CADMUS

Manufactured Homes Market Study

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Executive Summary

This study grew out of joint interest expressed by Puget Sound Energy (PSE), the Washington Utilities and Transportation Commission (WUTC), and stakeholders to examine the manufactured home sector, given longstanding interest in this energy conservation in this housing market. To make this examination more holistic and timely, PSE engaged with interested stakeholders to develop a research study to better understand the manufactured home market in its service area and determine what additional opportunities could provide cost-effective energy efficiency services to this market. This market study, which was co-managed by PSE and WUTC staff, is one step in helping formulate a plan of action.

PSE contracted with Cadmus to scope and conduct the study. This initial scope was shared with stakeholders and subsequently refined based on their comments. Cadmus also engaged directly with the stakeholder group to solicit feedback on survey tools and preliminary findings.

Cadmus researched existing primary and secondary sources to establish a thorough knowledge of the current manufactured home market size, household demographics, dwelling characteristics, and remaining conservation potential within PSE's service territory. Cadmus completed several primary tasks:

- Conducted statistical research from several sources (including census data, regional site visit data, and PSE's customer research and energy conservation participation history)
- Conducted an online customer survey with PSE customers who reside in a manufactured home
- Interviewed knowledgeable market actors
- Reviewed secondary research of other utilities' program offerings to provide an overview of best practices
- Estimated remaining energy conservation potential

This report provides an overview of the methods used and detailed findings of the market study. There are several key findings from this study:

There are at least 65,500 manufactured homes within PSE's service territory, the vast majority of which only receive electric service from PSE (approximately 3% of manufactured home customers receive PSE natural gas service). Of these homes, approximately 36% are in a manufactured homes park and over half are in an urban setting.

PSE's programs have touched approximately half of its customers in manufactured homes sector. Program data indicates that almost half of manufactured home customers have participated in at least one PSE conservation program since 2010. Program participation is also relatively even across PSE's service territory, with no significant geographical concentrations. PSE's program participation data also reveals that while of participating customers, most (77%) participated in a conservation program in a single year, 23% were repeat program participants.

Program participation and the associated energy savings have been historically driven by three programs: Single Family Weatherization (which used American Recovery and Reinvestment Act [ARRA]

funding from 2010 to 2015 and accounted for 36% of participation), Mobile Home Duct Sealing (34% of participation), and Appliances Rebates (19%). Of these three programs, only Appliance Rebates is still offered (measure offerings for the discontinued programs have migrated to other programs). Savings have historically been concentrated in the space heating end use, which includes duct sealing measures. Since 2016, savings have primarily been due to the installation of ducted and ductless heat pumps.

Program participation did not occur evenly between homes inside versus outside park designations. Mobile Home Duct Sealing participants were more likely to be outside a manufactured homes park (21% in park, 41% urban) than Single Family Weatherization – ARRA participants (54% in park, 81% urban). Mobile Home Duct Sealing participants were also more likely to be located outside an urban environment.

PSE currently offers a comprehensive set of measures for manufactured homes, comparable with offerings by other utilities. Even so, a targeted, manufactured homes-specific program offers opportunities to streamline the program participation process and take advantage of a network of contractors who are not only familiar with manufactured homes, but also of the unique needs of these customers. The most successful marketing strategies to encourage participation have been targeted at in-park manufactured homes. However, there are no comparative best practices for reaching manufactured homes in independent locations, where most manufactured homes in PSE Service territory are located.

Compared to residents of site-built single family homes, manufactured home residents are less likely to be in the labor force (35% of manufactured homes residents are not in the labor force, compared to 25% of site-built single family homes residents), more likely to have a lower income (manufactured homes residents' median income is $43,000 compared to site-built single family residents' median income of $93,000), and more likely to be below federal poverty thresholds (59% of manufactured homes households are above 200% of the federal poverty level, compared to 85% of single family households). Additionally, manufactured home residents were more likely to be renters than single family homes residents (but less likely than multifamily home residents). While 85% of manufactured home residents owned their home, only 50% of respondents owned the land where their home was positioned, potentially impacting their ability to secure loans for conservation improvements. Due to these demographics, the upfront cost of energy-efficient upgrades is the biggest challenge for this demographic. This sentiment was not only conveyed by manufactured home residents but is also consistent with stakeholder (contractors and advocacy groups) observations.

On average, manufactured home residents are slightly older than site-built single family home residents, are less likely to have achieved a higher education, are more likely speak Spanish in the household, and are more likely to have a person with a disability living in the household. In addition to financial barriers, this demographic has motivational challenges with completing energy efficiency upgrades, such as not wanting to be inconvenienced by participating in programs and having a lack of awareness about savings opportunities, which is partly driven by a language barrier for the subset of manufactured home residents who primarily speak Spanish in the household.

Electricity is the primary heating fuel for manufactured homes, with over 70% of manufactured homes using electricity as a heating fuel (compared to just over 30% of single family homes). In the online customer survey, most respondents (83%) said they did not have access to natural gas service. Additionally, while non-electrically heated homes rely on gas, they also rely on wood as a heating fuel to a similar degree. Manufactured home heating systems are primarily furnaces (over 60%), although heat pumps (over 14%) and stoves or fireplaces (over 15%) are also common. Additionally, while manufactured home customers are more likely to use room air conditioners to cool their home, they are less likely to have a central air conditioner than single family home customers. Overall, the fraction of homes having either central or window air conditioning systems is similar.

Electric furnaces were reported to be the oldest heating equipment type in manufactured homes, with over 50% of the equipment being over 11 years, and heat pumps were the newest equipment type, with over 50% being five years or less. An analysis of customers' electric bills showed that electric consumption of manufactured homes with electric space heating was 15,014 kWh per year, of which 8,444 kWh was for heating the home. While manufactured homes have higher electric and gas use per square foot than single family homes in Washington, the overall kBTU use per square foot is lower in manufactured homes because kBTU is heavily impacted by gas use, and a smaller percentage of manufactured homes use gas than single family homes in Washington.

Manufactured homes tend to be older, and there are relatively few newer homes. Most manufactured homes are between 16 and 25 years and the construction of manufactured homes has significantly tapered in the last 15 years. The data show that while 6% of site-built single family homes were less than six years old, only 1% of manufactured homes were constructed in that timeframe.

Site visit data show that manufactured homes have, on average, less well-insulated walls and ceilings than single family homes, although floors in manufactured homes are better insulated than floors in single family homes. Additionally, the windows in manufactured homes are slightly less efficient than the windows in single family homes. Several stakeholders noted that, because manufactured homes are structurally distinct from single family homes, retrofitting manufactured homes with floor and attic insulation, as well as sealing ducts, requires specialized knowledge and skill and cannot always be effectively accomplished by general contractors. This was echoed in programs customized to manufactured home customers, where utilities typically rely on networks of preapproved contractors already familiar with manufactured homes.

Both homeowner survey results and on-site data show that efficient lighting has been adopted in manufactured homes to a significant degree. Eighty-three percent of manufactured homes residents said they had installed LEDs in their home, and approximately 50% of this group said that they had installed LEDs in at least 50% of their fixtures. Secondary data showed that the efficient lighting has been adopted at similar levels in manufactured and site-built single family homes. Looking forward and considering the high penetration of LED lighting, the potential study found that the remaining potential for this end use was low. This is due to the considerable penetration of LED lighting as well as the 2020 Energy Independence and Security Act backstop standard.

Stakeholders cited awareness as the primary barrier for manufactured homes customer participation in energy efficiency programs; however, 64% of surveyed manufactured home customers indicated being aware (prior to the survey) of PSE's offerings, and most respondents had learned about the programs through a PSE email (however, PSE only has email addresses for about half its manufactured home customers), suggesting that the awareness barrier may be higher for manufactured home customers who cannot be reached by email.

Most customers also expressed that having insight into the cost of potential upgrades and available rebates before contacting contractors would be very important in their decision to pursue an upgrade. This information supported a stakeholder finding that manufactured home customers are discouraged when, after visiting their home, a contractor provides a quote that is not affordable.

When asked what would make it easier to participate in conservation programs, 46% of manufactured home customers said more information would be helpful, followed by 37% who suggested larger rebates. Manufactured home customers have divergent views on the potential helpfulness of financing opportunities for energy conservation upgrades. While 17% of these customers said they would be significantly more likely to install upgrades if they qualified for financing, 21% said they would not be more likely at all to complete financing should they qualify. Additionally, 38% of all customers said it would be helpful to make payments on their Puget Energy Sound bill (however, 29% said they were not interested in any financing opportunity).

Stakeholders identified ductless heat pumps as the most effective measure to increase the energy efficiency of manufactured homes. Most of the stakeholders identified this measure due to the building characteristics of manufactured homes and to the prevalence of electric heating in manufactured homes. Additionally, all stakeholders suggested that expanded financing opportunities that reduce the upfront cost of energy efficiency investments could reduce the cost barriers for manufactured home residents. The conservation potential study of the manufactured homes sector agreed with stakeholders' comments and found that ductless heat pumps have high remaining potential.

While there was general agreement between stakeholders and the potential study that replacing electric resistance heating with heat pumps (ductless or central) was beneficial, a few stakeholders had concerns that ductless heat pumps are not always used efficiently. Home residents may continue to use electric resistance heat after installing a ductless heat pump, resulting in reduced energy savings. This issue may be minimized by educating residents about the cost implications of continued use of electric resistance heat.

The potential study identified measures impacting the space heating end use had the highest remaining potential. According to the online manufactured home survey, most homes still have electric furnaces; therefore, the opportunity for ductless heat pump and air source heat pump conversions remain high. Weatherization retrofits also provide potential, such as windows replacements, duct insulation, and duct sealing. As noted previously, stakeholders agree and indicated the same space heating opportunities.

Water heating, after space heating, was second largest area of potential for both electric and natural gas end uses. The potential study found the primary electric water heating potential was heat pump water heaters. However, it should be noted heat pump water heaters have specific space requirements to provide proper air flow. Additional exhaust venting systems may be required for manufactured homes to allow for proper air flow for the heat pump water heaters.

Conclusion

Manufactured homes comprise a niche within energy conservation portfolios. Not only do these homes have specific challenges for installing energy conservation measures, but their residents comprise a population with limited means to make upgrades. These market characteristics present challenges and opportunities for achieving energy conservation in manufactured homes.

Despite these challenges, PSE has reached approximately 50% of this market segment, particularly during 2010 to 2016 when it had targeted programs and had access to federal dollars.

Even after accounting for historical program participation, opportunity exists to achieve additional energy conservation in the manufactured homes sector. The main opportunity is through converting inefficient electric heating to ductless and air source heat pumps. Thoughtful programming that accounts for the specialized needs of the homes and residents, including strategies to reach both manufactured homes in and outside of parks, will be required to achieve the remaining potential. In developing this programming, PSE has the opportunity to draw lessons from other regional and national programs that are also engaged in serving the manufactured homes market.

Introduction and Acknowledgment

Stakeholder engagement and support was central to conducting the manufactured homes market study. The stakeholders for this study encompassed PSE, the WUTC, Public Counsel, the NW Energy Coalition, Franklin Energy, UCONS, CLEAResult, Manufactured Homes Communities of Washington, the Washington Department of Commerce, Arrow Conservation, the Opportunity Council, CAZ Energy, and the Association of Manufactured Home Owners. These stakeholders contributed to the study in a variety of ways:

- Participated in a kickoff presentation before research activities commenced and provided feedback on the study design.
- Participated in interviews, sharing insight into the manufactured home market and opportunities and barriers to saving energy in the market.
- Attended a preliminary presentation of Cadmus' findings from reviewing PSE's program data and data from other sources, as well as from stakeholder interviews, and provided feedback and queried for additional details.
- Provided feedback on the initial draft of the online customer survey.
- Shared data and background materials for the study.
- Made technical expertise available to support research activities (Cadmus had several constructive interactions with analysts at the staff at the Washington State University Energy Program. The Commerce Department facilitated these interactions).
- Reviewed the final report.
- Attended in a final presentation.

Research Objectives

The manufactured homes market study had several research objectives, which were addressed through an extensive secondary data review, stakeholder interviews, an online customer survey, an analysis of manufactured homes customer energy consumption data, and a potential study analysis:

- Estimate the number of manufactured homes within PSE service territory.
- Estimate the percentage of manufactured homes in or out of a manufactured homes park.
- Determine average age and characteristics of manufactured homes.
- Determine space and water heating fuel sources for manufactured homes.
- Identify conservation measures installed since 2010.
- Determine household demographic characteristics of manufactured homes residents.
- Identify barriers for participating in PSE conservation program for customers living in manufactured homes.
- Estimate the remaining conservation potential.

- Identify best practices for conservation programs for manufactured homes.
- Estimate annual electric and gas consumption for manufactured homes in PSE service territory.

Definitions of Manufactured Homes

PSE,[1] the State of Washington,[2] the United States Census Bureau,[3] and the United States Department of Housing and Urban Development[4] have developed definitions of manufactured homes. The common themes throughout these various definitions is that manufactured homes are produced off the site, moved to location in one or more pieces, and constructed on a permanent chassis. We used this definition for the purposes of this study.[5] Standards for the construction of manufactured homes are set by the United States Department of Housing and Urban Development in accordance with the National Mobile Home Construction and Safety Standards Act of 1974. A manufactured home should not be confused with other types of site-built homes that rely on prefabricated materials delivered on the site, such as modular homes.

While manufactured homes are frequently found in communities or manufactured homes parks, they are not exclusively located in clusters and can be found in both urban and rural locations outside of parks.

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1 Puget Sound Energy. "Manufactured homes rebates." https://www.pse.com/rebates/manufactured-homes

2 Washington State Legislature. "Classification of Manufactured Home" https://app.leg.wa.gov/rcw/default.aspx?cite=65.20&full=true

3 United States Census Bureau. "Manufactured Housing Survey Frequently Asked Questions." https://www.census.gov/programs-surveys/mhs/about/faq.html

4 United States Department of Housing and Urban Development. "Manufactured Housing and Standards – Frequently Asked Questions." https://www.hud.gov/program_offices/housing/rmra/mhs/faqs

5 A photograph of a manufactured home can be found in the Online Customer Survey Instrument, in the Appendix.

Methods

This section provides details about the method and data sources Cadmus applied to the secondary data review, stakeholder interviews, online customer survey, benchmarking review, conservation potential study, and billing analysis. Table 1 provides an overview of the methods used in this study, and further details are provided below.

Table 1. Overview of Study Methods

Research Objective	Method	Data Sources
Estimate the number of manufactured homes within PSE service territory.	Geospatial mapping	PSE customer data
Estimate the percentage of manufactured homes in or out of a manufactured homes park.	Geospatial mapping	PSE customer data
Determine average age and characteristics of manufactured homes.	Secondary data review, online customer survey	Residential Characteristics Survey, online survey responses
Determine space and water heating fuel sources for manufactured homes.	Secondary data review, online customer survey	American Community Survey, online survey responses
Identify conservation measures installed in the last five years.	Online customer survey	Online survey responses
Determine household demographic characteristics of manufactured homes residents.	Secondary data review, online customer survey	American Community Survey, Residential Characteristics Survey, American Household Survey, online survey responses
Identify barriers for participating in PSE conservation program for customers living in manufactured homes.	Online customer survey, stakeholder interviews	Customer survey responses, stakeholder responses
Estimate the remaining conservation potential.	Update PSE Conservation Potential Study	Customer survey responses, PSE customer and program participation data
Identify best practices for conservation programs for manufactured homes.	Program benchmarking review	Program documentation
Estimate annual electric and gas consumption for manufactured homes in PSE service territory.	Billing analysis	PSE customer data

Secondary Data Review

Cadmus used several existing data sources, outlined below, to provide insight on general and specific characteristics about manufactured homes in the PSE service territory.

Puget Sound Energy Customer and Program Data

PSE manufactured homes customer data is composed of 69,381 residential customers who have been identified by PSE as living in a manufactured home. Cadmus performed a virtual geospatial review on a simple random sample of 400 customers to determine building type (manufactured home or other), whether the home was in a manufactured homes park, establish if the home was in an urban or rural location, and identify if the manufactured home was single, double, or triple wide. For homes unable to be defined using geospatial techniques, we supplemented the analysis using sources such as realty or

property management websites. If the home categorization was still unclear, we created consistency in the review process in several ways:

- If an address had multiple stories or was clearly a single family structure, it was classified as single family.
- If an address was part of a multi-unit complex (more than four units), it was classified as multifamily.
- Mobile homes and recreational vehicles (RVs) were categorized as manufactured homes (because for the purposes of the list PSE categorizes them as manufactured homes) but were identified as mobile/RVs in the review as an additional data point.
- If a home was clearly in a manufactured home park and its roof shape matched other manufactured home roof shapes, it was categorized as a manufactured home.
- If a home clearly fell outside of city or town boundaries, it was classified as rural.

After summarizing the information obtained through this review for the sample, Cadmus applied these findings to the full list of homes identified as being a manufactured home to make inference on the market size. Additionally, we sampled the customer data using simple random sampling of customers with a valid email address to conduct the online customer survey discussed below.

PSE program participation data includes 32,367 manufactured home customers who participated in PSE conservation programs between 2010 and 2018 where individual customer participation is tracked. This data included the program name, measures installed, dates of participation, incentives, and electric and gas savings of each measure. To summarize the data in a meaningful way, Cadmus mapped the diverse measures and programs to end uses, such as mapping duct sealing measures to the space heating end use and program. Additionally, Cadmus mapped the participants' home addresses to counties and mapped the programs to indicators of whether the program required a customer contribution (i.e. the customer paid for part of the equipment upgrade). Participation in programs such as point of purchase retail lighting rebates were not included because participating customers were not tracked.

Cadmus conducted a full review of program participation data, including assessing the percentage of the entire manufactured homes customer base that are program participants by program and county and by year of participation, and assessing historical program electric and gas savings.

Additionally, Cadmus performed geospatial analysis of 68 homes in each of the following selected programs: Low-Income Weatherization (2,044 total customers), Single Family Weatherization - ARRA (11,786 total customers), and Mobile Home Duct Sealing (10,950 total customers). This additional review was conducted to estimate the accuracy of the manufactured homes classifications for participants in programs targeted at manufactured homes.

Secondary Data

Cadmus used several secondary data sources, described below, to determine manufactured homes' resident and dwelling characteristics.

American Community Survey data is available at the public use microdata area data level.[6] Cadmus mapped the micro-areas to PSE territory by comparing PSE's service territory map with a map of 2010 public use micro-areas. We selected 30 public use micro-areas to be as inclusive of PSE territory as possible (these are listed in the appendix, in the *Public-Use Microdata Areas* section).

The American Community Survey data provided information on resident characteristics including ownership types, income and education levels, employment information, age information, and poverty status. The American Community Survey data also provided metrics on dwelling characteristics including number of bedrooms and information on heating fuels and systems.

Northwest Energy Efficiency Alliance 2018 Residential Building Stock Assessment (RBSA) II data was available to Cadmus in a database. Using manufactured homes in PSE service territory from the RBSA II database, Cadmus reproduced all tables from the 2018 RBSA II manufactured homes report,[7] allowing for comparisons to the manufactured homes data in the region as well as to single family homes. Due to how sites were sampled in the RBSA II study, Cadmus included only the homes sampled in the PSE service territory based on electric service. There are two manufactured and 132 single family PSE gas customers not included in the PSE analysis because they were sampled from different electric service territories. Including these PSE gas customers from other electric service territories would skew the results due to the sampling methodology. These tables are listed in the appendix. RBSA II data contributed to resident and dwelling characteristics for the PSE service territory.

PSE 2018 Residential Characteristics Survey data contains data on all the residential homes in PSE's territory and analysis of residential characteristics across buildings types, including 354 manufactured homes and 8,626 single family homes. Cadmus re-created several key tables using only the manufactured homes in the Residential Characteristics Survey data and provided these tables for comparison to full study results. The Residential Characteristics Survey data provided information on resident and dwelling characteristics for the PSE manufactured home market.

American Housing Survey data for the Seattle, Bellevue, and Tacoma Metropolitan Statistical Area (SBT-MSA), with a sample of 2,461 homes, and nationwide, with a sample of 66,752 homes, was used (via the American Household Survey Table Creator tool). Cadmus exported weighted tables of counts of households meeting each criterion both nationwide and within the SBT-MSA data, then used these tables to create distributions. These data include demographic information, housing quality, details of appliances and HVAC in the home, income, and housing costs.

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[6] Public Use Microdata Areas are statistical geographical areas used by the United States Census Bureau to disseminate American Community Survey data. For more information see: https://www.census.gov/programs-surveys/geography/guidance/geo-areas/pumas.html

[7] Northwest Energy Efficiency Alliance. March 2019. "Residential Building Stock Assessment II." https://neea.org/img/uploads/Residential-Building-Stock-Assessment-II-Manufactured-Homes-Report-2016-2017.pdf

Survey Sample Sizes, Coverage, and Methods of Survey and Site Visit Data

Cadmus used the secondary data outlined above to summarize manufactured home dwelling and resident characteristics, as well as to perform quality checks between data sources. Each of the data sources provided slightly different data and insights into the manufactured homes market and each also provided a different basis for comparison. For example, while the RBSA II has the smallest sample size, dwelling characteristics were verified on the premise by a trained field technician. Other data sources, such as the Residential Characteristics Survey or the American Community Survey, have much larger sample sizes but rely on self-reported data (which is less reliable). Additionally, while all data sources allow for comparisons between manufactured and single family homes, not all data allows for comparisons between PSE's service territory and the State of Washington. Details on each secondary data source are provided in Table 2.

Table 2. Survey and Site Visit Data Characteristics

Data Source	Home Type	Method	Year (s)	Sample Sizes by Area				
				PSE Service Territory (closeness of match)	SBT-MSA	Washington State	Regional Homes	National Homes
RBSA II	Manufactured	Cadmus Site Visit	2018	31 (exact)	--	134	411	--
	Single Family[a]			73 (exact)	--	568	1,100	--
Residential Characteristics Survey	Manufactured	Survey	2018	354(exact)	--	--	--	--
	Single Family			8,626 (exact)	--	--	--	--
	Multifamily			1,225 (exact)	--	--	--	--
American Community Survey	Manufactured	Survey	2013–2017	3,444 (approximate)	--	9,660	--	--
	Single Family			51,527 (approximate)	--	102,513	--	--
American Household Survey[b]	All Homes	Survey	2017	--	2,461	--	--	66,752

[a] Single family homes are generally assumed to be site-built.

[b] The American Household Survey Table Creator's documentation details the sample sizes by region for all home types combined, but reports estimates of the population values, not the raw counts. Thus, the sample sizes by household types are unavailable.

When presenting secondary data Cadmus considered the age of the information, the match to PSE service territory, if information was verified by a field technician, and if the data provided insight not provided by other data sources. Given the trade-offs between the data sources, such as smaller sample sizes for verified information or geographical matches, Cadmus sometimes presented data from multiple data sources for similar metrics. Because not all of the data from the various data sources was presented in the body of this study, Cadmus provided additional tables from the various data sources as appendices.

Billing Analysis

Cadmus conducted a billing analysis to estimate the energy consumption of a sample of PSE's customer homes that were verified as manufactured homes through a geospatial review (see the *Secondary Data Review* section above). We reviewed 365 homes, estimating the weather-normalized electric and gas consumption at these homes over 12 months.

PSE provided gas and electric billing data from May 2017 through April 2019. Cadmus estimated PRISM[8] models for the most recent 12 months of data—primarily May 2018 through April 2019. If there were vacancies or customer turnover in the manufactured home, we used a different and more representative 12 months. These models provided weather-normalized annual usage for each verified manufactured home in the sample.

In conducting the billing analysis, Cadmus completed several activities:

1. Matched the verified manufactured homes tracking data with the electric and gas billing data.
2. Obtained daily average weather data from January 2017 through April 2019 from 12 National Oceanic and Atmospheric Administration weather stations, representing all zip codes associated with the manufactured homes.
3. Used daily temperatures to determine base 45 through base 85 heating degree days (HDDs) and cooling degree days (CDDs) for each station.
4. Matched billing data periods with CDDs and HDDs from the associated stations.
5. Reviewed 12 months of billing data for each manufactured home for vacancies and to determine if the home was heated with electricity or other fuels by analyzing monthly energy consumption patterns.[9]
6. Used automated Zillow and other address searches to obtain information about the manufactured homes including square footage, year built, and heating fuel.
7. Used a PRISM model to estimate the average, weather-normalized electric and gas consumption for the manufactured homes in the verified sample.

Stakeholder Interviews

Cadmus conducted half-hour, in-depth interviews with the 10 stakeholders listed in Table 3. The stakeholders included representatives from PSE, weatherization contractors, program implementers, government agencies, and advocacy groups.

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[8] PRISM stands for Princeton Scorekeeping method, a statistical model frequently used to estimate weather-normalized energy consumption. http://www.marean.mycpanel.princeton.edu/images/prism_intro.pdf

[9] Customers with vacancies of less than 11 months of good data were excluded from the analysis. Cadmus was able to include over 90% of the manufactured homes sample in the gas and electric usage analysis.

Table 3. Interviewed Stakeholders

Stakeholder	Category[a]
PSE	Utility
Franklin Energy Services	Implementer/Contractor
UCONS	Advocacy Group/Implementer/Contractor
CLEAResult	Implementer/Contractor
Manufactured Homes Communities of Washington	Advocacy Group
Washington Department of Commerce	Government
Arrow Conservation	Contractor
Opportunity Council	Advocacy Group/Implementer
CAZ Energy	Implementer/Contractor
Association of Manufactured Home Owners	Advocacy Group

[a] Category labels are based on stakeholder self-designation. Stakeholders with multiple categories may be identified by only one category (chosen based on context) when attributing quotes in the report to maintain anonymity.

The interviews consisted of open-ended discussions centered around three main topics:

- Examples of successful energy efficiency initiatives in the manufactured homes market
- Challenges and barriers to energy efficiency in the manufactured homes market
- The greatest opportunities for energy efficiency in manufactured homes

Cadmus analyzed interview results with a qualitative data analysis software, NVivo, to identify similar responses from different stakeholders, as well as to identify instances where stakeholders provided divergent responses to the same discussion topic.

Online Customer Survey

Cadmus fielded an online survey with manufactured home customers between May 24 and May 31, 2019. An email survey invitation was sent to a random sample of 3,614 manufactured home customers (we drew the sample from PSE's list of manufactured home customers, of whom approximately 37,418 [54%] had an email address).

Prior to Cadmus sending the email invitation, PSE sent a primer customer service email, alerting customers that an email invitation to a survey was forthcoming. Manufactured home customers were offered a $10 gift card for completing the survey. As show in Table 4, 9%[10] of manufactured home customers who received the email invitation completed the online survey.

[10] This response rate is similar to response rates for other online surveys that Cadmus has conducted.

Table 4. Survey Response Rate

	Number	Percentage of Invitations Sent
Email invitations sent	3,614	--
Incorrect email (email bounced back)	217	6%
Completed Survey	337[a]	9%

[a] This does not include the 5% of respondents who said they do not live in a manufactured home and were screened out of the survey. Response rates for individual questions are shown with the notation "n=" in the report.

In the online survey, manufactured home customers answered questions about the characteristics of their home, their awareness and participation in PSE conservation programs, and barriers and opportunities for saving energy.

Conservation Potential Study

For the manufactured homes market study, Cadmus updated the Comprehensive Assessment of Demand-Side Resource Potentials (2020–2039) study it had developed for all of PSE sectors and building types.[11] This recent conservation potential assessment (CPA) model was updated with manufactured home information collected through this study, including the market size, equipment saturations, and measure applicability factors.

Technical and Achievable Potential

Cadmus assessed two types of potential—technical and achievable technical—described below.

- ***Technical potential*** assumes that all technically feasible resource opportunities may be captured, regardless of their costs or other market barriers. It represents the total demand-side reduction potential in PSE's service territory, after accounting for purely technical constraints.
- ***Achievable technical potential*** is the portion of technical potential that is assumed to be achievable during the study's 20-year forecast, regardless of the acquisition mechanism. (For example, savings may be acquired through utility programs, improved codes and standards, and market transformation.)

Cadmus did not estimate achievable economic potential as part of this study, which incorporates the cost-effectiveness of energy efficiency measures. PSE internally estimates achievable economic potential as part of its integrated resources planning optimization modeling process.

Figure 1 illustrates these two types of potential that Cadmus estimated as part the manufactured home CPA modeling.

[11] Cadmus. Prepared for Puget Sound Energy. *Comprehensive Assessment of Demand-Side Resource Potentials (2020 – 2039).*

Figure 1. Types of Energy Efficiency Potential

The timing of resource availability is also a key consideration in determining conservation potential. There are two distinct categories of resources:

- ***Discretionary resources*** are retrofit opportunities in existing facilities that, theoretically, are available at any point over the study period. Discretionary resources are also referred to as retrofit measures. Examples include weatherization, shell upgrades, and low-flow showerheads.
- ***Lost-opportunity resources***, such as conservation opportunities in new construction and replacements of equipment upon failure (natural replacement), are non-discretionary. These resources become available according to economic and technical factors beyond a program administrator's control. For example, when a furnace fails, the owner will seek to replace it relatively quickly. If they purchase a standard efficiency furnace to replace the failed furnace, they are unlikely to seek out a third furnace until the second furnace fails, meaning the opportunity for savings from upgrading to an energy efficient furnace has been lost. Examples of natural replacement measures include HVAC equipment, water heaters, appliances, and replace-on-burnout lighting fixtures.

Cadmus used a units-based approach to forecast energy efficiency potential in the manufactured homes market. This involved first estimating the number of units of an energy efficiency measure likely to be installed in each year, then multiplying unit forecasts by the measure's unit energy savings. The appendix contains a more detailed discussion of potential study methodology.

Updating Potential Study Model Inputs

Cadmus focused its update efforts on three potential study inputs: sector units, saturations, and applicability factors.

Sector Units

Cadmus received the number of existing manufactured home customers from PSE (for electric and gas, separately). We adjusted these numbers using the results of our investigation into the manufactured homes market size. We used the same forecasted growth rate as the Comprehensive Assessment of Demand-Side Resource Potentials (2020 – 2039) study.

Saturations

Cadmus incorporated online survey data of manufactured homeowners from 337 participants in PSE territory. The survey included questions to determine the saturation of primary heating and cooling equipment, water heating equipment, and large appliances. Cadmus did not update saturations from the 2019 Conservation Potential Assessment for measures not included in the survey. The 2019 Conservation Potential Assessment uses the most recent PSE-specific and regional stock assessments to determine saturations.

Applicability Factors

Cadmus adjusted the applicability for some measures using PSE historical program tracking data, focusing on measures of interest that had high participation. Applicability factors were originally based on the *Seventh Power Plan*, which relied on the 2012 RBSA data collection effort.[12] The 2012 RBSA collected the bulk of its data in 2011. Instead of relying on 2017 RBSA II data, which has a relatively small sample of manufactured homes, Cadmus relied on PSE's large historical program dataset from 2012 through 2018 to adjust the applicability factors of some measures. Cadmus did not use 2010 or 2011 participation data because program accomplishments in that timeframe are embedded in the *Seventh Power Plan* applicability factors. Using 2010 to 2011 participation data would result in an overcorrection to the applicability factors, which would incorrectly lower the available potential. Table 5 shows the top program measures and the corresponding number of manufactured homes in which they were installed between 2012 and 2018.[13]

Table 5. Manufactured Homes Top Measure Program Accomplishments 2012–2018

Measure	Number of Manufactured Homes
Showerheads	15,969
Duct Sealing	16,038
Attic Insulation	540
Floor Insulation	1,995
Bathroom Aerators	1,830
Kitchen Aerators	1,560

Benchmarking Review

Cadmus reviewed evaluation reports, plans, and websites of programs similar to PSE's, listed in Table 6, comparing relevant and available program offerings and design information specific to the manufactured homes market. Additionally, Cadmus reviewed materials for Tacoma Public Utilities'

[12] Northwest Power and Conservation Council. Seventh Power Plan: Energy efficiency, demand response, and existing natural gas plants key to ensuring a reliable, low-cost, clean power supply. February 25, 2016.

