the initial version of the ten-year plan is outlined, including the overarching goal of the plan, along with objectives, strategies, and tasks recommended to help guide the first steps toward achieving that goal.

The results of the assessment show that the energy affordability gap of low-income Oregonians is extensive – nearly \$350 million per year. Energy efficiency can significantly reduce that energy burden, and result in improved health of the occupants, habitability of their home, and significant greenhouse gas savings. However, while energy efficiency can alleviate a substantial portion of the energy burden, it cannot solve the energy burden problem alone.

Reducing the energy burden on the low-income population in Oregon is a huge undertaking; an undertaking that will require collaboration between multiple agencies, funding streams and stakeholders. This plan provides recommendations for the first steps that should be taken to orient the state toward a path to success. But, the success of this plan relies on persistent attention and follow-through from stakeholders involved at all levels.



** Potential savings in this paper can best be described as the annual savings potential available by the end of the ten-year period. Details can be found in the Potential Savings Primer section.*

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Section 1: Background

Definitions

Certain terms are defined in this section to assist in the understanding of the plan as these terms do not have universally accepted definitions. These definitions are subject to change in future revisions of the plan, as the market evolves and understanding of the market improves.

Affordable Housing

Often, affordable housing is used interchangeably with low-income housing. For this plan, these two terms have distinct definitions. The types of households included in these definitions include owner-occupied and renter-occupied units in single family, multifamily and manufactured homes.

Please note that certain special needs properties were not included in this assessment and the plan, including homeless shelters, group homes, transitional housing, assisted living facilities, residential care facilities, and on-farm housing.

Affordable housing is defined as housing that is affordable to the low-income household living in the unit. A unit is considered affordable if the housing expenditures are 30 percent or less of the household income. These housing expenditures include not only rent or mortgage payments, but also utility bills and, for home-owners, costs such as property taxes. For the initial version of the assessment and plan, the OHCS inventory of multifamily and manufactured homes represents the only known affordable housing in the State.

Low-income housing is defined as housing occupied by a household with income less than or equal to 80 percent of the area median income (AMI). Per this definition, 41 percent of Oregon households (~634,000 households) are considered low-income. In comparison, extremely-low-income households, per HUD's definition (households with incomes less than or equal to 30 percent of the AMI), account for about 14 ½ percent of Oregon households (~222,000 households)².

Energy Burden

Energy burden is defined as the percent of household income spent on energy bills.

Energy burden is a key component to determining if a housing unit is affordable. The most commonly used metric is that an affordable energy burden must be no higher than six percent of the household's income³.

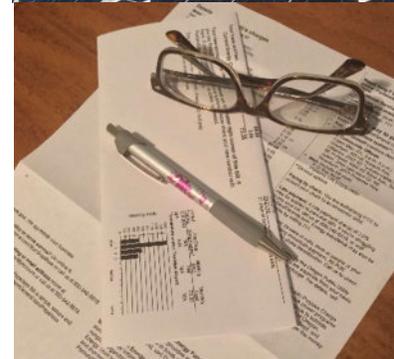
Energy affordability gap is the difference between a household’s actual energy costs and an “affordable” energy burden level equal to six percent of the household’s income.

It is well documented that the average energy burden of low-income households and of communities of color far exceeds the average energy burden on median-income households⁴. The census data shows that on a national average, low-income households have an energy burden three times higher than non-low-income households. This results in less money for these low-income households to spend on other essential needs, such as food, transportation and healthcare.

There are multiple methods available to reduce energy burden, each having advantages and drawbacks*. Executive Order 17-20 directed this plan to prioritize energy efficiency in reducing energy burden on low-income households, and therefore most of this plan focuses on that method. However, multiple options for consideration outside of this plan are outlined below.

Energy Efficiency

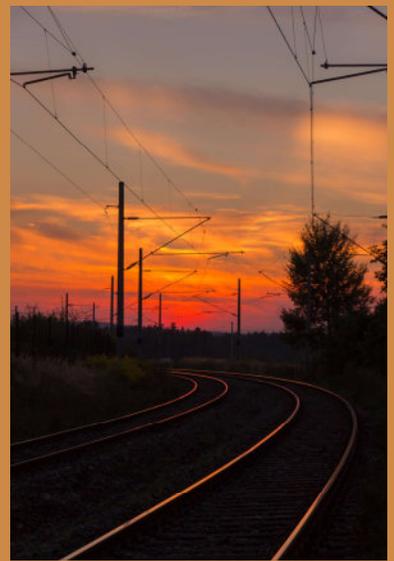
Energy efficiency reduces energy burden by reducing the amount of energy required to provide the same level of energy services (e.g., heating) to the home, thereby reducing the household’s energy bills. One of the main advantages of energy efficiency as a mechanism to reduce energy burden is that it results in persistent savings, and therefore persistent reduction in energy burden, while also providing non-energy benefits to the household, such as improved health, comfort and safety. It also increases the resiliency of the household to fluctuations in utility costs. Additionally, energy efficiency can reduce habitability issues in the unit and enhances long-term housing stability. Energy efficiency also results in reduced greenhouse gas emissions and increased health at a societal level.



**It is important to note that none of these methods are infallible. Each method, if not designed properly, could discourage energy conservation. It is possible these methods of reducing energy burden may result in an increase in energy use due to households being able to now afford to increase the comfort of their homes, for example being able to heat their homes to a more reasonable temperature during the winter.*

Transportation burden

This plan currently focuses on reducing the energy burden associated with housing-related energy use. However, transportation is the second-highest expenditure for households in the United States after housing expenditures, and, like the housing energy burden, low-income populations tend to have higher transportation energy burdens than the average household⁵. While not directly addressed elsewhere in this plan, it is recommended that accessibility of public transportation, electric vehicle charging stations, and proximity to employment opportunities and everyday services be considered when planning new affordable housing developments. Additionally, it is recommended that any new transportation infrastructure planning includes an analysis of how to better serve existing affordable housing developments to reduce the burden on those who can least afford it.



Energy Assistance

Energy assistance reduces energy burden by providing subsidies to assist low-income households in paying utility bills. The source of these subsidies are typically state, federal and utility dollars. One of the main advantages of energy assistance is that it can provide immediate, emergency assistance to low-income households. However, this mechanism does not result in persistent savings, as energy assistance is typically provided on an as-needed basis and requires reapplication for future assistance. It also does not result in improved health, comfort or safety of the household, or reductions in greenhouse gas emissions.

Renewable Energy

Renewable energy reduces energy burden by reducing the amount of energy the household must buy from the electrical grid. Like energy efficiency, renewable energy's advantages include persistent savings to the household and the societal benefit of greenhouse gas emission reduction. Depending on the technology, it also potentially has the added benefit of increasing the resiliency of the residence. However, it does not directly impact the household's health, comfort or safety, nor the habitability of the unit. It is also important to recognize that renewable energy, such as solar, is more expensive than energy efficiency. As such, it is generally accepted that when installing renewable energy systems, it is much more cost effective to first improve the energy efficiency of the unit.

Reduced Utility Rates

Reduced utility rates reduce energy burden by lowering the cost of energy for low-income households. For the State of Oregon, this would require a restructuring of utility rates to charge rates that reflect affordability barriers to low-income households. Other states have developed Percentage of Income Payment Programs or rate discount programs to address this

affordability gap, and there is currently a docket at the Oregon Public Utility Commission, UM 1787⁶, to investigate a Percentage of Income Payment Program in Oregon.

Reducing a low-income household's utility rate would have a profound effect on reducing their energy burden. However, it does not provide any of the additional benefits of health, comfort, safety, resiliency, or greenhouse gas emission reductions.

Maximum Efficiency

Per the Executive Order, this ten-year plan should focus on achieving “maximum efficiency, as well as a continuum of efficiency levels up to maximum efficiency in affordable housing”. The working group presents two options for defining maximum efficiency – the efficiency required to obtain technical achievable potential, or the efficiency required to obtain the cost-effective achievable potential, both defined below. More information on how these two options were quantified can be found in Appendix A: Potential Savings Methodology.

To put the savings potentials discussed below in context, the existing low-income annual consumption across Oregon was estimated using data from NEEA's Residential Building Stock Assessment (RBSA)⁷. This was done by first calculating the average annual electricity and gas use for the low-income Oregon building stock included in the RBSA using consumption data and case weights for individual units. Then the weighted average consumption per unit was multiplied by the number of low-income units in Oregon to approximate the electric and gas consumption of low-income housing across the State. This calculation, which serves only as a rough approximation of the low-income load across Oregon, results in an estimated 6.7 billion kWh of annual electricity use, and 350 million therms of annual natural gas of existing energy use. This analysis was done separately from the Potential Savings Methodology and did not influence the results of that study in any way.



Non-energy benefits

In addition to reducing energy usage in a home, energy efficiency upgrades can improve the health, safety, and finances of the occupants. Health benefits include improved indoor air quality, which among other things reduces the frequency of asthma attacks, and lowered risk of illness, due to the indoor spaces being warmer and drier. Energy efficient homes require less maintenance and are safer, with reduced carbon monoxide poisoning and fewer fires. Occupants benefit financially from reduced doctors' bills, fewer sick days from work, and lower water and energy bills. Energy efficiency upgrades can improve housing stability and are an opportunity to reduce some the barriers many low-income households, including communities of color, veterans and seniors, face in their daily lives.

Technical Achievable Potential

The *technical achievable potential* is the amount of energy use that efficiency can theoretically displace and is often referred to as maximum achievable potential. The technical achievable potential represents the sum of energy savings resulting from possible energy efficiency upgrades, including heating, cooling, appliances, weatherization, lighting, behavioral, and others measures that could theoretically be installed given the vintage, type, and condition of the unit. Technical achievable potential accounts for real-world barriers to convincing households to adopt efficiency measures irrespective of the cost of adopting those measures.

Cost-Effective Achievable Potential

The *cost-effective achievable potential* represents the same condition described above, but only includes savings from measures that are cost-effective. For this analysis, the cost-effective criteria used was a savings to investment ratio (SIR) greater than one.

Originally, a third option for defining “maximum efficiency” was suggested: the energy savings required to reduce the energy affordability gap of all low-income households in Oregon to zero dollars. However, based on the potential savings assessment performed, the energy savings that would be required to achieve a zero-energy affordability gap cannot be achieved using energy efficiency alone, at least not at this time. Emerging technologies, reduced utility rates, and other factors that evolve over time may make this possible in the future. As such, this definition may be considered in future versions of this plan.

Potential Savings Assessment

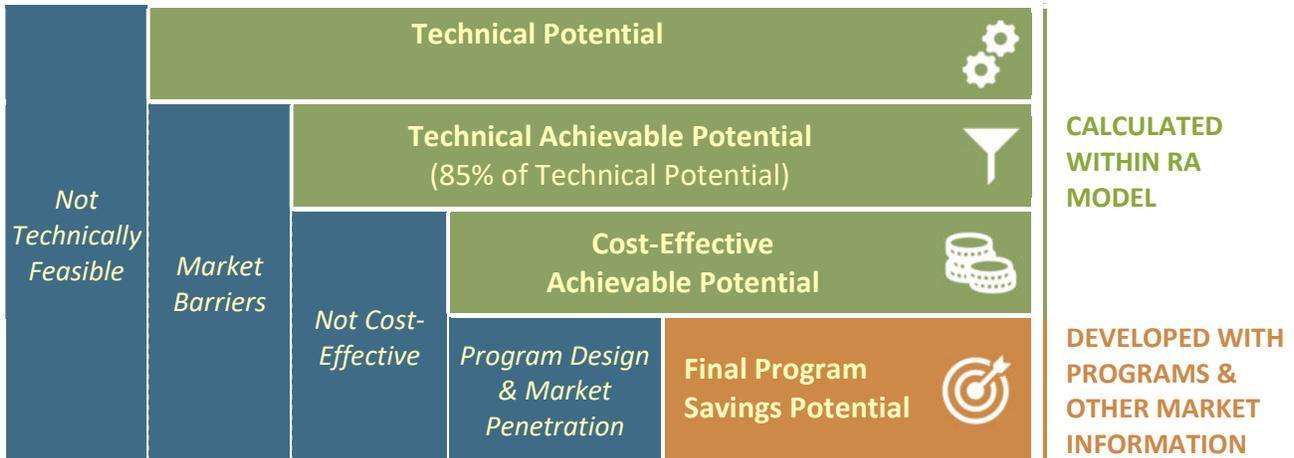
As part of the affordable housing assessment, the working group decided that it was important to determine the potential savings available from energy efficiency improvement in low-income households across Oregon. This information was seen as vital to understanding what the potential effect energy efficiency could have on reducing this population’s energy burden. Energy Trust volunteered to perform this analysis for the group, using their established methods, updated to reflect the low-income housing market. The following section provides an overview of that assessment, the sources of data used, the known limits to the data used, and a summary of the results. More detailed information on the methodology of this assessment can be found in Appendix A: Potential Savings Methodology.

Overview

Energy Trust, in conjunction with OHCS, developed a ten-year forecast for the working group’s assessment. This forecast was generated using Energy Trust’s Resource Assessment (RA) Model

to identify the total ten-year cost-effective modeled energy efficiency savings potential. There are four types of potential that are calculated to develop the final savings potential estimate, which are shown in Figure 1 and discussed in greater detail in Appendix A: Potential Savings Methodology. The fourth step, which requires program-specific details, was not completed for this initial version of the ten-year plan. Once specific programs are proposed to capture these savings, this step should be completed.

Figure 1 – Types of Potential Calculated in 10-year Forecast Determination



The RA Model utilizes the modeling platform Analytica^{®8}, an object-flow based modeling platform that is designed to visually show how different objects and parts of the model interrelate and flow throughout the modeling process. The model utilizes multidimensional tables and arrays to compute large, complex datasets in a relatively simple user interface.

Data sources

The data used in the RA Model for this plan replicated the data used by Energy Trust for their resource acquisition assessment modeling but were adjusted where deemed appropriate to better represent low-income households. The most impactful changes to this model are listed below.