[13] Cadmus excluded lighting measures from the top measures installed. A large number of compact fluorescents and LEDs have been installed in manufactured homes through various programs, including programs outside the specific manufactured home programs (e.g., upstream or direct buydown lighting programs). Therefore, Cadmus relied on the online customer survey to update the applicability for lighting measures.

offerings for manufactured home customers but was unable to find an evaluation report for this program sponsor.

Table 6. Comparison of Retrofit Programs with Manufactured Homes Offerings

Program Sponsor	Program State	Utility Type	Fuel Type(s)	Evaluation Year
PSE	Washington	Investor-Owned	Electric, natural gas	2013–2016
Avista Utilities	Washington	Investor-Owned	Electric, natural gas	2014-2015
Energy Trust of Oregon	Oregon	Statewide (Investor-Owned, Municipal, Public)	Electric, natural gas	2015-2016
Entergy	Arkansas	Investor-Owned	Electric, natural gas	2017
Tacoma Public Utilities	Washington	Public	Electric	N/A

Cadmus identified these target utilities from which to gather data, ensuring that each would match PSE in one or more criteria:

- The program sponsor's service territory covers a similar geography or climate to that of PSE (for example, the Pacific Northwest)
- The program sponsor offers services similar to those of PSE (electric and natural gas)
- The program sponsor offers a manufactured home retrofit program with results that were recently reviewed by a third-party evaluator

Additionally, Cadmus chose to include Entergy Arkansas, which the American Council for an Energy-Efficient Economy identified in its national review of energy efficiency programs as providing exemplary program design features.[14] Table 7 lists the comparison utilities and the reasons Cadmus selected them for the benchmarking study. Cadmus used industry reports, publicly available program information (such as program websites, report filings, and evaluation reports), and institutional knowledge to collect data on the comparison utilities. We also contacted Avista Utilities and the Energy Trust of Oregon to obtain several details directly.

Table 7. Program Selection Criteria

Program Sponsor	Similar Geography or Services	Recently Evaluated Program	Exemplary Manufactured Home Program
PSE	✓	--	--
Avista Utilities	✓	--	--
Energy Trust of Oregon	✓	✓	--
Entergy	✓	✓	✓
Tacoma Public Utilities	✓	--	--

[14] Nowak, S., M. Kushler, and P. Witte. January 2019. *New Leaders of the Pack: American Council for an Energy-Efficient Economy's Fourth National Review of Exemplary Energy Efficiency Programs.* https://aceee.org/sites/default/files/publications/researchreports/u1901.pdf

Findings

This section provides findings from the secondary data review (including program participation and market data and survey and site visit data), stakeholder interviews, online customer survey, benchmarking review, conservation potential assessment, and billing analysis.

Secondary Data Analysis

Cadmus determined the market size of the manufactured homes sector, historical program participation rates for manufactured home customers, resident characteristics, and manufactured home dwelling characteristics.

Manufactured Homes Market Size

PSE provided their full manufactured home customer list along with all manufactured home customers who participated in their programs since 2010. The full customer list was composed of 69,381 unique manufactured customers, of which only 2,097 received gas service from PSE. For this list, PSE defined manufactured homes to include RVs and mobile homes. Cadmus reviewed this data to estimate the total number of customers who were correctly identified as manufactured homes and to get a better understanding of dwelling characteristics, such as whether each home was located in a park or in an urban or rural area.

Customer Data Geospatial Review

Cadmus used the PSE customer and program participation data to determine the manufactured homes market size in the PSE service territory. Cadmus pulled a simple random sample of 400 addresses from the entire manufactured home customer base to perform geospatial and supplemental reviews. Of 400 addresses, Cadmus was able to determine that 394 were actual structures.[15] Additionally, in some cases the review resulted in ambiguous observations and Cadmus was unable to determine if there was a structure or if the structure was a residence. The breakdown by building type based on the geospatial review is outlined in Table 8.

[15] Six addresses pointed to the middle of a field or middle of a river, and we were unable to determine whether the address exists.

Table 8. Geospatial Results by Building Type

Building Type	Count	Percentage
Verified Manufactured Home	363	91%
Single Family Home	16	4%
RV/Trailer/Mobile Home	9	2%
Multifamily Home	2	1%
Retirement Home	2	1%
Commercial Building	1	0.3%
Condo/Timeshare	1	0.3%
Ambiguous	3	1%
No Structure	3	1%
Total	**400**	**100%**

Of the 394 homes identified as structures, 94% were correctly identified as manufactured homes (this includes RVs and trailer homes, which fit PSE's definition of manufactured home). By applying this factor to the original number in PSE's list of manufactured homes, Cadmus estimated that there are at least 65,500 manufactured homes in PSE's service territory (including RVs and mobile homes). Of the 372 homes correctly identified as manufactured or mobile homes in the sample, 36% were determined to be in a manufactured homes park. Of the homes determined to be in a park, 67% were also found on the Washington Department of Commerce list of manufactured home parks. Additionally, the review revealed that 71% of manufactured homes were double wide and 29% were single wide, and that 67% of manufactured homes were in urban locations.

Program Participant Data in Manufactured Homes Sample

Cadmus used the program participation data to cross-reference the sample of customers from the geospatial review and found that 51% of sampled customers were also program participants. Based on our review, two of the homes identified as program participants were single family residences, both of which participated in a program that did not focus on manufactured homes.

Cadmus performed additional geospatial reviews for three programs, shown in Table 9, including Mobile Home Duct Sealing, Single Family Weatherization - ARRA, and Low-Income Weatherization. Upon review, Cadmus determined that 100% of customers participating in these programs were correctly identified as having manufactured homes.

Table 9. Geospatial Review Sample Findings

Characteristic	PSE Customer Data	PSE Program		
		Mobile Home Duct Sealing	Single Family Weatherization - ARRA	Low-Income Weatherization
Total participants identified as having a manufactured home	69,381	10,950	11,786	2,044
Sample size (structures)	394	68	68	66
Percentage of homes correctly identified as manufactured	94%	100%	100%	100%
Percentage of manufactured homes in parks	36%	21%[a]	54%	53%
Percentage of manufactured homes in urban geographies	63%	43%	81%	82%

[a] Program data for 9,705 duct sealing measures shows that approximately 34% of duct sealing measures were installed in manufactured homes inside of a park.

Based on these findings, program participation can vary depending on the location of a manufactured home in a park or an urban geographic area.

Puget Sound Energy Manufactured Homes Customer Population

Cadmus did not review PSE full customer database to determine if there were manufactured homes in the area that were not already contained in the PSE manufactured home customer data. Therefore, our estimate of the adjusted population size of manufactured home customers based on the geospatial review is likely to underestimate the true population of PSE manufactured home customers. Based on the geospatial review, Cadmus adjusted the population of 69,381 customers by multiplying by the 94% correctly identified as being manufactured to estimate a PSE manufactured home customer base of approximately 65,500 customers.

Historical Program Participation

Historical program participant data shows that at least 32,367 PSE customers have participated in a program since 2010.[16] After adjusting the population of customers and accounting for the uncertainty in the estimated population size, Cadmus determined that between 47% (population adjusted based on geospatial review) and 49% (unadjusted population) of manufactured home customers are past program

[16] PSE also provided summary-level program participation data for 2007, 2008, and 2009. However, because this data is not available at a granular level and does not include customer identification information or measure details, Cadmus was not able to incorporate this information into the overall program participation summary. The 2007 to 2009 summary data shows an estimated 8 million kWh savings from 7,249 treated homes for a range of measures, including duct sealing, heat pumps, aerators, compact fluorescent light bulbs, and efficient electric furnaces. Given this additional historical data, Cadmus estimates the number of historical participants to be larger than 32,367 since 2010.

participants. Cadmus found in our random sample of 400 customers that 51% were program participants, which is comparable to the estimated percentage in the program data.

Cadmus also compared customer program participation rates by county. As shown in Table 10, many manufactured homes and program participants were in King County. While the program participation rate has been fairly even across counties, counties with fewer manufactured homes have a smaller participation rate. For example, while King County had a program participation rate of 53% with a population of over 16,000 manufactured homes, Snohomish County (which PSE only serves with gas) only had a participation rate of 33% and 281 estimated manufactured homes. This may indicate smaller, more rural, and gas-only populations of manufactured homes are harder to reach.

Table 10. Percentage of Manufactured Homes Participating in Programs by County

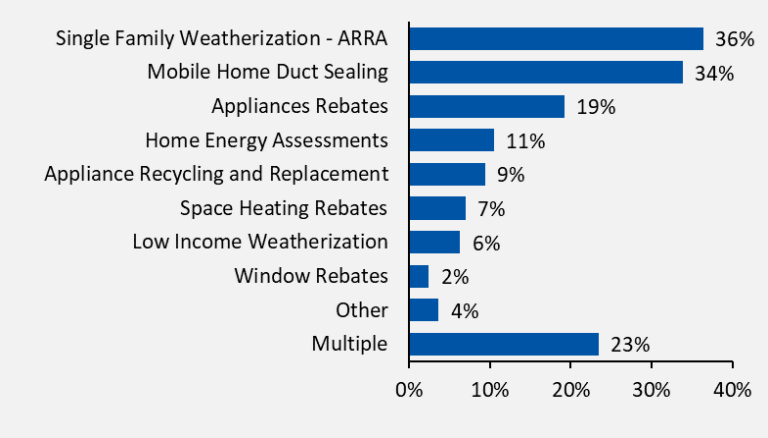
County	Percentage of Homes Served	Manufactured Homes Population	Program Participants
King	53%	16,784	8,881
Thurston	53%	11,736	6,233
Pierce	46%	10,197	4,736
Kitsap	41%	9,924	4,058
Whatcom	40%	9,444	3,773
Skagit	40%	6,075	2,440
Island	45%	3,320	1,485
Kittitas	24%	1,324	312
Lewis	49%	293	143
Snohomish	33%	281	94

Cadmus also estimated how many manufactured home customers participated in PSE's energy efficiency programs over multiple years. Seventy-seven percent of manufactured home customers in PSE program tracking data were in programs in a single year (customers could have participated in multiple programs in this year). However, 19% participated in two years and 3% participated in three years. Only a very small fraction of customers, less than 0.5%, participated in programs in more than four distinct years.

Since 2010, the programs with the most participation were Single Family Weatherization - ARRA[17] and Mobile Home Duct Sealing. Both these programs ended after 2016, when funding closed. As shown in Figure 2, these two programs together accounted for approximately 70% of manufactured home participation. Other programs saw relatively lower participation, and 23% of manufactured home customers participated in more than one program.

[17] ARRA is the American Recover and Reinvestment Act, which provided financial support to utilities to provide energy efficiency services in low-income communities.

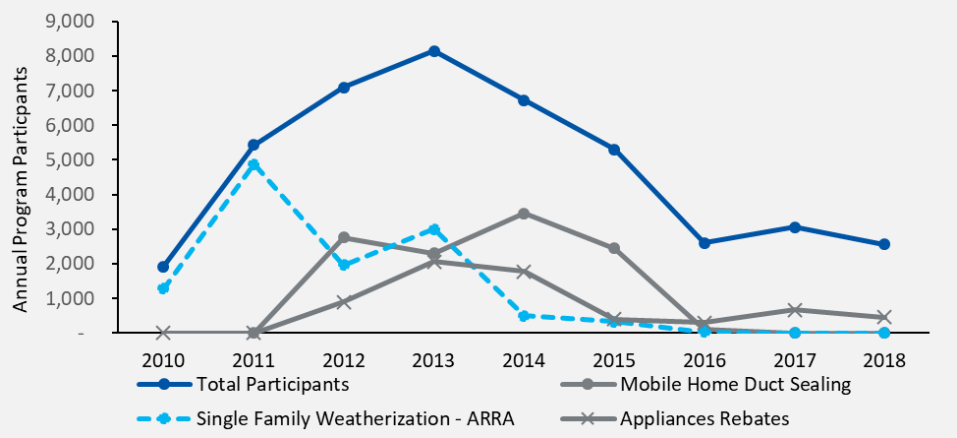
Figure 2. Manufactured Homes Program Participation



Cadmus also analyzed program participation rates by programs that required a customer contribution, such as Appliances Rebates, Space Heating, and Window Replacement Rebates, and programs that were completely cost free to customers, such as Mobile Home Duct Sealing or Single Family Weatherization - ARRA. Seventy-four percent of customers participated exclusively in programs that required no customer contribution, while 15% participated exclusively in programs that required a customer contribution and 11% participated in both types of programs.

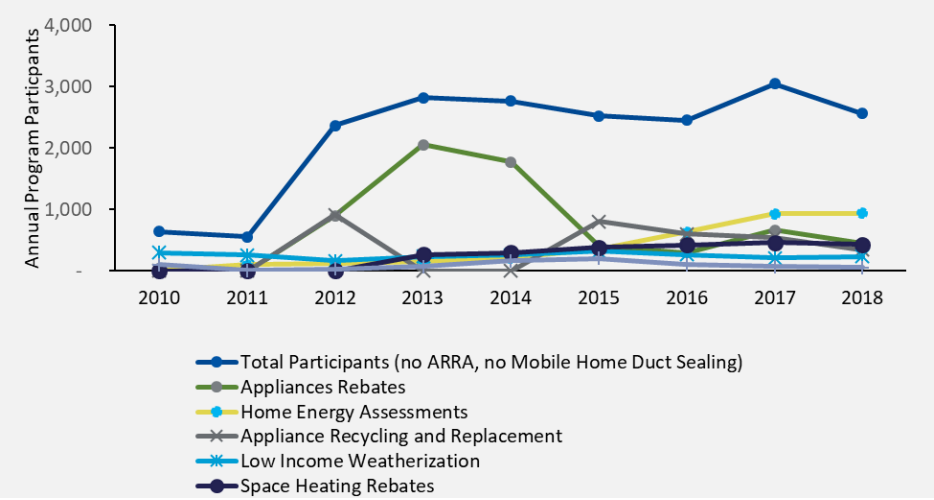
We analyzed the temporal aspect of program participation. According to the program participation data, manufactured homes program participation ramped up after 2010 and peaked in 2013. Participation was primarily driven by the Mobile Home Duct Sealing and Single Family Weatherization - ARRA programs. Figure 3 shows annual program participation for three programs with the most participation.

Figure 3. Annual Program Participation for Three Programs with Most Participation



In order to understand participation trends for continuing programs, Cadmus analyzed participation trends for all programs, exclusive of Mobile Homes Duct Sealing and Single Family Weatherization - ARRA. As shown Figure 4, when excluding these two programs that ended in 2016, program participation for manufactured home customers has remained relatively steady since 2013, driven in recent years by the Home Energy Assessments, Space Heating Rebates, Appliance Recycling, and Appliances Rebates programs.

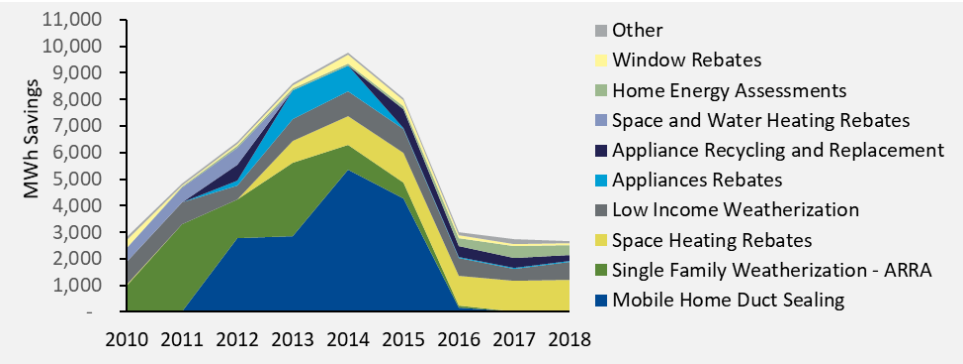
Figure 4. Annual Program Participation for Programs Excluding Mobile Home Duct Sealing and Single Family Weatherization – ARRA



The number of program participants for each year is provided in a table in the Appendix. The table includes several programs that were not graphed above because participation was relatively minimal.

In addition to exploring program participation by PSE customers, Cadmus analyzed the program participation data by program and end-use saving. As shown in Figure 5, the Mobile Home Duct Sealing and Single Family Weatherization - ARRA programs made the biggest contributions to electric savings between 2010 and 2016. Space Heating Rebates also contributed significantly after 2013.

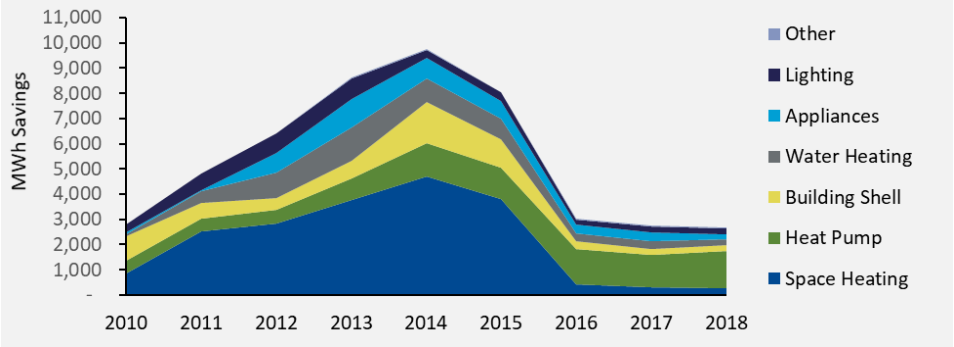
Figure 5. Electric Savings by Program per Year



Details on each program's savings in each year are provided in the Appendix. While manufactured home customers participated in 12 different programs, savings were primarily generated by several programs between 2011 and 2016.

As illustrated in Figure 6, the space heating and heat pump end uses contributed most significantly to program savings, particularly between 2011 and 2016. The space heating measures include duct sealing measures, as well as upgrades of heating equipment.

Figure 6. Electric Savings by End-Use



The Appendi provides details about electric savings by each year by end use. Lighting made a relatively small contribution to electric savings because lighting savings from instant point of purchase discounts are not captured in this data, as they typically cannot be ascribed to individual participants. In addition to reviewing electric savings from manufactured home customers, Cadmus reviewed gas savings from program participation. Compared to the electric savings, therms savings are relatively modest, primarily because most manufactured homes are not heated with gas and many manufactured homes do not have gas service (see the *Dwelling Characteristics* section).

As shown in Table 11, the Single Family Weatherization - ARRA program was the primary contributor to gas savings through 2012. After 2012, a variety of other programs provided gas savings for manufactured home customers, including Space Heating Rebates and the Low Income Weatherization.

Table 11. Gas Savings by Program

Therms Savings by Program	2010	2011	2012	2013	2014	2015	2016	2017	2018
Single Family Weatherization - ARRA	7,526	9,071	10,391	--	--	--	--	--	--
Mobile Home Duct Sealing	--	--	9,419	--	--	--	--	--	--
Space Heating Rebates	--	--	--	1,574	1,574	1,832	1,134	2,860	2,602
Space and Water Heating Rebates	3,086	1,492	1,574	--	--	--	--	--	--
Low Income Weatherization	1,731	1,054	1,066	608	--	618	513	640	474
Window Rebates	831	172	--	--	775	457	676	371	256
Home Energy Assessments	--	--	--	--	80	80	925	536	456
Single Family Weatherization	--	--	359	366	262	156	537	--	215
Smart Thermostat Rebates	--	--	--	--	--	--	85	574	540
Appliance Recycling and Replacement	--	--	--	--	--	285	127	268	133
Water Heating Rebates	--	--	--	--	--	--	--	--	240
Appliances Rebates	--	--	--	--	--	39	20	24	20

As shown in Table 12, space heating measures, such duct sealing and equipment upgrades, contributed most significantly to gas savings overall. Savings for these measures dropped significantly after 2012, likely because the Single Family Weatherization - ARRA program had already treated most gas-heated homes by that time.

Table 12. Gas Savings by End Use

Therms Savings by End Use	2010	2011	2012	2013	2014	2015	2016	2017	2018
Space Heating	9,691	9,374	17,452	1,867	1,649	2,155	1,929	3,922	3,506
Building Shell	2,161	1,108	737	679	962	907	1,016	520	564
Water Heating	1,322	1,308	4,620	2	80	366	1,051	807	844
Clothes Washers	--	--	--	--	--	39	20	24	20

Resident Characteristics

This section provides information about the characteristics of manufactured home residents in PSE's service territory, including residents' income and poverty levels as well as other demographics, and compares these to the demographics of single family home residents and of statewide populations. This section primarily relies on data from the American Community Survey and PSE's Residential Characteristics Survey.

Income and Poverty Levels

The American Community Survey provided information about the employment status of manufactured home residents. Table 13 shows that residents of manufactured homes, both in and outside of PSE's service territory, are more likely to not be in the labor force. The table shows unemployment rates for both manufactured home and single family home residents.

Table 13. Employment Characteristics of Manufactured Homes Residents

	PSE Territory		Washington	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Not in labor force	35%	25%	36%	27%
Employed	42%	51%	39%	49%
Unemployed	4%	3%	4%	3%
Not answered	20%	21%	20%	21%
Data source	American Community Survey			

The Residential Characteristics Survey provides further detail about the employment status of PSE's service territory residents, including manufactured homes residents (Table 14). The survey results show that over half the residents in manufactured homes are retired, coinciding with a high rate of residents not being in the labor force. Table 13 and Table 14 provide slightly different employment characteristics, due to the questions asked in the survey. Variations in employment rates are likely due to survey methods, such as how "not answered" or "prefer not answer" are counted in the percentages. Overall, both tables tell a consistent story: manufactured homes residents are less likely to be employed than single family home residents, and also see a higher rate of retirement.

Table 14. Employment Characteristics of PSE Service Territory Residents

Employment Status	Manufactured Home	Single Family Home	Multifamily Home
Employed or self-employed	40%	64%	71%
Retired	51%	29%	18%
Not employed/unable to work/choose not to work (temporary or permanent)	5%	1%	3%
Homemaker/child care provider	1%	2%	1%
Student	0%	0%	2%
Prefer not to answer	4%	4%	6%
Data source	Residential Characteristics Survey		

PSE's Residential Characteristics Survey information on the number of residents per home. As shown in Table 15, the distribution of number of persons per home is similar for manufactured and single family homes in PSE service territory.

Table 15. Number of Persons per Home

Household Size	Manufactured Home	Single Family Home	Multifamily Home
1 person	26%	24%	36%
2 persons	37%	36%	32%
3 persons	13%	17%	15%
4 persons	14%	15%	10%
5 persons	5%	6%	4%
6 persons	3%	2%	1%
7 or more persons	1%	1%	1%
Data source	Residential Characteristics Survey		

PSE's Residential Characteristics Survey provides resident's household income distributions. As shown in Table 16, while manufactured homes residents and multifamily home residents have similar household income levels, single family households have the highest incomes.

Table 16. Household Income Levels of PSE Service Territory Residents

Income ($)	Manufactured Home	Single Family Home	Multifamily Home
0–24,999	19%	14%	22%
25,000–49,999	23%	18%	23%
50,000–74,999	20%	18%	18%
75,000–100,000	13%	15%	12%
Over 100,000	25%	35%	24%
Data source	Residential Characteristics Survey		

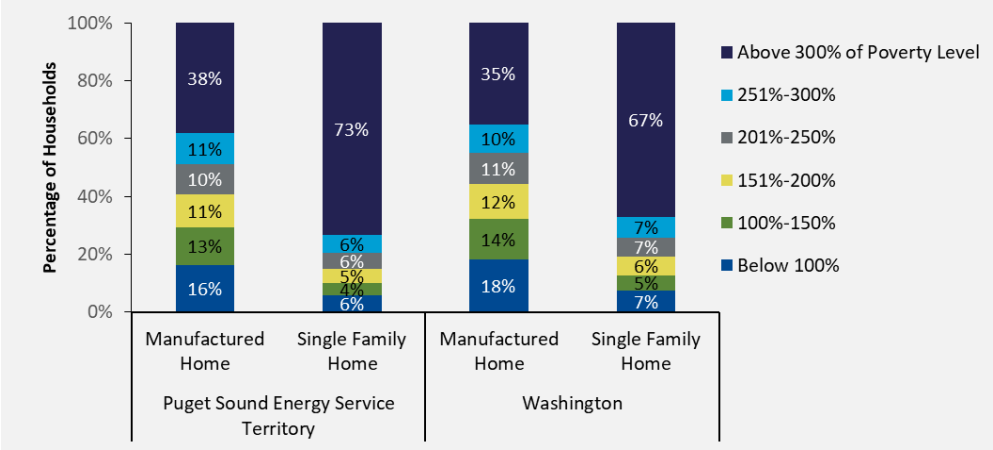
The American Community Survey provides additional information about the mean and median income levels of manufactured and single family households. Table 17 shows that manufactured home residents' household incomes are significantly lower than single family home residents' incomes, both in PSE's service territory and in Washington.

Table 17. Mean and Median Income Levels

	PSE Service Territory		Washington	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Mean income	$54,360	$119,229	$50,631	$103,499
Median income	$43,001	$93,291	$41,000	$79,662
Data source	American Community Survey			

In addition to income statistics, the American Community Survey provides data on the distribution of households at various federal poverty thresholds. As shown in Figure 7, manufactured home households are significantly more likely to be below various federal poverty thresholds and below single family household incomes, both in PSE's service territory and in Washington.

Figure 7. Households below Federal Poverty Thresholds



The American Community Survey also collects information on household fuel expenses. Table 18 shows the reported mean and median annual gas and electric expenses for manufactured and single family

households. Additionally, using billing information of a random sample of homes, Cadmus calculated the mean gas and electric bills for manufactured homes in PSE service territory. While the American Community Survey and PSE data showed similar results for electric cost, the PSE billing data showed lower gas costs than provided by the American Community Survey. Unfortunately, this data was not disaggregated by fuel access, making it impossible to compare the overall fuel cost.

Table 18. Fuel Expenses for Manufactured and Single Family Households

	PSE Service Territory		Washington	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Mean gas bill	$1,110[a]	$1,140	$1,038	$1,067
Median gas bill	$846	$960	$744	$864
Mean electric bill	$1,778[b]	$1,732	$1,749	$1,730
Median electric bill	$1,488	$1,476	$1,488	$1,476
Data source	American Community Survey			

[a] Cadmus calculated the mean gas bill based on manufactured homes energy consumption data provided by PSE. We calculated the mean annual gas expenses to be $538.

[b] Cadmus calculated the mean electric bill based on manufactured homes energy consumption data provided by PSE. We calculated the mean annual electric expenses to be $1,417.

Resident Demographics – Ownership, Age, Ethnicity, Education, and Language

Both the American Community Survey and the Residential Characteristics Survey provide information on manufactured home residents' homeownership status. While the surveys provide slightly different estimates, the overall story is consistent: as shown in Table 19, manufactured home residents are slightly more likely to rent their homes than single family home residents.[18]

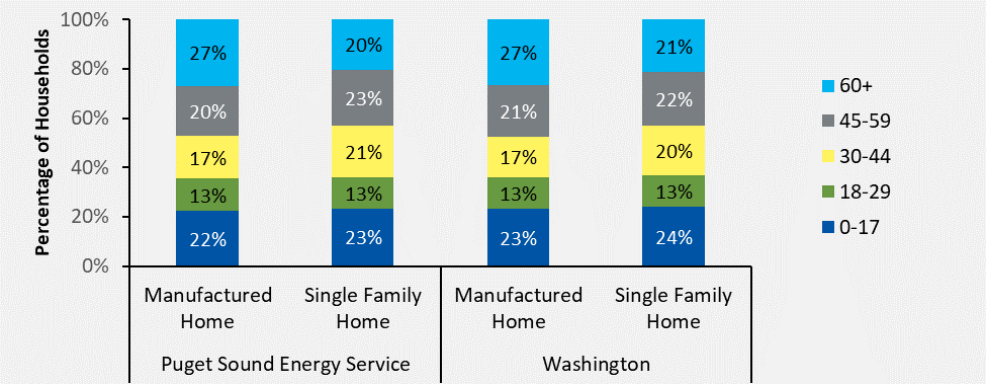
Table 19. Homeownership Status

Ownership Type	PSE Service Territory		Washington		PSE Service Territory		
	Manufactured Home	Single Family	Manufactured Home	Single Family	Manufactured Home	Single Family	Multifamily
Owned	74%	82%	74%	81%	66%	71%	40%
Rented	26%	18%	26%	19%	34%	29%	60%
Data Source	American Community Survey				Residential Characteristics Survey		

The American Community Survey (Figure 8) shows that the distribution of age categories skews slightly older for residents of manufactured homes than residents of single family homes, both in PSE service territory and in Washington overall.

[18] The American Community Survey and Residential Characteristics Survey did not gather information on if residents of manufactured homes owned the land on which their home is located. The online customer survey found that while most manufactured homes residents owned their homes, many do not own the land on which their home is located.

Figure 8. Age Distribution of Manufactured Homes and Single Family Homes Residents



Additionally, the American Community Survey provides information about the racial characteristics of manufactured home and single family home residents. Table 20 shows that overall, most manufactured home and single family home residents (both in PSE service territory and in Washington) are white. The table also shows that residents of manufactured homes are more likely to be black or Hispanic and less likely to be Chinese than residents of single family homes.

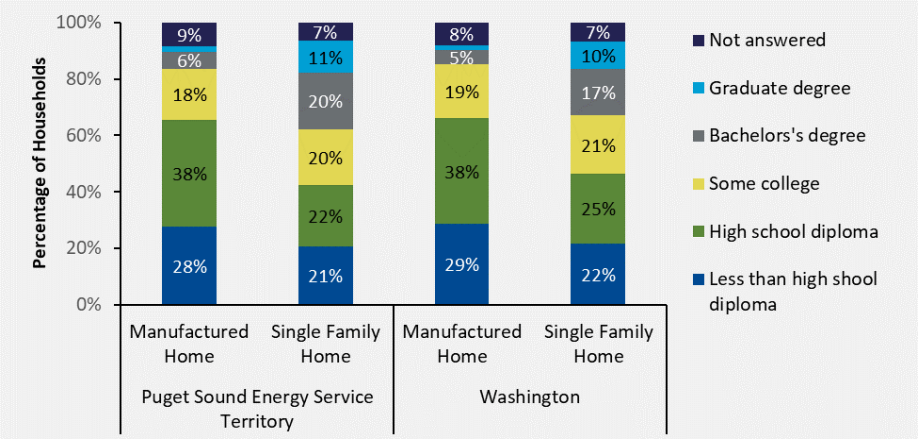
Table 20. Race/Ethnicity of Manufactured Home and Single Family Home Residents

Race/Ethnicity	PSE Service Territory		Washington	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
White	77%	76%	79%	80%
Black	13%	2%	12%	3%
American Indian or Alaska Native	3%	5%	4%	5%
Chinese	3%	9%	2%	6%
Other	3%	5%	3%	5%
Two major races/ethnicities	0%	3%	0%	2%
Three or more major races/ethnicities	0%	1%	0%	1%
Hispanic[a]	27%	8%	25%	10%
Data source	American Community Survey			

[a] Residents may be of any race and report Hispanic ethnicity.

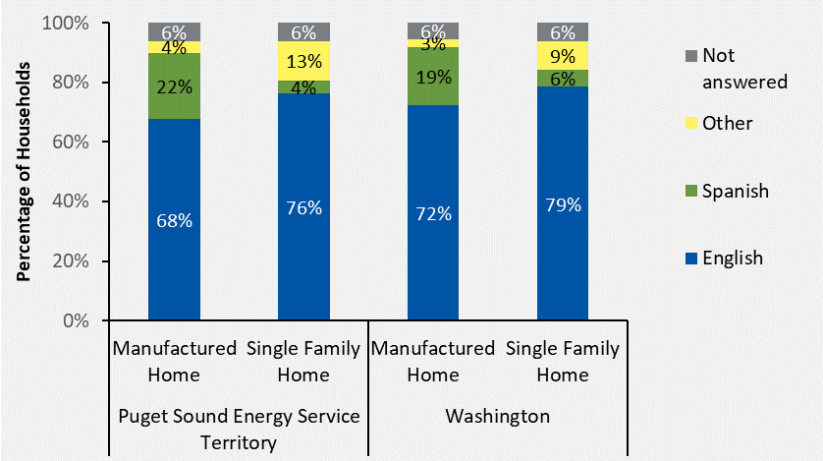
According to data from the American Community Survey, manufactured home residents both in PSE service territory and in Washington are less likely to have achieved higher education degrees than residents of single family homes. As shown in Figure 9, manufactured home residents are also more likely to have less than a high school diploma than single family home residents and are less likely to have achieved more than a high school education.