- ◆ *Existing unit count.* The model was run twice for this plan: once to determine the potential savings associated with known affordable housing units and once for the potential savings associated with low-income housing units, which includes the entire known low-income population. The affordable housing unit count was taken from OHCS’s Oregon Affordable Housing Inventory (OAHI) unit counts for Oregon multifamily subsidized rental housing and OHCS’s manufactured home parks database. For the low-income housing unit count, DOE’s Low-Income Energy Affordability Data (LEAD) Tool, County Pacific 2015 dataset was used².

Household numbers and percentages in the LEAD dataset are based on ACS 2011-2015 5-year estimates. All units in structures with two or more units are included in the multifamily unit count.

- ◆ *New construction and demolition unit count.* For both versions of the model, the new construction unit count was based on the goal set by both the Governor’s Housing Policy Agenda⁹ and OHCS’s Statewide Housing Plan¹⁰ – 25,000 units to be created or preserved by 2023. As this plan covers ten years instead of five, it was assumed that 50,000 new units would be created or preserved during the scope of this plan. The average split between created and preserved units from the past ten years was used to estimate the split between created and preserved units for the 50,000 new units. Additionally, the Energy Trust model uses an assumption provided by the utilities to estimate the number of homes demolished each year. This assumption is equal to approximately 0.75 percent of the existing building stock per year.
- ◆ *Space heating and water heating fuel splits.* NEEA’s Residential Building Stock Assessment⁷ (RBSA) dataset was used to estimate the space heating and water heating fuel splits for each housing type separately. As discussed in the following Data Limits section, this dataset is based on all housing stock across the Pacific Northwest and is not specific to low-income building stock.
- ◆ *Climate zone splits.* NEEA’s RBSA dataset was used to estimate the percent of multi-family (MF), manufactured home (MH) and single-family (SF) units in each of Oregon’s two climate zones.
- ◆ *Baseline saturation rates.* The baseline saturation data used, which relies heavily on NEEA’s RBSA, were adjusted to reflect average saturation of the households that self-reported as qualified for subsidized energy bill assistance instead of the entire population. On average, the adjustments result in a two percent higher baseline saturation. Many measures have no adjustments as either there was an inadequate number of data points in RBSA to discern different baseline conditions, or there was no discernible difference between the subsidized and market rate datasets.

It is important to note that the potential savings calculated for multifamily units is limited to the in-unit savings and excludes all potential savings from the common areas, as the assessment focused specifically on the potential savings available to the low-income households themselves, not building owners.

Data Limits

The model was run with the best data available to the working group at the time of publication of this plan; however, the working group acknowledges that there were limitations to those datasets. A few of the more impactful limitations are listed below.

- ◆ *Space heating and water heating fuel splits by county.* Statewide averages of fuel splits were used in the current analyses. However, if county-by-county fuel splits were used instead, more accurate county-level potential savings by fuel type can be determined. This limitation results in county-level inaccuracies, such as likely overestimation of natural gas potential savings in counties that have limited access to natural gas, such as Harney County.
- ◆ *Fuel switching savings.* This analysis does not include any savings related to fuel switching measures (e.g., changing from gas to electric space heating). As the state continues to explore decarbonization, there may be interest in supporting fuel switching measures.
- ◆ *Non-energy benefits.* The model incorporates a limited number of non-energy benefits that are easily quantifiable such as cold-water savings from low-flow fixtures. However, there are other non-energy benefits that should also be accounted for in the cost-effectiveness calculations to accurately capture the true benefits of these energy efficiency upgrades.
- ◆ *Low-income housing stock assessment.* Many aspects of the current model are based on NEEA's RBSA. However, only two percent of the interviewees in the RBSA study were Oregonians eligible for energy bill assistance. It is unknown what the impact to the potential savings assessment would be if a larger number of low-income Oregon households were included in the study; however, the cost of performing an affordable housing-specific assessment similar to the RBSA would likely be expensive.

Results

The main output of this model was statewide savings, broken down by building type, and separated into technical achievable and cost-effective technical achievable savings. The model output data for both electric and gas measure savings. Additionally, it broke out savings by most impacted end use (e.g., heating or domestic hot water). The data was analyzed from many different angles to provide insight into the best opportunities for reducing energy burden through energy efficiency and the results of those analyses are summarized below.

Potential Savings Primer

It is important to understand what the potential savings values discussed in the tables below represent; however, it is not a simple answer. The answer is complex because the measures used to calculate potential savings are each assigned one of three different delivery methods,

and the time frame in which the savings can be achieved varies based on which delivery method is assumed. The potential savings results presented in this section can best be described as the annual potential savings available by the end of the ten-year period.

The three delivery methods are retrofit, replace on burnout, and new construction. The replace on burnout and new construction delivery methods assume that there is a specific window of time in which it is possible to capture the savings – either when the equipment fails or when a new construction project is built. Otherwise, the opportunity is lost until the measure fails again, which could be a significant amount of time. The model constrains the available stocks for each measure based on the measure life and turnover of stocks each year (i.e., a measure with a 15-year measure life has 1/15th of total stocks available each year rather than the full stocks like retrofit measures). Thus, measures that are delivered as a replace on burnout or as new construction have a ten-year total potential savings that is approximately* ten times larger than the potential savings of any given year within that ten-year period.

The retrofit delivery method assumes that the savings can be captured at any time and is not constrained to any specific event such as equipment failure. In theory, the ten-year potential savings for a retrofit could be achieved in one year; however, it is unrealistic to assume that a measure could be upgraded across all statewide building stock within such a short time period. Regardless, measures that are delivered as a retrofit have a ten-year total potential savings approximately* equivalent to the potential savings of any given year within that ten-year period.

Additionally, the model includes savings from emerging technologies. Savings from these emerging technologies are not included in the model until 2020 at the earliest, given the fact that they are still emerging and not yet market-ready. Therefore, none of the potential savings from these measures are available in year one. Depending on their assigned delivery method, their potential savings patterns follow the same as those listed above, starting on the year that they are predicted to be available for market deployment.

So, as mentioned above, the potential savings results presented in this section can best be described as the annual potential savings available by the end of the ten-year period. However, a large portion of that savings could be achieved in year one – in theory all the retrofit measures savings plus year one of the replace on burnout and new construction measures

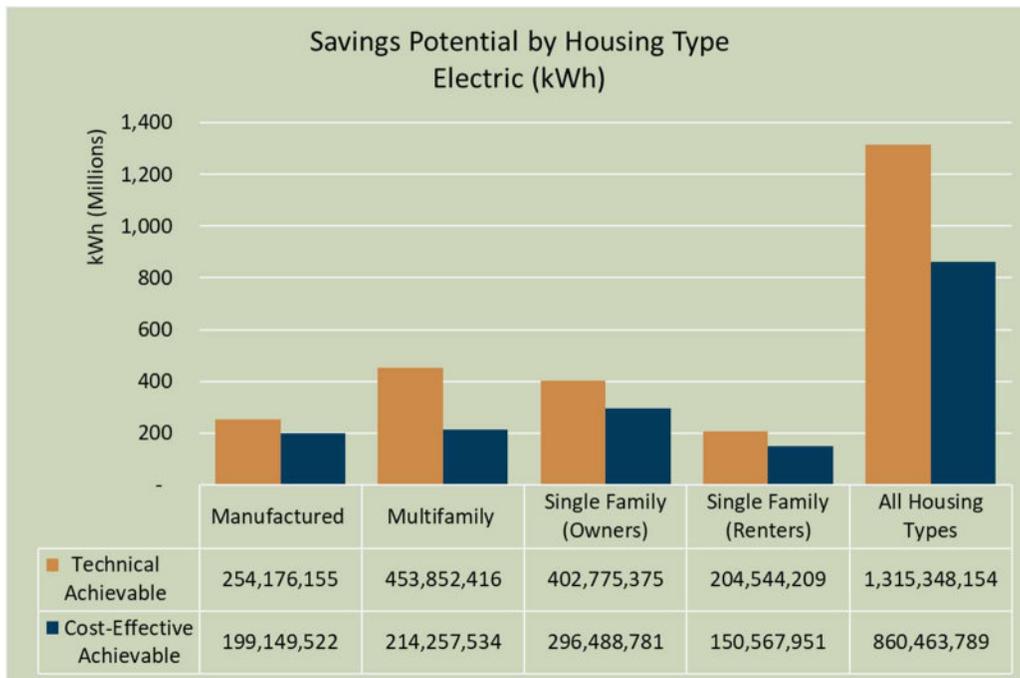
** Since the model includes assumptions on both building stock growth, from new construction, and building stock decline, from demolition, the year-to-year building stock numbers vary.*

savings. But, there is also a portion of the total potential savings that cannot be achieved in year one – the replace on burnout and new construction savings attributed to years two through ten. Looking at both the technical and cost-effective achievable potential savings of both electric and natural gas, approximately 60 percent of the savings are technically able to be achieved in year one of the plan.

One last important note is that all savings, regardless of delivery type, are expressed in first year annual savings. These savings can be expected to persist each year that the measure remains in operation.*

Electric Savings Results

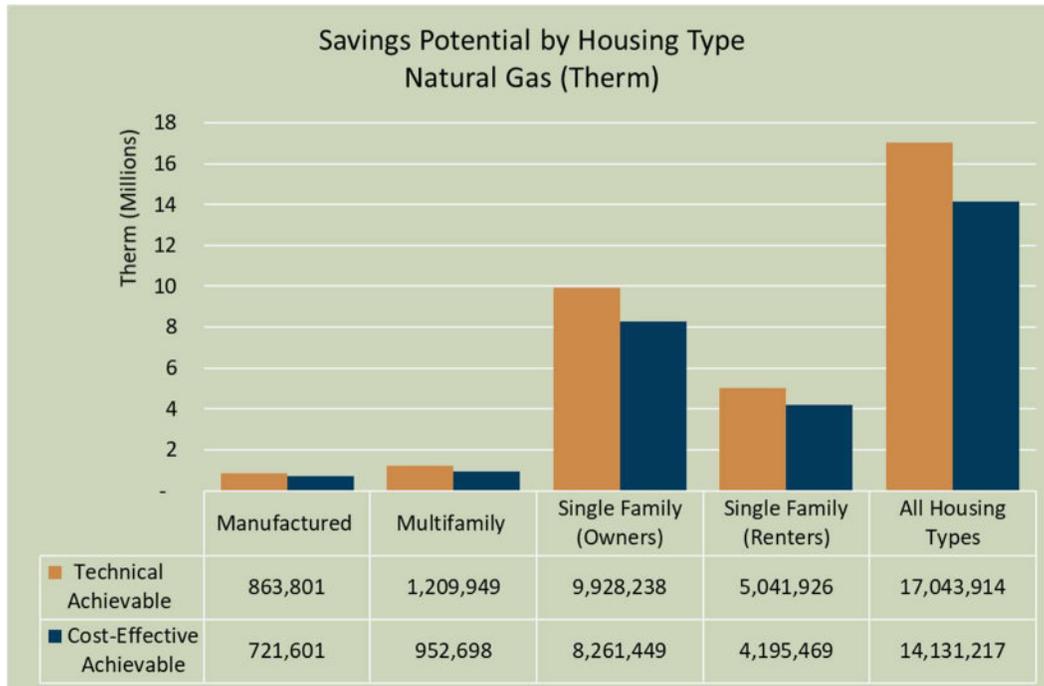
The following figure shows the electric potential savings calculated for the entire low-income population of Oregon. The results show that 65 percent of the technical achievable potential savings are also cost-effective across the total residential building stock. Multifamily has the lowest portion of cost-effective savings, with only 47 percent. So, while multifamily units across the state have higher technical achievable potential savings than owner-occupied single-family units, they have a lower amount of cost-effective achievable potential savings.



* The actual savings persistence after year one varies based on multiple factors, including changes to operating conditions, human behavior, degradation of the equipment's efficiency, early replacement of equipment, and, when looking at savings from a cost perspective, utility rates.

Natural Gas Savings Results

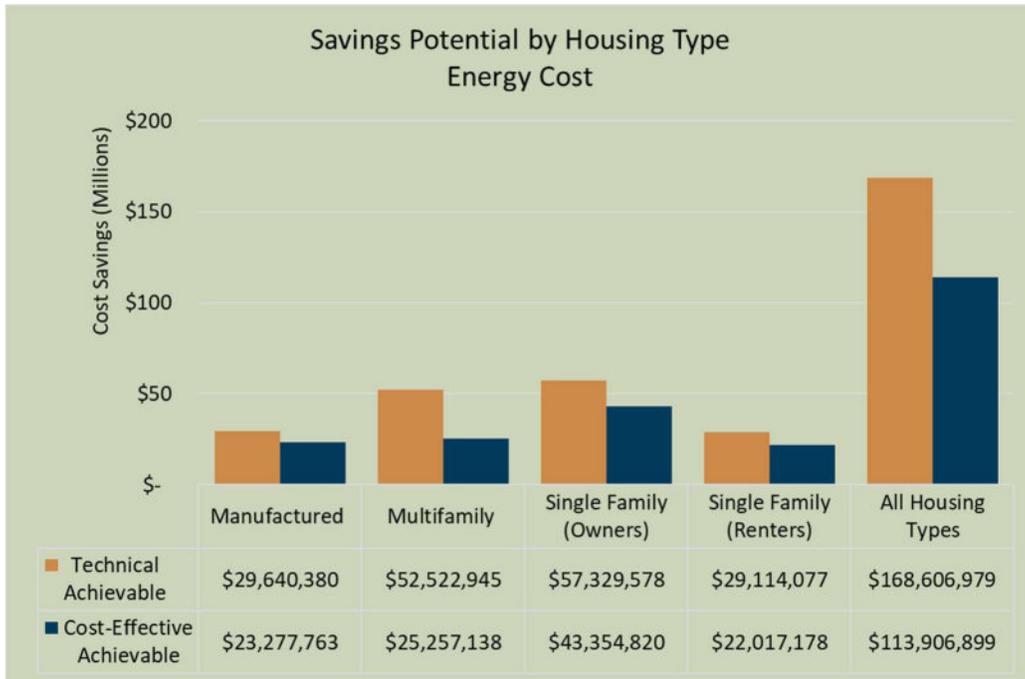
The following figure shows the natural gas potential savings calculated for the entire low-income population of Oregon. The results show that about 83 percent of the technical achievable potential savings are also cost-effective across all building types. The vast majority of savings available to the low-income population, 88 percent, are found in single-family homes.



Cost Savings Results

The results shown above were combined with average statewide utility rates to produce energy cost savings potential for the low-income population in Oregon. While the technical achievable potential savings is over \$165 million, once cost-effectiveness is factored, the potential savings drops to less than \$115 million. The results are shown below.

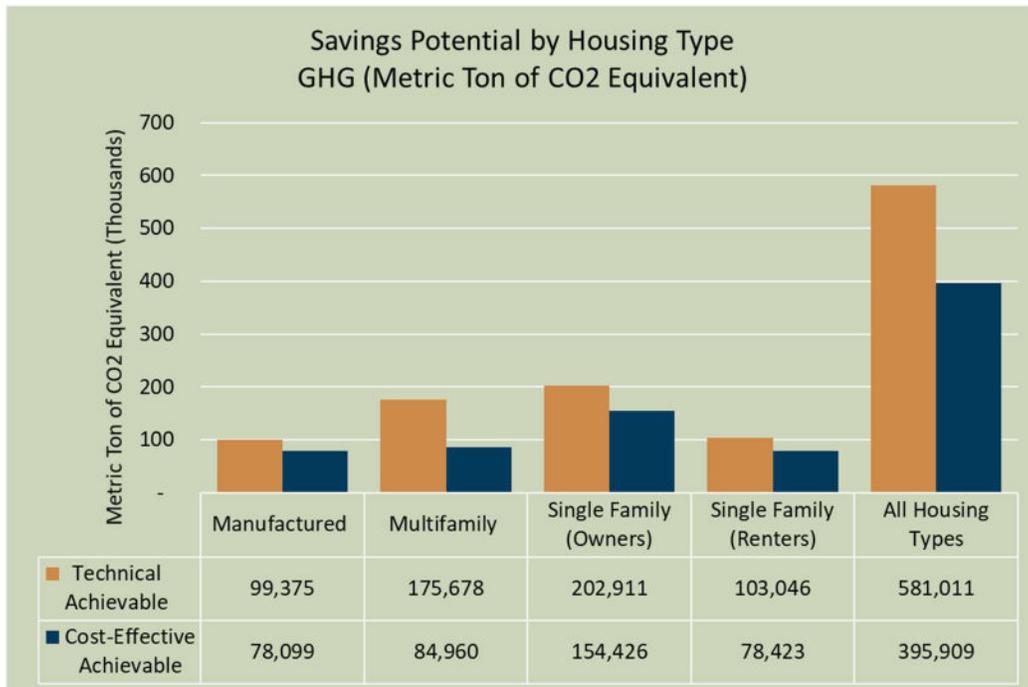
As previously discussed, a rough estimate of total annual energy consumption for the low-income population of Oregon was calculated to be able to get a general understanding of how much relative potential saving are available. The electric and gas savings were combined and converted to cost savings using state-average utility rates. Based on that estimate, and these results, the technical achievable potential savings represents a 14 percent savings over current energy cost; the cost-effective achievable potential savings represents about 10 percent of the current annual energy costs to the low-income population across the State.



Greenhouse Gas Savings Results

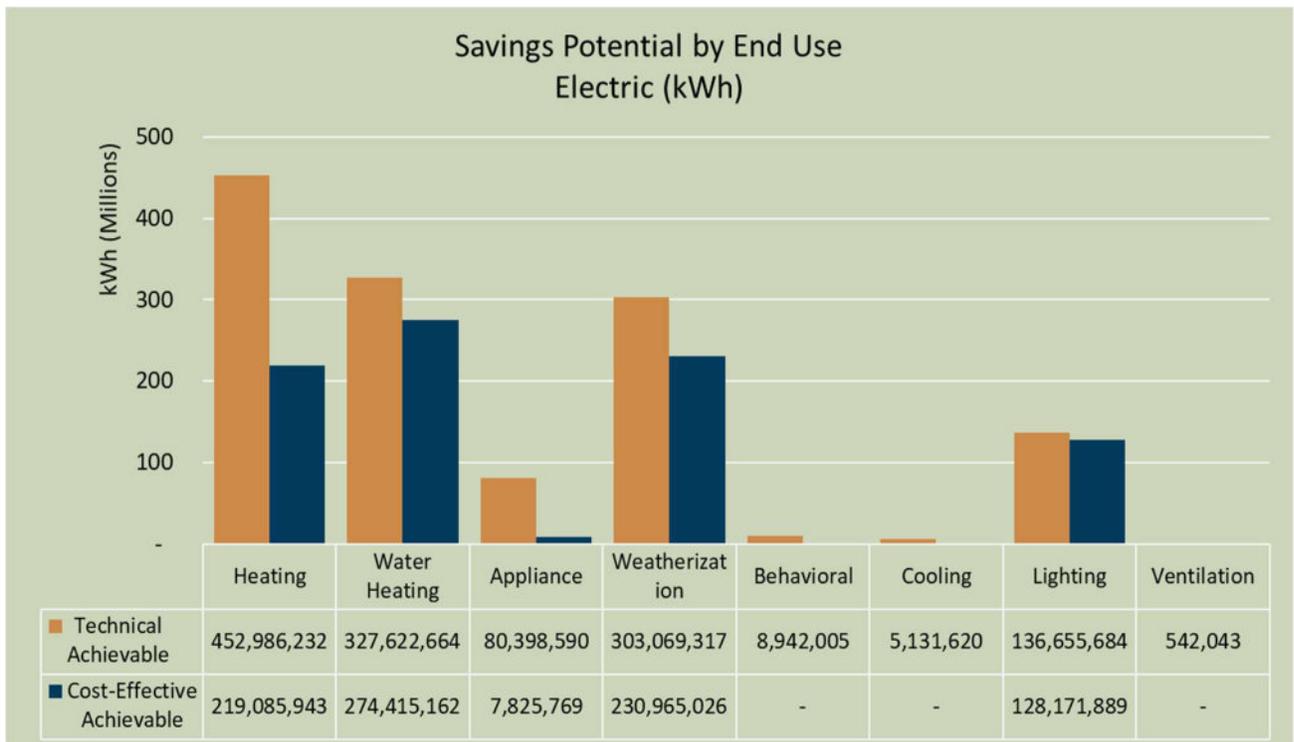
Similarly, the results of the potential savings model were combined with greenhouse gas emission factors for Oregon utilities* to produce potential savings of greenhouse gas emissions from performing energy efficiency in low-income households across Oregon. The results are shown below in metric tons of carbon dioxide equivalent avoided.

* The conversion factors used to convert electric savings to greenhouse gas savings were provided by the Oregon Department of Energy (ODOE). For all electric utilities other than Idaho Power, the conversion factors used were those developed by the utilities as part of the process of developing the Oregon Home Energy Score. Idaho Power’s conversion factor came from the Department of Environmental Quality’s Mandatory Reporting (DEQ’s MR) data. The statewide electric savings were first weighted based on the distribution of residential building stock among the utilities, and then converted to GHG savings using the utility-specific conversion factors.

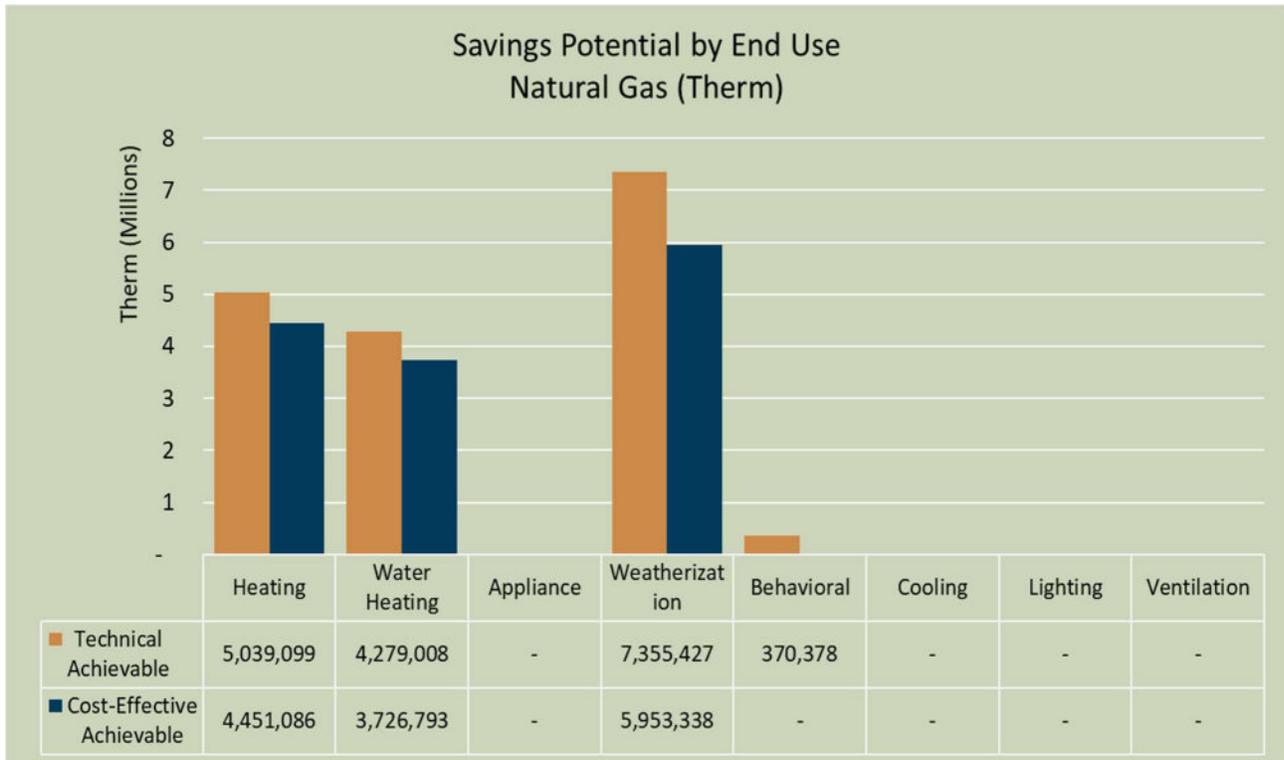


End Use Potential Savings

The potential savings outputs from the model were split up by most impacted end use for each modeled measure. There are two graphs shown below, one for electric savings and one for natural gas savings.



These graphs provide more detail into the type of energy efficiency measures that could significantly impact the low-income population’s energy burden.



Potential Savings by Measure

As mentioned previously, the total potential savings was calculated by summing measure-level savings. Therefore, another output of the model was measure-level savings for each building type.

Analyzing the natural gas savings measures, there was one measure that clearly stood out as having the highest cost-effective achievable potential savings – *smart thermostats* in homes with gas furnaces. This measure was cost-effective for all types of existing housing, including multifamily, manufactured housing and single-family. The total cost-effective achievable potential savings for this measure was about 3 million therms in savings. Other measures that showed natural gas cost-effective achievable potential savings greater than 1 million therms included two emerging technologies - gas absorption heat pump water heaters and high-performance insulation in exterior walls - and the conventional technologies of duct and air sealing.

A similar analysis of electric-saving measures resulted in several opportunities for significant cost-effective savings across all types of existing housing. The highest potential was shown to

be installing Tier 3 *heat pump water heaters* in all existing low-income housing, which had a potential savings of 144 million kWh. The second highest potential was found to be installing *smart thermostats* in units with electric furnaces or heat pumps. The cost-effective achievable potential savings across all building types for this measure was 98 million kWh. The third highest potential savings came from *replacing electric resistance heating* with residential split-system heat pumps, again in all types of housing. The potential savings for this measure was found to be 95 million kWh.

Lastly, for low-income new construction, there were two electric-savings measures that were found to be impactful. For new manufactured homes, building to meet the Northwest Energy Efficient Manufactured Home Program (*NEEM*) 2.0 *specification* had a cost-effective achievable potential savings of 11.2 million kWh. And for single-family homes, building to meet the *EPS™ Path 3 standard*¹¹, which requires the house be at least 25 percent better than code, was found to have a potential cost-effective savings of 38.6 million kWh.

Existing Housing

Natural Gas
Savings Measures



Smart
Thermostats

Cost Effective Savings:
3 million
therms

Electric
Savings Measures



Heat Pump
Water Heaters

Cost Effective Savings:
144 million
kWh



Smart
Thermostat

Cost Effective Savings:
98 million
kWh



Replace Electric
Resistance Heating

Cost Effective Savings:
95 million
kWh

New Construction

Electric
Savings Measures



Manufactured Home:
NEEM 2.0 Specification

Cost Effective Savings:
11.2 million
kWh



Single-Family Home:
EPS Path 3 Standard

Cost Effective Savings:
38.6 million
kWh

Section 2: Affordable Housing Assessment

Overview

The goal of the assessment was to identify the regions with the greatest need and to identify gaps in existing resources to inform efforts to reduce energy burden and achieve maximum efficiency in low-income and affordable housing in Oregon.

The assessment, available online at http://bit.ly/OHCS_AHA, is presented in an ArcGIS mapping platform that can be easily updated, appended, or adjusted in the future. A variety of metrics were chosen to help identify the needs of the low-income population and the gaps in assistance across the State. Data is presented in three types of resolutions: county-level, Community Action Agencies (CAAs) level and electric and natural gas utilities levels. The majority of the data is presented at the county-level as that is the finest level at which accurate information exists for the many of the metrics and having multiple layers of data at the same level allows for better comparison and analysis.