Figure 9. Education Level of Manufactured Home and Single -Family Home Residents



Spanish is more likely to be the first language spoken in a manufactured home than in a single family home. According to the American Community Survey, and as shown in Figure 10, Spanish is the first language spoken in 22% of manufactured home households in PSE service territory, compared to 4% in single family homes. However, other languages, such as Russian, Hindi, Chinese, and Japanese are more likely to be the first language spoken in single family households.

Figure 10. First Language Spoken in Manufactured and Single Family Homes



Using data from the American Housing Survey, manufactured homes have a higher rate of residents with a disability of any kind compared to single family homes, as shown in Table 21.

Table 21. Percentage of Single Family and Manufactured Homes with a Person with Disability

Percentage of Households with Disabled Persons	National		SBT-MSA	
	Manufactured Home	Single Family	Manufactured Home	Single Family
With a person with disability	34%	21%	31%	17%
Without a person with disability	64%	76%	63%	78%
Not reported	2%	3%	6%	5%
Data source	American Housing Survey			

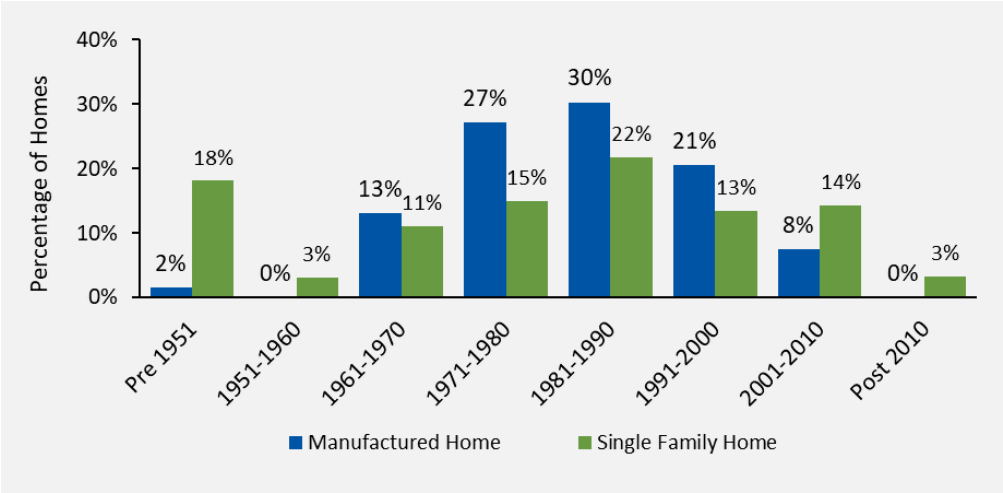
Dwelling Characteristics

This section provides information about the characteristics of manufactured homes in PSE's service territory. These characteristics include building information, such as the age, heating fuel, mechanical characteristics, envelope, lighting, and appliance saturations. This section primarily relies and data from the RBSA II, the Residential Characteristics Survey, and the American Community Survey.

Building Information

According to data collected during site visits for the RBSA II, most manufactured homes in PSE's service territory were constructed between 1981 and 1990. While most single family homes included in site visits for the RBSA II were also constructed during those years, single family homes had a wider distribution of vintages than manufactured homes, and therefore a higher probability of being older and of being newer. The RBSA II's age distribution of manufactured and single family homes is shown in Figure 11.

Figure 11. Age of Manufactured and Single Family Homes – RBSA II Data



The RBSA II also binned manufactured homes according to three Department of Housing and Urban Development (HUD) code timelines: pre-1976, 1976 to 1994, and post-1994. According to the data 36% of the manufactured homes were constructed before 1976, 38% between 1976 and 1994, and 25% after 1994.

PSE's Residential Characteristics Survey also collected information about the age of manufactured and single family homes. While the survey does show a small fraction of manufactured homes being constructed in the last five years, the survey also shows a similar distribution to the RBSA II data: most manufactured homes are between 16 and 25 years (Table 22).

Table 22. Age of Manufactured and Single Family Homes – Residential Characteristics Survey

Age of Home	Manufactured Home	Single Family Home
0 to 5	1%	6%
6 to 15	8%	19%
16 to 25	60%	49%
26 to 50	31%	24%
50+	0%	3%

Mechanical Systems Characteristics

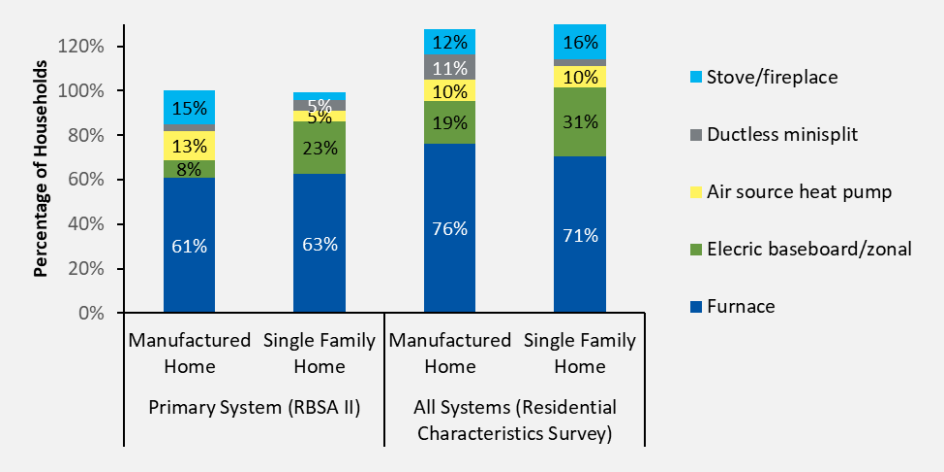
Both the American Community Survey and the RBSA II provide information about the heating fuel for manufactured and single family homes in PSE's service territory. The American Community Survey shows all heating fuels used in a home, while the RBSA II shows the primary heating fuel. As shown in Table 23, manufactured homes primarily relied on electricity as a heating fuel, while single family homes primarily used gas. Additionally, wood was frequently used as a heating fuel in manufactured homes, and the RBSA II site visit data indicates that wood was used as the primary heating fuel in 13% of the homes visited in PSE's service territory.

Table 23. Heating Fuel in Manufactured and Single Family Homes

Heating Fuel	PSE Service Territory		Washington		PSE Service Territory	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Electricity	77%	31%	78%	41%	75%	37%
Utility gas	7%	56%	6%	47%	13%	59%
Bottled, tank, or liquefied petroleum gas	5%	5%	3%	4%	0%	1%
Fuel oil, kerosene, other liquid fuels	0%	3%	0%	3%	0%	2%
Wood	9%	4%	11%	5%	13%	1%
Other	1%	0%	1%	1%	0%	0%
Data source	American Community Survey				RBSA II	

Both the RBSA II and the Residential Characteristics Survey collected information about the heating systems used in manufactured and single family homes. As with heating fuel, the RBSA II data provides information about the primary system and the Residential Characteristics Survey provides information about all systems used to heat the home. Figure 12 shows that most homes were heated with furnaces, both in manufactured and single family homes. The data also shows that 13% of manufactured homes used air-source heat pumps (ducted and ductless) as primary heating systems. At the same time, stoves and fireplaces continued to be a heating system used by many homes.

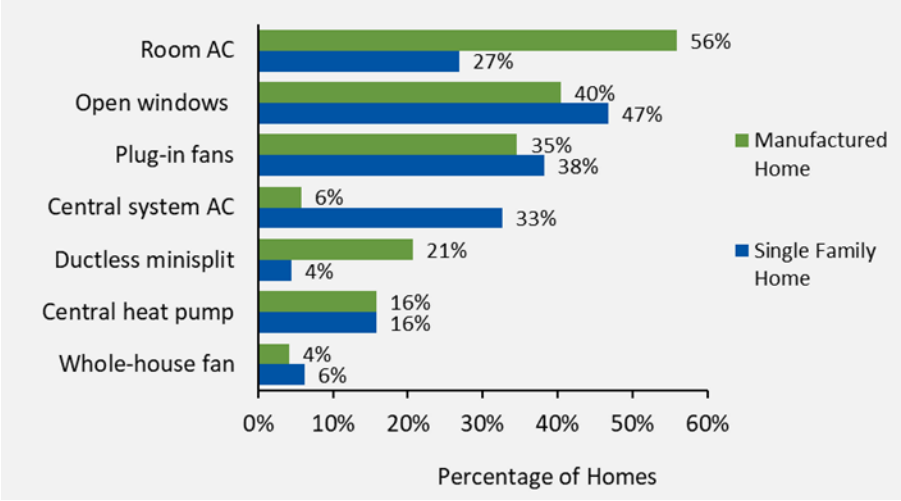
Figure 12. Heating Systems Used in Manufactured and Single Family Homes



During RBSA II site visits, engineers confirmed if manufactured and single family homes in PSE service territory used cooling systems. The proportion of homes using cooling systems was slightly higher for manufactured homes than for single family homes. Forty-nine percent of manufactured homes used cooling systems, compared to only 43% of single family homes.

The Residential Characteristics Survey asked how respondents cooled their home (see Figure 13). According to survey results, manufactured homes had a higher incidence of room air conditioners and ductless heat pumps, whereas single family homes were more likely to use a central air conditioning system.

Figure 13. Cooling Systems Used in Manufactured and Single Family Homes – Residential Characteristics Survey



The American Housing Survey asks households about the adequacy of their housing and about housing deficiencies, as reported in Table 24. Manufactured homes in the Seattle Metropolitan statistical area

had a higher rate of reporting signs of cockroaches, holes in floors, and cracks or holes in the interior than single family homes.

Table 24. Selected Housing Deficiencies in Single Family and Manufactured Homes

Percentage of Households with Deficiency	SBT-MSA		National	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Signs of mice or rats inside home in last 12 months	6%	7%	24%	14%
Signs of cockroaches in last 12 months	3%	0%	15%	10%
Holes in floors	5%	1%	4%	1%
Open cracks or holes (interior)	10%	6%	9%	5%
Broken plaster or peeling paint (interior)	2%	1%	2%	2%
No electrical wiring	0%	0%	0%	0%
Exposed wiring	5%	4%	3%	3%
Rooms without electric outlets	0%	2%	2%	2%
Data Source	American Housing Survey			

Envelope, Lighting, and Appliances Characteristics

During RBSA II site visits, engineers estimated the insulation levels of manufactured and single family homes in PSE's service territory. As shown in Table 25, the RBSA II data shows that manufactured homes had lower average wall and ceiling insulation but more floor insulation.

Table 25. Insulation Levels of Manufactured and Single Family Homes

Insulation Surface (Insulation metric)	PSE Service Territory		Washington	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Wall (R-value)	8.8	9.1	9.6	8.6
Floor (R-value)	14.1	11.1	15.4	11.7
Ceiling (R-value)	12.0	14.9	13.0	15.0
Window (U-factor)	0.6	0.5	0.6	0.5
Data source	RBSA II			

Engineers also collected information about the light bulbs used in manufactured and single family homes in PSE's service territory. As shown in Table 26, this distribution of bulb types is relatively consistent between home types, where LEDs average one-third of the bulbs in use.

Table 26. Distribution of Light Bulbs in Manufactured and Single Family Homes

Bulbs Used	PSE Service Territory		Washington		Regional	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Compact fluorescent	25%	28%	28%	26%	27%	26%
Light emitting diode	33%	27%	20%	24%	18%	20%
Incandescent	27%	33%	37%	35%	39%	39%
Halogen	5%	6%	7%	8%	7%	7%
Linear fluorescent	8%	5%	7%	6%	7%	7%
Other	2%	2%	2%	2%	2%	1%
Data source	RBSA II					

During RBSA II site visits, engineers also collected information about appliances used in homes. As shown in Table 27, manufactured homes have, on average, fewer appliances of all types.

Table 27. Average Number of Appliances per Manufactured and Single Family Homes

Appliance	PSE Service Territory		Regional	
	Manufactured Home	Single Family Home	Manufactured Home	Single Family Home
Dishwasher	0.6	0.8	0.8	0.9
Clothes washer	0.9	1.0	1.0	1.0
Clothes dryer	0.8	1.0	0.9	0.9
Freezer	0.3	0.4	0.4	0.4
Refrigerator	1.1	1.4	1.2	1.3
Water heater	1.0	1.0	1.0	1.0
Data source	RBSA II			

As shown in Table 28, manufactured homes in all regions have less average blower door airflow than single family homes, as measured in cubic feet per minute at 50 pascals of pressure. However, when adjusting for building size, the overall airtightness of manufactured and single family homes is very similar.

Table 28. Average Blower Door Airflow by Region for Manufactured and Single Family Homes

State/Region	Blower Door Airflow	
	Manufactured Homes	Single Family Homes
Washington	1,581	2,193
Region	1,506	2,241
PSE	1,455	2,212
Data source	RBSA II	

The blower door airtightness of manufactured homes represented in air changes per hour in PSE service territory is comparable to the airtightness in single family homes, as shown in Table 29.

Table 29. Average Blower Door Airtightness by Region for Manufactured and Single Family Homes

State	Manufactured Homes	Single Family Homes
	Blower Door Airtightness (ACH50)	
Washington	9.8	8.7
Region	8.9	8.9
PSE	9.3	9.2
Data source	RBSA II	

Billing Analysis

Cadmus reviewed energy consumption data for the 363 customer homes that we verified as being manufactured homes through our geospatial analysis. We were able to leverage electric billing data for 342 of these homes and gas billing data for 23 of these homes. Cadmus compared the billing analysis estimates to estimates of homes in Washington using the energy consumption analysis from the RBSA II.

Manufactured Homes Electric Consumption

Cadmus determined that a manufactured home consumes, on average, 14,229 kWh per year, which is lower than another study had estimated in 2003.[19] The estimated energy use intensity (EUI) in our current estimate was 11.2 kWh per square foot. Additionally, we found that electrically heated homes consume approximately 8,664 kWh more than homes heated with other fuels, as shown in Table 30.

Table 30. Electric Consumption of Manufactured Homes

Heating Fuel	n	Annual Consumption (kWh)	Average Square Footage	EUI (kWh/sq ft)
Electricity	311	15,014	1,263	11.9
Electric Space Heating	311	8,444	1,263	6.7
Non-Electric	31	6,350	1,405	4.5
All Fuels	342	14,229	1,276	11.2

Manufactured Homes Gas Consumption

Of the 363 verified manufactured homes, Cadmus was able to review the gas consumption of 23 homes. As shown in Table 31, gas-heated manufactured homes consumed, on average, 588 therms per year.

Table 31. Gas Consumption of Manufactured Homes

Heating Fuel	n	Annual Consumption (therms)	Average Square Footage	EUI (therms/SQFT)
Gas	23	588	1,257	0.44

[19] A 2003 study found that manufactured homes consumed, on average, between 15,717 kWh (in the park) and 19,963 kWh (outside the park). See: Reichmuth, Howard. December 2003. "Independent M&V Report - Puget Sound Energy Manufactured Home Duct Sealing (MHDS) Program." Prepared for UCONS, LLC.

Manufactured Homes Energy Consumption Benchmarks

Cadmus compared the results of the billing analysis to energy consumption estimates for single family homes in Washington from the RBSA II study. The assessment revealed that electric consumption for space heating is slightly higher for PSE manufactured homes than for single family homes in Washington, and that the EUI for electrically heated PSE manufactured homes is slightly higher than for Washington single family homes. The gas consumption of homes heated with gas is slightly higher for single family homes in Washington than for PSE manufactured homes.

Table 32 shows the energy consumption for manufactured and single family homes, the EUI for electrically heated manufactured and single family homes, and the annual consumption of electric heating for both types of homes. The table also shows the gas consumption of manufactured and single family homes. Because kBTU is heavily driven by gas use, overall kBTU per square foot is lower in manufactured homes than in single family homes because of the relatively limited use of gas heating in manufactured homes.

Table 32. Comparative Energy Consumption: Manufactured and Single Family Homes

Home Type	Annual Electric Consumption (kWh) – all homes and fuel types	Electric EUI (kWh/SQFT) - Electrically Heated Homes	Annual Consumption of Electric Space Heat	Annual Gas Consumption (therms) – Gas Heated Homes	Gas EUI (therms/SQFT) – Gas Heated Homes	kBTU EUI (kBTU/SQFT) – All Homes
Manufactured[a]	14,229	11.9	8,444	588	0.44	38.6
Single Family[b]	12,306	11.3	8,265	693	0.37	44.4

[a] This represents manufactured homes in PSE's service territory based on the billing analysis (n = 342).

[b] This represents single family homes in Washington, based on RBSA II analysis (n = 501 for electric consumption, n=265 for gas consumption, n=474 for kBTU consumption).

Stakeholder Interviews

This section details the results of Cadmus' in-depth interviews with 10 stakeholders. We began each interview with an overview of each stakeholder's organization and their prior experience related to energy efficiency in the manufactured homes market. The interviews were free-flowing and semi-structured to allow stakeholders to discuss anything they felt was relevant but were centered around three key topics: examples of successful energy efficiency initiatives for manufactured homes, challenges and barriers to increased energy efficiency in manufactured homes, and opportunities for increased energy efficiency in manufactured homes.

Challenges and Barriers

Cadmus asked stakeholders about challenges and barriers to increased energy efficiency in the manufactured homes market. Almost every stakeholder mentioned financial barriers, citing the upfront costs associated with many energy efficiency projects as being challenging for a market segment with a lower average income. Other barriers identified included low motivation (not enough time or too much

hassle), lack of awareness of existing programs and of the benefits of energy efficiency, and the limited investment value of energy-efficient upgrades to manufactured homes.

Financial Barriers

While stakeholders identified several challenges and barriers to increased energy efficiency in manufactured homes, nine of the 10 interviewed stakeholders mentioned financial barriers, and five of those stakeholders specified that finances were the primary barrier. Stakeholders referenced lower average incomes among manufactured homes residents, leaving less discretionary funds available to invest in energy efficiency projects. One contractor explained that the biggest barrier was "upfront cost… somebody calls and says they want [energy efficiency services]… when we say how much it costs, that's when the call ends." Another stakeholder suggested that, "the vast majority of this segment is low to moderate income…so that first cost is really the barrier to entry in [energy efficiency programs]."

Stakeholders offered differing opinions regarding whether effective energy efficiency programs targeting manufactured homes should be reduced cost (through rebates) or free for the participant. Five stakeholders (encompassing four contractors and one advocacy group) believed that an effective energy efficiency program for manufactured homes needed to be cost free. One contractor clarified by saying, "there's tons of opportunity, but [even an] aggressive rebate…it's just not enough…they just don't have the finances typically." Three stakeholders (two implementers and one advocacy group) disagreed and said cost-reduced energy efficiency programs for manufactured homes can be effective. One implementer referenced a program they were previously involved with where "we got the rebate set right and [people] said 'oh, I can probably do that.'"

Motivational Barriers

In addition to financial barriers, several stakeholders discussed motivational barriers that inhibited some manufactured home customers from pursuing energy efficiency projects. Four stakeholders (two advocacy groups and two implementers) identified a lack of time to facilitate an energy efficiency project, the "hassle factor" of completing a home project, and reservations about having people in their home. One advocacy group expanded to specify that in addition to the "hassle factor," some seniors were reluctant to participate for fear of being conned. An implementer said there were "psychological factors" in some cases where manufactured homes residents did not want people coming in their home if there "could be something going on in the house, or they are ashamed the house is messy."

One stakeholder (an implementer) said that some manufactured home residents were reluctant to pursue energy-efficient upgrades if they did not know the cost of a project ahead of time. This stakeholder thought residents assumed they could not afford upgrades and did not want to have a contractor come to their home to provide a quote for a project they could not afford. The stakeholder clarified that marketing a fixed price for an upgrade was preferable to marketing the available rebates. As they explained, "the [typical rebate] program says 'we have an incentive, call a contractor,' but [some manufactured home residents] don't want to be embarrassed [by not being able to afford a quoted price], they don't want to waste people's time… if you say '$1,000 out of pocket' then some of these folks will realize they can find a way to complete the project."

Awareness Barriers

Four stakeholders (two implementers and two advocacy groups) identified awareness barriers that limited energy efficiency in manufactured homes. These barriers included lack of awareness of existing energy efficiency programs available for the manufactured homes market (cited by three), lack of awareness of the benefits of energy efficiency overall (cited by two implementers and one advocacy group), and lack of awareness of energy efficiency opportunities among the Spanish-speaking population due to language barriers (cited by one advocacy group and one implementer).

One implementer said, "The big one…is just getting people [to know] about the program, that's the biggest hurdle." One advocacy group explained the barrier to Spanish-speakers by saying, "extra [energy efficiency education] should be available for Spanish-speakers who aren't able to understand education [offered] only in English." Finally, one implementer specified that effective duct sealing is very important for manufactured homes, but it's "one of those tricky things because it's hard to describe and many people are unaware of its benefits."

Investment Value of Upgrades

Stakeholders also identified limitations on the investment value of home upgrades as another barrier to increased energy efficiency in manufactured homes. Two stakeholders suggested that making energy-efficient upgrades to a manufactured home may not improve the value of the home in the same way it would improve the value of a single family home. Both these stakeholders were concerned that some manufactured homes—especially older manufactured homes—are diminishing assets and homeowners may be reluctant to invest in their property.

One implementer explained their dilemma when considering energy-efficient improvements to an older manufactured home: "You run into this interesting debate where it's like…'sorry your bill is really high, but we don't think this [manufactured home] is going to be here in five years.'" Another stakeholder said energy efficiency programs for manufactured homes needed to focus more on the comfort and health benefits rather than on the financial benefits since "it can't be thought of like an investment…it's not going to increase the value of the home much."

Quality Assurance Concerns with Weatherization Measures

Most of the barriers mentioned by stakeholders to increased energy efficiency in manufactured homes involved decisions about whether to make energy-efficient improvements. However, some stakeholders also questioned whether energy-efficient measures were always installed adequately in manufactured homes to achieve the desired energy savings. Three stakeholders (one implementer, one contractor, and one advocacy group) expressed concerns that energy efficiency programs for manufactured homes do not always require an adequate amount of quality assurance to ensure the proper installation of program measures. As one advocacy group explained, "it's important…that programs delivered to manufactured homes…be high quality… [having quality control inspections on too few homes] can lead to problems."

These stakeholders felt that belly/floor insulation, attic insulation, and duct sealing required separate knowledge and experience to install properly in manufactured homes as opposed to single family

homes. One implementer clarified, saying "unless a utility wants to commit to 100% quality control on [insulation measures in manufactured homes], they're probably smart not [offering] it." One contractor who was discussing duct sealing and insulation installation in manufactured homes believed that "being conscientious of QA/QC [will] ensure that contractors are getting the work done correctly."

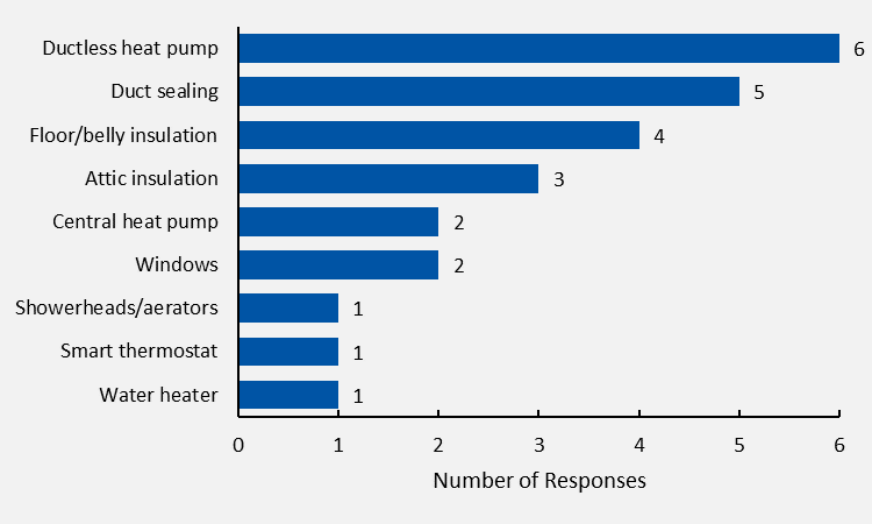
Best Practices and Opportunities

Each stakeholder also talked about the best practices and greatest opportunities for increasing energy efficiency in manufactured homes, including the most effective measure(s) to prioritize. Stakeholders also provided suggestions for successfully marketing an energy efficiency program targeting the manufactured homes market and their opinions of the opportunities for financing energy efficiency projects in manufactured homes.

Most Effective Measures

All 10 stakeholders reported one or more measures that provide effective opportunities for increased energy efficiency in manufactured homes, shown in Figure 14.

Figure 14. Most Effective Measures for Increased Energy Efficiency



Ductless Heat Pumps/Central Heat Pumps

The measure chosen as the best fit for manufactured homes by the greatest number of stakeholders (six of 10) was a ductless heat pump, and a central heat pump was selected by an additional two stakeholders. Advocates for ductless heat pumps said the layout of typical manufactured homes and the existence of electric resistance heating in most manufactured homes made this home type ideal for achieving energy savings through the installation of a ductless heat pump. As one contractor explained, "given the layout of a manufactured home, the ductless heat pump is essentially a perfect design." An implementer expanded on the benefits of ductless heat pumps in manufactured homes saying, "for a home with lousy ducts ([like] a manufactured home), you can't find a better fit for a heating system than a ductless heat pump."

While there was general agreement that replacing electric resistance heating with heat pumps (ductless or central) was beneficial, four stakeholders (two implementers and two advocacy groups) had concerns that ductless heat pumps are not always used efficiently. An implementer contended, "In very few homes do [ductless heat pumps] actually get the savings that they should, and a lot of that is behavioral." These stakeholders said manufactured home residents often continued to use their electric resistance heat after a ductless heat pump was installed. While decommissioning older heating system is an option, stakeholders did not believe this to be common practice.

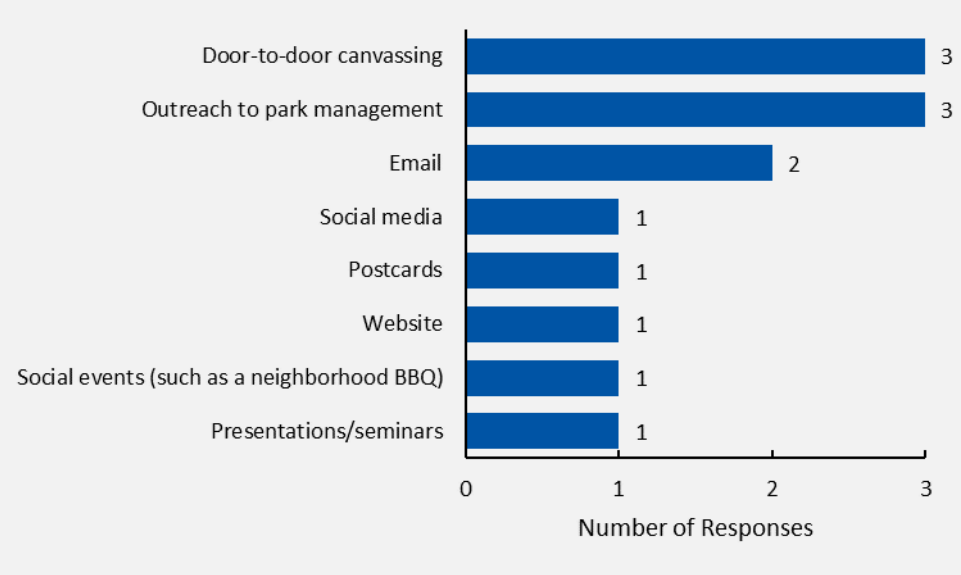
Building Retrofit Measures

Stakeholders also frequently chose building retrofit measures as being good fits for manufactured homes, such as duct sealing (five stakeholders), floor/belly insulation (four stakeholders), and attic insulation (three stakeholders). Stakeholders explained that the ductwork underneath a manufactured home is often in poor condition and prone to significant leaks. An advocacy group explained that "the biggest [opportunity for savings] I see is underneath the home…the ductwork, the skirting…all of the heating systems run underneath the home." Stakeholders also explained that there are fewer opportunities for insulation in a manufactured home compared to a site-built home, which makes the existing opportunities for insulation even more important. One contractor explained the long-term benefits of properly installed insulation, "it's great because we do it once and it's good for the life of the home." Another contractor said the priority for installing effective measures in manufactured homes is "duct sealing, then floor insulation, then attic insulation."

Marketing Approaches

Cadmus asked stakeholders about the most effective ways to market energy efficiency programs for manufactured homes. Stakeholders provided a variety of responses, shown in Figure 15, and most frequently suggested to take advantage of the economies of scale available for outreach in manufactured home parks.

Figure 15. Most Effective Marketing Approaches



Door-to-Door Canvassing

Six stakeholders (three contractors, two advocacy groups, and one implementer) recommended marketing within manufactured home parks, though their suggested approaches varied. All six of these stakeholders believed it was important to take advantage of the economies of scale available within manufactured home parks, as it would be more efficient to concentrate outreach to parks where many manufactured homes are clustered together geographically.

Three stakeholders suggested starting with door-to-door outreach within manufactured home parks. One advocacy group noted, "the most successful [marketing approach] is to go door to door…the people in the community all know each other and the word will get around." Three other stakeholders recommended canvassing in manufactured home parks by starting with outreach to park management. After communicating with park management, these stakeholders suggested marketing to park residents through community newsletters, bulletin boards, and door-to-door canvassing. One contractor explained, "what has been successful is [first] making sure to get park management on board…and utilize their bulletin boards or newsletters to get the word out…and then canvass[ing] door-to-door."

Other Marketing Methods

Stakeholders recommended additional marketing approaches including social media, neighborhood events, presentations/seminars, postcards, websites, and emails. Two stakeholders (one implementer and one contractor) noted challenges with email targeting the manufactured homes market. Both stakeholders said they received lower response rates from email marketing campaigns targeting manufactured homes compared to email marketing that targeted other market segments. One contractor explained, "email marketing is one of the struggles…when we email [manufactured homes] we're not getting the same response rate…we may send [the email] to a whole community and only get a few signups."

Measure Financing

All the interviewed stakeholders agreed that the availability of financing would help manufactured home customers increase the energy efficiency of their home by helping them overcome the associated financial barriers. One contractor explained, "the potential [for financing] is great…if you can reduce people's upfront costs you would see an uptick in [energy efficiency program] participation."

Cost-Free versus Cost-Reduced

Despite agreeing on the benefits and opportunities afforded through financing, several stakeholders disagreed about whether there were viable options for financing available to manufactured home residents. Three stakeholders (one advocacy group and two contractors) identified existing financing opportunities for energy efficiency projects available through banks or credit unions. Each of these stakeholders identified Puget Sound Cooperative Credit Union's Energy Smart Loans as a financing option they recommended to manufactured home customers. As one contractor explained, "we'll run these jobs through PSCCU's Energy Smart Loans that are pretty easy to get…it's a great option for [manufactured home residents]."

Three other stakeholders (two implementers and one advocacy group) said banks were typically reluctant to lend to manufactured home customers—especially if the customer leased the land where their home was located (which is typical for homes located in manufactured home parks). These stakeholders were doubtful that many manufactured home customers would be approved for financing. One implementer said, "[typical manufactured home customers] don't have equity in their home or own the land, so what can they really borrow?"

Online Customer Survey

The online survey asked manufactured home customers about their awareness of and participation in PSE's conservation programs, barriers and opportunities for taking part in programs, household characteristics, and the manufactured homes' characteristics. The text and charts provide the number of respondents for each question, which varies for each question asked because respondents sometimes skip questions. While not every survey participant answered each question, 337 manufactured homes customers completed the survey.

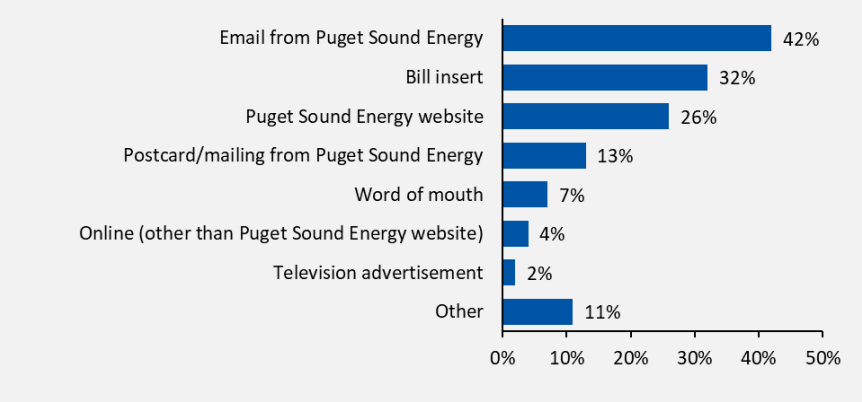
Historical Program Participation and Installation of Efficient Measures

Cadmus asked manufactured home residents if they were aware, before taking the survey, that PSE offered energy efficiency rebates and services. Of the 64% who said they were aware of these offerings (n=319), the largest portion (42%) learned about them from a PSE email.[20] As shown in Figure 16, manufactured home customers also learned about program offerings from bill inserts, online, and through mailings and word of mouth. The "Other" ways listed in the figure in which customers learned

[20] Only customers with email addresses on record by PSE were surveyed for this study. Those without email addresses would not be able to receive communication this way. PSE has email addresses for approximately 54% of its customers in manufactured homes.

about program offerings included from park managers, social media, contractors, newspaper articles, community organizations (such as the Opportunity Council), and direct contact with PSE representatives.

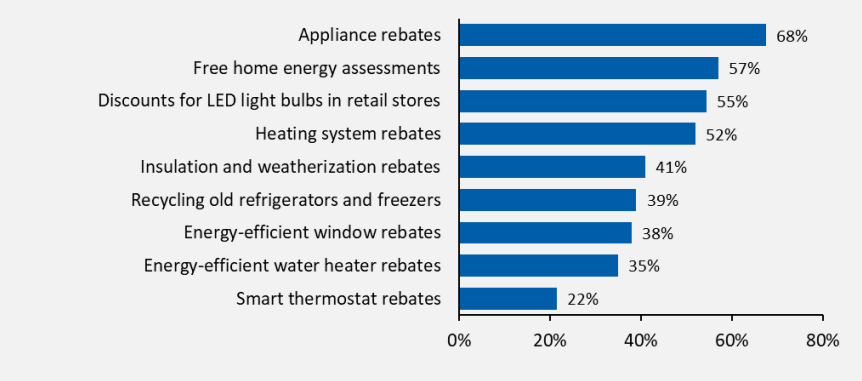
Figure 16. Ways Manufactured Home Customers Learned about PSE Programs



Source: Online Customer Survey Question B2. "How did you learn about PSE's energy efficiency services?" (n=203, multiple responses allowed)

Additionally, Cadmus asked manufactured home customers which PSE energy efficiency offerings were familiar. Respondents indicated being aware of range of offerings, including appliance rebates (68%), home energy assessments (57%), and discounts for LED light bulbs (55%).

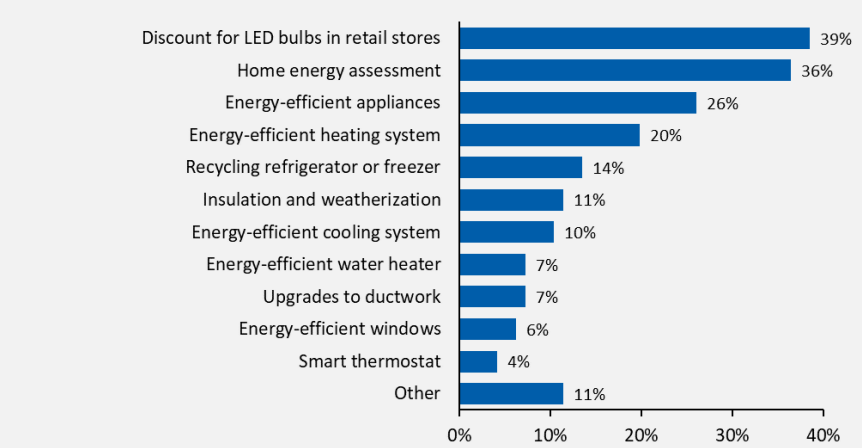
Figure 17. PSE Offerings with which Manufactured Home Customers are Familiar



Source: Online Customer Survey Question B3. "Which PSE energy efficiency services are you familiar with?" (n=200, multiple responses allowed)

Forty-one percent (n=201) of the surveyed customers who knew of PSE's offering said the utility had provided energy efficiency products, rebates, or services to them in the last five years. Additionally, 10% said another organization had provided conservation rebates or services, including the Opportunity Council, Sustainable Connections, and Pierce County. Manufactured home customers said they had received discounted LED bulbs (39%), home energy assessments (36%), and rebates for energy-efficient appliances (26%). Figure 18 show the percentage of manufactured home customers reporting participation in various efficiency offerings (note that this question was only asked of the 103 customers who said they had received rebates or participated in offerings). The "Other" category listed in the figure includes free light bulbs, free showerheads, exchanged light bulbs, and heat pumps.

Figure 18. Energy Efficiency Products, Rebates, or Services Provided in Last Five Years



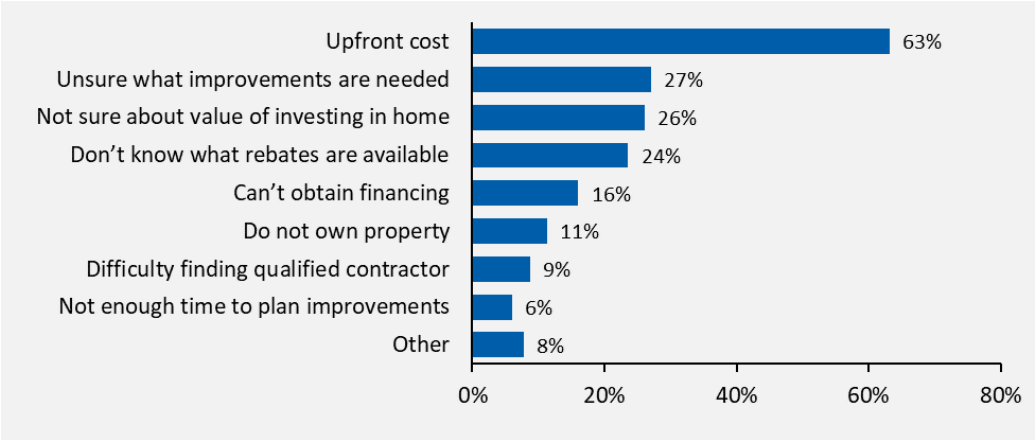
Source: Online Customer Survey Question B5. "What products, rebates, or services did PSE or another agency provide?" (n=96, multiple responses allowed)

Cadmus also asked customers who knew of efficiency offerings but had not participated why they had not participated. Of the 107 respondents who replied to this question, the largest portion (41%) said they could not afford the upfront cost, while 23% said they needed more information, 16% said their home was already as energy efficient as possible, 13% didn't know what options were available, and 9% did not own the property.

Participation Barriers and Opportunities

Cadmus asked manufactured home customers if they experienced challenges in completing energy efficiency improvements and what could help to alleviate those challenges. When asked the biggest challenge to completing efficiency improvements in their manufactured home, 63% of customers cited the upfront cost (Figure 19). The "Other" category of challenges listed in the figure includes the home already being energy efficient, the home not needing improvements, and not facing any challenges.

Figure 19. Challenges and Obstacles to Making Energy Efficiency Home Improvement

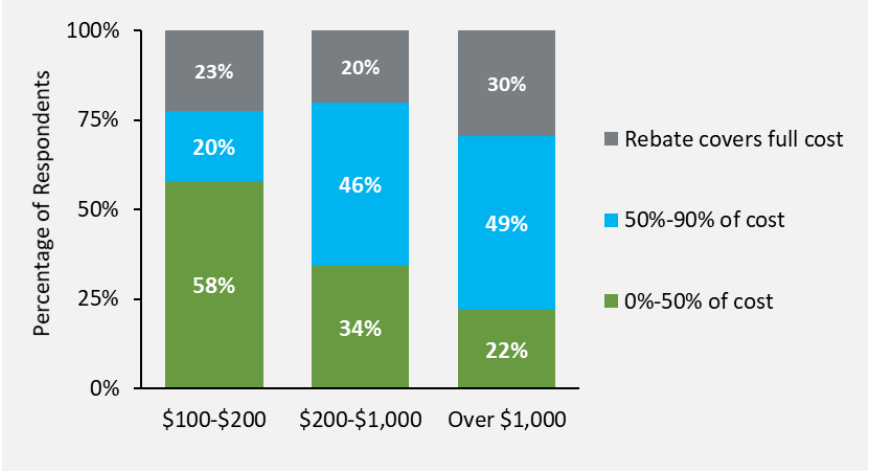


Source: Online Customer Survey Question C1. "What are the biggest challenges or obstacles you face in completing energy efficiency improvements in your home?" (n=318, multiple responses allowed)

When asked what PSE could do to help them overcome these challenges, the largest portion of manufactured home customers (46%, n=311) indicated needing more information about programs and rebates or wanting larger rebates (37%). Respondents also said PSE could provide more information about financing (23%) or about home energy-savings opportunities (20%),[21] or could connect them with a qualified contractor (8%) or simplify the rebate application process (8%).[22] Respondents also suggested that PSE make it easier to connect to a gas service (available in the respondent's area), reduce the cost of contractors, and pay for upfront costs rather than offering rebates. Twenty percent of respondents said there was nothing PSE could to help them overcome barriers to making energy efficiency improvements in their home.

Cadmus then asked manufactured home customers what percentage of an upgrade need to be rebated for them to proceed with the investment. As shown in Figure 20, for smaller projects (up to $200), most respondents said they would move ahead with a project if up 50% were covered. However, for larger projects, especially those over $1,000, most respondent said over 50% of the cost would need to be covered for them to proceed.

Figure 20. Percentage of Cost of Upgrade Needed to be Covered by Rebate



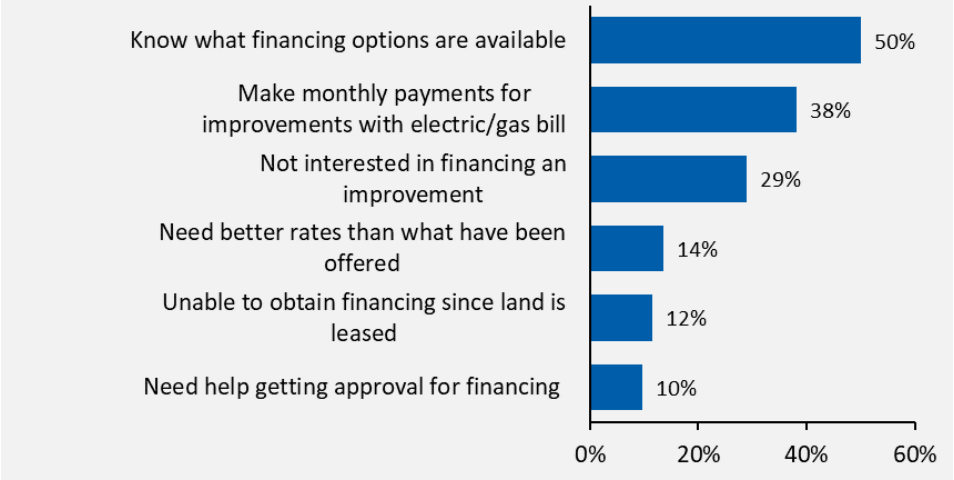
Source: Online Customer Survey Question C3. "What percentage of an improvement's cost would need to be covered by a rebate for you to complete an improvement for each project cost range ($100–$200, $200–$1,000, over $1,000)?" (n=102, n=105, n=102)

[21] Most customers (58%, n=147) said they would prefer to learn about opportunities by email. Other preferred ways of learning about energy savings included direct mail (41%), Puget Sound Energy's website (34%), and individualized suggestions following a home visit (24%).

[22] When asked what could be done to simplify the application process, one respondent said the language in the application forms was "intimidating" and geared toward "mid to high income households." Another respondent said Puget Sound Energy should work more closely with "Community Action Councils" to "streamline the applications for appliance upgrades."

When asked what information or assistance would be helpful when considering financing for energy efficiency home improvements, 50% of respondents said they needed to know what financing options were available and 38% said they wanted to be able to make monthly payments through their PSE bill. As shown in Figure 21, some respondents expressed that they were not interested in financing improvements or said they could not obtain financing since they leased the land where their home was located.

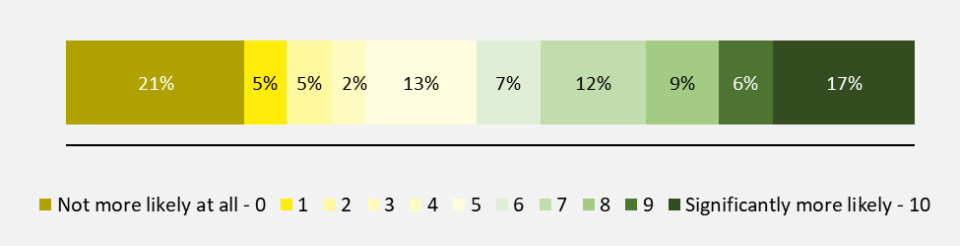
Figure 21. Helpful Information or Assistance Needed for Considering Financing



Source: Online Customer Survey Question C5. "What information or assistance would be helpful to you when considering whether to seek financing for energy efficiency home improvement?" (n=286, multiple responses allowed)

When asked to rate how much more likely they would be to complete an energy efficiency improvement project if financing were available, the largest portion of manufactured customers (21%) said the financing would *not* make them more likely to complete a project. However, many other customers said they would be more likely to complete a project, indicating that financing opportunities could be very helpful to a subset of customers (Figure 22).

Figure 22. Likelihood to Complete Projects if Financing were Available



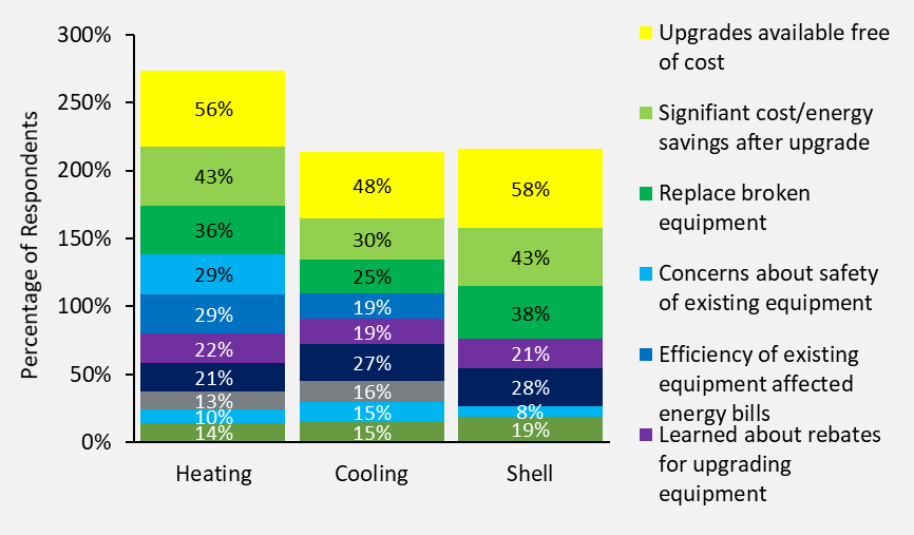
Source: Online Customer Survey Question C6. "How much more likely would you be to complete an energy efficiency improvement in your home if you qualified for financing (and were paying off the cost of the improvement monthly)?" (n=281)

The surveyed manufactured home customers provided details of what circumstances would encourage them to make upgrades to their home, such as to heating equipment, cooling equipment, or the building shell (windows, doors, and insulation). As shown in Figure 23, most manufactured home customers said

they would make upgrades if equipment were available free of cost, followed by if those upgrades created significant cost or energy savings.

Twenty-nine percent of respondents said they would upgrade their heating equipment if they had concerns about the safety of existing equipment. Interestingly, only 36% of respondents said they would replace broken heating equipment (if the cost of new equipment were less than the cost of the repair) and only 38% of respondents said they would replace broken shell equipment, such as broken windows or doors. We interpret these findings to indicate that manufactured home customers assumed that equipment would still be sufficiently operational to make the home habitable or use other equipment available in the home (such as secondary heating equipment). Learning about rebates for upgrades also had a relatively modest impact on whether respondents would upgrade existing equipment. The "Other reasons" for making upgrades included contractor and acquaintance recommendations, as well as the landlord making the investment.

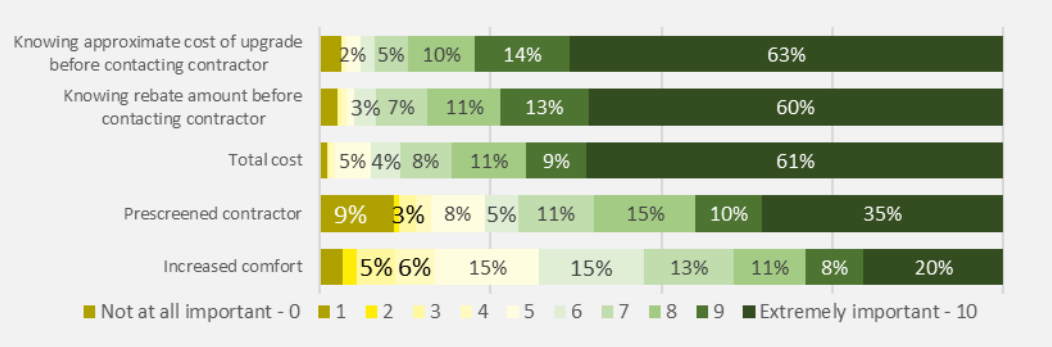
Figure 23. Circumstances under which Manufactured Home Customers Would Upgrade Existing Equipment



Source: Online Customer Survey Questions D1, D2, and D3. "Under what circumstances would you replace your functioning heating equipment?" (n=312); "Under what circumstances would you replace or buy new equipment to cool your home?" (n=312); and "Under what circumstances would you upgrade the efficiency of your home by adding insulation or installing high-efficiency windows or doors?" (n=312; multiple responses allowed for all questions)

Surveyed manufactured home customers responded about the relative importance of various factors on their potential decision to upgrade equipment. As shown in Figure 24, manufactured home customers indicated that having information about equipment costs and about rebate amounts before contacting a contractor were the most important factors in deciding to upgrade equipment. However, having a prescreened contractor was also relatively unimportant.

Figure 24. Importance of Various Factors on Decision to Upgrade Equipment



Source: Online Customer Survey Questions D6, D7, D5, D9, and D8. "How important is increased comfort in your decision to make upgrades to your home?" (n=274); "How important is a prescreened contractor referral in your decision to make upgrades to your home?" (n=269); "How important is the cost of the equipment after rebates in your decision to make upgrades to your home?" (n=279); "How important is knowing the rebate amount for an equipment or home upgrade before contacting a contractor for a quote?" (n=281); and "How important is knowing the approximate cost of an equipment or home upgrade before contacting a contractor for a quote?" (n=287)

Resident Characteristics

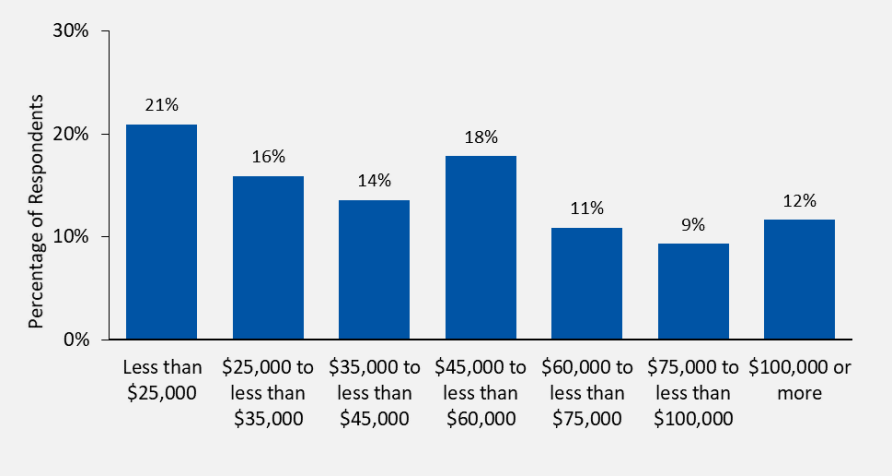
Manufactured home customers answered a limited number of demographic questions, including the number of persons living in the home, the primary language spoken in the home, the household income, and the highest educational level achieved by someone in the home.

Almost half the respondents (47%, n=300) said their household had only two residents year-round. Additionally, 22% of the households had only one resident and 25% had three or four residents (only 5% of respondents said that their household had five or more residents). The persons per home distribution was similar to the distribution reported by the Residential Characteristics Survey.

Respondents reported that English was the primary language spoken in 97% of the households (with Spanish or Laotian being the primary language in the remaining 3% of households). The percentage of Spanish-speaking households was significantly lower for survey respondents than was reported by the American Community Survey. In terms of education, 20% of respondents (n=295) said that the highest education achievement in their households was a high school diploma, while 34% reported having "some college," 33% said someone had an associate's or bachelor's degree, and 14% said someone had a master's or doctorate degree. Survey respondents reported slightly higher educational achievements than reported by the Residential Characteristics Survey.

As shown in Figure 25, most customers reported a household income of less than $60,000 per year. Only 12% of customer reported a household income that exceeded $100,000 per year. The income distribution for survey respondents was relatively similar to the income distribution reported by the Residential Characteristics survey, although the Residential Characteristics Survey reported a high fraction of households earning over $100,000 per year.

Figure 25. Reported Household Income of Manufactured Home Customers



Online Customer Survey Question F4: "Which category best describes your total household income in 2018 before taxes? (n=258)

Dwelling Characteristics

Survey respondents were evenly split between living inside versus outside a mobile home park. Fifty-two percent said their home was located at an independent location while 48% said their home was in a manufactured homes park (n=333). Most survey respondents said they owned their home (85%, n=329),[23] but only 50% owned the land where their home was located (n=332). While survey respondents reported a relatively similar percentage of home ownership compared to the American Community Survey, the reported percentage of manufactured homes in parks was higher than determined through the geospatial review.

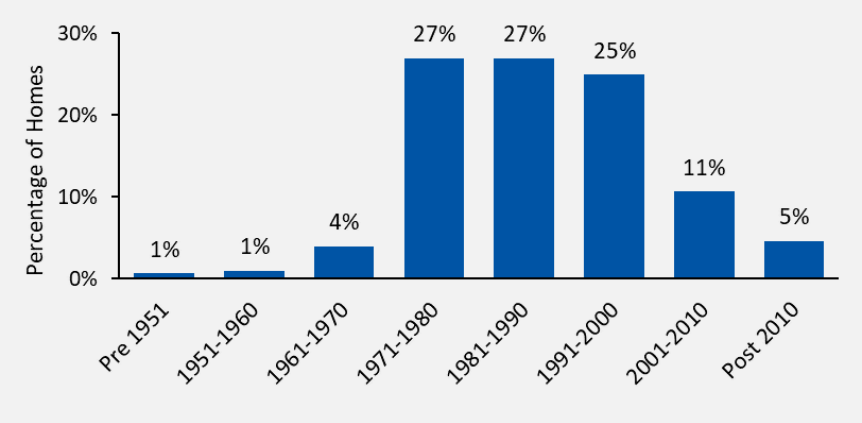
While the distribution regarding homeownership was very similar for manufactured home customers living inside versus outside a park, there were significant difference regarding land ownership: 83% of respondents living inside a park said they rented the land where their home was located compared to 13% of those living in an independent location.

Building Information

Most survey respondents (79%) indicated that their home was built between 1971 and 2000. Very few homes were built before 1971 (6%) and only 16% were built after 2000 (Figure 26). The home age distribution is similar to distribution reported by RBSA II. Additionally, respondents said 69% of homes were double wide, 23% were single wide, and 8% were triple wide (n=335). Although the geospatial review did not identify any triple wide manufactured homes, other aspects of the distribution are similar to what Cadmus found in secondary data review.

[23] Eight percent said they leased their home and 5% said they lived in their home rent free.

Figure 26. Manufactured Home Age



Source: Online Customer Survey Question A7. "In what year was your home built?" (n=300)

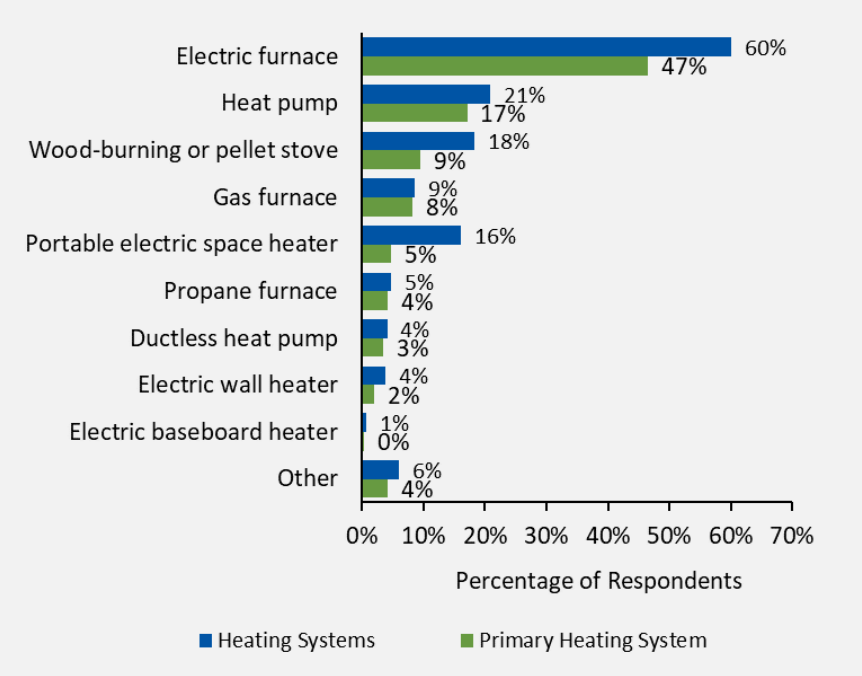
When asked, 22% of respondents said they had lived in their home for less than five years, while 27% had been in their home for between five and 10 years, 24% had lived in their home for between 10 and 20 years, and 27% had been in their home for over 20 years (n=316).

Mechanical Systems

Similar to the secondary data review finding that manufactured homes primarily rely on electricity as their fuel, eighty-three percent of survey respondents (n=333) said they did not have natural gas service at their home. Of those who did have gas service, 8% said PSE provided gas service and 8% said another utility provided gas service. Respondents living in parks were slightly more likely (21%) to have natural gas service than respondents living in independent locations (12%).

Cadmus asked manufactured home customers what type of equipment they used to heat their home and, when respondents identified multiple heating equipment types, we asked which was the primary source of heating. As illustrated in Figure 27, most respondent used electric furnaces as their primary heating source. An additional 17% of respondents used ducted heat pumps, but relatively few used ductless heat pumps in their home. These responses are similar to the RBSA II findings regarding manufactured homes' primary heating equipment.

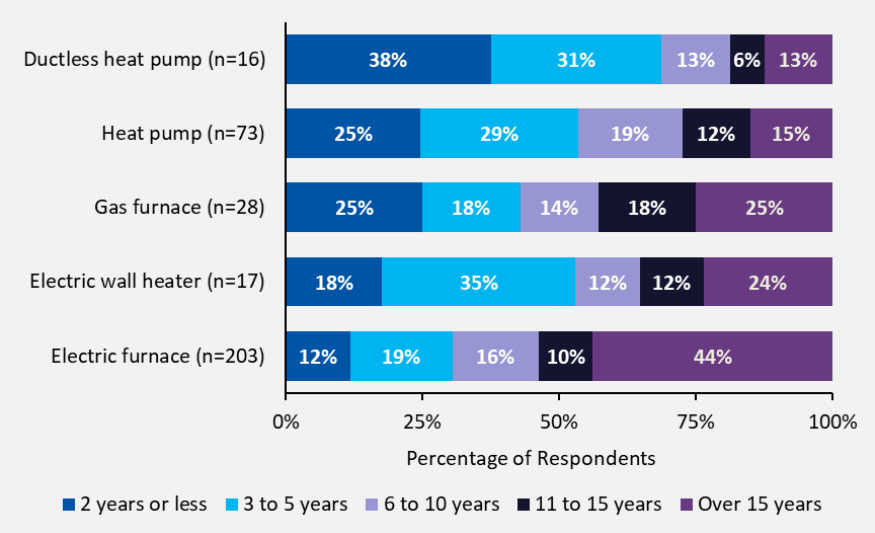
Figure 27. Manufactured Home Heating Source



Source: Online Customer Survey Questions E8 and E9. "What type of equipment do you use to heat your home?" (n=316, multiple responses allowed); and "Of the equipment that you use to heat your home, which is the primary source of heating?" (n=316)

Manufactured home customers also provided the age of their heating equipment. As shown in Figure 28, while there were relatively few ductless heat pumps in respondents' manufactured home, these heating systems were the newest. Electric furnaces, which were the most frequently used system by manufactured home customers, were also the oldest and had the most opportunity to be replaced with newer, efficient equipment.

Figure 28. Age of Heating Equipment



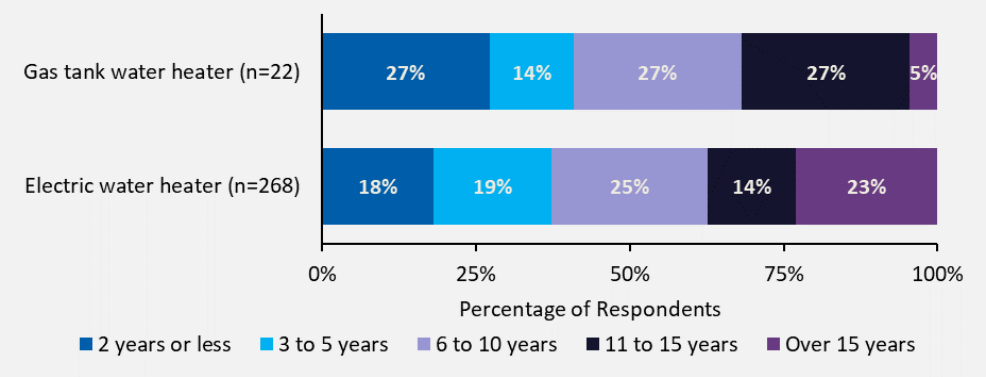
Source: Online Customer Survey Question E10. "About how old is your [heating equipment]?"

Manufactured home customers indicated using fans as the primary mode of cooling their home (51%, n=317; multiple responses allowed). Additionally, 34% said they used room air conditioners, 24% used heat pumps (ducted and ductless), and 6% used central air conditioners to cool their home. Eleven percent of respondents said they did not use any equipment to cool their home. The percentage of respondents reporting using room air conditioners and heat pumps was lower than the percentages reported by the Residential Characteristics Survey.

When asked, 67% of manufactured home customers said they did not regularly use a contractor to maintain their heating and cooling equipment. Additionally, the largest portion of manufactured home customers said they used a programmable thermostat (48%, n=301) or manual thermostat (39%) to control their heating and cooling equipment. Eight percent did not use any thermostats[24] and 4% used a smart thermostat.

For water heating, 87% of respondents (n=310) said they used electric water heaters, while 9% used gas water heaters (1% of which were identified as tankless), 3% used propane water heaters, and 1% used heat pump water heaters. As shown in Figure 29, the age of gas and electric water heaters varied greatly: while roughly one-third were less than five years old, over one-third were older than 10 years.