Data Presented

The Affordable Housing Assessment currently has fourteen layers of data, listed below. For more information about each layer or about the assessment methodology, refer to <https://go.usa.gov/xEamt>. Additionally, all sources of data are listed in Appendix D: Cited References as indicated.

Layer 1. Affordable housing inventory of multifamily properties

This layer displays all publicly-funded affordable multifamily rental housing properties in Oregon, defined as those properties that have received funding from any level of government that include units with income or rent restrictions. The properties in this inventory come from the following partners: Oregon Housing and Community Services, HUD, USDA, Metro, Network for Oregon Affordable Housing, all 20 of Oregon's Housing Authorities, and many county and city governments¹².

The pop-up window in this layer provides the following additional information for each property.

- ◆ Name of multifamily rental property
- ◆ Number of units within that property
- ◆ Housing type (e.g., rental housing)

Layer 2. Affordable housing inventory of manufactured home parks

This layer displays locations of all mobile/manufactured home parks registered with OHCS¹³. Red circles represent family parks, blue circles represent senior (55+) park communities, and green circles have no reported specialty population. The relative size of each circle indicates the number of total spaces within the park.

The pop-up window in this layer provides the following additional information for each park.

- ◆ Name of the manufactured home park
- ◆ Type of park (e.g., family)
- ◆ Number of spaces within the park

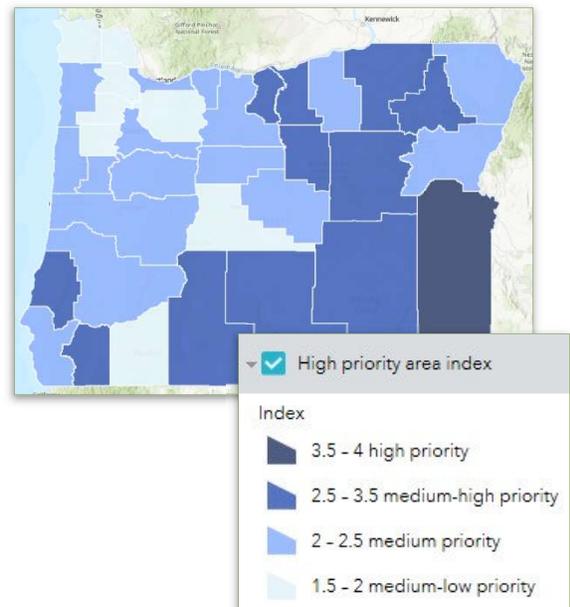
Layer 3. High priority area index

To more easily identify counties with the greatest energy burden, an index was created that encompasses high valued measures to understanding energy burden. The index included a measure of energy burden itself along with other factors that are known to drive energy burden⁴. These factors include affordability hardship due to low household income (economic driver); poor home energy efficiency due to older home vintage (physical driver); and housing inequity issues due to ethnicity/race (systemic driver). There are likely other factors that can lead to a household experiencing energy burden and identifying those factors should be explored for future revisions of this assessment and the ten-year plan.

The index was calculated by breaking down each measure's value into a low (score of 1) to high (score of 4) continuum based on the mean and standard deviation, and then averaging the scores of the four variables for each county. For more information about how this index was created, refer to <https://go.usa.gov/xEamt>.

The four variables used to develop this index for each county were:

- ◆ Percent of energy burdened households,
- ◆ Percent of low-income households,
- ◆ Percent of units built prior to 1990, and
- ◆ Percent of people of color.

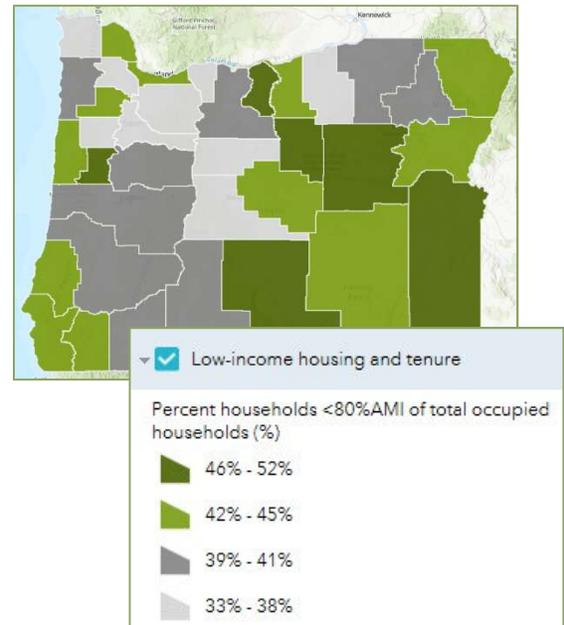


The pop-up window in this layer provides the four variables listed above, in addition to the county’s calculated index.

Layer 4: Low-income housing and tenure

This layer displays the percent of total occupied households per county that are low-income, based on this plan’s definition (i.e., households that earn <80% AMI)². The pop-up window in this layer provides the following additional information related to the number of low-income households by housing type, and the number of known affordable households by housing-type, by county.

- ◆ Total number of occupied households²
- ◆ Percent of occupied households that are low-income²
- ◆ Number of low-income, single-family, renter-occupied households^{2*}
- ◆ Number of low-income, single-family, owner-occupied households^{2*}
- ◆ Number of low-income multifamily households²
- ◆ Number of low-income manufactured homes households²
- ◆ Number of affordable multifamily units¹²
- ◆ Number of spaces within affordable manufactured home¹³



Layer 5: Energy affordability gap

This layer displays the average energy affordability gap, in dollars, for energy burdened households, by county. The energy affordability gap represents a dollar amount needed to bring energy burdened households to an “affordable” (6 percent of income) level of energy burden.

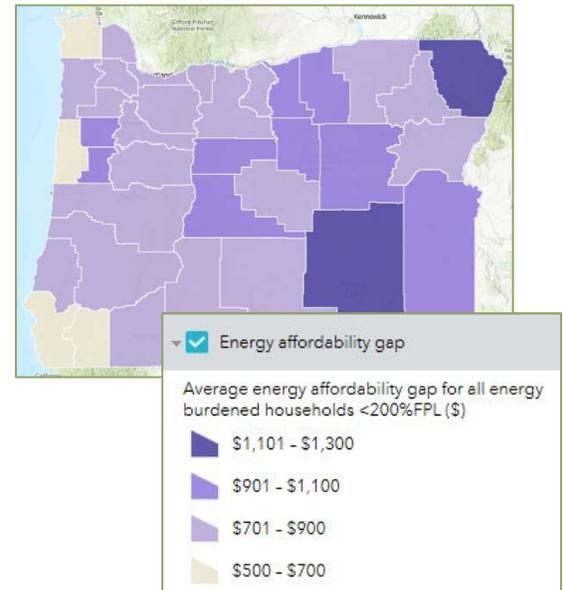
It is important to note that this dataset, which is based on the Fisher, Sheehan and Colton’s 2017 Home Energy Affordability Gap dataset¹⁴, is calculated for households <200% Federal Poverty Level (FPL), which does not align with this plan’s definition of low-income households

** Single-family households include “1 unit detached” only. Multifamily households include all categories with 2+ units. Manufactured households include those categorized as “other units”. The one-unit attached households were not included in this initial unit count. Including these units in future versions of the assessment should be considered.*

(<80% AMI). Therefore, this dataset includes the energy burden from a larger number of households than the low-income households displayed in Layer 4.

The pop-up window in this layer provides for the following additional information by county.

- ◆ Total energy affordability gap, in dollars
- ◆ Average energy affordability gap, in dollars, for all energy burdened households <200% FPL
- ◆ Average energy affordability gap, in dollars, for energy burdened households <100% FPL
- ◆ Average energy affordability gap, in dollars, for energy burdened households between 100%-150% FPL
- ◆ Average energy affordability gap, in dollars, for energy burdened households between 150%-200% FPL
- ◆ Percent energy burdened households of total occupied housing in a county



Layer 6: Home vintage and fuel type

This layer displays the percent of total housing units that were built before 1990 by county¹⁵.

The year 1990 was chosen as a proxy for the date when meaningful residential energy code first became law in the State.

The pop-up window for this layer provides the following additional information by county.

- ◆ Percent of pre-1990 housing of total housing units
- ◆ Percent of occupied households with electricity as primary fuel
- ◆ Percent of occupied households with utility gas as primary fuel
- ◆ Percent of occupied households with bottled, tank, or LP gas as primary fuel
- ◆ Percent of occupied households with fuel oil or kerosene as primary fuel
- ◆ Percent of occupied households with wood as primary fuel
- ◆ Percent of occupied households with solar as primary fuel
- ◆ Percent of occupied households with other as primary fuel

Layer 7. Ethnicity and race

This layer displays the percent of people of color by county¹⁶.

The pop-up window for this layer provides the following, more detailed ethnic and racial information by county.

- ◆ Percent Non-Hispanic White
- ◆ Percent People of Color

The people of color population is further delineated as follows.

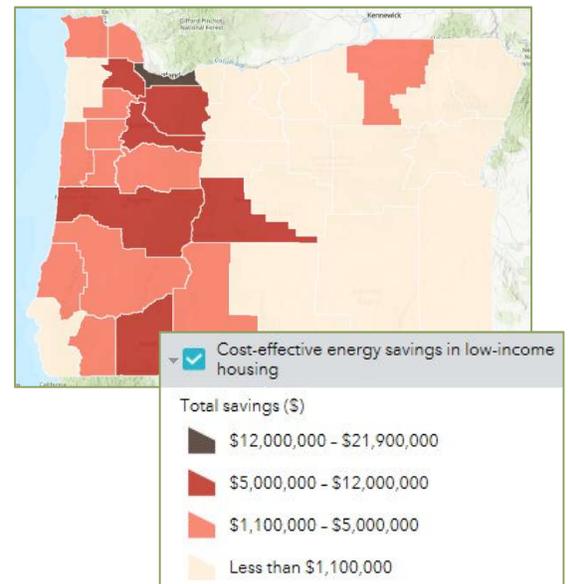
- ◆ Percent Hispanic or Latino
- ◆ Percent Non-Hispanic Black or African American
- ◆ Percent Non-Hispanic American Indian and Alaska Native
- ◆ Percent Non-Hispanic Asian
- ◆ Percent Non-Hispanic Native Hawaiian and other Pacific Islander
- ◆ Percent Non-Hispanic some other race
- ◆ Percent Non-Hispanic two or more races

Layer 8: Cost-effective energy savings in low-income housing

This layer displays the total cost-effective achievable potential energy savings in low-income housing by county. These potential savings were calculated by the Energy Trust of Oregon, using the Potential Savings Assessment discussed later in this section and again, in more detail, in Appendix A: Potential Savings Methodology. It is important to note that this assessment only evaluated savings opportunities for natural gas and electricity.

The pop-up window in this layer provides the following additional information on the cost-effective achievable potential savings in low-income housing for each county.

- ◆ Total energy savings, in dollars
- ◆ Total energy savings, in kWh
- ◆ Total energy savings, in therms
- ◆ Total energy savings, in CO₂e



Layer 9: Cost-effective energy savings in OHCS affordable housing

This layer displays the cost-effective achievable potential energy savings in affordable housing by county. This information was calculated using the same assessment as Layer 8 but was limited to affordable housing building stock – OHCS subsidized multifamily and manufactured homes – instead of all low-income buildings.

The pop-up window in this layer provides the following additional information on cost-effective achievable savings for each county.

- ◆ Total energy savings, in dollars
- ◆ Total energy savings, in kWh
- ◆ Total energy savings, in therms
- ◆ Total energy savings, in CO₂e

Layer 10: Federal and state energy assistance and weatherization programs (Community Action Agency (CAA) territories)

The layer shows Oregon's Community Action Agencies' (CAA) territories and total annual funding for Federal Fiscal Year (FFY) 2018 for weatherization and energy assistance programs by CAA. This information was provided by the internal Energy Section at OHCS. Assistance programs presented in this layer include:

- ◆ Low Income Home Energy Assistance Program (LIHEAP) weatherization and energy assistance programs
- ◆ U.S. Department of Energy Weatherization Assistance Program (DOE)
- ◆ Bonneville Power Administration Low Income Weatherization Program (BPA)
- ◆ State Home Oil Heating Program (SHOW)

The pop-up window for this layer provides the following information about the total funding for weatherization and energy assistance programs, in FFY 2018.

- ◆ Name of Community Action Agency
- ◆ Annual funding for each assistance program (Value of "0" refers to the absence of a particular program in a given CAA territory)
- ◆ CAA website and contact phone

Unlike most other layers in this map, this layer is not displayed by county. The reason for this discrepancy is that several of the CAAs cover multiple counties, and the information on energy assistance allocations by county was not available at the time of publication.

Layer 11-14: Existing Weatherization and Energy Assistance programs administered by electric and natural gas utilities

These layers show the average annual benefit allocated per household for utility-administered energy assistance and weatherization programs, based on the number of participating households in a given year. Because information was self-reported by the utilities, different

utilities provided information from different years; however, the majority of energy assistance and weatherization funding allocation presented here is for FFY 2018. Also note that for most utilities, the data provided was either the average household benefit or the total program funding, not both. As such, for most utilities, one of these two data points show “0” to signify that the data is not available at that level.

The pop-up window for this layer displays the following information for each utility.

- ◆ Utility name
- ◆ Utility rate
- ◆ Name of the assistance program
- ◆ Type of program (e.g., weatherization)
- ◆ Average annual household benefit in dollars, where available (value of “0” means data is not available at this level of detail)
- ◆ Annual funding level in dollars, where available (value of “0” means data is not available at this level of detail)

Utility territories that do not have either energy assistance or weatherization programs are not displayed on the map.

Data Limits

The assessment was created using the best data available to the working group at the time of publication of this plan; however, the working group acknowledges that there were limitations to those datasets. A few of the more impactful limitations are listed below.