Figure 29. Age of Water Heaters in Manufactured Homes



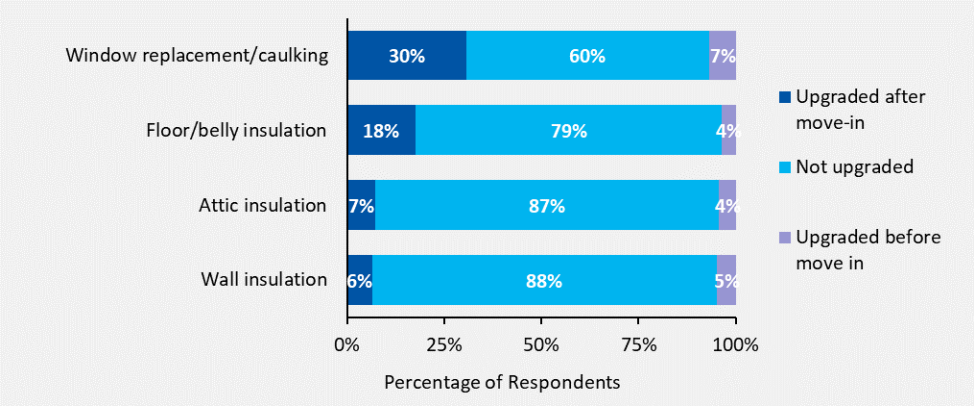
Source: Online Customer Survey Question E15. "About how old is your [cooling equipment]?"

Envelope, Lighting, and Appliances Characteristics

Respondents provided details of whether they had made any building shell upgrades to their home since moving in and if they knew about upgrades that had occurred prior. As shown in Figure 30, while approximately one-third of respondents had made or knew of window upgrades, fewer respondents knew of upgrades to the manufactured home insulation levels.

[24] Most of these customers used either portable electric heaters or wood-burning stoves to heat their homes.

Figure 30. Shell Upgrades Made in Manufactured Homes

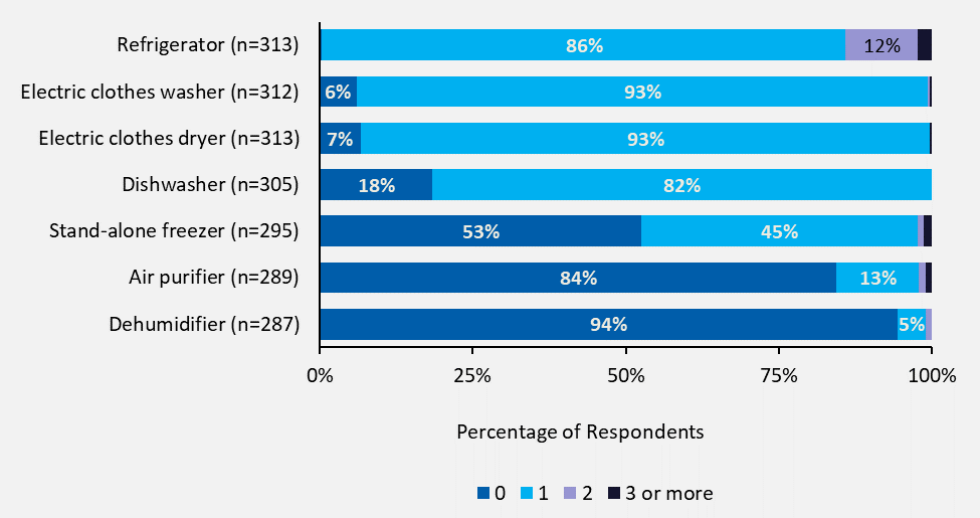


Source: Online Customer Survey Questions E2, E3, E4, and E5. "During the time you have lived in your home, have you upgraded your attic insulation?" (n=310); "wall insulation?" (n=312); "floor/belly insulation?" (n=311); and "Added weather stripping to windows or caulked windows?" (n=321)

Eighty-three percent of respondents (n=321) said they had LED light bulbs in their home. Of these respondents, half said LEDs were installed in between 50% and 90% of the fixtures in their home, while 32% said LEDs were installed in less than half their home fixtures and 18% said they had LEDs installed in all the fixtures in their home (n=259). The RBSA II also reported a high penetration of efficient light bulbs in manufactured homes.

Almost all manufactured home customers said they had at least one refrigerator (one respondent reported not having a refrigerator) and 93% said they had an electric clothes washer or dryer. As shown in Figure 31, relatively few customers had an air purifier or dehumidifier. Overall, the distribution is similar to the distribution reported by the RBSA II regarding appliances in manufactured homes.

Figure 31. Appliances in Manufactured Homes



Source: Online Customer Survey Questions E18.A–G. "Please identify how many of the following appliances/items you have in your home: electric clothes washer"; "electric clothes dryer"; "refrigerator"; "stand-alone freezer"; "dishwasher"; "air purifier"; and "dehumidifier."

Conservation Potential Study

Cadmus used data from this study to update conservation potential estimates; the estimates provided in this section incorporate findings from past program participation, market size estimates, and equipment saturations.

Table 33. Manufactured Home 10 and 20-Yr Achievable Technical Potential

Potential Type	Achievable Technical Potential	
	aMW	MMTherms
10 Year	24	0.19
20 Year	47	0.34

Electric Conservation Potential Estimates

Space heating end uses represent the largest portion (61% or 28.9 aMW) of achievable technical potential. Water heating also represents over 21% (9.9 aMW) of the total identified potential. Lighting, an end use with considerably higher amounts of energy efficiency potential in previous PSE studies, comprises only 1% (0.5 aMW) of the total residential electric energy efficiency potential in 2020 due to the 2020 Energy Independence and Security Act backstop standard and to the greater penetration of LEDs in recent years.

Figure 32 shows the *total* achievable technical potential by residential end use. The heating end use comprises all electric heating end-use equipment except central heat pumps.[25] The top two highest-potential measures represent homes converting from electric furnaces to ductless heat pumps and air source heat pumps. The potential from these measures is captured in the electric furnace end use and is included in the heating end use group in Figure 32. Together, these two measures represent 21.6 aMW, or about 46% of the overall electric potential.

The heating and heat pump end uses also include potential from weatherization measures. As mentioned in the methods section of this report, Cadmus adjusted applicability downward for certain measures to account for program participation. The resulting applicability values for weatherization measures such as duct sealing, attic insulation, and floor insulation are quite low as a result. The potential for weatherization measures is also low due to the low applicability factors. For example, duct sealing, which had very high program participation, represents 0.6 aMW, or about 1% of the overall electric potential.

[25] End uses represent currently installed equipment. Potential for conversion measures such as converting an electric forced air furnace to an air source heat pump will be included as potential for the electric forced air furnace end use because that is the existing equipment in this case.

Figure 32. Existing Manufactured Homes Total Electric Achievable Potential by End Use

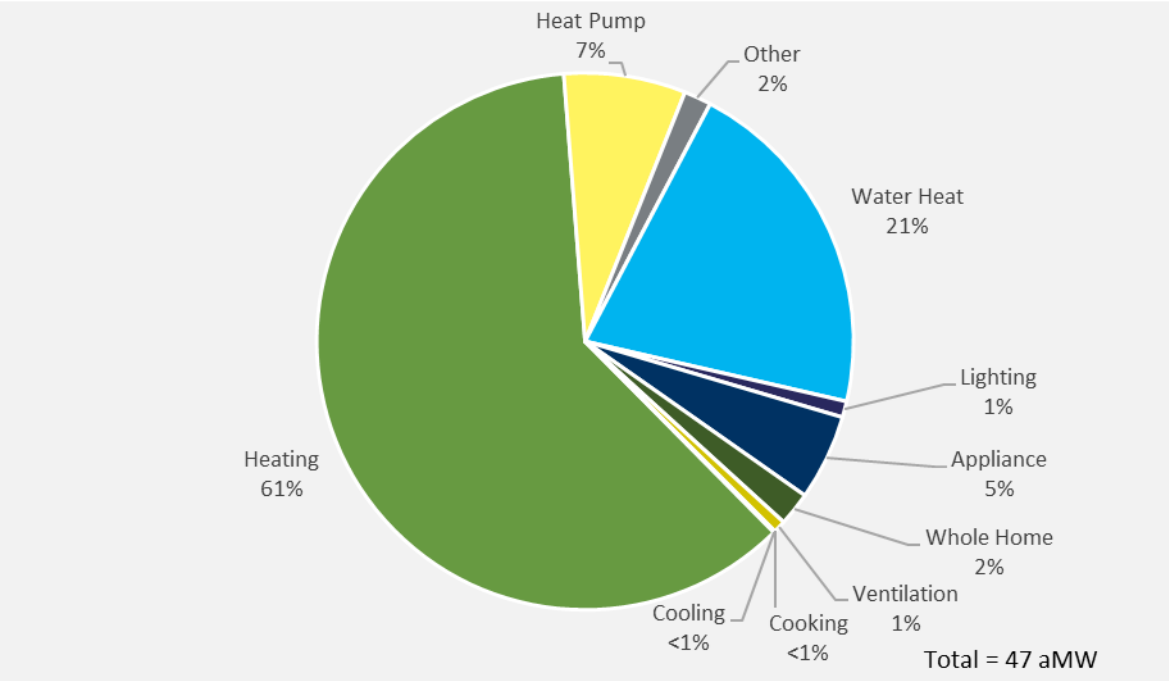


Figure 33 shows the 20-year *cumulative* achievable technical potential by residential end use.

Figure 33. Existing Manufactured Homes Cumulative Electric Achievable Potential by End Use

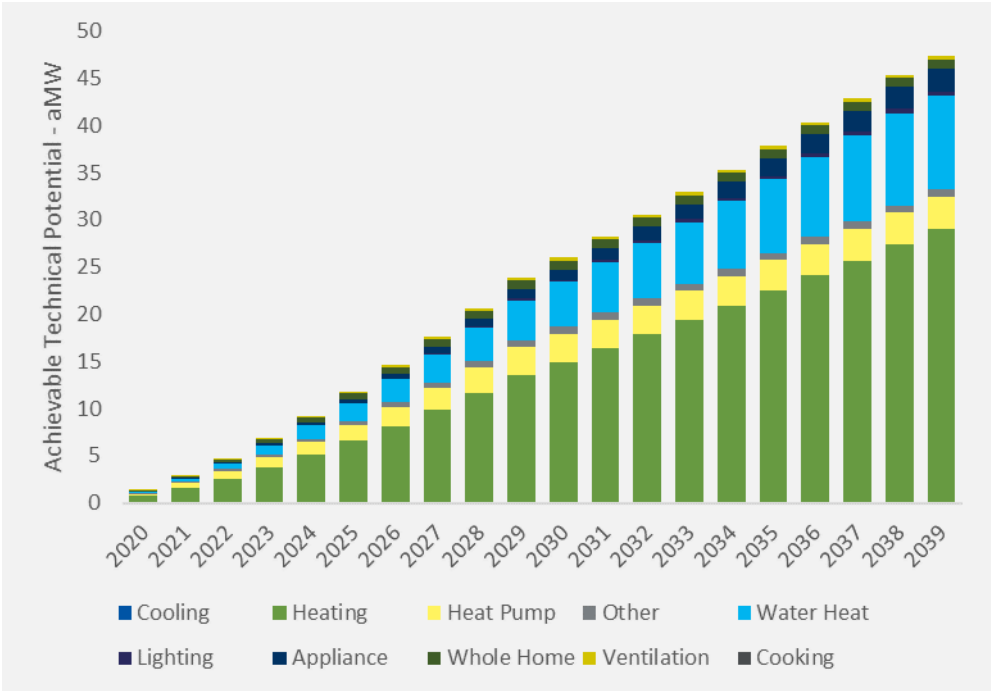


Table 34 lists the top 15 residential electric energy efficiency measures ranked in order of cumulative 20-year achievable technical potential. Combined, these 15 measures account for 40 aMW, or

approximately 85% of the total manufactured homes achievable technical potential. Nine of the top 15 measures reduce electric heating loads. Consistent with stakeholder feedback, the potential assessment found ductless heat pump and air source heat pump conversions from electric furnaces have the highest electric energy savings potential.

Table 34 also lists the weighted average levelized cost ($/kWh) for the top 15 residential electric energy efficiency measures. The 20-year levelized cost calculation incorporates numerous factors (costs and benefits), which are consistent with the Northwest Power and Conservation Council methodology. Levelized cost is a metric of cost-effectiveness, and the lower it is for a measure the more cost-effective that measure is. Levelized cost is the capital cost of a measure divided by the present value of the benefits of that measure (e.g., transmission and distribution deferrals, conservation credits, non-energy benefits, and secondary energy benefits). When considering energy efficiency as an energy resource that competes with supply side energy resources the levelized cost of an energy efficiency measure can be considered the cost of that energy resource in dollars per kWh.

Table 34. Top Manufactured Homes Electric Energy Saving Measures

Measure Name	Weighted Average Levelized Cost ($/kWh)*	Cumulative Achievable Technical Potential (aMW)	
		10-Year	20-Year
Install Ductless Heat Pump in House with Existing Forced Air Furnace	$0.07	5.0	14.7
Existing Manufactured Home HVAC Conversion – Forced Air Furnace to Air Source Heat Pump	$0.19	2.3	6.9
Heat Pump Water Heater - Tier 2	$0.07	2.4	6.6
Windows Double Pane – U30	$0.54	2.3	2.3
Web Enabled Thermostat	$0.02	2.1	2.1
Heat Pump Water Heater - Tier 3, No Resistance, Split System	$1.01	0.4	1.2
Duct Insulation – R0 to R8	$0.21	1.0	1.0
Home Energy Reports	-$0.02	0.9	0.9
Heat Pump Sizing	$0.08	0.8	0.8
Existing Manufactured Home HVAC Upgrade – Central Heat Pump Upgrade to Variable Capacity Central Heat Pump	$1.72	0.2	0.6
Infrared sensing advanced power strip – owner installed	$0.04	0.6	0.6
Duct Sealing	$0.04	0.6	0.6
Standard Size Refrigerator and Refrigerator-Freezer – CEE Tier 1	$0.34	0.2	0.6
ENERGY STAR Most Efficient Electric Clothes Washer	-$0.08	0.2	0.6
R-4 Pipe Wrap	-$0.01	0.5	0.5

* Negative weighted average levelized costs for a measure indicates that the present value of the benefits are greater than the present value of the capital costs, meaning the measure is extremely cost-effective.

Combined, the measures with the lowest levelized costs (<= 0.055 $/kWh) account for 6.6 aMW, or about 15%, of 20-year achievable technical potential. The top measures include web enabled thermostats, home energy reports, advanced power strips, and duct sealing.

Gas Conservation Potential Estimates

As shown in Figure 34, space heating (68%) and water heating (23%) end uses account for 91% of the identified achievable technical potential, which combines high-efficiency equipment (such as condensing

furnaces and water heaters) with retrofits (such as shell measures, duct and pipe insulation, and low-flow showerheads).

The heating end use comprises gas furnace and boiler end use equipment. Furnace upgrades account for 12,900 therms, or about 38% of total gas potential. Non-furnace retrofit space heating upgrades (thermostats, weatherization, etc.) account for the remaining heating end use potential. Similar to electric, gas weatherization potential is low due to low applicability factors.

Figure 34. Existing Manufactured Homes Total Natural Gas Achievable Potential by End Use

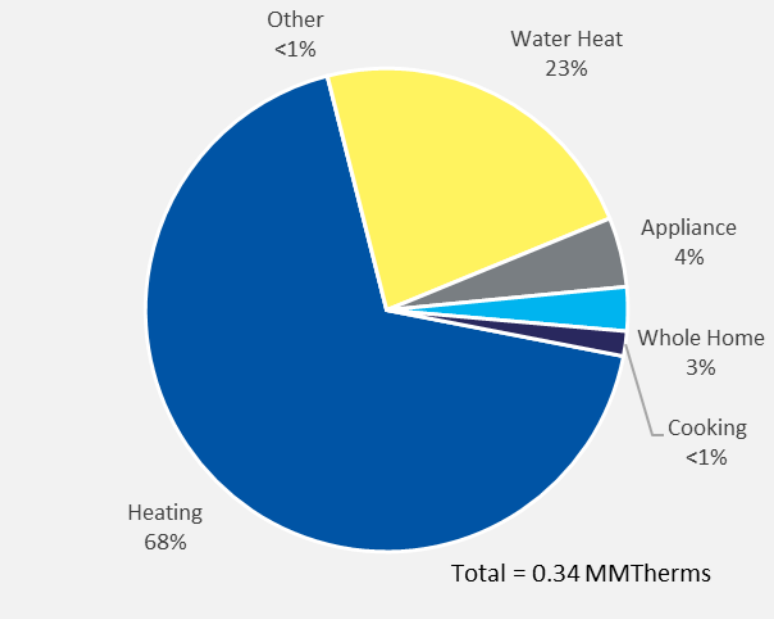


Figure 35 shows the *cumulative* natural gas achievable technical potential by residential end use.

Figure 35. Existing Manufactured Homes Cumulative Natural Gas Achievable Potential by End Use

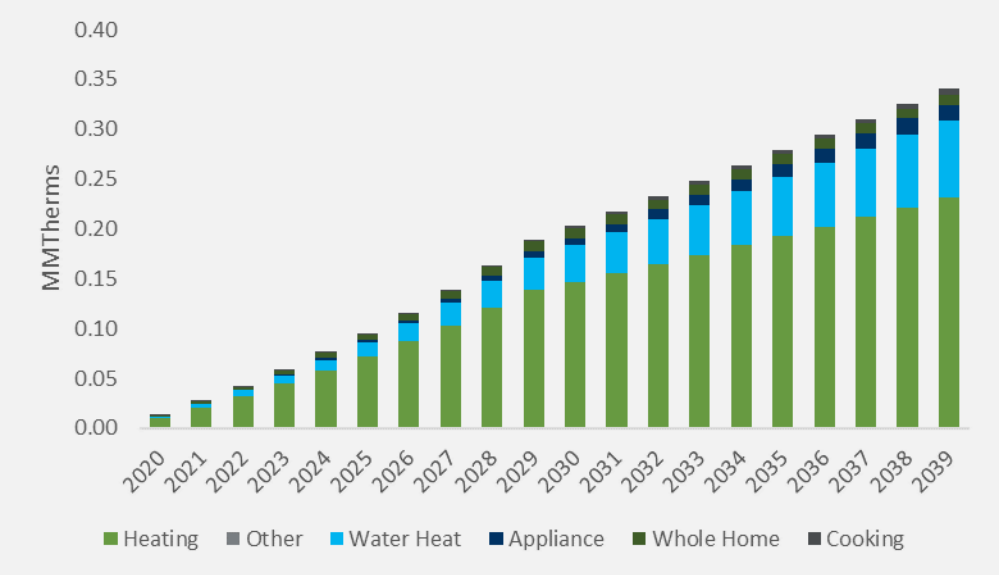


Table 35 shows the top 15 residential natural gas energy efficiency measures ranked in order of cumulative 20-year achievable technical potential. Combined, these 15 measures account for 32,700 therms, or approximately 95% of the total residential achievable technical potential.

Table 35. Top Manufactured Homes Gas Energy Saving Measures

Measure Name	Weighted Average Levelized Cost ($/Therm)*	Cumulative Achievable Technical Potential (1,000 Therms)	
		10-Year	20-Year
ENERGY STAR Furnace	$0.78	3.6	12.9
Storage Water Heater .67 EF	$1.00	1.0	3.4
Duct Insulation - R0 to R8	$3.24	3.1	3.1
Tankless Water Heater .91 EF	$2.78	0.8	2.9
Web-Enabled Thermostat	$1.60	2.4	2.4
Duct Sealing	$0.99	1.9	1.9
Home Energy Reports	-$0.70	1.0	1.0
Door Weatherstripping	$2.36	1.0	1.0
ENERGY STAR Gas Dryer	$5.95	0.6	0.6
Windows - Double Pane - U30	-$1.38	0.2	0.6
ENERGY STAR Most Efficient Gas Clothes Washer	$1.54	0.2	0.6
High Efficiency Convection Cooking Oven	$1.08	0.5	0.5
R-4 Pipe Wrap	$0.00	0.5	0.5
1.75 GPM Showerhead	$12.60	0.3	0.3
Low E Storm Window - Double Pane Metal Frame	$0.78	3.6	12.9

* Negative weighted average levelized costs indicates that the present value of the benefits are greater than the present value of the capital costs.

Combined, the measures with the lowest levelized costs (<= 0.30 $/therm) account for 2,535 therms, or about 7%, of 20-year achievable technical potential. These measures are home energy reports, ENERGY STAR clothes washers, 1.5 GPM kitchen faucet aerators, and low-flow showerheads.

Potential Study Gaps

While the potential study measure list is comprehensive, there are some measures in PSE's program data that are not included in the potential study: cooking ranges, bathroom ventilating fans, various repair measures, gas fireplaces, and gravity film heat exchangers. The potential study did not look at a whole manufactured home replacement measure to avoid double counting. The potential for whole manufactured home replacements is captured in the potential estimate because Cadmus accounted for the individual measures that comprise whole manufactured home replacement. These measures include building shell, lighting, water heat, and HVAC equipment measures.

Benchmarking

Cadmus compared PSE's Manufactured Homes Duct Sealing program offerings against comparable utilities for several key elements:

- Program offerings available for existing manufactured homes
- Implementation activities used to deliver the program to customers
- Marketing and outreach activities that support implementation

Cadmus collected these details through the most recent evaluation reports, plans, or program websites, as available. Additional information about our research methods and approach can be found in the *Methods* section.

Additionally, we reviewed best practices for implementing successful program offerings and, where available, provided examples of how the comparison utilities execute these actions specific to the manufactured homes customer segment.

Program Implementation

Program sponsors use several approaches and mechanisms to encourage customers to take advantage of the offerings and services available for manufactured homes. All the comparison utilities offer prescriptive measures through an income-neutral program and also offer equipment and services (typically via community action agencies) through an income-qualified program. Two of the five program sponsors—Entergy Arkansas and Tacoma Power—currently deliver no-cost and prescriptive measures through a manufactured home retrofit program, while the remaining three target manufactured home customers through their income-qualified and income-neutral programs. Cadmus could not find enough data to provide a comprehensive comparison of manufactured homes participation across all program sponsors. For Entergy Arkansas Cadmus found that over 1,500 manufactured homes participated between 2015 and 2017, and for Energy Trust Cadmus found that 114 manufactured homes had heat pump replacements in 2018. Implementation approaches by program sponsor are shown in Table 36.

Table 36. Program Implementation Approaches

Program Sponsor	Manufactured Homes Direct Install Program	Energy-Savings Kit	Income-Qualified Program	Income-Neutral Program	On-Bill Financing
PSE	✓[a]	--	✓	✓	--
Avista Utilities	✓[b]	✓	✓	✓	--
Energy Trust of Oregon	✓[c]	✓	✓	✓	✓
Entergy Arkansas	✓	--	✓	✓	--
Tacoma Power	✓	--	✓	✓	✓

[a] This was offered in 2010.

[b] This was offered in 2014.

[c] This was offered for a limited time through a pilot.

Manufactured Homes Direct Install Programs

PSE first piloted a direct install offering for manufactured home customers in 2010. Through a third-party implementer in 2014, Avista Utilities offered the direct installation of duct sealing, compact fluorescents, and showerheads to manufactured home customers. While Avista Utilities' program targeted low- to moderate-income residents by default of the end-use housing type, it did not explicitly require income eligibility criteria to participate.

According to Energy Trust of Oregon staff, it offered no-cost, direct installation of air and duct sealing measures in its first year of operation (2002). In 2015, Energy Trust of Oregon offered direct installation of measures and on-bill financing to income-qualified customers for heat pumps, water heaters, and windows, in addition to the income-neutral incentives offered through its Existing Homes program. From November 2015 to August 2016, the program sponsor ran a pilot to install ducted heat pumps in manufactured homes, with homeowners contributing $1,000 to the project costs. Today, Energy Trust of Oregon revised the offer to deliver a program through qualified installation contractors that is exclusive to manufactured homes, offering deeply discounted ducted or ductless heat pumps (customers now pay between $1,500 and 2,500 per project) and beginning in mid-2019, the program sponsor will offer direct install, no-cost measures.

Through Entergy Arkansas' Manufactured Homes program, participants enroll through an implementation contractor and participating installation contractors deliver direct installed measures, applying to the program for cost reimbursement. The program has no income or ownership qualifications. Entergy Arkansas recruits and trains participating installation contractors to deliver outreach and installation services on behalf of the utility. Installation contractors perform no-cost, direct installation services and, in some cases, also provide prescriptive measures for a fee during the initial site visit.

Tacoma Power's Manufactured Home Direct Install program is implemented through participating installation contractors, who promote the offering to park managers to identify and pre-qualify manufactured home parks for participation. Installation contractors then engage homeowners to participate.

Energy-Saving Kits

Avista Utilities provides energy-saving kits to residential customers who attend community energy efficiency workshops or through participation in an income qualified program delivered through community action agencies, while Energy Trust of Oregon encourages residential customers to request a kit through its website.

Income-Qualified Programs

Income-qualified manufactured home customers are also eligible to participate in all the program sponsors' weatherization programs. To be eligible for incentives, participating contractors must install the qualified measure(s). Customers typically seek out no-cost installation services through community action agencies. Tacoma Power also offers income-qualified grants for eligible owner-occupied customers, who contact a participating contractor and collect a quote, apply for grant funding, then submit the standard incentive application.

Income-Neutral Programs

The program sponsors also each offer typical prescriptive programs for all residential customers. Through its residential Dealer Channel program, PSE offers increased incentives to manufactured home customers for HVAC, water heating, windows, and insulation measures. To be eligible for incentives, participating contractors must install the qualified measure(s). Program sponsors commonly hire a third-party implementation contractor, who in turn encourages installation contractors to provide products and services to end users regardless of housing type.

On-Bill Financing

On-bill financing is available to income-qualified participants for projects through the Energy Trust of Oregon's Savings Within Reach program and as an income-neutral offering to residential customers who install heat pumps and insulation. Beyond its standard, income-neutral incentive and direct install offerings for manufactured home customers, Tacoma Power offers a zero-interest loan program for ducted and ductless heat pumps. However, loans from these sponsors are only available for customers who own the home *and* the land, which would typically exclude those residing in manufactured home parks.

Marketing and Outreach Activities

Program sponsors who targeted homeowners to offer programs that were available regardless of the customer's housing type used typical marketing tactics (such as program websites and brochures) and often relied on installation contractors to perform customer outreach. Within the income-qualified programs, program sponsors typically relied on partnerships with community action agencies to recruit income-qualified participants. This section details additional approaches that program sponsors planned to use or did use to target income-qualified or manufactured home participants.

During its 2010 direct install pilot, PSE shifted from individual customer outreach to conducting park manager outreach followed by park "sweeps" to enroll multiple customers. Currently and according to its 2019 plan, PSE will implement direct marketing campaigns and better leverage partnerships with community action agencies to target the manufactured home market segment and, in particular,

income-eligible and Spanish-speaking customers. The utility also used propensity modeling to identify customers in targeted market segments or communities (like customers with high energy bills).

Through its 2014 pilot offering, Avista Utilities partnered with the Washington State University Community Energy Efficiency Program (CEEP), which received funding through the U.S. Department of Energy's State Energy program through June 2015. Avista Utilities used the same park manager outreach model that PSE piloted in 2010. Due to the level of program interest, Avista Utility's funding was exhausted in 2014, and it does not currently perform targeted marketing or outreach exclusively to the manufactured housing market segment.

Through its heat pump pilot offering in 2015 and 2016, one of Energy Trust of Oregon's top-performing installation contractors reported approaching park managers with fliers for homeowners, offering gift cards for every referral, and using postcard mailings with "a very refined mailing list." Another top-performer, credited with holding a large share of the home park market, relied on word of mouth to promote the offer.

For its Manufactured Homes program, Entergy Arkansas' marketing and outreach strategies are primarily geared toward park managers and are delivered through the implementation contractor and its network of participating installation contractors. However, in its 2017–2019 program plan, Entergy Arkansas also noted several typical ways it markets directly to manufactured home customers, including direct mail and the program website. It also employs a few unique approaches to increase program awareness and encourage participation from manufactured home customers:

- To increase participation among the Spanish-speaking community, program materials are available in Spanish, the program implementer's account managers are bilingual in English and Spanish, and program representatives participate in a regional Spanish-speaking radio talk show.
- After onboarding park managers, the implementation contractor or installation contractors host park-wide meetings to discuss the process and recruit homeowners.
- Entergy Arkansas uses a "refer a friend" campaign to encourage word of mouth participation.

As noted in its 2018-2019 conservation plan, Tacoma Power markets its Manufactured Home Direct Install program through its installation contractor network, and the installation contractors perform direct outreach to park managers and in-park homeowners.

Program Offerings

Although not all the utilities offer programs that are exclusive to the manufactured homes segment, PSE and the comparison utilities offer a variety of energy efficiency services or adjusted incentives specifically targeting manufactured homes.

In the past, PSE has offered duct sealing, lighting, and showerheads as direct install measures. Today, through its Dealer Channel program that is available to all residential customers, many PSE offerings are tailored to the manufactured homes market segment, including recently-increased incentive levels for HVAC, water heating, and insulation when replacing equipment in manufactured homes (where the insulation incentives covers 75% of the cost, compared to covering just 50% of the cost for insulation in

a site-built home). PSE also offers incentives for duct sealing and whole-house ventilation systems exclusively to customers in manufactured homes. Through its Home Energy Assessment program, customers are eligible to receive no cost LED bulbs, showerheads, and aerators as part of their home audit. Through its Low Income Weatherization program, PSE provides insulation and duct sealing at no cost to the customer, along with several additional measures: air sealing, ductless heat pumps, refrigerator replacements, water heaters, programmable thermostats, pipe insulation, LED bulbs, aerators, and showerheads.[26]

In 2014, Avista Utilities offered duct sealing at no cost to its manufactured home customers (funding was no longer available beginning in 2015). Avista Utilities also installed compact fluorescents and showerheads during the duct sealing installations. Through its Residential Rebates program across all single family residential home types, the utility also currently offers rebates for standard equipment and shell measures that were installed through a participating contractor (while thermostats may be self-installed). Avista Utilities also provides residential customers with access to energy-saving kits when they attend community energy efficiency workshops or through community action agencies.

After PSE, Energy Trust of Oregon offers the second-largest variety of measures to residential customers in manufactured homes, which are delivered through its Existing Homes and Savings Within Reach programs. In 2018 and 2019, through competitively selected contractors throughout the state, Energy Trust of Oregon also employed limited-time bonus heat pump rebates to manufactured homeowners: $3,000 for ducted heat pumps and $2,500 for ductless heat pumps (compared to the standard $800 and $700 offerings, respectively); utility staff said it paid 400 bonus rebates from September 2018 to May 2019. Incentives for income-qualified customers who install ducted or ductless heat pumps are also available at an increased level ($1,000). Self-installed thermostats and floor/belly insulation are also eligible for incentives, while all other types of equipment must be installed by a program-approved installation contractor.

Through its Manufactured Homes program, Entergy Arkansas offers the direct installation of typical measures (such as lighting and water saving measures). Prescriptive measures include air conditioning tune-ups, duct sealing, air sealing, and insulation. Through its Residential Lighting and through its Appliances programs, Entergy Arkansas also offers thermostat and water heater rebates for customers regardless of housing type.

Through the Residential Rebates program, Tacoma Power offers standard incentives for heat pumps, heat pump water heaters, and duct sealing. Incentives are the same regardless of housing type, except for duct sealing, where the incentive for manufactured homes is lower than for site-built homes ($250 and $450, respectively). Customers must use participating contractors to qualify for all but its

[26] Though we limited our comparisons to programs that offer retrofit services to existing homes, Puget Sound Energy also recently opened a manufactured homes replacement pilot program, offering incentives to fully replace at least five existing manufactured homes with new, ENERGY STAR or ENERGY STAR with NEEM+ manufactured homes.

thermostat and showerhead incentive offerings. However, in its 2018-2019 conservation plan, Tacoma Power detailed a direct installation program exclusively for manufactured homes, through which its incentives cover 100% of the cost of heat pump installations as well as other direct install measures (such as duct sealing, water saving measures, and lighting). The model was contingent upon contractors meeting program-assumed price thresholds, which may be possible for contractors' economies of scale if the program achieves adequate participation.

Table 37 provides a detailed summary of measure offerings by program sponsor.