Underserved Populations

Low-income households, along with those in communities of color and rural communities, frequently experience higher energy burdens than the average household and are disproportionately impacted by the effects of climate change⁴. These same populations are less able than others to cope with and respond to these changes. The Governor and multiple State agencies, including OHCS and ODOE, have recognized this issue and are actively working toward reducing these inequities through actions such as mandating the creation of this low-income assessment and ten-year plan. One example of the type of program that could be replicated to help these underserved populations is OHCS’s Local Innovation and Fast Track (LIFT) Rental Housing Program that was launched in 2017. The program’s primary goal is to create a large number of new affordable housing units for low-income Oregon families and to support historically underserved communities. While some preliminary steps have been taken to help these vulnerable communities, there is much more work to be done to do this issue justice. That work was not able to be completed prior to the initial release of this plan. It is highly recommended that an in-depth focus on this issue be one of the first steps performed after the release of this plan, and that this plan be amended in the near future to provide more information, insight, and recommendations on next steps.

- ◆ **Energy burden.** The dataset referenced is for households at or below 200% federal poverty level (FPL), which does not align with the census dataset nor the plan’s definition of low-income (less than 80% AMI). Ideally, the assessment would include energy burden for the same population as that represented in the other datasets.
- ◆ **Demographics.** The dataset used in the demographics layer is based on county-level census data, not specific to low-income households. It is essential to ensure that work done through this plan is done equitably and understanding the demographics of the low-income population across the State is key to doing that successfully.
- ◆ **Energy efficiency program funding.** The datasets used for layers 10-14 include the federal and state programs implemented through the CAAs or through the utilities, that are available only to low-income households. This dataset does not include funding currently provided to the low-income population from either Energy Trust of Oregon or Bonneville Power Administration (BPA) through their standard offer programs not specific to low-income households. It is known that the low-income population participates in these programs¹⁷, but the level of assistance is not included in this assessment.
- ◆ **Energy assistance/weatherization funding.** The datasets used for the utility energy assistance and weatherization programs tend to include either average benefit to households served or total annual funding of the program, but not both. Having complete data on these programs would improve the working group’s ability to understand what funding is currently being expended to help reduce the energy burden on Oregon’s low-income population.
- ◆ **Non-electric and natural gas energy.** This dataset only includes potential savings from electric and natural gas measures. It does not include potential savings from fuel oil, propane, wood or other fuels.

Results

The goal of the assessment was to identify the regions with the greatest need and to identify gaps in existing resources to inform efforts to reduce energy burden and achieve maximum efficiency in low-income and affordable housing in Oregon. The initial results from the assessment are discussed here.

Regions with Greatest Need

The high priority area index discussed above was developed to assist in addressing the first part of the goal – identifying the regions with the greatest need. The results of that analysis,

including the data used to determine the level of need, is presented in Appendix B: Affordable Housing Assessment Index by County.

The four variables used to calculate this index for each county were:

- ◆ Percent of energy burdened households,
- ◆ Percent of low-income households,
- ◆ Percent of units built prior to 1990, and
- ◆ Percent of people of color.

Based on this index, the regions of greatest need in Oregon tend to be the rural counties. If the average energy burden per low-income household is also factored into this need analysis, the Eastern Oregon rural counties again demonstrate the most need. Others have found similar trends across the country. The American Council for an Energy-Efficient Economy (ACEEE) recently published a report, “The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency”¹⁸ that found that the share of income rural households spend on energy is significantly higher than their non-rural counterparts’ expenditures. It is also important to note that rural households are more likely to use fuel oil or propane for heating. And, often, there is only limited funding available to provide energy efficiency services for these types of fuels, making it even more difficult to serve these rural households. An example case study of one of these high need rural counties, Malheur county, is shown below.

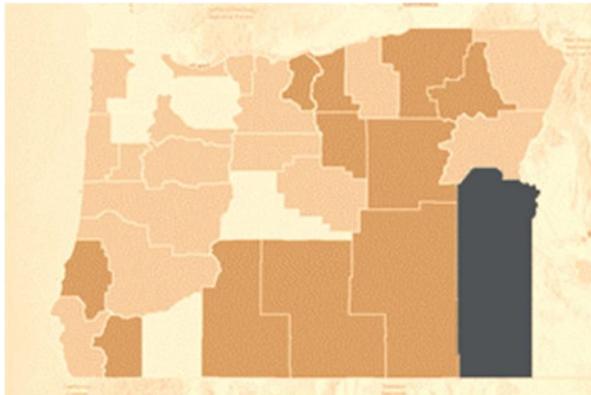
The information in the case study presented below can be used to justify funding for energy efficiency programs in Malheur County. In addition to the low-income population clearly needing assistance in reducing their energy burden, there is substantial savings to be had through energy efficiency that will not only reduce this burden and provide non-energy benefits to the occupants such as improved health, it will also provide substantial greenhouse gas reductions for the State. Once the fuel oil and propane potential savings can be determined, the potential greenhouse gas emissions reductions will increase even further, given the high carbon intensity of those fuels.

This high priority area index can also be used by OHCS to help target areas with the most need for future funding of projects.

Gaps in existing resources

The second goal of the assessment was to identify gaps in existing resources to inform future efforts to reduce energy burden. Unfortunately, the current information on existing resources

Case Study: Malheur County



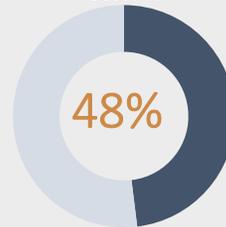
Malheur County

Malheur County scored the highest on the high priority area index, 4 out of 4. The following table provides summary statistics for Malheur County that are accessible through the assessment.

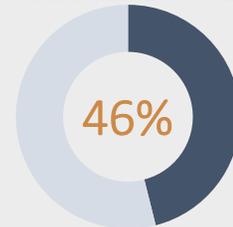
- Malheur’s percent of occupied households that are low-income (<80% AMI) is **48%**, one of the highest in the state.
- Malheur’s percent of energy burdened households <200% FPL is **46%**, meaning that almost half of all households are energy burdened.
- **78%** of housing units in Malheur are pre-1990, which means they were built to less rigorous energy efficiency standards.
- Malheur’s non-white population represents **37%** of the county, one of the highest in the State.
- Malheur’s total energy gap for households <200% FPL is **\$4,700,341**. This gap could be reduced significantly via energy efficiency improvements, by **\$1,031,913**.

High Priority Area Index

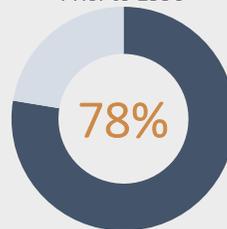
Low-income Households
<80% AMI



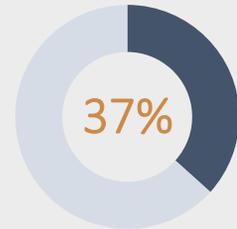
Energy Burdened
Households <200% FPL



Housing Units Built
Prior to 1990



Non-White Population



Energy Affordability Gap

\$993

Average gap for energy burdened households < 200% FPL



\$4,700,341

Total gap for energy burdened households < 200% FPL

Energy Savings Potential



\$1,031,913

Total dollar savings potential from energy efficiency improvements in low-income housing



7,882,790 kWh

Total electric energy savings in low-income housing



123,160 therms

Total gas energy savings in low-income housing

has some significant known gaps and, therefore, the current version of the assessment is not able to yet provide a complete picture. However, the assessment can assist in understanding the scale of the issue for many regions of the State.

For example, for Malheur County, one can evaluate the rough magnitude of existing energy assistance and weatherization programs using the current assessment and get a reasonable understanding of how those funds can contribute to reducing the known energy affordability gap in the county, which per the assessment is approximately **\$4,700,000**.

Malheur is served by the Community in Action (CINA), the community action agency that distributes Federal weatherization and bill assistance dollars to not only Malheur, but also Harney county. Unfortunately, there is no precise information on the split of funding between the two counties at this moment. Additional funding comes from the utilities that serve Malheur county, which include Idaho Power and Harney Electric Cooperative for electricity and Cascade Natural for natural gas. The utility funding is also divided between several counties based on where each utility operates, and again, no county-specific splits are available. The funding administered through CINA (for both Malheur and Harney) and through the utilities (for their entire service territories) equals about **\$1,386,000**.

So, assuming that all Federal and utility energy assistance and weatherization funding listed above went to only Malheur County to reduce the energy affordability gap, Malheur would still fall short by **\$3,314,000**. In addition, energy assistance programs include both bill assistance and weatherization assistance. While bill assistance can be directly applied to reduce energy affordability gap, weatherization makes an indirect contribution to reducing energy bill via improving energy efficiency of a home, and so the actual reduction of energy bills to the household is unknown based on funding amounts only.

While this data is incomplete, it does provide a very high-level overview of the available funding compared to the known energy affordability gap. And, based on that information, it seems clear that much more assistance is needed to reduce the energy burden for Malheur's low-income population.

Achieving maximum energy efficiency

The last part of the goal of this assessment was to understand the scale of maximum energy efficiency available to this population. The statewide potential savings calculated by the potential savings assessment performed by Energy Trust of Oregon was divided up into county-level savings in the affordable housing assessment. This provides information on the savings opportunities available for each county in Oregon and helps inform the best path to achieving

maximum energy efficiency statewide. While the greatest need is found in rural counties across the State, the greatest opportunities for cost effective large-scale savings are found in the urban areas of the State.

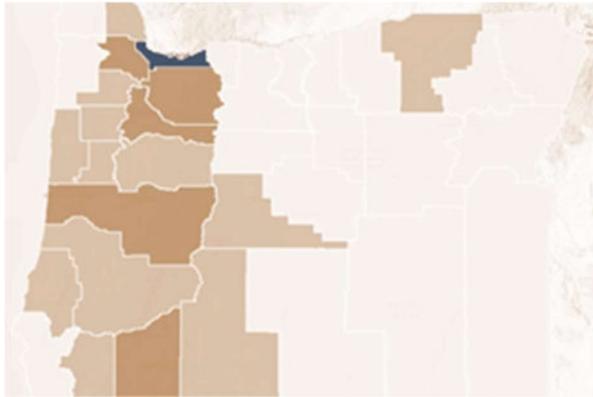
An example case study for Multnomah County is presented on the next page. The information in this case study can be used to help justify energy efficiency program funding in Multnomah County. There is huge potential savings in this county, where more than one in five low-income Oregon households live. More than three-quarters of the units in Multnomah were built prior to 1990, before any meaningful residential building code existed, meaning that there is a great opportunity for improvements not only for reducing energy burden, but also improving the habitability of the housing stock as well.

Portland's Clean Energy Bill

The citizens of the City of Portland recently approved ballot measure 26-201, which will place a tax on large retail corporations operating in Portland to help fund clean energy projects. This bill is focused on addressing the need to reduce greenhouse gases and increase energy efficiency in Portland, to help the city meet its Climate Action Plan. Eligible projects will promote energy efficiency, renewable energy, job training, food production and green infrastructure. There is priority given to any project that supports the low-income population or communities of color. This new bill is a huge opportunity to help fund the type of work discussed in this plan.



County Case Study: Multnomah County



Multnomah County

Multnomah County has the highest savings potential of the State, with over \$21 million of cost-effective energy efficiency savings achievable in low-income housing.

- Multnomah County houses **22%** of the total low-income population in Oregon.
- Almost **1/3** of all multifamily low-income households live in Multnomah.
- **76%** of housing units in Multnomah were built before 1990, which means they were built to less rigorous energy efficiency standards than a home built today.
- Multnomah's total energy gap for households <200% FPL is **\$57,927,455**. This gap could be reduced significantly via energy efficiency improvements, by **\$21,813,688**.
- Energy efficiency in residential low-income households in Multnomah could result in cost-effectively reducing the State's greenhouse gas emissions by **75,873 metric tons of CO₂e**.

Savings Potential

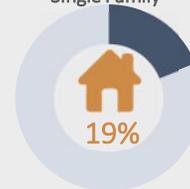
State Low Income Multifamily Housing



State Low Income Manufactured Housing



State Low Income Single Family



State Low Income Population



Housing units built prior to 1990

Energy Affordability Gap

\$718

Average gap for energy burdened households < 200% FPL



\$57,927,455

Total gap for energy burdened households < 200% FPL

Energy Savings Potential



\$21,813,688

Total dollar savings from energy efficiency in low-income housing



164,388,687 kWh

Total electric energy savings in low-income housing



2,757,634 therms

Total gas energy savings in low-income housing



75,873 metric tons CO₂e

Total GHG savings in low income housing

Section 3: The Ten-Year Plan

Based on the information produced in the Affordable Housing Assessment, the BEEWG 5(B) subcommittee established the following goal for this ten-year plan: *Reduce the energy burden on the low-income population in Oregon, while prioritizing energy efficiency to achieve that reduction.*

The working group has identified three main objectives to assist in achieving this goal.

- ◆ *Objective 1.* Increase our understanding of the current low-income housing market, including market demographics and market size, as well as our understanding of the opportunities and barriers for reducing energy burden in this market.
- ◆ *Objective 2.* Provide resources and best practices to low-income housing stakeholders to support their ability to reduce the energy burden on the low-income population in Oregon.
- ◆ *Objective 3.* Make recommendations for new programs, or updates to current programs, that would have a large impact on reducing the energy burden on low-income households.

This section presents the recommended strategies and initial tasks associated with each of these three objectives. As stated previously, it is anticipated that this plan will evolve and adapt over the next ten years. These objectives, strategies and tasks serve as a starting point for the conversations and actions that need to occur to successfully achieve significant reductions in energy burden for low-income households. The success of this plan entirely depends on persistent attention and follow-through from stakeholders involved at all levels.

Objective 1: Understand the market

The first objective to enabling our ability to decrease the energy burden on the low-income population is to increase our understanding of the current low-income housing market, including market demographics and market size, as well as our understanding of the opportunities and barriers for reducing energy burden in this market.

Strategy 1: Create a Task Force.