Table 37. Measure Offerings by Program Sponsor

Measure	PSE	Avista Utilities	Energy Trust of Oregon	Entergy Arkansas	Tacoma Power
Equipment					
Thermostats (programmable, smart)	✓	✓	✓	✓	✓
Furnaces	--	✓	--	--	--
Ducted heat pumps	✓	✓	✓	--	✓
Ductless heat pumps	✓	✓	✓	--	✓
Boilers	--	✓	--	--	--
Whole-house ventilation	✓	--	--	--	--
Water heaters	✓	✓	✓	✓	✓
Refrigerator and/or freezer replacement	✓	--	--	--	--
Building Shell (may be direct-installed)					
Attic/wall insulation	✓	✓	✓	✓	--
Floor/belly insulation	✓	✓	✓	--	--
Air sealing	✓	--	✓	✓	--
Duct sealing/repairs	✓	✓[a]	✓	✓	✓
Duct insulation	✓	--	--	--	--
Windows	✓	✓	✓	--	--
Other Direct Install					
Advanced power strips	--	--	--	✓	--
Lighting	✓	✓[a]	✓	✓	✓
Air conditioning tune-up	--	--	--	✓	
Water saving devices (aerators, showerheads)	✓	✓[a]	✓	✓	✓[b]
Pipe insulation	✓	--	--	✓	✓
Water heater jackets	--	--	--	✓	--

[a] These measures were implemented in 2014 as direct install and are currently offered through energy-saving kits.

[b] Outside of its planned direct install program for manufactured homes, Tacoma Power does not provide direct install services for showerheads. These are available at no charge from its administrative services building or are discounted by $5 through participating stores.

Best Practices for Delivering Successful Manufactured Homes Programs

To identify program best practices, Cadmus reviewed literature published by third-party experts, government agencies, and nonprofit organizations, and assessed the relevancy and applicability of the

literature's cited best practices to PSE's unique goals and circumstances.[27] We applied our expertise and knowledge of the utility sector to further develop these best practices and to document implemented examples by the comparison utilities. Recognizing that there has been limited national research on the existing manufactured homes market segment, yet this market commonly encounters an income barrier, Cadmus also documented successful strategies to implementing programs for the low-income housing market segment.[28]

Best Practice: Offer a Customized Program Targeting Manufactured Homes

Offering a specific program that targets manufactured home customers can simplify the participation process and maximize program participation. Streamlining program designs could be accomplished in several different ways:

- Adopt a single contact point, not only for customers and contractors but also for organizations that share the objective of supporting the income-qualified community. This includes clarifying *who* that contact point is and how to reach them. Then, once a customer is connected with a program contact, limit the need to transfer that customer from one person to another. The contact point may differ for customers, contractors, and organizations.
- Minimize the number of touch points, which has proved instrumental in moving participants through the process without their dropping from the program.
- Develop a dedicated contractor pool that is familiar with manufactured homes and their residents.

Installing measures in a single visit can minimize touch points and maximize savings. For example, Entergy Arkansas encouraged its installation contractors to install no-cost and prescriptive equipment for a fee in the first visit. Successful programs focus on streamlining the process by collaborating with installation contractors to provide a "one-stop-shop" experience for customers (this can be accomplished by having installation contractors work with park managers and customers, such as in Tacoma Power's Manufactured Home Direct Install program, or by offering direct install and deeply

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[27] Environmental Protection Agency. *Energy Efficiency Program Best Practices*. https://www.epa.gov/sites/production/files/2015-08/documents/napee_chap6.pdf
Nexant and Cadmus. October 2011. *Saving Energy and Money: How to Start, Expand, or Refine MOU Programs, a Guide to Best Practices for Energy Efficiency in Locally Governed Electric Service Areas in the State*. http://www.seco.cpa.state.tx.us/resources/docs/ee_best_practices_guide.pdf

[28] Applied Public Policy Research Institute for Study and Evaluation. December 2017. *Low-Income Energy Efficiency Opportunities Study*. https://www.edf.org/sites/default/files/APPRISE_Low-Income-Energy-Efficiency-Opportunities-Study-2017.PDF
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Environmental Defense Fund. February 2018. *Low-income Energy Efficiency, A Pathway to Clean, Affordable Energy for All*. https://www.edf.org/sites/default/files/documents/liee_national_summary.pdf

discounted heat pumps, such as through Energy Trust of Oregon's pilot offering for manufactured homes customers).

Best Practice: Provide a Program that Encourages a Comprehensive, Whole-Home Approach

Providing a program that encourages a comprehensive approach requires leveraging multiple funding sources to address health and safety issues and structural issues and to implement upgrades regardless of fuel type. This can be accomplished in multiple ways:

- Form partnerships with community groups and public health institutions to identify and capture alternative funding sources that are focused on health and safety, particularly in support of income-qualified retrofits.
- Partner with neighboring utilities to deliver programs collaboratively, ensuring that fuel type does not render a project ineligible for incentives.

While none of the comparison programs partnered with public health institutions explicitly, many addressed health and safety issues through community action agencies (PSE, Energy Trust of Oregon, and Tacoma Power used these partnerships to target income-qualified participants).

Best Practice: Prioritize Deep-Savings Measures while Achieving Cost-Effectiveness through Low Cost, Direct-Install Measures

Successful programs not only serve their customer target market, but also provide deeper savings for the greatest impact. Some design elements encouraged the installation of measures with deeper savings. Establishing goals that focus on savings per participant, rather than on overall total savings, may help to prioritize deeper savings. However, as cost-effectiveness may be of concern with some deep-savings measures, offset those measures with a comprehensive package of low-cost, direct install measures. For example, PSE and Energy Trust of Oregon offer a suite of measures that are directly installed, but also encourage deeper retrofits through home assessments and increased incentives for manufactured home customers.

Best Practice: Leverage Existing Customer Channels and Communities to Promote and Deliver the Program

Address awareness and social barriers by collaborating with organizations that manufactured homeowners and tenants trust and seek out for other services, such as food banks, housing resource centers, cultural groups where English is a second language, and community organizations and events. These partnerships will help to engage harder-to-reach customers. For example, Entergy Arkansas overcame language barriers by hiring bilingual program representatives and using Spanish language materials and media platforms.

Additionally, targeting park managers and park communities has proved successful for most of the program sponsors, driving participation and contractor productivity. For example, Energy Trust of Oregon's top-performing contractors had already engaged the manufactured home park market share in the service territory or relied on park manager engagement.

Appendix

This appendix provides program participation data, details about the methodologies used to estimate remaining conservation potential and manufactured homes energy consumption. Additionally, it provides data from the secondary research in the manufactured homes sector, details about the public-use micro areas used to match the American Community Survey data to PSE service territory, and the data collection instruments used in this study. The appendix also contains references to materials used for the benchmarking research as well as stakeholder comments on the report.

Program Participation Data

Annual Program Participation Counts

Program	2010	2011	2012	2013	2014	2015	2016	2017	2018
Single Family Weatherization - ARRA	1,279	4,874	1,967	3,007	505	334	36	--	--
Mobile Home Duct Sealing	--	--	2,758	2,309	3,450	2,446	106	--	--
Appliances Rebates	--	--	899	2,058	1,777	405	294	668	453
Home Energy Assessments	17	102	129	152	211	354	636	930	935
Appliance Recycling and Replacement	--	--	915	--	--	802	603	548	346
Space Heating Rebates	3	--	--	263	296	386	420	460	434
Low Income Weatherization	295	258	167	238	261	325	269	213	232
Window Rebates	99	11	33	73	162	201	106	71	52
Space and Water Heating Rebates	206	169	197	--	--	--	--	--	--
Smart Thermostat Rebates	--	--	--	--	--	--	29	111	65
Single Family Weatherization	--	--	21	24	17	8	67	30	21
Water Heating Rebates	--	--	--	16	35	43	30	17	16
Manufactured Homes New Construction	20	11	6	--	--	--	--	--	7
Fuel Conversion	3	1	1	1	5	3	3	4	--

Electric Savings (MWh) by Year by Program

MWh Savings by Program	2010	2011	2012	2013	2014	2015	2016	2017	2018
Mobile Home Duct Sealing	--	--	2,781	2,871	5,373	4,270	176	--	--
Single Family Weatherization - ARRA	1,000	3,311	1,466	2,732	926	610	56	--	--
Space Heating Rebates	11	--	--	827	1,066	1,104	1,144	1,161	1,219
Low Income Weatherization	880	802	527	826	947	887	659	445	677
Appliances Rebates	--	--	164	1,091	949	61	31	49	34
Appliance Recycling and Replacement	--	--	604	--	--	687	403	395	200
Space and Water Heating Rebates	507	559	618	--	--	--	--	--	--
Home Energy Assessments	-	61	94	55	83	136	302	416	400
Window Rebates	295	18	67	141	323	231	122	100	60
Single Family Weatherization	--	--	48	52	37	17	54	33	19
Manufactured Homes New Construction	94	56	31	--	--	--	--	--	16
Water Heating Rebates	--	--	--	10	24	37	35	27	17
Fuel Conversion	21	14	4	14	31	11	21	33	--
Smart Thermostat Rebates	--	--	--	--	--	--	10	81	44

Electric Savings by Year by End Use

MWh Savings by End Use	2010	2011	2012	2013	2014	2015	2016	2017	2018
Space Heating	841	2,504	2,838	3,774	4,714	3,786	412	293	247
Heat Pump	497	523	532	840	1,290	1,271	1,395	1,286	1,513
Building Shell	978	637	477	689	1,647	1,130	339	222	198
Water Heating	93	464	998	1,337	945	824	278	344	260
Appliance	61	34	783	1,116	821	673	355	338	189
Lighting	331	660	767	845	305	347	218	244	243
Other	7	--	10	18	36	18	16	13	36

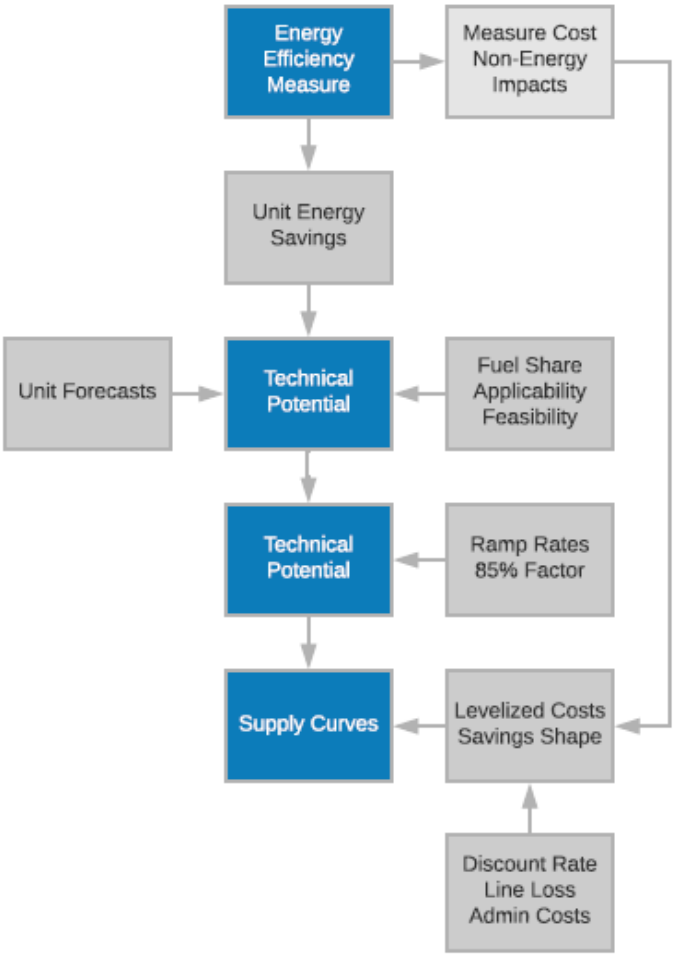
Detailed Methodology for Estimating Conservation Potential

Cadmus followed a series of steps to estimate energy efficiency potential:

1. ***Market Segmentation****:* This involved identifying the sectors and segments for estimating energy efficiency potential. Segmentation accounts for variation across different parts of PSE's service territory and across different applications of energy efficiency measures.
2. ***Develop Efficiency Measure Datasets:*** This required researching viable energy efficiency measures that can be installed in each segment. We estimated measure savings, costs, applicability factors, lifetimes, and baseline assumptions, as well as the treatment of federal standards.
3. ***Develop Unit Forecasts:*** Unit forecasts vary by sector (and is the number of homes for the residential sector, the square footage of floor space for the commercial sector, the amount of energy use for the industrial sector, and the number of poles for the street lighting sector) and reflects the number of units that could be installed for each measure. Cadmus developed sector-specific methodologies to determine the number of units.
4. ***Calculate Levelized Costs:*** IRP modeling requires levelized costs for each measure and the costs in aggregate to be able to compare energy conservation to supply-side resources.
5. ***Forecast Technical Potential:*** Technical potential forecasts rely on the sector-specific unit forecasts and the measure data compiled from prior steps. The *Forecast Technical Potential* section presents the general equation we used for calculating technical potential.
6. ***Forecast Achievable Technical Potential:*** Achievable technical potential forecasts use a similar equation as that used to determine technical potential forecasts but with additional terms, as described in the *Forecast Achievable Potential* section, to account for market barriers and ramping.

The following figure provides a general overview of the process and inputs required to estimate potential and develop conservation supply curves.

Overview of Energy Efficiency Methodology



Baseline Units Forecast General Approach

Cadmus developed a 20-year forecast (2020 through 2039) of the number of units that could feasibly be installed for each permutation of each energy efficiency measure we researched. We developed separate unit forecasts for two types of lost opportunity measures (natural replacement and new construction) and for one type of discretionary measures (retrofit):

- ***Natural replacement (lost opportunity) measures*** are installed when the equipment it replaces reaches the end of its effective useful life. Examples include appliances, such as clothes washers and refrigerators, and HVAC equipment, such as heat pumps and chillers.
- ***New construction (lost opportunity) measures*** are applied to homes and buildings that will be constructed over the study forecast. The unit forecast for new construction is driven by anticipated new home and new commercial construction, which we derived from utility customer forecasts and regional *Seventh Power Plan* forecasts.
- ***Retrofit (discretionary) measures*** encompass upgrades to existing equipment or buildings and measures that can theoretically be completed any time over the study forecast. Unlike natural

replacement measures, the timing of retrofit savings is not determined by turnover rates. Examples of retrofit measures include weatherization and controls.

To determine measure-specific unit forecasts, used to estimate technical potential, Cadmus considered four factors:

- ***Sector unit forecasts*** are estimates of the number of homes (residential) or square footage of floor space (commercial) derived from PSE's customer information system and load forecast data.
- ***Measure saturations (units per sector unit)*** are estimates of the number of units per sector unit (per home or per square foot) within PSE's natural gas and electric service territory. Where possible, Cadmus calculated measure saturations using data from the PSE Residential Consumption Survey and from the Northwest Energy Efficiency Alliance Commercial Building Stock Assessment (CBSA) and RBSA II.[29,30]
- ***Applicability factors (technical feasibility and measure competition)*** are the percentage of homes or buildings that can feasibly receive the measure and the percentage of eligible installations, after accounting for competition with similar measures.
- ***Turnover rates (for natural replacement measures)*** are used to determine the percentage of units that can be installed in each year for natural replacement measures. The turnover rate equals 1 divided by the measure effective useful life.

The following figure illustrates the general equation we used to determine the number of units for each measure over the study forecast horizon. By default, the turnover rate for retrofit and new construction measures is 100% (turnover is not accounted for in these permutations).

Unit Forecast Equation

To determine unit forecasts, Cadmus relied on data that represents PSE's service territory, as shown in the table below. The sections following the table describe our approach for developing technical and achievable unit forecasts in each sector.

[29] Northwest Energy Efficiency Alliance (NEEA). Commercial Building Stock Assessment (CBSA). 2014.

[30] Northwest Energy Efficiency Alliance (NEEA). Residential Building Stock Assessment II (RBSA II). 2018.

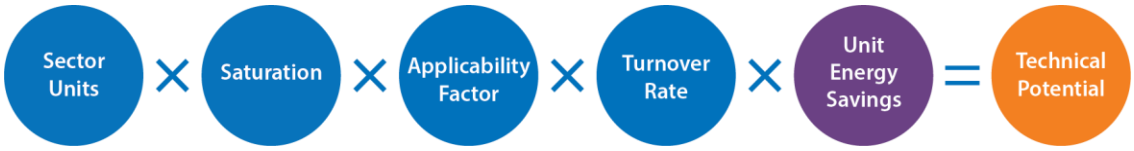
Unit Forecast Components and Data Sources

Component	Data Source
Sector Units	PSE customer information system data; Geomapping of registered manufactured homes to determine actual housing type; PSE RCS sample design file;
Saturation	Online survey of PSE manufactured home customers; PSE RCS; Northwest Energy Efficiency Alliance regional stock assessments (RBSA)
Applicability Factor	Online survey of PSE manufactured home customers; PSE RCS; Northwest Energy Efficiency Alliance regional stock assessments (RBSA)
Turnover Rate	PSE, Regional Technical Forum, and *Seventh Power Plan* measure workbooks

Forecast Technical Potential

After compiling unit energy saving estimates and developing unit forecasts for each permutation of each energy efficiency measure, Cadmus multiplied the two resulting values to determine 20-year forecasts of technical potential beginning in 2020. The figure below shows the equation for calculating technical potential, where the blue components make up the measure unit calculation.

Technical Potential Equation



Forecast Achievable Potential

As illustrated in the figure below, achievable technical potential is the product of technical potential and both the maximum achievability factor and the ramp rate percentage. Blue components are a part of the measure unit calculation, while the purple component is part of the technical potential calculation. The blue, purple, and orange components together are used to determine the achievable technical potential.

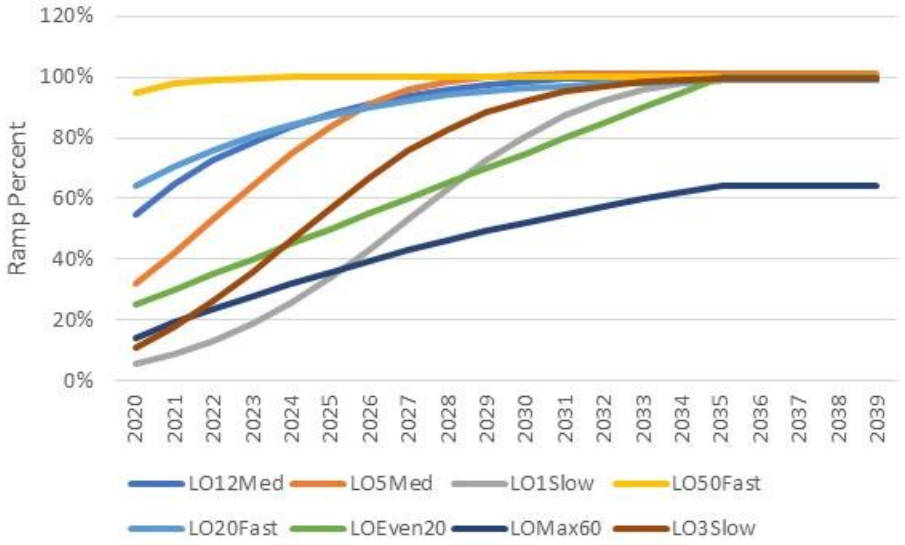
Achievable Technical Potential Equation

Cadmus used a maximum achievability factor of 85% for all measures. Ramp rates are measure specific, which we based on the ramp rates developed for the *Seventh Power Plan* and adjusted to account for this study's 2020 to 2039 horizon.

For lost opportunity measures, we used the ramp rates listed in the *Seventh Power Plan*. However, *Seventh Power Plan* ramp rates only cover the years from 2020 to 2035; because nearly all lost

opportunity ramp rates approach 100%, we set ramp values for 2036 to 2039 equal to the 2035 value from the *Seventh Power Plan*. The following figure illustrates the lost opportunity ramp rates.

Lost Opportunity Ramp Rates



For discretionary measures, Cadmus assumed that all savings are acquired at an even rate over the first 10 years of the study. In other words, the achievable technical potential for discretionary measures equals one-tenth of the total cumulative achievable technical potential in each year from 2020 through 2029. After 2029, there is no additional achievable technical potential from discretionary measures.

Detailed Methodology for Estimating Manufactured Homes Energy Consumption

This section provides additional information about the PRISM model used to estimate manufactured homes' electric and gas consumption.

PRISM Modeling: Electric

For each manufactured home, Cadmus weather-normalized the raw monthly electricity billing data. Each model allowed the heating reference temperature to range from 45°F to 85°F and the cooling reference temperature to range from the heating reference temperature to 85°F.

The PRISM model used the following specification:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \beta_2 AVGCDD_{it} + \varepsilon_{it}$$

Where, for each customer 'i' and month 't':

ADC_{it}	=	The average daily kilowatt-hour consumption over 12 months (by default this was May 2018 to April 2019)
α_i	=	The participant intercept representing the average daily kilowatt-hour baseload
β_1	=	The model space heating slope
$AVGHDD_{it}$	=	The base 45 to base 85 average daily HDDs for the specific location
β_2	=	The model cooling slope
$AVGCDD_{it}$	=	The base 45 to base 85 average daily CDDs for the specific location
ε_{it}	=	The error term

Using the PRISM model, Cadmus computed weather-normalized annual consumption for each heating and cooling reference temperature:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i + \beta_2 LRCDD_i$$

Where, for each customer 'i':

NAC_i	=	The normalized annual kilowatt-hour consumption for customer 'i'
α_i	=	The intercept, or the average daily or baseload for each participant that represents the average daily baseload from the model
$\alpha_i * 365$	=	The annual baseload kilowatt-hour usage (non-weather sensitive) for customer 'i'
β_1	=	The heating slope (usage per HDD from above model)
$LRHDD_i$	=	The annual, long-term HDDs of a typical meteorological year in the 1991–2005 series from the National Oceanic and Atmospheric Administration, based on home location
$\beta_1 * LRHDD_i$	=	The weather-normalized, annual weather-sensitive heating usage, also known as HEATNAC
β_2	=	The cooling slope (usage per CDD from above model)
$LRCDD_i$	=	The annual, long-term CDDs of a typical meteorological year in the 1991–2005 series from the National Oceanic and Atmospheric Administration, based on home location
$\beta_2 * LRCDD_i$	=	The weather-normalized, annual weather-sensitive cooling usage, also known as COOLNAC

If the above heating and cooling models yielded negative intercepts, negative heating slopes, or negative cooling slopes, Cadmus estimated additional models that only separated out cooling usage (cooling-only models) or that only separated out heating usage (heating-only models). If these models had correct signs on all parameters, we selected the best model for each manufactured home based on the highest R-square.

PRISM Modeling: Gas

For each manufactured home, we weather-normalized the raw monthly gas billing data. Each model allowed the heating reference temperature to range from 45°F to 85°F.

The PRISM model used the following specification:

$$ADC_{it} = \alpha_i + \beta_1 AVGHDD_{it} + \varepsilon_{it}$$

Where, for each customer 'i' and month 't':

ADC_{it}	=	The average daily therm consumption over 12 months (by default this was May 2018 to April 2019)
α_i	=	The participant intercept representing the average daily therm baseload
β_1	=	The model space heating slope
$AVGHDD_{it}$	=	The base 45 to base 85 average daily HDDs for the specific location
ε_{it}	=	The error term

Using this PRISM model, Cadmus computed weather-normalized annual consumption for each heating reference temperature:

$$NAC_i = \alpha_i * 365 + \beta_1 LRHDD_i$$

Where, for each customer 'i':

NAC_i	=	The normalized annual therm consumption for customer 'i'
α_i	=	The intercept, or the average daily or baseload for each participant that represents the average daily baseload from the model
$\alpha_i * 365$	=	The annual baseload therm usage (non-weather sensitive) for customer 'i'
β_1	=	The heating slope (usage per HDD from above model)
$LRHDD_i$	=	The annual, long-term HDDs of a typical meteorological year in the 1991–2005 series from the National Oceanic and Atmospheric Administration, based on home location
$\beta_1 * LRHDD_i$	=	The weather-normalized, annual weather-sensitive heating usage, also known as HEATNAC

If these models had correct signs on all parameters, Cadmus chose the best model for each manufactured home as the one with the highest R-square.

American Community Survey Tables

This section provides detailed tables of the American Community Survey outputs on a range of topics.

Number of Bedrooms per Home by Region and Home Type

# of bedrooms	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
1	1%	0%	1%	0%
2	6%	2%	5%	2%
3	41%	14%	38%	16%
4	46%	47%	50%	48%
5	6%	28%	6%	26%
6	0%	7%	1%	6%

Percentage of Homes with Internet Access by Region and Home Type

Internet access	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
Yes, with a subscription to an Internet Service	89%	96%	82%	95%
Yes, without a subscription to an Internet Service	2%	1%	2%	1%
No Internet access at this house, apartment or mobile home	9%	3%	16%	4%

Highest Level of Education of Residents by Region and Home Type

Years of schooling	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
NA or no schooling	9%	7%	8%	7%
Nursery school to grade 4	9%	9%	9%	9%
Grade 5, 6, 7, or 8	9%	6%	9%	7%
Grade 9	3%	2%	3%	2%
Grade 10	3%	2%	3%	2%
Grade 11	4%	2%	4%	2%
Grade 12	38%	22%	38%	25%
1 year of college	12%	12%	13%	13%
2 years of college	6%	7%	6%	8%
4 years of college	6%	20%	5%	17%
5 or more years of college	2%	11%	2%	10%

Employment Status of Residents over 16 Years of Age by Region and Home Type

Employment Status	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
Employed	52%	65%	49%	62%
Unemployed	5%	3%	5%	3%
Not in labor force	43%	32%	45%	35%

Distribution of Housing Types by Region

Home Type	Washington	PSE
Manufactured Home	6%	4%
Single Family Home	68%	65%
Multi-Family Home	26%	31%

Ownership Status of Household by Region and Home Type

Ownership status	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
Owned or being bought	74%	82%	74%	79%
Rented	26%	18%	26%	21%

Year Home was Built by Region and Home Type

Year/Decade	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
1939 or earlier	1%	11%	1%	12%
1940s	0%	5%	0%	6%
1950s	1%	10%	1%	10%
1960s	8%	11%	7%	10%
1970s	30%	14%	30%	14%
1980s	27%	12%	24%	11%
1990s	22%	16%	26%	16%
2000s	100%	9%	17%	10%
2010s	100%	1%	4%	1%

Average Annual Water Costs by Region and Home Type

Annual Water Costs	Mean	Median	n
Washington Single-Family	$902.32	$800.00	83,118
Washington Manufactured	$641.38	$518.00	4,485
PSE Single Family	$986.36	$900.00	44,044
PSE Manufactured	$660.08	$526.00	1,659

Average Annual Household Income by Region and Home Type

Annual Household Income	Mean	Median	n
Washington Single-Family	$103,499.04	$79,662.00	102,513
Washington Manufactured	$50,631.10	$41,000.00	9,660
PSE Single Family	$119,229.20	$93,291.00	51,527
PSE Manufactured	$54,360.44	$43,000.50	3,440

Average Household Value by Region and Home Type

Household Value	Mean	Median	n
Washington Single Family	$380,809.14	$300,000.00	85,682
Washington Manufactured	$111,758.75	$85,000.00	7,576
PSE Single Family	$467,914.32	$375,000.00	43,785
PSE Manufactured	$113,683.36	$80,000.00	2,742

Annual Natural Gas Costs by Region and Home Type

Annual Natural Gas Costs	Mean	Median	n
Washington Single Family	$1,067	$864	46764
Washington Manufactured	$1,038	$744	1176
PSE Single Family	$1,140	$960	27443
PSE Manufactured	$1,111	$846	534

Annual Electricity Costs by Region and Home Type

Annual Electricity Costs	Mean	Median	n
Washington Single Family	$1,730.43	$1,476.00	100,522
Washington Manufactured	$1,748.67	$1,488.00	9,417
PSE Single Family	$1,732.21	$1,476.00	50,621
PSE Manufactured	$1,778.29	$1,488.00	3,341

Main Heating Fuel Type by Region and Home Type

Heating Fuel Type	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
No fuel used	1%	0%	1%	0%
Utility gas	7%	56%	6%	47%
Bottled, tank, or liquefied petroleum gas	5%	5%	3%	4%
Electricity	77%	31%	78%	41%
Fuel oil, kerosene, other liquid fuels	0%	3%	0%	3%
Coal or coke		0%	0%	0%
Wood	9%	4%	11%	5%
Solar energy	0%	0%	0%	0%
Other	1%	0%	1%	1%

Ethnicity by Region and Home Type

Ethnicity	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
Not Hispanic	72%	92%	75%	90%
Mexican	25%	5%	23%	8%
Puerto Rican	0%	0%	0%	0%
Cuban	0%	0%	0%	0%
Other	2%	2%	2%	1%

Household Poverty Level by Region and Home Type

Poverty Level	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
Below 100% of poverty level	16%	6%	18%	7%
100% to 149% of poverty level	13%	4%	14%	5%
150% to 199% of poverty level	11%	5%	12%	6%
Above 200% of poverty level	59%	85%	56%	81%

Race of Householder by Region and Home Type

Race	PSE - Manufactured Homes	PSE - Single Family	Washington - Manufactured Homes	Washington - Single Family
White	77%	76%	79%	80%
Black	1%	3%	1%	3%
American Indian or Alaska Native	2%	1%	2%	1%
Chinese	0%	3%	0%	2%
Japanese	0%	1%	0%	1%
Other Asian or Pacific Islander	3%	9%	2%	6%
Other race	13%	2%	12%	3%
Two major races	3%	5%	4%	5%
Three or more major races	0%	1%	0%	1%

American Household Survey Tables

This section provides detailed tables from the American Household Survey.

Race and Hispanic Origin of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
White alone	83%	85%	82%	94%
Non-Hispanic	73%	72%	77%	79%
Hispanic	10%	14%	4%	14%
Black alone	10%	9%	3%	2%
Non-Hispanic	10%	8%	3%	2%
Hispanic	0%	0%	0%	0%
American Indian or Alaska Native alone	1%	3%	1%	0%
Asian alone	4%	1%	11%	1%
Asian Indian only	1%	0%	1%	0%
Chinese only	1%	0%	4%	1%
Filipino only	1%	0%	2%	0%
Japanese only	0%	0%	1%	0%
Korean only	0%	0%	1%	0%
Vietnamese only	0%	0%	1%	0%
Some other Asian group only	1%	0%	1%	0%
Two or more Asian groups	0%	0%	0%	0%
Pacific Islander alone	0%	0%	1%	1%
Native Hawaiian only	0%	0%	0%	0%

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Guamanian or Chamorro only	0%	0%	0%	0%
Samoan only	0%	0%	0%	1%
Some other Pacific Islander group only	0%	0%	0%	0%
Two or more Pacific Islander groups	0%	0%	0%	0%
Two or more races	1%	2%	2%	2%
Hispanic or Latino (any race)	11%	15%	5%	14%

Age of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Under 25 years old	1%	3%	1%	1%
25 to 29 years old	4%	5%	4%	1%
30 to 34 years old	7%	7%	7%	8%
35 to 44 years old	17%	15%	18%	15%
45 to 54 years old	21%	20%	22%	15%
55 to 64 years old	23%	22%	23%	34%
65 to 74 years old	16%	16%	16%	13%
75 years old and over	11%	11%	8%	12%
Median (years old)	54	54	53	58

Educational Attainment of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Less than 9th grade	3%	8%	1%	1%
9th to 12th grade, no diploma	6%	16%	3%	12%
High school graduate (includes equivalency)	28%	43%	20%	40%
Additional vocational training	13%	11%	24%	20%
Some college, no degree	16%	16%	16%	22%
Associate's degree	10%	8%	8%	13%
Bachelor's degree	23%	6%	32%	10%
Graduate or professional degree	14%	2%	21%	2%
Percent high school graduate or higher	91%	76%	97%	87%
Percent bachelor's degree or higher	37%	90%	53%	12%

Educational Enrollment Status of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Enrolled in a high school, college, or university	5%	3%	4%	2%
Not enrolled	91%	94%	91%	91%
Not reported	4%	3%	5%	7%

Citizenship of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Citizen of the United States	96%	92%	93%	91%
Naturalized citizen of the United States	8%	4%	10%	2%
Not citizen of the United States	4%	8%	7%	9%

Number of Occupants by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
1 person	20%	30%	16%	30%
2 persons	37%	32%	36%	36%
3 persons	17%	17%	18%	12%
4 persons	16%	11%	19%	18%
5 persons	7%	6%	7%	2%
6 persons	3%	3%	3%	1%
7 persons or more	1%	1%	2%	0%

Year Householder Moved into Unit by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
2016 to 2017	13%	18%	15%	17%
2010 to 2015	27%	31%	28%	33%
2005 to 2009	15%	15%	13%	19%
2000 to 2004	12%	13%	12%	12%
1995 to 1999	10%	12%	8%	13%
1990 to 1994	6%	5%	7%	2%
1985 to 1989	5%	3%	6%	2%
1980 to 1984	3%	2%	3%	0%
1975 to 1979	3%	1%	3%	1%
1970 to 1974	2%	1%	2%	0%
1960 to 1969	3%	0%	2%	0%
1950 to 1959	1%	0%	1%	0%
1940 to 1949	0%	0%	0%	0%
1939 or earlier	0%	0%	0%	0%
Median (year)	2006	2009	2006	2010

Year Householder Immigrated to the United States by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
2016 to 2017	1%	0%	2%	0%
2010 to 2015	6%	7%	12%	0%
2005 to 2009	7%	9%	8%	0%
2000 to 2004	12%	24%	13%	33%
1995 to 1999	14%	21%	14%	22%
1990 to 1994	12%	13%	10%	11%
1980 to 1989	23%	15%	17%	22%
1979 or before	25%	11%	23%	11%
Percent of Householders Immigrated	12%	11%	16%	11%

Household Composition by Age of Householder by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
2-or-more-person households	**80%**	**70%**	**84%**	**70%**
Married-couple families, no nonrelatives	74%	58%	77%	66%
Under 25 years old	1%	2%	0%	0%
25 to 29 years old	3%	4%	3%	3%
30 to 34 years old	7%	8%	7%	15%
35 to 44 years old	19%	18%	22%	20%
45 to 64 years old	46%	45%	47%	43%
65 years old and over	24%	22%	21%	19%
Other male householder	10%	16%	11%	17%
Under 45 years old	44%	44%	49%	32%
45 to 64 years old	40%	42%	37%	59%
65 years old and over	16%	14%	14%	8%
Other female householder	16%	26%	12%	17%
Under 45 years old	37%	46%	29%	22%
45 to 64 years old	42%	34%	50%	78%
65 years old and over	21%	20%	20%	0%
1-person households	**20%**	**30%**	**16%**	**30%**
Male householder	46%	49%	46%	54%
Under 45 years old	25%	18%	26%	8%
45 to 64 years old	42%	45%	48%	53%
65 years old and over	33%	37%	26%	40%
Female householder	54%	51%	54%	46%
Under 45 years old	11%	10%	8%	9%
45 to 64 years old	35%	38%	34%	27%
65 years old and over	54%	51%	57%	66%

Household Composition of Households with Single Children under 18 Years Old by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Total households with children	**33%**	**31%**	**36%**	**29%**
Married couples	74%	54%	83%	73%
One child under 6 years old only	12%	13%	13%	6%
One under 6 years old, one or more 6 to 17 years old	15%	16%	15%	16%
Two or more under 6 years old only	8%	8%	7%	6%
Two or more under 6 years old, one or more 6 to 17 years old	5%	4%	5%	0%
One or more 6 to 17 years old only	60%	59%	60%	73%
Other households with two or more adults	16%	28%	12%	18%
One child under 6 years old only	13%	16%	12%	46%
One under 6 years old, one or more 6 to 17 years old	15%	17%	11%	0%
Two or more under 6 years old only	6%	6%	7%	23%
Two or more under 6 years old, one or more 6 to 17 years old	3%	5%	2%	0%
One or more 6 to 17 years old only	63%	56%	68%	31%
Households with one adult or none	9%	18%	5%	9%
One child under 6 years old only	8%	5%	10%	0%
One under 6 years old, one or more 6 to 17 years old	12%	14%	0%	50%
Two or more under 6 years old only	2%	2%	0%	0%
Two or more under 6 years old, one or more 6 to 17 years old	3%	5%	0%	0%
One or more 6 to 17 years old only	74%	74%	91%	50%
Total households with no children	**67%**	**69%**	**64%**	**71%**
Married couples	53%	35%	57%	36%
Other households with two or more adults	17%	21%	19%	23%
Households with one adult	30%	44%	24%	42%

Number of Single Children under 18 Years Old by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
None	67%	69%	64%	71%
1	14%	15%	15%	14%
2	12%	9%	14%	12%
3	5%	5%	4%	1%
4	1%	1%	2%	1%
5	0%	1%	0%	0%
6 or more	0%	0%	0%	0%

Homes with Householder's Own Children under 18 Years Old by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
No own children under 18 years old	**71%**	**73%**	**67%**	**74%**
With own children under 18 years old	**29%**	**27%**	**33%**	**26%**
Under 6 years old only	19%	18%	18%	19%
1	62%	66%	66%	50%
2	33%	24%	32%	50%
3 or more	5%	10%	2%	0%
6 to 17 years old only	64%	61%	64%	63%
1	49%	56%	45%	65%
2	37%	27%	43%	36%
3 or more	14%	16%	12%	0%
Both age groups	18%	20%	18%	18%
2	46%	32%	47%	52%
3 or more	54%	68%	53%	48%

Homes with Persons over 65 Years Old by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
None	69%	69%	72%	71%
1 person	19%	22%	16%	22%
2 persons or more	13%	9%	11%	8%

Households with Persons Other than Spouse or Children by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With other relatives:	**89%**	**85%**	**85%**	**90%**
Single adult offspring 18 or over	**20%**	**18%**	**16%**	**20%**
Grandparent headed household, no parent present	**2%**	**2%**	**1%**	**0%**
Households with members of multiple generations	**46%**	**44%**	**47%**	**41%**
2 generation households	92%	90%	94%	93%
Householder and one younger generation	97%	96%	98%	97%
Householder and one older generation	3%	4%	2%	3%
3 or more generation households	8%	10%	6%	7%
Householder and two or more younger generations	69%	69%	65%	100%
Householder and at least one younger generation and at least one older generation	31%	31%	35%	0%
Householder and two or more older generations	0%	0%	0%	0%
Households with 1 subfamily	**3%**	**3%**	**2%**	**3%**
Households with 2 or more subfamilies	**0%**	**0%**	**0%**	**0%**
With nonrelatives	**11%**	**15%**	**15%**	**10%**
One or more secondary families	**4%**	**4%**	**2%**	**0%**

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
2-person households, none related to each other	**45%**	**42%**	**41%**	**83%**
Households with persons other than spouse or children	**79%**	**80%**	**78%**	**70%**

Households with Unmarried Partner Couples by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With unmarried partner couples	6%	8%	6%	6%

Veteran Status of Household Residents by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
One person served in the military	18%	15%	18%	27%
Active duty	5%	2%	7%	0%
Veteran	95%	98%	93%	100%
Two or more persons served in military	1%	1%	1%	1%
Active duty, all persons	5%	.	.	.
Veterans, all persons	81%	.	62%	.
Both present	14%	.	38%	.
Percentage of homes with veterans	19%	16%	19%	28%

Wars/Time Periods in Which Household Residents Served by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Served September 2001 or later	12%	12%	12%	8%
Served August 1990 - August 2001 (including Persian Gulf War)	16%	12%	16%	8%
Served May 1975 - July 1990	24%	23%	24%	30%
Served Vietnam era (August 1964 - April 1975)	29%	32%	32%	38%
Served February 1955 - July 1964	11%	12%	10%	7%
Served Korean War (July 1950 - January 1955)	6%	6%	5%	4%
Served January 1947 - June 1950	1%	1%	0%	0%
Served World War II (December 1941 - December 1946)	2%	1%	1%	4%
Served November 1941 or earlier	0%	0%	0%	0%

Accessibility of Structure by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Use of steps not required	54%	21%	53%	35%
Use of steps required	46%	79%	47%	65%

Foundation Types by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Basement under all of house	31%	.	17%	.
Basement under part of house	11%	.	11%	.
Crawl space	22%	.	56%	.
Concrete slab	33%	.	15%	.
Mobile home set on masonry foundation	.	19%	.	13%
Mobile home resting on concrete pad	.	18%	.	25%
Mobile home up on blocks, but not on concrete pad	.	60%	.	56%
Mobile home foundation not reported	.	1%	.	3%
Foundation setup in some other way	2%	3%	1%	3%

Mobile Home Anchoring Types by Region

Characteristics	National Manufactured Home	Seattle MSA Manufactured Home
Anchored by tiedowns, bolts, or other means	85%	76%
Not anchored	12%	17%
Anchoring not reported	4%	7%

Manufactured/Mobile Homes in Group by Region

Characteristics	National Manufactured Home	Seattle MSA Manufactured Home
1 to 6	73%	47%
7 to 20	5%	9%
21 or more	22%	44%

Monthly Total Housing Costs by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Less than $100	0%	1%	0%	0%
$100 to $199	1%	6%	0%	1%
$200 to $249	1%	5%	0%	3%
$250 to $299	2%	5%	1%	2%
$300 to $349	3%	5%	1%	1%
$350 to $399	3%	6%	0%	1%
$400 to $449	3%	4%	1%	2%
$450 to $499	3%	5%	1%	1%
$500 to $599	6%	10%	3%	4%
$600 to $699	6%	10%	5%	3%
$700 to $799	5%	9%	4%	6%
$800 to $999	10%	13%	8%	23%
$1,000 to $1,249	12%	7%	8%	15%
$1,250 to $1,499	10%	4%	9%	17%

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
$1,500 to $1,999	14%	2%	15%	8%
$2,000 to $2,499	8%	1%	15%	.
$2,500 or more	12%	2%	28%	5%
No cash rent	2%	4%	1%	5%
Median (excludes no cash rent) (dollars)	$1,112.00	$613.00	$1,767.00	$973.00

Monthly Total Housing Costs as a Percentage of Household Income by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Less than 5 percent	3%	4%	3%	8%
5 to 9 percent	13%	12%	9%	6%
10 to 14 percent	16%	14%	16%	5%
15 to 19 percent	16%	12%	16%	12%
20 to 24 percent	12%	10%	13%	7%
25 to 29 percent	9%	8%	12%	15%
30 to 34 percent	6%	6%	8%	6%
35 to 39 percent	4%	5%	6%	2%
40 to 49 percent	5%	6%	6%	9%
50 to 59 percent	3%	4%	2%	5%
60 to 69 percent	2%	2%	2%	7%
70 to 99 percent	3%	3%	2%	6%
100 percent or more	5%	7%	3%	8%
Zero or negative income	1%	2%	1%	0%
No cash rent	2%	4%	1%	5%
Median (excludes 2 previous lines) (percent)	20%	21%	21%	28%
Median (excludes 3 lines before medians) (percent)	19%	20%	21%	26%

Monthly Cost Paid for Rent by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Rent paid	15%	23%	15%	12%
Less than $250	6%	7%	4%	0%
$250 to $499	12%	35%	3%	10%
$500 to $749	22%	36%	5%	29%
$750 to $999	18%	14%	9%	0%
$1,000 to $1,249	13%	4%	18%	53%
$1,250 to $1,499	9%	1%	12%	8%
$1,500 to $1,749	7%	0%	10%	0%
$1,750 to $1,999	4%	0%	8%	0%
$2,000 to $2,249	3%	0%	8%	0%
$2,250 to $2,499	1%	0%	7%	0%

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
$2,500 to $2,999	2%	0%	9%	0%
$3,000 or more	3%	2%	7%	0%
Median (dollars)	$865.00	$500.00	$1,400.00	$1,000.00

Household Monthly Cost Paid for Utilities by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Utilities paid separately	99%	98%	99%	100%
Less than $50	0%	2%	1%	1%
$50 to $99	2%	10%	2%	7%
$100 to $149	11%	24%	8%	25%
$150 to $199	19%	25%	15%	31%
$200 to $249	22%	17%	18%	12%
$250 to $299	17%	10%	19%	7%
$300 to $399	18%	7%	24%	9%
$400 or more	10%	4%	13%	8%
Median (dollars)	$238.00	$174.00	$269.00	$182.00

Household Monthly Cost Paid for Electricity by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Electricity paid separately	99%	97%	99%	99%
Less than $25	1%	1%	1%	.
$25 to $49	5%	7%	11%	2%
$50 to $74	14%	12%	22%	5%
$75 to $99	17%	17%	21%	16%
$100 to $149	30%	30%	27%	32%
$150 to $199	17%	18%	9%	30%
$200 or more	17%	15%	9%	16%
Median (dollars)	$120.00	$119.00	$93.00	$141.00
Included in rent, other fee, or obtained free	1%	3%	1%	1%

Household Monthly Cost Paid for Gas by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Gas paid separately	72%	41%	72%	13%
Less than $25	7%	20%	11%	37%
$25 to $49	29%	39%	18%	17%
$50 to $74	29%	17%	29%	24%
$75 to $99	16%	9%	21%	.
$100 to $149	12%	5%	15%	13%
$150 to $199	3%	4%	3%	.
$200 or more	3%	5%	4%	8%
Median (dollars)	$60.00	$42.00	$67.00	$38.00
Included in rent, other fee, or obtained free	3%	9%	2%	0%

Household Monthly Cost Paid for Fuel Oil by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Fuel oil paid separately	6%	2%	4%	.
Less than $25	5%	8%	11%	.
$25 to $49	9%	13%	10%	.
$50 to $74	14%	30%	16%	.
$75 to $99	15%	13%	20%	.
$100 to $149	25%	24%	27%	.
$150 to $199	13%	5%	8%	.
$200 or more	19%	8%	8%	.
Median (dollars)	$100.00	$67.00	$83.00	.
Included in rent, other fee, or obtained free	6%	9%	6%	.

Household Monthly Cost Paid for Other Fuel by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Other fuel paid separately	5%	7%	5%	7%
Less than $25	46%	36%	46%	50%
$25 to $49	23%	22%	29%	32%
$50 to $74	14%	19%	13%	.
$75 to $99	9%	9%	7%	.
$100 to $149	5%	11%	3%	.
$150 to $199	1%	1%	.	18%
$200 or more	2%	2%	3%	.
Median (dollars)	$25.00	$40.00	$25.00	$17.00
Included in rent, other fee, or obtained free	53%	47%	55%	56%

Household Monthly Cost Paid for Trash Collection by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Trash collection paid separately	62%	41%	86%	61%
Less than $25	45%	54%	21%	33%
$25 to $49	27%	29%	39%	52%
$50 to $74	14%	9%	19%	5%
$75 to $99	5%	4%	5%	4%
$100 to $149	6%	3%	10%	6%
$150 to $199	1%	1%	2%	..
$200 or more	1%	1%	2%	.
Median (dollars)	$25.00	$22.00	$40.00	$27.00
Included in rent, other fee, or obtained free	34%	53%	11%	30%

Household Monthly Cost Paid for Water by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Water paid separately	57%	39%	70%	37%
Less than $25	16%	29%	7%	25%
$25 to $49	30%	40%	14%	19%
$50 to $74	25%	20%	21%	18%
$75 to $99	11%	5%	14%	18%
$100 to $149	13%	5%	29%	12%
$150 to $199	3%	0%	9%	3%
$200 or more	2%	1%	5%	3%
Median (dollars)	$50.00	$33.00	$81.00	$50.00
Included in rent, other fee, or obtained free	43%	61%	30%	64%

Housing Adequacy by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Severely inadequate	1%	2%	1%	2%
Plumbing	30%	14%	29%	0%
Heating	39%	45%	39%	50%
Electric	14%	2%	27%	0%
Wiring	3%	4%	0%	0%
Upkeep	19%	39%	6%	50%
Moderately inadequate	3%	6%	2%	2%
Upkeep	63%	70%	79%	100%
Other	41%	32%	21%	0%
Adequate	96%	91%	98%	96%

Occurrence of Selected Housing Deficiencies by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Signs of mice or rats inside home in last 12 months	14%	24%	7%	6%
Signs of cockroaches in last 12 months	10%	15%	0%	3%
Holes in floors	1%	4%	1%	5%
Open cracks or holes (interior)	5%	9%	6%	10%
Broken plaster or peeling paint (interior)	2%	2%	1%	2%
No electrical wiring	0%	0%	0%	0%
Exposed wiring	3%	3%	4%	5%
Rooms without electric outlets	2%	2%	2%	0%

Flush Toilet Breakdowns in the Past Three Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With at least one toilet working at all times in last 3 months	**99%**	**98%**	**99%**	**99%**
None working some time in last 3 months	**1%**	**2%**	**1%**	**1%**
No breakdowns lasting 6 hours or more	20%	14%	24%	0%
Number of breakdowns that lasted 6 hours or more:				
1	51%	62%	56%	100%
2	14%	7%	11%	0%
3	4%	1%	0%	0%
4 or more	12%	17%	11%	0%

Heating Problems in the Last Winter by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With heating equipment and occupied last winter	**95%**	**94%**	**95%**	**98%**
Not uncomfortably cold for 24 hours or more	**95%**	**90%**	**90%**	**89%**
Uncomfortably cold for 24 hours or more	**5%**	**10%**	**10%**	**11%**
Equipment breakdowns	32%	38%	23%	25%
No breakdowns lasting 6 hours or more	1%	0%	0%	0%
1	69%	55%	79%	0%
2	13%	14%	10%	46%
3	6%	10%	4%	0%
4 or more	11%	21%	7%	46%
Other causes	68%	62%	77%	75%
Utility interruption	35%	33%	36%	32%
Inadequate heating capacity	16%	25%	23%	16%
Inadequate insulation	20%	27%	14%	32%
Cost of heating	13%	15%	18%	34%
Other	22%	14%	21%	0%
Not reported	1%	1%	1%	0%

Fuses Blown in the Past Three Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
No fuses or breakers blown in last 3 months	91%	91%	88%	86%
With fuses or breakers blown in last 3 months	9%	9%	12%	14%
1 time	57%	49%	46%	43%
2 times	23%	26%	26%	36%
3 times	8%	10%	11%	9%
4 times or more	11%	15%	17%	12%

Water Supply Stoppage in the Past Three Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
No stoppage in last 3 months	97%	94%	98%	94%
With stoppage in last 3 months	2%	5%	1%	5%
No stoppage lasting 6 hours or more	18%	16%	22%	22%
1	55%	55%	56%	26%
2	14%	15%	17%	26%
3	4%	7%	0%	0%
4 or more	8%	5%	6%	26%
Number of stoppages not reported	1%	0%	0%	0%
Stoppage not reported	1%	0%	1%	1%

Reported Water Leakage During the Past 12 Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
No leakage from inside structure	93%	91%	92%	92%
With leakage from inside structure	7%	9%	8%	8%
Fixtures backed up or overflowed	25%	25%	21%	12%
Pipes leaked	42%	41%	51%	44%
Broken water heater	11%	17%	12%	12%
Other or unknown (includes not reported)	27%	23%	21%	29%
No leakage from outside structure	89%	85%	91%	85%
With leakage from outside structure	11%	15%	9%	15%
Roof	47%	72%	55%	77%
Basement	34%	2%	24%	0%
Walls, closed windows, or doors	15%	24%	11%	28%
Other or unknown (includes not reported)	11%	9%	13%	8%

External Building Deficiencies by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Sagging roof	2%	4%	2%	3%
Missing roofing material	4%	5%	2%	0%
Hole in roof	1%	3%	1%	5%
Missing bricks, siding, or other outside wall material	3%	5%	2%	3%
Sloping outside walls	1%	3%	1%	3%
Boarded up windows	1%	2%	1%	5%
Broken windows	4%	9%	3%	4%
Bars on windows	2%	1%	2%	1%
Foundation crumbling or has open crack or hole	6%	4%	5%	6%

Household Mold Presence by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Housing units with mold in last 12 months	3%	5%	3%	4%
Kitchen	16%	23%	11%	50%
Bathroom(s)	34%	49%	43%	27%
Bedroom(s)	22%	35%	23%	77%
Living room	10%	26%	23%	.
Basement	27%	.	22%	.
Other room	19%	14%	26%	.
Not reported	27%	15%	45%	27%

Sewage Disposal Breakdowns in the Past Three Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With public sewer	**76%**	**55%**	**79%**	**60%**
No breakdowns in last 3 months	99%	98%	100%	98%
With breakdown(s) in last 3 months	1%	2%	0%	2%
No breakdowns lasting 6 hours or more	22%	12%	39%	0%
1	54%	64%	21%	100%
2	14%	1%	0%	0%
3	4%	9%	0%	0%
4 or more	5%	12%	39%	0%
With septic tank or cesspool	**24%**	**46%**	**21%**	**43%**
No breakdowns in last 3 months	99%	98%	99%	100%
With breakdown(s) in last 3 months	1%	2%	1%	0%
No breakdowns lasting 6 hours or more	23%	0%	32%	
1	63%	73%	60%	
2	2%	10%	41%	
3	2%	0%	0%	
4 or more	9%	18%	0%	

Sustainability of Home for Year Round Use by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Built and heated for year-round use	99%	99%	100%	99%
Not suitable	0%	1%	0%	1%

Duration of Vacancy for Vacant Housing Units by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Vacant units	9%	22%	5%	8%
Less than 1 month vacant	12%	7%	14%	14%
1 month up to 2 months	11%	6%	14%	0%
2 months up to 6 months	17%	18%	26%	14%
6 months up to 1 year	9%	13%	2%	0%
1 year up to 2 years	8%	7%	5%	14%
2 years or more	24%	30%	13%	44%
Never occupied	3%	4%	6%	14%
Don't know	15%	15%	19%	0%

Time Since Seasonally Vacant Housing Unit was Used as a Permanent Residence by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Vacant seasonal	2%	7%	0%	2%
Less than 1 month since occupied as permanent home	9%	7%	.	.
1 month up to 2 months	2%	1%	.	.
2 months up to 6 months	5%	10%	14%	.
6 months up to 1 year	3%	7%	.	.
1 year up to 2 years	2%	1%	.	50%
2 years or more	27%	19%	28%	.
Never occupied as permanent home	39%	38%	14%	50%
Not reported	13%	16%	44%	.

Sale Status of Home by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Up for rent only	1%	4%	1%	1%
Up for rent or for sale	0%	1%	0%	.
For sale only	3%	3%	2%	1%
Not for rent or for sale	91%	87%	91%	95%
Not reported	4%	6%	6%	2%

Extra Unit Status of Unit by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Extra units	4%	11%	1%	3%
Previous usual residence	7%	8%	9%	33%
Used for recreational purposes	47%	53%	37%	0%
Investment purposes	8%	3%	9%	0%
Unable to sell property	1%	2%	4%	0%
Inherited property	8%	7%	0%	0%
Other reasons	12%	15%	18%	67%
Not reported	16%	13%	23%	0%

Location of Extra Unit by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Within 150 miles of current residence	47%	43%	62%	67%
150 miles or more from current residence	38%	43%	9%	.
Not reported	16%	15%	28%	33%

Number of Nights Owner Spent at Extra Unit in the Last 12 Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
0 to 2 nights	18%	17%	5%	67%
3 to 7 nights	4%	6%	0%	0%
8 nights or more	52%	59%	67%	33%
Not reported	27%	17%	28%	0%

Number of Rooms in Unit by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
1	0%	0%	.	.
2	0%	1%	0%	.
3	1%	6%	1%	2%
4	7%	29%	6%	23%
5	22%	37%	16%	43%
6	26%	19%	24%	27%
7	20%	6%	20%	4%
8	13%	2%	17%	1%
9	6%	1%	10%	.
10 or more	5%	0%	7%	.

Number of Bedrooms in Unit by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
None	0%	0%	0%	.
1	2%	7%	2%	2%
2	15%	38%	13%	39%
3	50%	48%	46%	54%
4 or more	33%	7%	39%	5%

Number of Bathrooms by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
At least 1 complete bathroom	100%	100%	100%	100%
1	21%	32%	15%	19%
1.5	13%	9%	14%	6%
2	33%	55%	22%	73%
2.5	17%	2%	31%	2%
3	14%	2%	16%	.
More than 3	3%	0%	2%	.

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
No complete bathroom	0%	0%	0%	0%
Sink and tub present	2%	.	.	.
Sink and toilet present	11%	.	.	.
Tub and toilet present	1%	.	.	.
Sink only present	0%	.	.	.
Tub only present	2%	.	.	.
Toilet only present	3%	.	.	.
No sink, bathtub, shower, or toilet present	80%	.	.	.

Presence of Selected Amenities by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Porch, deck, balcony, or patio	93%	86%	94%	92%
Usable fireplace	48%	15%	75%	18%
Separate dining room	57%	28%	55%	31%
With 2 or more living rooms or recreation rooms, etc.	44%	13%	57%	17%

Parking Availability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Garage or carport	81%	35%	89%	64%

Percentage of Units Using Each Fuel by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Electricity	92%	84%	96%	93%
Gas	68%	38%	71%	12%
Fuel oil	6%	3%	4%	.
Other	10%	11%	12%	15%

Main Heating Equipment Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Warm-air furnace	68%	65%	75%	68%
Steam or hot water system	7%	1%	2%	.
Electric heat pump	12%	15%	6%	13%
Built-in electric units	3%	2%	9%	5%
Floor, wall, or other built-in hot-air units without ducts	4%	3%	3%	.
Room heaters with flue	1%	1%	1%	.
Room heaters without flue	1%	2%	0%	.
Portable electric heaters	1%	6%	1%	7%
Stoves	1%	3%	1%	6%
Fireplaces with inserts	0%	0%	1%	.
Fireplaces without inserts	0%	0%	.	.
Cooking stove	0%	0%	0%	.
Other	0%	1%	0%	.
None	1%	2%	0%	1%

Main House Heating Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Housing units with heating fuel	99%	98%	100%	99%
Electricity	37%	63%	38%	86%
Piped gas	48%	18%	53%	4%
Bottled gas	6%	11%	3%	2%
Fuel oil	5%	2%	4%	.
Kerosene or other liquid fuel	0%	2%	0%	.
Coal or coke	0%	0%	0%	.
Wood	3%	4%	2%	7%
Solar energy	0%	.	.	.
Other	0%	0%	0%	.

Primary Air Conditioning System and Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With primary air conditioning	**89%**	**88%**	**48%**	**55%**
Central air conditioning	82%	71%	53%	38%
Electric	97%	98%	88%	95%
Piped gas	3%	1%	11%	.
Liquid propane gas	0%	1%	0%	5%
Other	0%	0%	0%	.

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Room air conditioning	18%	29%	47%	62%
Unit has 1 room air conditioner	36%	40%	68%	73%
Unit has 2 room air conditioners	33%	37%	26%	15%
Unit has 3 room air conditioners	18%	18%	4%	11%
Unit has 4 room air conditioners	9%	5%	2%	.
Unit has 5 room air conditioners	3%	1%	.	.
Unit has 6 room air conditioners	1%	0%	.	.
Unit has 7 or more room air conditioners	0%	0%	.	.
Unit does not have air conditioning	**11%**	**12%**	**52%**	**45%**

Secondary Air Conditioning System Type and Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With secondary air conditioning	**12%**	**12%**	**3%**	**2%**
Central air conditioning	61%	40%	52%	58%
Electric	96%	100%	88%	100%
Piped gas	3%	0%	12%	.
Liquid propane gas	0%	.	.	.
Other	1%	.	.	.
Room air conditioning	39%	60%	48%	42%
Unit has 1 room air conditioner	69%	58%	80%	100%
Unit has 2 room air conditioners	21%	24%	5%	.
Unit has 3 room air conditioners	6%	14%	15%	.
Unit has 4 room air conditioners	2%	5%	.	.
Unit has 5 room air conditioners	1%	.	.	.
Unit has 6 room air conditioners	0%	0%	.	.
Unit has 7 or more room air conditioners	0%	.	.	.
Unit does not have secondary air conditioning	**88%**	**88%**	**97%**	**98%**

Primary Water Heating Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With hot piped water	100%	100%	100%	100%
Electricity	41%	76%	46%	89%
Piped gas	51%	16%	50%	8%
Bottled gas	5%	7%	3%	3%
Fuel oil	3%	0%	0%	.
Solar energy	0%	.	.	.
Other	0%	0%	.	.

Presence of Kitchen Appliances and Equipment by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With complete kitchen (sink, refrigerator, and oven or burners)	97%	94%	100%	95%
Lacking complete kitchen facilities	3%	6%	0%	5%
Kitchen sink	99%	98%	100%	98%
Refrigerator	98%	94%	100%	95%
Cooking stove or range	98%	94%	99%	96%
Burners, no stove or range	0%	1%	0%	0%
Microwave oven only	0%	1%	0%	1%
Dishwasher	76%	47%	92%	82%

Presence of Laundry Equipment by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Washing machine	93%	81%	98%	93%
Clothes dryer	92%	79%	98%	93%

Primary Cooking Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With cooking fuel	98%	95%	100%	97%
Electricity	59%	68%	63%	92%
Piped gas	35%	18%	33%	7%
Bottled gas	6%	14%	4%	1%
Other	0%	0%	0%	0%

Primary Clothes Dryer Fuel Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With clothes dryer	92%	79%	98%	93%
Electricity	77%	93%	88%	97%
Piped gas	21%	6%	11%	2%
Bottled gas	2%	1%	1%	1%
Other	0%	0%	0%	0%

Supplemental Heating Equipment Type by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Warm-air furnace	2%	2%	2%	1%
Steam or hot water system	0%	0%	0%	1%
Electric heat pump	1%	1%	1%	1%
Built-in electric units	1%	1%	3%	.
Floor, wall, or other built-in hot-air units without ducts	0%	0%	0%	1%
Room heaters with flue	0%	0%	1%	.
Room heaters without flue	1%	2%	1%	.
Portable electric heaters	6%	8%	12%	12%
Stoves	3%	2%	3%	4%
Outdoor wood fired boiler	0%	0%	0%	.
Gas oven with the door open	0%	0%	.	.
Cooking stove	3%	3%	2%	1%
Other	2%	2%	2%	3%
Not reported	0%	0%	.	.
No supplemental heating	82%	81%	75%	75%

Presence of Carbon Monoxide Detector by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Yes	65%	77%	61%	28%
No	34%	3%	4%	39%
Not reported	1%	20%	35%	33%

Presence of Solar Panels by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Yes	3%	1%	1%	1%
No	97%	99%	99%	99%
Not reported	0%	0%	0%	.

Total Household Income by Region and Fuel Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Less than $5,000	4%	8%	2%	5%
$5,000 to $9,999	2%	6%	1%	3%
$10,000 to $14,999	3%	9%	1%	3%
$15,000 to $19,999	4%	8%	2%	9%
$20,000 to $24,999	4%	8%	3%	9%
$25,000 to $29,999	4%	6%	1%	4%
$30,000 to $34,999	4%	8%	2%	2%
$35,000 to $39,999	4%	7%	3%	5%
$40,000 to $49,999	8%	11%	5%	7%
$50,000 to $59,999	7%	8%	5%	16%
$60,000 to $79,999	13%	11%	12%	14%
$80,000 to $99,999	11%	5%	13%	11%
$100,000 to $119,999	9%	3%	10%	3%
$120,000 or more	23%	4%	41%	8%
Median (dollars)	$68,600.00	$33,000.00	$100,000.00	$50,000.00

Household Income as a Percentage of the Federal Poverty Level by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Less than 50 percent	5%	11%	2%	6%
50 to 99 percent	5%	13%	2%	7%
100 to 149 percent	7%	15%	3%	10%
150 to 199 percent	8%	13%	4%	13%
200 percent or more	76%	48%	89%	63%

Food Stamp Eligibility and Status by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Families and primary individuals eligible to receive food stamps	72%	88%	66%	81%
Received food stamps	8%	20%	6%	23%
Did not receive food stamps	87%	76%	87%	68%
Not reported	5%	4%	7%	9%

Primary Source of Water by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Public or private system	85%	72%	94%	86%
Individual well	15%	27%	6%	14%
Other	0%	1%	0%	.