At this time, most of this plan has been based on the work of a limited group of experts from state agencies and program implementers. To truly understand the needs of low-income Oregonian households and the barriers and opportunities for reducing energy burden in these households, additional stakeholders need to be involved.

Task 1: Convene a Task Force comprised of key stakeholders to oversee the future development of this plan. The BEEWG recommends the creation of a Task Force to ensure the implementation of this ten-year plan. It is recommended that a list of key stakeholders be created, that should include, but not be limited to, the original BEEWG 5(B) subcommittee members, affordable housing advocates, local and state elected officials, Community Action Partnership of Oregon (CAPO), Oregon Citizens' Utility Board (CUB), Oregon Housing Alliance, utility representatives, and diversity, equity and inclusion (DEI) representatives such as the Coalition for Communities of Color (CCC).

Task 2: Once the Task Force is formed, hold a kick-off meeting to establish realistic goals and expectations for the Task Force. It is intended that one of the main goals of the Task Force be the creation of policy recommendations to inform the continued development and implementation of this plan in its entirety. As the Task Force meetings develop, establish clear roles and responsibility for individual members, and follow best practices for successful working groups.

The remainder of this plan includes recommendations of next steps for this Task Force to investigate and potentially implement once formalized.

Strategy 2: Upkeep of the affordable housing assessment.

The intent of the affordable housing assessment is to inform efforts in reducing the energy burden on the low-income population in Oregon. As such, it is vital to understand the limitations of this data, to improve the quality of the data, and to update this data as the market changes.

Task 1: Address known gaps and limitations in data. The affordable housing assessment in its current form includes the best data available to the team at the time of publication. However, as described in Section 2, there are known limitations and gaps in that data. The first step is to identify and address these limitations and gaps, as funding allows, to ensure that accurate information is being leveraged to properly inform the implementation of this plan. Examples of gaps and limitations that could be revisited are listed in Section 2, such as investigating the funding levels of all existing programs to increase our understanding of current statewide funding. Once better data is available, the data in the assessment should be updated.

It is highly recommended that the demographic data for low-income households be one of the first data quality issues addressed. The data currently used in the assessment is based on census-level county data, not specific to the low-income population. This data is vital to

understand how to equitably serve the yet-to-be-reached demographic groups such as communities of color.

Task 2. Revise potential savings assessments and affordable housing assessment when significant shifts in the market occur. Market changes that should trigger revision of these assessments include significant changes to fuel prices, improved cost-effectiveness of emerging technologies, introduction of new incentive programs, or successful implementation of other parts of the Executive Order 17-20, such as improvements to code.

Strategy 3: Identify and track key performance indicators (KPIs) to measure success of this plan.

Task 1. It is recommended that the Task Force select a list of key performance indicators (KPIs) to enable tracking progress toward the goal of this plan. Once the appropriate KPIs are selected, the group should then establish targets for those KPIs. Some KPIs worth considering include statewide energy affordability gap, percent of low-income households in affordable housing, savings achieved through energy efficiency programs, and percent of total savings achieved in communities of color.

Task 2. Establish a process and schedule for updating the identified KPIs and track progress towards their targets.

Objective 2: Support the market

The second objective is to provide resources and best practices to low-income housing stakeholders to support their ability to reduce the energy burden in the low-income populations that they serve.

Strategy 1: Create tools, including new resources and best practices, that address known barriers to reducing energy burden in low-income populations.

Task 1. Identify tools that can help low-income housing stakeholders overcome barriers and/or take advantage of opportunities in the market. As a first step in reducing the energy burden of the low-income population of Oregon, it is suggested that new tools be identified and created to help the entities that already exist and are already supporting the low-income market. Examples of these market actors include the community action agencies and organizations such as the members of the Affordable Housing Alliance. Anticipating this potential need, the BEEWG 5(B) subcommittee released a request for information questionnaire during the development of this initial plan, which in part sought feedback from the market on the usefulness of six concepts for tools that could be developed. The feedback was overwhelmingly positive for all six. They are listed below, with the concept that was

identified as potentially most useful listed first. This list serves only as an example of the types of tools that could be developed and should not be considered an exhaustive list of options.

- ◆ Updated utility allowance calculations that better recognize savings from efficiency projects
- ◆ Online tool that identifies incentive programs available by geographic area
- ◆ Document that outlines financing options for efficiency projects in low-income housing
- ◆ Toolkit (e.g. checklists, resource guides) that highlights best practices for implementing efficiency projects in low-income housing
- ◆ Assistance with benchmarking portfolios of buildings to identify priority projects to fund first
- ◆ Case studies of projects that have successfully reduced energy burden in low-income housing

Task 2. Create and make available the tools identified in Task 1 above.

Objective 3: Fund programs

The third objective is to make recommendations on new programs and updates to current programs that would have a large impact on reducing the energy burden on low-income households.

Strategy 1. OHCS to expand its existing Multifamily Energy Program and Green Energy Path requirements, including a manufactured home replacement program through pilot programs and initiatives, while considering multiple values from energy efficiency improvement, such as health and habitability.

This strategy is taken directly from the Executive Order and OHCS has already started work to address this directive.

Task 1. Expand the Multifamily Energy Program. The OHCS Low-income Weatherization Program (LIWP) has offered incentives for energy efficiency measures to eligible new construction and existing building projects since 2003. In 2016, OHCS solicited proposals from third parties to redesign and implement the program. The redesigned and renamed Oregon Multifamily Energy Program (OR-MEP), launched in January 2018 by the chosen third-party implementor, TRC. The main goals for the redesign of the program were to create an intuitive and efficient program model, promote financing and utility allowance options, and expand program reach and savings. As of November 2018, less than one year after the launch, OR-MEP has reserved incentives for over 1,800 units and has a pipeline of over 1,500 units in application or undergoing technical assistance. In the two years prior to the redesign, OHCS only completed

1,310 units. This doubling of units in 2018 is a result of new program offerings and services, including three flexible program participation pathways with scaling incentives, dedicated technical assistance, expansion of incentivized measures, trainings, and targeted marketing and outreach by program staff. Additionally, the program is set to deliver a workforce development strategy in 2019 to continue to support the needs of low-income multifamily projects in Oregon.

Task 2. Create a fuel-blind Multifamily Energy Program. Currently, Public Purpose Charges from Pacific Power and Portland General Electric fund the Oregon Multifamily Energy Program. Therefore, the program is only able to serve multifamily projects that are electrically heated within those utility service territories and is restricted to incentivize electric savings measures only. Additionally, no fuel switching measures can be incentivized through the program. With these restrictions the program is not able to serve the entire multifamily project, only energy efficiency measures associated with electric savings. Creating a fuel-blind source would allow the program to support more properties serving low-income Oregonians throughout the state and incentivize upgrades more holistically (including gas measures).

Task 3. Expand Green Energy Path options. OHCS offers funding for multifamily affordable housing projects in a competitive process called the Notice of Funding Availability (NOFA). One of the criteria to be eligible for most NOFAs is that the project must meet one of the Green Energy Path required pathways. Currently, there are four options to meet this requirement: Enterprise Green Communities compliance, Earth Advantage certification, LEED certification or the OHCS Green Building Path. Currently, there are two types of NOFAs, the 4% low-income housing tax credit (LIHTC) program and the Local Innovation and Fast Track (LIFT) Rental Housing Program, that do not require compliance with these Green Energy Paths.

With the most recent release of NOFAs, OHCS has updated these rules. Now all types of NOFAs, including the 4% LIHTC and the LIFT programs, must meet these Green Energy Path requirements. Additionally, the OHCS Green Building Path has been replaced with a self-directed path, that requires hiring a green consultant to help develop a green path appropriate for the individual project, potentially leveraging the energy audit within the project's Capital Needs Analysis (CNA). The green consultant must verify after construction completion that the scope of work was completed as promised.

OHCS has also added two new green modules to their NOFAs. In addition to the Green Energy Path, new construction and substantial rehabilitation projects must ensure the buildings are

solar-ready and electric vehicle (EV)-ready. These new requirements align with additional directives from Executive Order 17-20.

Task 4. Include a manufactured home replacement program through pilot programs and initiatives. Over the past several years, the percentage of weatherization dollars administered by OHCS directed toward retrofits of manufactured homes have been increasing – up to 80 percent of funds in one county alone. Many of the manufactured homes receiving weatherization upgrades were built before 1980, prior to any mandated construction code or energy standard, and typically use 70 percent more energy per square foot than a site-built home. These pre-1980 manufactured homes are past their useful life; energy efficiency work in these units is ineffective and expensive.

Acting on this information, OHCS recently launched an initiative that authorizes community action agencies that deliver weatherization services the ability to redirect weatherization funding using dollars for Pacific Power and Portland General Electric service territories to purchase replacements for pre-1980 manufactured homes in lieu of retrofit work. Community action agencies can invest up to \$20,000 per unit with this funding source, though other funding partners need to be secured and leveraged to afford the full cost of decommission and replacement of the units. These replacement manufactured homes are above-code, energy-efficient units. BPA has a similar offering when using weatherization dollars from consumer-owned utilities, allowing investment of up to \$7,500 per unit with this funding source.

Additionally, OHCS has partnered with Energy Trust of Oregon, as well as CASA of Oregon, NeighborWorks Umpqua, St. Vincent de Paul of Lane County, and regional Community Action Agencies, to design a pilot offering of up to \$15,000 per replacement of pre-1980 manufactured homes. This program has a goal of serving 20-40 units by the end of 2019. For more information on this please refer to Appendix C, Energy Trust’s marketing piece on this pilot.

OHCS has also proposed a collaborative program that seeks to develop a co-investment strategy, braiding together the funding sources discussed above, resulting in the commitment of \$5 million in funding to be used to replace 100 pre-1976 HUD Manufactured Homes across Oregon. The pilot will focus on OHCS’s existing portfolio of manufactured home communities, containing over 900 manufactured homes financed and preserved through state multifamily finance resources and weatherization programs. In addition to improving housing stability, the pilot may also improve health outcomes for the Oregonians trading in their old units for new manufactured homes. OHCS will partner with a local university to assess the impact of the

program on resident health. This pilot already has two locations participating: Oak Leaf Mobile Home Park in Portland and Umpqua Ranch Cooperative, Inc. in Roseburg.

Task 5. Account for multiple values from energy efficiency improvement, such as health and habitability. It is recommended that options on incorporating health and habitability benefits into OHCS's program be explored. Recent legislative concepts include a proposal the creation of a Healthy Homes Program to research housing health hazards and to provide funds for organizations addressing health hazards. This proposal also suggests the establishment of the Homeownership Repair and Rehabilitation Program to provide grants to nonprofits providing financial assistance to low-income households to increase the habitability of their homes. Both programs are suggested to be implemented through OHCS.

Strategy 2. Consider reviewing the current barriers to integrating various funding sources and pursue program design modifications, where appropriate, to enable combining program efforts to achieve additional savings benefits. Currently, Energy Trust is limited in its ability to serve low-income households in various ways, which results in limiting the State's ability to fund energy efficiency for low-income households. There are several options to consider to expand Energy Trust's ability to assist in reducing the energy burden on low-income households.

Task 1. Address attribution, program requirements, and data sharing issues that may prevent Energy Trust and OHCS/CAA weatherization funding from being combined efficiently and effectively to fund measures in low-income households. Addressing these barriers to providing combined funding in these projects would allow existing funds to go further.

Strategy 3. Address gaps in available incentive programs.

Based on the information provided by the affordable housing assessment, the Task Force should identify the most cost-effective, impactful opportunities to significantly reduce the energy burden on low-income households. These opportunities could focus on a specific end use (e.g., hot water heating), measure type (e.g., heat pump retrofits), geography, utility service area or building type. Once identified, these program suggestions should be proposed to utilities, local governments, state agencies and other funding sources, as appropriate. Some examples of potential programs are presented here.

Task 1. Design a statewide smart thermostat program. As discussed in the results section of the Potential Savings Assessment, the measure with the most potential savings statewide is installation of smart thermostats. This measure was shown to be the largest natural gas savings measure when installed in units currently heated by standard, non-modulating natural gas

furnaces, and the second largest electric savings measure when installed in units currently heated by electric resistance forced air furnaces and standard, non-inverter heat pumps. (Note: smart thermostats may not pair well with inverter driven heat pumps, as the algorithms for the heat pump control and those in the thermostat may not be compatible.)

Smart thermostats allow you to program a heating and cooling schedule, like a programmable thermostat. But, smart thermostats have additional functionalities including monitoring how the heating and cooling systems are functioning in the unit and reporting back when problems are detected (e.g., the filter needs to be changed, or you need to contact a heating contractor to service your equipment). They also can be controlled by smartphones, they can sense when the house is unoccupied and set-back the temperature set points, and some smart thermostats can learn the occupant's schedule and fine-tune the schedule to optimize energy efficiency. Compared to programmable thermostats, smart thermostats allow maximizing the use of "away time" setbacks, resulting in more reliable savings. In addition, better control of electric strip backup heat in traditional heat pumps can be found when smart thermostats are combined with proper setting of lockout controls. It is recommended that if this program be pursued, that the household receive a best practices document with the new thermostat that explains how to use it to maximize energy savings for their type of heating system.

Smart thermostats have significant statewide potential savings on their own, but they can also provide information that could be used to perform additional, targeted weatherization services in the homes that would benefit most. Smart thermostat-driven weatherization can ensure that traditional electric weatherization measures are only applied to homes with either high use, fast cool down periods, long heating cycles, or that show near real time impact of windy weather. While no specific savings numbers yet exist, several manufacturers and energy efficiency experts are working on the algorithms and projections for how to maximize this data.

The potential savings number below is based on the smart thermostat installation alone. They do not include potential future savings from additional targeted work.

- ◆ Potential energy savings from program: 3 million therms and 98 million kWh annually*

** As smart thermostats are assumed to be delivered as a retrofit in the Potential Savings Assessment, these annual savings technically can be achieved in year one, or any year after. The feasibility of performing the required number of retrofits to achieve that total savings in one year, however, is improbable.*

- ◆ Potential dollar savings from program: \$14.7 million annually, or \$161 million over the life of the thermostats
- ◆ Potential greenhouse gas (GHG) emissions avoided from program: 52,600 metric tons CO₂e annually
- ◆ Estimated cost of program: \$82 million*

Task 2. Design a statewide water heating program. Per the Potential Savings Assessment, the biggest cost-effective opportunity for multifamily units is electric water heating savings. Specifically, the measures identified in the assessment were retrofitting existing electric resistance water heaters with Tier 3 heat pump water heaters, low-flow showerheads (1.5 gpm), kitchen faucet aerators (1.0 gpm) and bathroom faucet aerators (0.5 gpm).

Heat pump water heaters use electricity to move heat from one place to another instead of generating heat directly. Therefore, they can be two to three times more energy efficient than conventional electric resistance water heaters. To move the heat, heat pumps work like a refrigerator in reverse. In the past, there have been concerns about the true efficiency of heat pump water heaters as they use heat from the air around them to heat the water. But, studies over the past few years have shown that even in scenarios with negative space-heat interaction, the heat pump can still provide almost twice the net efficiency when applied to the whole house.

Note: A program such as this seems like an excellent option in Portland, given the recent approval of Portland’s Clean Energy bill, which seeks to fund projects that “benefit low income individuals and that broaden access to energy efficiency and clean renewable energy infrastructure to low income communities and communities of color.”

- ◆ Potential energy savings from program: 204 million kWh annually^{†‡}
- ◆ Potential dollar savings from program: \$23 million annually, or \$311 million over the life of the measures
- ◆ Potential GHG emissions avoided from program: 76,000 metric tons CO₂e annually

* Cost of the program were calculated assuming that non-measure costs (e.g., administrative, implementation, marketing) would equal approximately 20% of the measure cost.

† As water heaters are assumed to be delivered as a replace on burnout in the Potential Savings Assessment, these total savings represent the annual savings that can be obtained by the end of the ten-year plan. The average savings achievable each year would be approximately 1/10 of the values shown here.

‡ The low-flow fixtures carry no measure cost, as the Potential Savings Assessment model captures water savings, and that water savings alone more than offsets the upfront costs of the fixtures.

- ◆ Estimated cost of program: \$146 million*

Task 3. Design a new construction program for Southeastern Oregon. Comparing the low-income population to affordable housing units for each county across the State, it appears that there is a need for more affordable housing in Southeastern Oregon. One of the priorities of the 2018 Oregon’s Statewide Housing Plan is to “unlock opportunities for housing development” in rural communities. This potential program could help ensure that the housing developments in these rural communities are energy efficient and leverage cost-effective existing standards.

For single family homes, the potential savings assessment identified EPS™ Path 3 standards¹¹ as the most cost-effective opportunity for new construction. Through a combination of improved envelopes, measures such as inverter heat pumps, heat pump water heaters, and smart controls, this EPS standard can cost-effectively deliver homes that are 40 percent more efficient than current codes. It can also deliver homes that are future code ready or convertible to Net Zero Energy with the addition of renewables. In addition, these same technologies often make these homes more grid flexible and provide non-wire alternatives to grid modernization through future demand response and distributed energy programs, which could provide additional savings to the occupants in the future as utility rate structures evolve.

For manufactured homes, the assessment identified the NEEM 2.0 standard, also known as ENERGY STAR with NEEM+ certification, as the most cost-effective opportunity for new construction. Traditional manufactured homes do not follow standard state or international energy codes, but instead use an antiquated system designed to allow for inexpensive design and construction. The NEEM program has found cost-effective ways to achieve large savings by requiring more efficient envelopes and high-performance systems in these homes.

- ◆ Potential energy savings from program: 1.4 million kWh annually*
- ◆ Potential dollar savings from program: \$0.2 million annually, or \$6.7 million over the life of the housing units
- ◆ Potential GHG emissions avoided from program: 537 metric tons CO₂e annually
- ◆ Estimated cost of program: \$1.9 million[†]

* As these are new construction measures, these total savings represent the annual savings that can be obtained by the end of the ten-year plan. The average savings achievable each year would equal approximately 1/10 of the values shown here.

[†] Cost of the program were calculated assuming that non-measure costs (e.g., administrative, implementation, marketing) would equal approximately 20% of the measure cost.

Appendix A: Potential Savings Methodology

Energy Trust's ten-year forecast for energy efficiency savings follows six overarching steps from initial calculations to deployed energy savings, as shown in Figure 2. The first five steps in the varying shades of blue nodes - Data Collection and Measure Characterization to Cost-Effective Achievable Potential - are calculated within Energy Trust's RA Model. This results in the total cost-effective potential that is achievable over the ten-year forecast.

The actual deployment of these savings (the acquisition percentage of the total potential each year, represented in the green node of the flow chart) is done exogenously of the RA model. The remainder of this section provides further detail on each of the steps shown below.

Step 1 - Data Collection and Measure Characterization

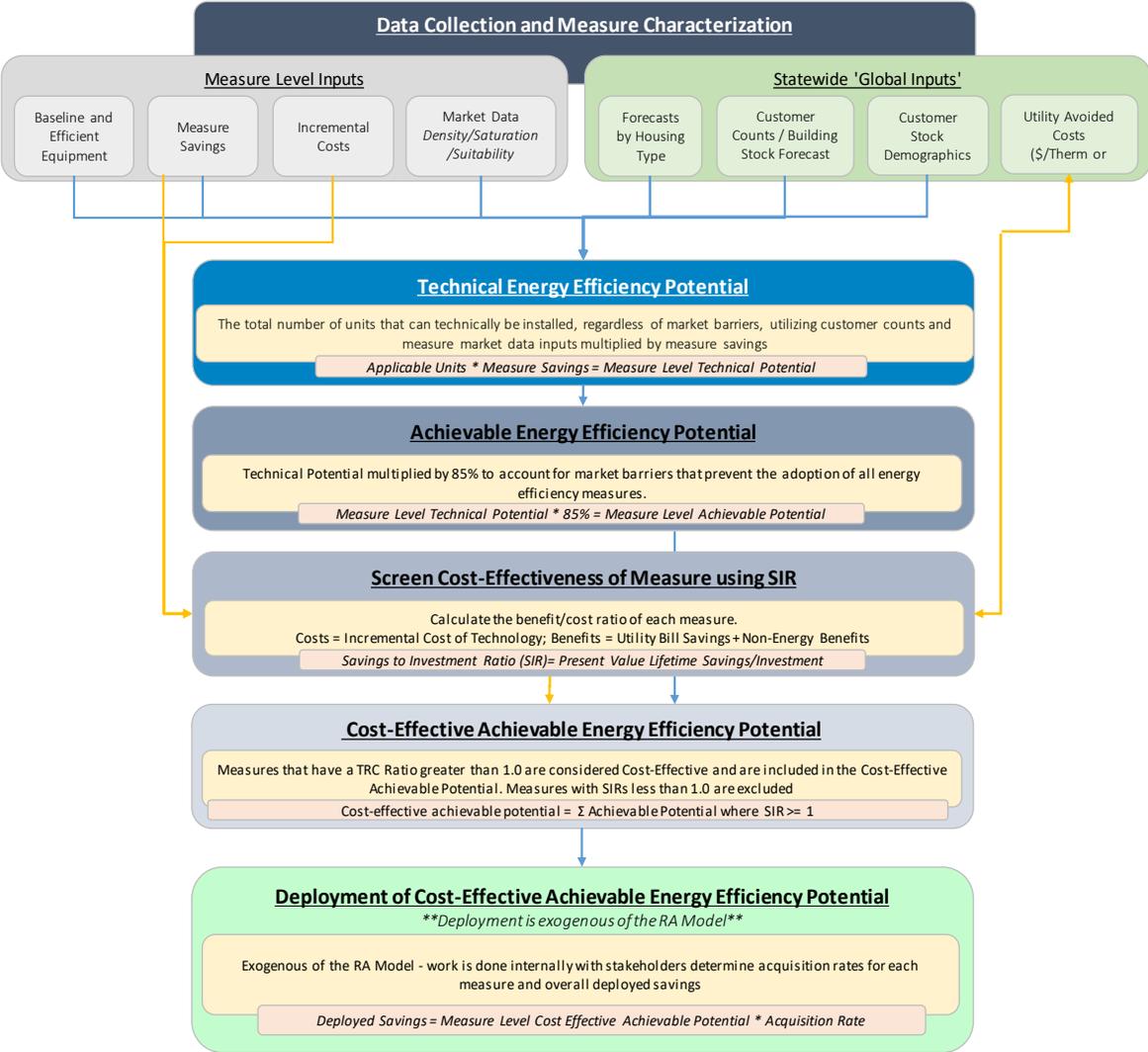
The first step of the modeling process is to identify and characterize a list of measures to include in the model, as well as receive and format statewide "global" inputs for use in the model. Energy Trust compiles a list of commercially available and emerging technology measures for residential applications installed in new or existing structures. The list of measures is meant to reflect the full suite of measures offered by Energy Trust and others, plus a spectrum of emerging technologies.* Simultaneous to this effort, Energy Trust collects necessary data from OHCS and governmental agencies to run the model and scale the measure-level savings to a given service territory (known as "global inputs").

◆ **Measure-Level Inputs:**

Once the measures to include in the model have been identified, they must be characterized to determine their savings potential and cost-effectiveness. The characterization inputs are determined through a combination of Energy Trust primary data

** An emerging technology is defined as technology that is not yet commercially available but is in some stage of development with a reasonable chance of becoming commercially available within a ten-year timeframe. The model is capable of quantifying costs, potential, and risks associated with uncertain, but high-saving emerging technology measures. The savings from emerging technology measures are reduced by a risk-adjustment factor based on what stage of development the technology is in. The working concept is that the incremental risk-adjusted savings from emerging technology measures will result in a reasonable amount of savings over standard measures for those few technologies that eventually come to market without having to try and pick winners and losers.*

Figure 2 - Energy Trust's Ten-Year DSM Forecast Determination Flow Chart



analysis, regional secondary sources^{*}, and engineering analysis. There are over 30 measure-level inputs that feed into the model, but on a high level, the inputs are put into the following categories:

1. **Measure Definition and Equipment Identification:** This is the definition of the efficient equipment and the baseline equipment it is replacing (e.g., a ductless mini-split heat pump replacing residential electric resistance space heat). A measure's replacement type is also determined in this step – retrofit, replace on burnout, or new construction.
2. **Measure Savings:** The kWh or therms savings associated with an efficient measure calculated by comparing the baseline and efficient measure consumptions.
3. **Incremental Costs:** The incremental cost of an efficient measure over the baseline. The definition of incremental cost depends upon the replacement type of the measure. If a measure is a retrofit measure, the incremental cost of a measure is the full cost of the equipment and installation. If the measure is a replace on burnout or new construction measure, the incremental cost of the measure is the difference between the cost of the efficient measure and the cost of the baseline measure.
4. **Market Data:** Market data of a measure includes the density, saturation, and suitability of a measure. Density is the number of measure units that can be installed per scaling basis (e.g., the average number of showers per home for showerhead measures). The saturation is the average saturation of the density that is already efficient (e.g., 50 percent of the showers already have a low flow showerhead). Suitability of a measure is a percentage input to represent the percent of the density that the efficient measure is actually suitable to be installed in. These data inputs are all generally derived from regional market data sources such as NEEA's Residential Building Stock Assessment (RBSA).

◆ **Statewide 'Global' Inputs:**

The RA Model requires several statewide agency level inputs to create the DSM forecast. These inputs include:

1. **Customer Forecasts:** These inputs are essential to scale the measure-level savings to a statewide level. For example, residential measures are characterized on a scaling basis

^{*} *Secondary Regional Data sources include: The Northwest Power Planning Council (NWPPC), the Regional Technical Forum (the technical arm of the NWPPC), and market reports such as NEEA's Residential Building Stock Assessment (RBSA)*

per home, so the measure densities are calculated as the number of measures per home. The model then takes the number of homes that identified as “affordable housing” by OHCS and the forecasted number of new homes to scale the measure-level potential to the entire state.

2. **Customer Stock Demographics:** These data points are specific to Oregon and identify the percentage of stock that utilize different heating fuels for both space heating and water heating. The RA Model uses these inputs to segment the total stocks to the stocks that are applicable to a measure (e.g., gas storage water heaters are only applicable to customers that have gas water heat). Energy Trust relied on NEEA’s latest residential building stock assessment to provide these values.
3. **Utility Rates:** Statewide average residential utility rates derived from the Energy Information Administration are applied to savings and present valued. These values are used to screen measures in cost effectiveness and serve as the primary benefits from adopting energy efficiency for participants.

Step 2 - Calculate Technical Potential

Once measures have been characterized and statewide data loaded into the model, the next step is to determine the technical potential of energy that could be saved. Technical potential is defined as the total potential of a measure in the service territory that could be achieved regardless of market barriers, representing the maximum potential energy savings available. The model calculates technical potential by multiplying the number of applicable units for a measure in the service territory by the measure’s savings. The model determines the total number of applicable units for a measure utilizing several of the measure-level and utility inputs referenced above.

Total Applicable Units =

Measure Density x Baseline Saturation x Suitability Factor x
Heat Fuel Multipliers (if applicable) x Total Stock (e.g., number of homes)

Technical Potential =

Total Applicable Units x Measure Savings

The measure-level technical potential is then summed up to show the total technical potential across all building types. This savings potential does not consider the various market barriers that will limit a 100 percent adoption rate.

Step 3 - Calculate Technical Achievable Potential

Technical achievable potential is simply a reduction to the technical potential by 15 percent to account for market barriers that prevent total adoption of all cost-effective measures. Defining the technical achievable potential as 85 percent of the technical potential is the generally accepted method employed by many industry experts, including the NWPCC and National Renewable Energy Lab (NREL).

$$\text{Technical Achievable Potential} = \text{Technical Potential} \times 85\%$$

Step 4 - Determine Cost-effectiveness of Measures using SIR Screen

The RA Model screens all measures in every year of the forecast horizon using the Savings to Investment Ratio (SIR) that measures the cost-effectiveness of the investment being made in an efficiency measure. This test evaluates the total present value of benefits attributable to the measure divided by the total present value of all costs. An SIR value equal to or greater than 1.0 means the value of benefits is equal to or exceeds the costs of the measure and is therefore cost-effective and contributes to the total amount of cost-effective achievable potential. The SIR is expressed formulaically as follows:

$$\text{SIR} = \text{Present Value of Lifetime Benefits} / \text{Investment}$$

Where the *Present Value of Lifetime Benefits* includes the sum of the following two components:

- ◆ Utility bill savings: The present value of electricity or natural gas saved over the life of the measure, as determined by the total kWh or therms saved multiplied by the average electric or natural gas utility rate per kWh or therm. The net present-value of these benefits is calculated based on the measure's expected lifespan using Energy Trust's discount rate.
- ◆ Non-energy benefits are also included when present and quantifiable by a reasonable and practical method (e.g., water savings from low-flow fixtures, operations and maintenance cost reductions from reduced replacements or longer equipment lifetimes).

Where the Investment includes:

- ◆ Total measure incremental cost

The cost-effectiveness screen is a critical component for modeling and planning because most programs are limited to incentivize only measures that are cost-effective.

Step 5 - Quantify the Cost-Effective Achievable Potential

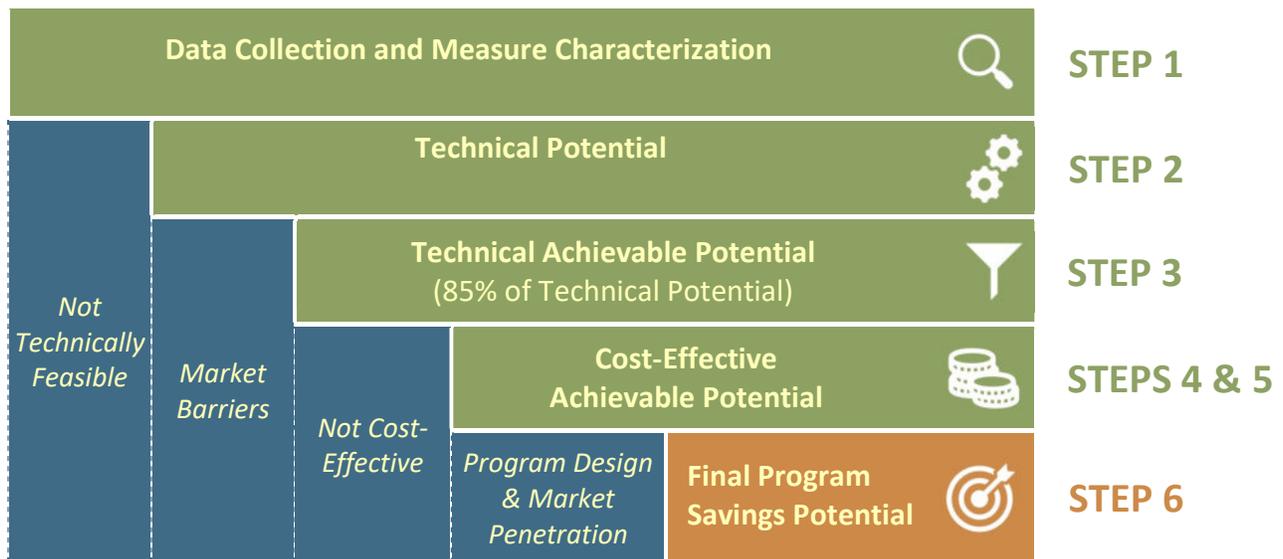
The RA Model’s final output of potential is the quantified cost-effective achievable potential. If a measure passes the SIR test described above, then the *achievable savings* (85 percent of technical potential) from this measure is included in the cost-effective achievable potential. If the measure does not pass the SIR test above, the measure is not included in the cost-effective achievable potential.

Step 6 - Deployment of Cost-Effective Achievable Potential

This portion of the model was not completed for the development of this plan, as the analysis was of the savings potential of the market, not specific to any particular program design. When and if programs are designed to deploy these measure installations, this section should be revisited to account for market barriers experienced in similar existing programs, knowledge of current and developing markets, and future codes and standards.

Figure 3 illustrates the types of potential shown in Figure 1 and the corresponding steps above.

Figure 3 - The Progression to Program Savings Projections



Appendix B: Affordable Housing Assessment Index by County

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Baker	3					\$763	\$2,001,841	\$625,849	4,688,555	82,955
Benton	3					\$929	\$9,687,705	\$2,792,409	21,160,454	344,351
Clackamas	2					\$764	\$17,641,720	\$10,017,423	75,250,996	1,302,017
Clatsop	2					\$683	\$2,822,252	\$1,114,793	8,305,993	150,671

* For energy burdened households <200% FPL.

† As a result of energy efficiency improvements in low-income housing.

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Columbia	2	 23%	 44%	 64%	 8%	\$891	\$3,949,676	\$1,816,961	13,603,974	241,857
Coos	3	 40%	 43%	 77%	 11%	\$773	\$8,002,847	\$2,427,727	18,159,032	324,646
Crook	3	 45%	 44%	 52%	 9%	\$844	\$3,499,777	\$887,009	6,634,094	118,828
Curry	2	 37%	 41%	 65%	 10%	\$592	\$2,298,555	\$997,218	7,779,255	105,449
Deschutes	2	 29%	 37%	 43%	 10%	\$933	\$18,535,712	\$5,049,634	37,344,602	710,869

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Douglas	2	 29%	 40%	 71%	 8%	\$836	\$10,679,736	\$3,928,921	30,064,515	466,458
Gilliam	3	 43%	 45%	 74%	 13%	\$906	\$308,790	\$82,528	599,440	12,628
Grant	3	 41%	 46%	 74%	 5%	\$976	\$1,249,806	\$346,577	2,621,131	44,011
Harney	3	 44%	 44%	 77%	 10%	\$1,207	\$1,636,762	\$320,495	2,449,081	38,470
Hood River	3	 31%	 38%	 67%	 34%	\$832	\$2,138,964	\$625,425	4,640,442	86,606

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Jackson	2	 30%	 40%	 61%	 15%	\$819	\$20,301,970	\$6,917,193	52,749,173	833,473
Jefferson	3	 44%	 35%	 53%	 39%	\$1,090	\$3,624,514	\$612,568	4,657,055	75,419
Josephine	3	 44%	 44%	 66%	 10%	\$700	\$10,647,781	\$3,371,487	25,364,137	438,554
Klamath	3	 40%	 40%	 72%	 17%	\$804	\$8,706,988	\$2,450,391	18,540,156	309,413
Lake	3	 50%	 52%	 72%	 11%	\$888	\$1,513,934	\$452,325	3,489,616	51,475

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Lane	3					\$767	\$42,816,244	\$10,732,150	81,418,633	1,322,131
Lincoln	3					\$679	\$5,251,634	\$1,933,265	14,794,665	228,983
Linn	3					\$726	\$12,352,711	\$3,666,915	27,818,148	454,227
Malheur	4					\$993	\$4,700,341	\$1,031,913	7,882,791	123,160
Marion	2					\$818	\$27,881,457	\$7,829,111	59,437,203	959,749

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Morrow	3	 40%	 37%	 62%	 37%	\$1,017	\$1,565,892	\$333,208	2,589,387	36,195
Multnomah	3	 26%	 43%	 76%	 26%	\$718	\$57,927,455	\$21,813,688	164,388,687	2,757,634
Polk	2	 24%	 35%	 55%	 18%	\$972	\$6,792,944	\$1,853,764	13,982,495	235,355
Sherman	3	 40%	 48%	 84%	 8%	\$824	\$263,711	\$93,882	711,111	11,840
Tillamook	2	 36%	 40%	 64%	 13%	\$860	\$3,154,453	\$887,401	6,632,609	119,229

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Umatilla	3					\$842	\$8,585,223	\$2,264,393	17,177,140	280,722
Union	3					\$781	\$3,105,815	\$849,485	6,428,377	106,681
Wallowa	3					\$1,120	\$1,220,363	\$297,386	2,258,008	36,870
Wasco	3					\$793	\$2,727,221	\$802,950	6,074,018	101,076
Washington	2					\$739	\$28,661,999	\$11,546,555	87,248,463	1,440,815

County	High Priority Area Index	Energy Burdened Households <200% FPL (%)	Households <80% AMI (%)	Housing Units Built Prior to 1990 (%)	Non-White Population (%)	Average Energy Affordability Gap* (\$)	Total Energy Affordability Gap* (\$)	Total Potential Energy Cost Savings† (\$)	Total Potential Electric Energy Savings (kWh)	Total Potential Gas Energy Savings (therms)
Wheeler	3					\$966	\$265,616	\$78,867	586,251	10,936
Yamhill	2					\$808	\$9,210,835	\$3,054,370	22,933,334	399,254

Appendix C: Energy Trust of Oregon Manufactured Home Replacement Pilot



ENERGY TRUST OF OREGON MANUFACTURED HOME REPLACEMENT PILOT

Background

Oregon has over 170,000 manufactured homes, representing about 10 percent of total residential building stock. More than 110,000 of these homes were built before 1995, when federal standards for energy efficiency were minimal or non-existent. These older manufactured homes have less insulation in the ceiling, walls and floor than manufactured homes built in 1995 or after; have significant air leakage; and have inefficient windows and heating systems. As a result, residents of these homes spend about 70 percent more on energy per square foot than residents of site-built homes according to the U.S. Energy Information Administration. These higher energy costs disproportionately affect those with lower incomes.

Retrofitting older manufactured homes with efficiency measures can be ineffective and expensive. Attics and walls are usually narrow and/or inaccessible, making it difficult to increase insulation levels. Some older manufactured homes are deteriorating to the point that they cannot be made more efficient. The cost of improvements frequently exceed the home's value and remaining useful life.

Objective

To deliver durable savings to a segment of the rural housing stock where few practical, lasting options exist, **Energy Trust launched a pilot program to retire aging manufactured homes and replace them with code-exceeding energy-efficient new manufactured homes.** In addition to refining the costs and benefits, the pilot aims

to build partnerships to establish a replicable model that integrates energy, poverty alleviation and affordable housing investments.

Pilot design

Energy Trust, in partnership with Oregon Housing and Community Services, CASA of Oregon, NeighborWorks Umqua, St. Vincent de Paul of Lane County, and regional Community Action Agencies, will identify qualified homes/parks, seek additional funding opportunities and monitor the impact of retiring and replacing older (pre-1995) manufactured homes with new, energy-efficient models. This innovative approach will benefit manufactured home occupants and communities for decades. It can also provide non-energy benefits such as healthier living conditions and greater economic security.

The new manufactured homes in this pilot will meet the standards of the Northwest Energy Efficient Manufactured Home Program, NEEM, delivering the maximum cost-effective efficiency benefit. Incentives available to the customer for qualified products are based on the NEEM 1.1 specification; additional incentives are available for homes reaching NEEM 2.0 specification. The estimated energy-savings benefits and incentives are as follows, based on replacement of an existing home with a like-sized home:

Energy savings and incentives for replacing older manufactured homes

Home config.	Year built	Climate zone	Energy savings in kWh	Maximum Energy Trust Incentive*
Single-wide	Pre-1976	West of Cascades	7,937	\$10,000
		East of Cascades	14,935	\$15,000
	1976-1994	West of Cascades	4,723	\$7,500
		East of Cascades	9,695	\$9,000
Double-wide	Pre-1976	West of Cascades	15,148	\$15,000
		East of Cascades	27,656	\$17,500
	1976-1994	West of Cascades	9,653	\$12,500
		East of Cascades	18,696	\$15,000

*Incentive levels reflect conversion to like-sized home. Adjusted incentives are available for single to double-wide conversions.

Savings estimates for the manufactured home retirement pilot were established by Energy Trust utilizing NEEA's Regional Building Stock Assessment, Northwest Energy Works and NEEA's technical specifications for NEEM credentialed homes, county-level property tax enrollment and Energy Trust data.

Over a two-year period from 2017 to 2019, Energy Trust intends to retire and replace 20 to 40 manufactured homes.

Evaluation efforts will examine pre- and post-pilot home characteristics. The evaluation efforts will:

- Analyze pre- and post-replacement energy bills
- Collect basic home characteristics during program recruitment to continually update and refine assumptions pertaining to existing home stock
- Conduct pre- and post-replacement participant interviews to capture the qualitative benefits and/or challenges to replacing homes



If you know of interested homeowners, property managers or manufactured home parks within Energy Trust service territory that have potential to benefit for participation in this pilot, we want to hear from you. Email Mark Wyman at mark.wyman@energytrust.org or call **503.445.2950**.

Evaluation activities will help Energy Trust understand energy and non-energy benefits achieved from the replacement homes. The evaluation and anonymized participant interview results will be made publically available to assist program administrators nationally.

Pilot funding structure

Energy Trust is seeking affordable housing solutions that cost no more than 30 percent of a household's income after grants, incentives and other funding. Within manufactured home parks, housing costs include both debt service on a home purchase along with lot space rental or cooperative dues.

The financing package will likely include third-party loans to qualified consumers to purchase homes and/or loans to park owners to purchase homes for use as affordable housing. Energy Trust is engaged with public, nonprofit and private sector lenders to explore accessible and affordable loan options for manufactured home replacements.

Get involved

This pilot's success depends on the collaboration and engagement of many organizations and individuals, including participants, funding partners and lenders. To date, recruitment efforts have targeted parks owned and operated by nonprofits or member-owned cooperatives. Energy Trust seeks to work in parks with stable ownership, a demonstrated record of prioritizing resident needs and critical capital improvement needs.

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