Type of Sewage System by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Public sewer	76%	53%	79%	57%
Septic tank or cesspool	24%	46%	21%	43%
Standard septic tank and subsurface leach field	95%	96%	88%	97%
Pump used to distribute wastewater	3%	2%	12%	3%
Elevated above natural soil surface	1%	1%	0%	.
Applied treated wastewater	0%	0%	0%	.
Other	0%	0%	.	.
Other	0%	0%	0%	.
None	0%	0%	.	.
Not reported	0%	0%	.	.

Number of Units Connected to Septic Tank or Cesspool by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Septic tank or cesspool	24%	46%	21%	43%
1	98%	92%	97%	81%
2 to 5	1%	5%	3%	14%
6 or more	0%	2%	0%	5%

Number of Persons per Room by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
0.50 or less	75%	67%	76%	72%
0.51 to 1.00	24%	30%	23%	26%
1.01 to 1.50	1%	3%	1%	2%
1.51 or more	0%	0%	0%	0%

Number of Persons Per Bedroom by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
0.50 or less	29%	30%	28%	30%
0.51 to 1.00	50%	44%	51%	45%
1.01 to 1.50	14%	13%	14%	18%
1.51 or more	7%	13%	7%	7%
No bedrooms	0%	0%	0%	0%

Percentage of Units with Resident with Disability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with disability	21%	34%	17%	31%
Without a resident with disability	76%	64%	78%	63%
Not reported	3%	2%	5%	6%

Percentage of Units with Resident with Hearing Disability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with hearing disability	9%	12%	8%	9%
Without a resident with hearing disability	88%	86%	88%	85%
Not reported	3%	2%	5%	6%

Percentage of Units with Resident with Vision Disability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with vision disability	4%	7%	2%	4%
Without a resident with vision disability	93%	91%	93%	90%
Not reported	3%	2%	5%	6%

Percentage of Units with Resident with Mentally Disability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with mental disability	6%	12%	5%	12%
Without a resident with mental disability	91%	86%	90%	82%
Not reported	3%	2%	5%	6%

Percentage of Units with Resident with Physically Disability by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with physical disability	11%	19%	8%	18%
Without a resident with physical disability	86%	79%	87%	76%
Not reported	3%	2%	5%	6%

Percentage of Units with Residents with Self-Care Disabilities by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with self-care disability	4%	5%	2%	7%
Without a resident with self-care disability	94%	93%	93%	87%
Not reported	3%	2%	5%	6%

Percentage of Units with Resident with Disabilities that Prevent Leaving the Home by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
With a resident with go-outside-home disability	7%	11%	4%	9%
Without a resident with go-outside-home disability	91%	87%	91%	85%
Not reported	3%	2%	5%	6%

Percentage of Homes Built before 2007 With Gut Rehabilitation in the Last 10 Years by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Units built before 2007	80%	70%	79%	77%
Yes	20%	17%	18%	13%
No	79%	81%	81%	87%
Not Reported	1%	1%	1%	0%

Survey Respondents Reporting Having Moved in Past Two Years by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Total	17%	21%	18%	20%

Percentage of Survey Respondents Who Moved in Past Two Years Reporting Early Housing Search End by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Yes	11%	15%	11%	18%
Reason housing search ended early:				
Had to move quickly	49%	63%	58%	72%
Had difficulty with travel	1%	3%	0%	0%
Both	9%	12%	4%	0%
No reason given	40%	22%	39%	28%
No	89%	85%	89%	82%

Comparison of New Home to Old Home of Recent Movers by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Better home	61%	44%	68%	54%
Worse home	8%	21%	10%	19%
About the same	26%	28%	18%	14%
Not reported	5%	6%	4%	13%

Comparison of New Neighborhood to Old Neighborhood of Recent Movers by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Better neighborhood	47%	40%	49%	62%
Worse neighborhood	7%	14%	10%	19%
About the same	37%	36%	33%	6%
Same neighborhood	4%	4%	5%	0%
Not reported	5%	6%	4%	13%

Utility Delinquencies in the Past Three Months by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Received notice of utilities shut-off due to missed payment(s):				
Yes	15%	19%	10%	13%
Have or had utilities shut-off:				
Yes	5%	9%	5%	0%
No	94%	91%	95%	100%
Not reported	0%	0%	1%	0%
No	81%	78%	84%	81%
Not reported	3%	3%	6%	7%

Likelihood of Leaving Current Home within Two Months Due to Eviction by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
Very likely	1%	1%	.	.
Somewhat likely	6%	7%	7%	23%
Not very likely	90%	90%	85%	70%
Not reported	3%	3%	8%	7%

Likeliest New Housing Situation in Event of Eviction by Region and Home Type

Characteristics	National Single Family	National Manufactured Home	Seattle MSA Single Family	Seattle MSA Manufactured Home
New home	62%	52%	55%	41%
Family member's home	22%	29%	19%	11%
Friend's home	6%	8%	11%	14%
Household members would move to different places	3%	2%	6%	.
Shelter	2%	4%	0%	23%
Not reported	5%	5%	9%	11%

RBSA II Tables

This section provides tables from the RBSA II. Tables include data on building characteristics for manufactured and single family homes in PSE service territory and also provide regional comparative information.

Manufactured Home Structure Type Distribution in PSE Service Territory

Home Type	Percentage of Homes		
	WA		n
	%	EB	
Single Wide	15.7%	12.7%	5
Double Wide	81.2%	11.5%	25
Triple Wide	3.1%	19.4%	1
Modular / Prefab	0.0%	0.0%	0
Total	**100.0%**	**0.0%**	**31**

Manufactured Home Structure Type Distribution by State

Home Type	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Single Wide	31.1%	8.4%	41.5%	9.8%	14.3%	6.1%	20.5%	5.8%	21.7%	3.5%	108
Double Wide	63.6%	8.4%	51.8%	9.9%	77.1%	6.8%	73.0%	6.2%	71.3%	3.8%	272
Triple Wide	4.2%	4.4%	2.8%	3.7%	3.2%	3.3%	5.2%	3.7%	4.3%	1.9%	18
Modular / Prefab	1.1%	6.6%	4.0%	5.7%	5.4%	3.9%	1.3%	2.6%	2.8%	1.4%	13
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**411**

Year Manufactured Home was Built in PSE Service Territory

Vintage	Percentage of Homes		n
	WA		
	%	EB	
Pre 1951	1.5%	0.0%	1
1951-1960	0.0%	0.0%	0
1961-1970	13.1%	12.8%	4
1971-1980	27.1%	15.2%	8
1981-1990	30.3%	15.5%	9
1991-2000	20.5%	14.5%	6
2001-2010	7.5%	14.2%	2
Post 2010	0.0%	0.0%	0
Total	**100.0%**	**0.0%**	**30**

Year Manufactured Home was Built by State

Vintage	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	1.1%	6.6%	0.9%	5.7%	0.0%	0.0%	0.5%	0.0%	0.4%	0.4%	3
1951-1960	0.0%	0.0%	1.8%	3.7%	0.0%	0.0%	0.8%	4.9%	0.5%	0.9%	3
1961-1970	4.2%	4.4%	10.7%	6.7%	6.0%	4.7%	9.6%	4.4%	7.8%	2.5%	31
1971-1980	24.0%	7.6%	27.5%	8.3%	22.8%	7.2%	29.2%	6.8%	26.3%	4.0%	111
1981-1990	14.5%	6.7%	10.3%	7.7%	18.3%	6.2%	19.3%	6.0%	17.6%	3.5%	66
1991-2000	45.7%	8.2%	35.7%	9.5%	38.5%	8.2%	27.2%	6.7%	33.9%	4.2%	143
2001-2010	7.4%	5.0%	13.1%	7.8%	12.4%	5.7%	11.2%	4.8%	11.2%	2.9%	44
Post 2010	3.2%	4.2%	0.0%	0.0%	2.1%	4.3%	2.2%	3.0%	2.1%	1.5%	8
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**409**

Year Single Family Home in PSE Service Territory was Built

Vintage	Percentage of Homes		n
	WA		
	%	EB	
Pre 1951	18.1%	8.2%	13
1951-1960	3.1%	6.2%	2
1961-1970	11.0%	7.0%	8
1971-1980	15.0%	7.6%	11
1981-1990	21.8%	8.7%	15
1991-2000	13.4%	7.3%	10
2001-2010	14.3%	7.4%	11
Post 2010	3.3%	4.6%	3
Total	**100.0%**	**0.0%**	**73**

Year Single Family Home was Built by State

Vintage	Percentage of Homes										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	15.9%	5.7%	17.6%	5.6%	30.8%	5.7%	21.5%	3.7%	23.3%	2.6%	276
1951-1960	5.0%	3.8%	7.3%	4.0%	8.5%	3.7%	8.0%	2.3%	7.7%	1.6%	102
1961-1970	7.5%	4.4%	8.0%	4.1%	9%	3.4%	10.3%	3.0%	9%	1.9%	90
1971-1980	20.0%	6.2%	15.2%	5.5%	14.4%	4.1%	13.5%	3.3%	14.7%	2.2%	159
1981-1990	9.2%	4.7%	18.4%	6.0%	7.5%	3.4%	12.3%	3.4%	10.9%	2.1%	101
1991-2000	15.0%	5.7%	11.3%	5.1%	15.5%	4.3%	13.7%	3.3%	14.2%	2.2%	140
2001-2010	22.5%	6.5%	18.8%	6.0%	10.0%	3.4%	15.6%	3.3%	15.1%	2.2%	161
Post 2010	5.0%	3.9%	3.5%	3.0%	4.6%	2.4%	5.0%	1.7%	4.8%	1.2%	59
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**1,088**

Conditioned Floor Area of Manufactured Homes by State

State	Conditioned Floor Area (sq. ft.)		
	Mean	EB	n
ID	1,287.0	80.1	85
MT	1,481.1	160.8	84
OR	1,361.0	60.0	108
WA	1,339.8	59.5	134
Region	1,351.0	37.5	411
PSE	1,260.7	93.1	31

Conditioned Floor Area of Single Family Homes by State

State	Conditioned Floor Area (sq. ft.)		
	Mean	EB	n
ID	2,156.3	147.8	121
MT	2,075.1	145.9	129
OR	1,985.0	127.4	282
WA	1,962.1	81.5	568
Region	2,001.7	60.0	1,100
PSE	1,840.5	179.9	73

Number of Bedrooms per Manufactured Home by Region

State	Bedrooms per Home		
	Mean	EB	n
ID	2.65	0.14	85
MT	2.75	0.15	84
OR	2.77	0.11	108
WA	2.60	0.11	134
Region	2.67	0.06	411
PSE	2.52	0.22	31

Number of Bedrooms per Single Family Home by Region

State	Bedrooms per Home		
	Mean	EB	n
ID	3.1	0.2	121
MT	3.0	0.2	129
OR	2.9	0.1	282
WA	2.9	0.1	568
Region	3.0	0.1	1,100
PSE	2.9	0.2	73

Number of Bathrooms per Manufactured Home by Region

State	Bathrooms per Home		
	Mean	EB	n
ID	1.85	0.10	85
MT	1.80	0.11	84
OR	1.88	0.08	108
WA	1.82	0.07	134
Region	1.84	0.04	411
PSE	1.70	0.15	31

Number of Bathrooms per Single Family Home by Region

State	Bathrooms per Home		
	Mean	EB	n
ID	2.3	0.1	121
MT	2.1	0.1	129
OR	2.3	0.1	282
WA	2.2	0.1	568
Region	2.2	0.1	1,100
PSE	2.1	0.2	73

Wall Insulation Levels of Manufactured Homes in PSE Service Territory by Year of Construction

Vintage	Wall Insulation Levels										
	R0–R8		R9–R14		R15–R21		R22–R30		All Walls		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	1
1951-1960	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0
1961-1970	33.3%	68.3%	66.7%	31.6%	0.0%	0.0%	0.0%	0.0%	11.0%	13.7%	3
1971-1980	44.7%	21.1%	41.4%	22.4%	13.8%	44.7%	0.0%	0.0%	25.5%	15.2%	7
1981-1990	49.7%	21.9%	33.2%	27.2%	17.1%	0.0%	0.0%	0.0%	21.9%	14.9%	6
1991-2000	0.0%	0.0%	79.3%	17.6%	20.7%	52.0%	0.0%	0.0%	18.2%	14.5%	5
2001-2010	0.0%	0.0%	14.5%	0.0%	85.5%	0.0%	0.0%	0.0%	22.1%	11.1%	3
Post 2010	0.0%	0.0%	34.2%	0.0%	65.8%	0.0%	0.0%	0.0%	1.3%	1.9%	3
All Housing Vintages	26.8%	14.9%	43.7%	15.5%	29.5%	13.3%	0.0%	0.0%	100.0%	0.0%	25

Wall Insulation Levels of Single Family Homes in PSE Service Territory by Year of Construction

Vintage	Wall Insulation Levels										
	R0–R8		R9–R14		R15–R21		R22–R30		All Walls		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1951	20.5%	6.3%	44.7%	6.9%	34.8%	6.9%	0.0%	0.0%	16.7%	5.8%	47
1951-1960	64.7%	3.5%	33.9%	3.3%	1.3%	1.5%	0.0%	0.0%	7.7%	4.5%	20
1961-1970	17.4%	9.2%	74.5%	7.9%	8.1%	17.7%	0.0%	0.0%	15.3%	6.8%	17
1971-1980	15.5%	7.5%	84.5%	5.7%	0.0%	0.0%	0.0%	0.0%	11.0%	5.2%	15
1981-1990	0.0%	0.0%	61.0%	8.5%	39.0%	9.1%	0.0%	0.0%	13.3%	5.7%	16
1991-2000	0.0%	0.0%	19.2%	3.5%	80.8%	2.6%	0.0%	0.0%	15.4%	6.5%	20
2001-2010	2.7%	7.3%	12.0%	7.0%	85.2%	5.4%	0.0%	0.0%	16.9%	6.5%	27
Post 2010	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	3.6%	2.2%	9
All Housing Vintages	11.6%	5.5%	46.8%	8.4%	41.6%	8.2%	0.0%	0.0%	100.0%	0.0%	171

Mean Wall U-Value in Manufactured Homes by Region

State	Wall U-Value		
	Mean	EB	n
ID	0.095	0.006	85
MT	0.100	0.006	84
OR	0.096	0.004	108
WA	0.104	0.005	133
Region	0.100	0.003	410
PSE	0.114	0.012	31
PSE – Single Family	0.110	0.022	73

Mean Floor U-Value in Manufactured Homes by Region

State	Floor U-Value		
	Mean	EB	n
ID	0.060	0.005	85
MT	0.069	0.007	83
OR	0.063	0.005	108
WA	0.067	0.004	134
Region	0.065	0.003	410
PSE	0.071	0.009	31
PSE – Single Family	0.090	0.012	73

Mean Ceiling U-Value in Manufactured Homes by Region

State	Ceiling U-Value		
	Mean	EB	n
ID	0.072	0.006	85
MT	0.077	0.006	84
OR	0.073	0.005	108
WA	0.077	0.005	134
Region	0.075	0.003	411
PSE	0.083	0.009	31
PSE – Single Family	0.067	0.010	73

Mean Window U-Value in Manufactured Homes by Region

State	Window U-Value		
	Mean	EB	n
ID	0.54	0.02	85
MT	0.60	0.04	84
OR	0.56	0.03	108
WA	0.60	0.03	134
Region	0.58	0.02	411
PSE	0.60	0.07	31
PSE – Single Family	0.51	0.03	73

Distribution of Primary Heating System Type in Manufactured Homes in PSE Service Territory

Heating System Type	Primary Heating Systems		
	%	EB	n
Air Source Heat Pump	9.2%	9.2%	4
Boiler	0.0%	0.0%	0
Electric Baseboard and Wall Heaters	3.2%	6.1%	2
Furnace	73.0%	10.3%	21
Mini-split HP	2.1%	13.2%	1
Other Zonal Heat	0.0%	0.0%	0
Plug-In Heaters	2.1%	13.2%	1
Stove/Fireplace	10.5%	8.7%	5
Total	**100.0%**	**0.0%**	**33**

Distribution of Primary Heating System Type in Single Family Homes in PSE Service Territory

Heating System Type	Primary Heating Systems		
	%	EB	n
Air Source Heat Pump	4.9%	5.2%	4
Boiler	0.9%	5.5%	1
Electric Baseboard and Wall Heaters	17.8%	8.2%	12
Furnace	62.7%	9.6%	45
Mini-split HP	4.9%	5.2%	4
Other Zonal Heat	1.5%	9.6%	1
Plug-In Heaters	4.0%	5.4%	3
Stove/Fireplace	3.3%	4.6%	3
Total	**100.0%**	**0.0%**	**73**

Primary Heating System Fuel Type in Manufactured Homes in PSE Service Territory

Fuel Type	Fuel Choice (Primary System)		
	PSE		n
	%	EB	
Electric	74.9%	12.7%	23
Gas	12.6%	12.3%	4
Oil/Kerosene	0.0%	0.0%	0
Propane	0.0%	0.0%	0
Wood	12.6%	12.3%	4
Pellets	0.0%	0.0%	0
Total	**100.0%**	**0.0%**	**31**

Primary Heating System Fuel Type in Manufactured Homes by Region

Fuel Type	Fuel Choice (Primary System)										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	58.9%	9.2%	12.8%	7.4%	76.9%	6.8%	81.7%	5.6%	71.5%	3.6%	257
Gas	24.0%	8.0%	51.7%	8.4%	10.8%	5.7%	7.3%	4.3%	14.3%	2.8%	91
Oil/Kerosene	2.9%	6.0%	0.0%	0.0%	0.8%	5.0%	0.0%	0.0%	0.7%	0.9%	3
Propane	5.1%	5.4%	15.8%	8.0%	0.0%	0.0%	2.1%	2.8%	2.9%	1.3%	19
Wood	6.9%	6.1%	15.5%	8.4%	9.5%	5.6%	7.2%	4.2%	8.6%	2.6%	32
Pellets	2.1%	4.4%	4.2%	8.3%	2.1%	4.3%	1.7%	3.4%	2.1%	1.4%	8
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**410**

Primary Heating System Fuel Type in Single Family Homes in PSE Service Territory

Fuel Type	Fuel Choice (Primary System)		
	WA		n
	%	EB	
Electric	36.6%	9.6%	28
Gas	59.1%	9.6%	41
Oil/Kerosene	2.4%	5.1%	2
Propane	0.9%	5.5%	1
Wood	0.9%	5.5%	1
Pellets	0.0%	0.0%	0
Total	**100.0%**	**0.0%**	**73**

Primary Heating System Fuel Type in Single Family Homes by Region

Fuel Type	Fuel Choice (Primary System)										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	22.4%	6.4%	16.9%	5.7%	33.2%	5.2%	41.7%	4.4%	35.1%	2.8%	429
Gas	63.6%	7.2%	66.6%	6.4%	58.2%	5.4%	52.3%	4.4%	56.4%	2.9%	552
Oil/Kerosene	0.0%	0.0%	0.0%	0.0%	2.1%	2.8%	2.4%	1.3%	1.8%	0.9%	25
Pellets	0.8%	5.2%	1.4%	2.8%	1.5%	1.1%	0.0%	0.0%	0.7%	0.4%	11
Propane	4.1%	3.6%	8.4%	4.6%	0.4%	0.6%	1.3%	0.9%	1.9%	0.6%	25
Wood	9.1%	4.7%	6.7%	4.3%	4.5%	2.1%	2.2%	1.2%	4.1%	1.1%	58
Geothermal Well	0.0%	0.0%	0.0%	0.0%	0.1%	0.7%	0.0%	0.0%	0.0%	0.2%	1
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**1,098**

Mean Number of Lamps per Manufactured Home by Region

State	Lamps per Home		
	Mean	EB	n
ID	34.8	2.8	85
MT	40.9	4.4	84
OR	41.5	3.3	108
WA	37.0	2.4	134
Region	38.5	1.6	411
PSE	32.8	4.2	31

Mean Number of Lamps per Single Family Home by Region

State	Lamps per Home		
	Mean	EB	n
ID	60.8	5.5	121
MT	62.0	6.2	129
OR	59.4	4.4	282
WA	62.5	3.3	568
Region	61.3	2.3	1,100
PSE	58.4	7.1	73

Mean Number of Fixtures per Manufactured Home by Region

State	Fixtures per Home		
	Mean	EB	n
ID	22.0	1.5	85
MT	26.2	2.5	84
OR	26.4	1.7	108
WA	23.7	1.6	134
Region	24.5	1.0	411
PSE	22.1	3.2	31

Mean Number of Fixtures per Single Family Home by Region

State	Fixtures per Home		
	Mean	EB	n
ID	37.9	3.6	121
MT	40.3	3.8	129
OR	38.2	2.7	282
WA	42.4	2.4	568
Region	40.4	1.6	1,100
PSE	39.9	5.3	73

Distribution of Lamp Types in Manufactured Homes in PSE Service Territory

Lamp Type	Percent of Lamps		
	PSE		n
	%	EB	
Compact Fluorescent	25.3%	13.3%	26
Halogen	4.8%	7.0%	15
Incandescent	27.1%	13.6%	26
Incandescent / Halogen	0.0%	0.0%	0
Light Emitting Diode	32.9%	14.6%	22
Linear Fluorescent	8.3%	8.7%	17
Other	1.5%	3.9%	10
Total	**100.0%**	**0.0%**	**31**

Distribution of Lamp Types in Manufactured Homes by Region

Lamp Type	Percentage of Lamps										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	31.2%	8.6%	28.9%	8.4%	24.1%	7.1%	27.6%	6.5%	27.1%	4.0%	388
Halogen	6.5%	4.7%	5.9%	4.8%	6.0%	3.9%	6.9%	3.7%	6.5%	2.2%	245
Incandescent	42.5%	9.1%	46.0%	9.8%	39.0%	8.1%	36.8%	7.0%	39.0%	4.4%	381
Incandescent / Halogen	0.5%	1.8%	0.0%	0.0%	0.6%	1.5%	0.0%	0.5%	0.3%	0.5%	20
Light Emitting Diode	12.0%	6.1%	6.2%	5.0%	21.1%	6.7%	19.8%	5.9%	18.1%	3.6%	254
Linear Fluorescent	5.7%	4.4%	11.5%	6.9%	7.1%	4.3%	7.0%	3.9%	7.2%	2.4%	201
Other	1.5%	2.4%	1.3%	2.4%	2.0%	2.3%	1.9%	2.0%	1.8%	1.2%	126
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100%**	**0.0%**	**411**

Distribution of Lamp Types in Single Family Homes in PSE Service Territory

Lamp Type	Percent of Lamps		n
	WA		
	%	EB	
Compact Fluorescent	27.6%	8.9%	68
Halogen	5.6%	4.5%	47
Incandescent	32.9%	9.4%	71
Incandescent / Halogen	0.2%	1.2%	3
Light Emitting Diode	26.8%	8.8%	62
Linear Fluorescent	5.3%	4.5%	42
Other	1.7%	2.6%	24
Total	**100.0%**	**0.0%**	**73**

Distribution of Lamp Types in Single Family Homes by Region

Lamp Type	Percentage of Lamps										n
	ID		MT		OR		WA		Region		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	26.0%	6.6%	26.8%	6.4%	25.4%	5.2%	26.2%	4.1%	26.0%	2.8%	1,056
Halogen	6.0%	3.6%	9.5%	4.4%	6.3%	2.8%	7.5%	2.3%	7.1%	1.5%	747
Incandescent	41.5%	7.4%	44.7%	7.3%	43.6%	5.9%	34.7%	4.4%	38.9%	3.0%	1,063
Incandescent / Halogen	0.7%	1.3%	0.1%	0.8%	0.4%	0.7%	0.3%	0.5%	0.3%	0.4%	54
Light Emitting Diode	17.0%	5.5%	9.4%	4.3%	17.1%	4.4%	23.8%	4.0%	20.0%	2.5%	844
Linear Fluorescent	7.7%	4.0%	8.3%	4.1%	6.5%	2.9%	6.0%	2.2%	6.5%	1.5%	663
Other	1.2%	1.6%	1.1%	1.6%	0.7%	0.9%	1.5%	1.2%	1.2%	0.7%	374
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100%**	**0.0%**	**1,100**

Average Number of Installed LEDs per Manufactured Home by Region

State	Average Number of Installed LEDs per Home		
	Mean	EB	n
ID	3.5	1.0	85
MT	2.6	1.3	84
OR	8.2	2.0	108
WA	7.0	1.7	134
Region	6.6	1.0	411
PSE	11.3	4.7	31

Average Number of Installed LEDs per Single Family Home by Region

State	Average number of LEDs installed per home by state		
	Mean	EB	n
ID	9.0	2.7	121
MT	6.1	1.8	129
OR	10.2	1.6	282
WA	14.5	1.8	568
Region	11.9	1.1	1,100
PSE	15.6	3.8	73

Average Number of Installed Incandescent Lamps per Manufactured Home by Region

State	Number of Lamps		
	Mean	EB	n
ID	14.3	2.1	85
MT	17.6	2.9	84
OR	15.4	2.1	108
WA	13.6	1.7	134
Region	14.6	1.1	411
PSE	7.9	2.2	31

Average Number of Installed Incandescent lamps per Single Family Home by Region

State	Average Number of Incandescent Lamps Installed per Home by State		
	Mean	EB	n
ID	24.8	3.1	121
MT	27.1	4.3	129
OR	25.3	3.2	282
WA	20.9	1.7	568
Region	23.1	1.4	1,100
PSE	18.5	3.5	73

Percentage of Manufactured Homes with LEDs by Region

State	Homes with LEDs		
	%	EB	n
ID	48.0%	9.3%	85
MT	40.8%	9.7%	84
OR	73.6%	7.1%	108
WA	65.7%	6.8%	134
Region	63.8%	4.1%	411
PSE	67.5%	14.3%	31

Percentage of Single Family Homes with LEDs by Region

State	Percent of Homes		
	%	EB	n
ID	59.6%	7.0%	121
MT	54.6%	7.3%	129
OR	76.3%	5.2%	282
WA	79.7%	3.8%	568
Region	74.4%	2.7%	1,100
PSE	81.3%	7.8%	73

Average Number of Appliances per Manufactured Home in PSE Service Territory

Appliance	Number of Appliances per Home		
	Mean	EB	n
Dishwasher	0.60	0.15	31
Clothes Dryer	0.84	0.11	31
Freezer	0.34	0.17	31
Refrigerator	1.07	0.09	31
Clothes Washer	0.87	0.10	31
Water Heater	1.00	0.00	31

Average Number of Appliances per Single Family Home in PSE Service Territory

Appliance	Number of Appliances per Home		
	Mean	EB	n
Dishwasher	0.82	0.08	73
Clothes Dryer	0.95	0.04	73
Freezer	0.40	0.13	73
Refrigerator	1.36	0.14	73
Clothes Washer	0.95	0.04	73
Water Heater	0.99	0.06	73

Distribution of Cooktop Fuel Types in Manufactured Homes in PSE Service Territory

Fuel Type	Cook Top Fuel		
	%	EB	n
Electric	90.6%	8.7%	28
Gas	9.4%	12.0%	3
Propane	0.0%	0.0%	0
Total	**100.0%**	**0.0%**	**31**

Distribution of Cooktop Fuel Types in Single Family Homes in PSE Service Territory

Fuel Type	Cook Top Fuel		
	%	EB	n
Electric	62.9%	9.9%	44
Gas	34.6%	10.0%	24
Propane	2.6%	3.3%	3
Total	**100.0%**	**0.0%**	**70**

Distribution of Water Heater Fuel Types in Manufactured Homes in PSE Service Territory

Water Heater Fuel Type	Water Heaters		
	PSE		n
	%	EB	
Electric	83.0%	11.6%	24
Natural Gas	13.6%	13.2%	4
Propane	3.4%	21.0%	1
Total	**100.0%**	**0.0%**	**29**

Distribution of Water Heater Fuel Types in Manufactured Homes by Region

Water Heater Fuel Type	Water Heaters										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	73.3%	8.5%	53.2%	9.3%	90.4%	5.3%	91.3%	4.3%	85.5%	2.9%	293
Natural Gas	18.1%	6.9%	34.4%	7.4%	9.6%	5.9%	7.0%	4.4%	11.6%	2.7%	66
Propane	8.6%	6.9%	12.4%	7.8%	0.0%	0.0%	1.7%	3.6%	3.0%	1.4%	15
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**374**

Distribution of Water Heater Fuel Types in Single Family Homes in PSE Service Territory

Water Heater Fuel Type	Water Heaters		
	PSE		n
	%	EB	
Electric	44.6%	10.3%	32
Natural Gas	54.6%	10.2%	36
Propane	0.9%	5.5%	1
Total	**100.0%**	**0.0%**	**68**

Distribution of Water Heater Fuel Types in Single Family Homes by Region

Water Heater Fuel Type	Water Heaters										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric	47.5%	7.5%	39.7%	7.6%	49.6%	6.0%	50.5%	4.7%	49.1%	3.1%	573
Natural Gas	50.9%	7.5%	51.9%	7.3%	49.7%	5.9%	47.6%	4.7%	48.9%	3.1%	458
Propane	1.6%	3.4%	8.4%	5.0%	0.7%	1.0%	2.0%	1.0%	1.9%	0.7%	23
Total	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**100.0%**	**0.0%**	**1,046**

Percentage of Manufactured Homes Reporting Natural Gas Service by Region

State	Households Reporting Gas Service		
	%	EB	n
ID	30.6%	8.6%	85
MT	53.5%	8.8%	83
OR	13.9%	5.7%	107
WA	10.8%	4.6%	130
Region	17.9%	3.1%	405
PSE	18.8%	11.4%	31

Percentage of Single Family Homes Reporting Natural Gas Service by Region

State	Households Reporting Gas Service		
	%	EB	n
ID	64.7%	7.1%	119
MT	65.4%	6.6%	125
OR	64.3%	5.1%	279
WA	56.6%	4.4%	562
Region	60.5%	2.9%	1,085
PSE	61.7%	9.4%	72

Weather-Normalized Annual Energy Usage per Manufactured Home by Region

State	kWh per Home		
	Mean	EB	n
ID	14,612.7	1,418.4	76
MT	10,756.4	1,255.3	72
OR	13,213.7	1,035.3	97
WA	15,374.4	903.6	120
Region	14,209.1	572.6	365
PSE	12,416.6	1,761.0	28

Weather-Normalized Annual Energy Usage per Single Family Home by Region

State	kWh per Home		
	Mean	EB	n
ID	12,228.2	1,064.4	106
MT	10,338.6	1,075.0	118
OR	11,326.7	739.7	249
WA	12,306.1	706.0	501
Region	11,877.9	447.1	974
PSE	11,647.7	1,544.9	60

Average Electric Energy Use Intensity per Manufactured Home by Region

State	Electric EUI per Home (kWh/sq. ft.)						
	Other Heat		Electric Heat		All Homes		n
	Mean	EB	Mean	EB	Mean	EB	
ID	8.9	1.0	14.4	1.0	11.6	0.7	75
MT	7.1	1.0	13.1	2.2	10.1	1.1	72
OR	8.8	0.7	10.8	0.8	9.8	0.5	97
WA	7.8	0.8	13.3	0.9	10.7	0.6	120
Region	8.2	0.4	12.7	0.5	10.5	0.3	364
PSE	5.5	1.6	11.6	1.3	8.9	1.0	28

Average Electric Energy Use Intensity per Single Family Home by Region

State	Electric EUI per Home (kWh/sq. ft.)						
	Homes w/ Electric Heat		Homes w/ Other Heat		All Homes		n
	Mean	EB	Mean	EB	Mean	EB	
ID	9.4	0.7	5.4	0.5	7.4	0.4	106
MT	11.7	0.8	4.7	0.5	8.2	0.5	118
OR	10.0	0.6	5.1	0.4	7.5	0.4	249
WA	11.3	0.6	4.7	0.2	7.9	0.3	499
Region	10.7	0.4	4.9	0.2	7.7	0.2	972
PSE	4.5	0.4	11.0	0.9	7.3	0.4	174

Weather-Normalized Annual Therm Usage per Manufactured Home by Region

State	Therms per Home		
	Mean	EB	n
ID	577.4	104.3	11
MT	617.2	53.3	38
OR	438.2	93.7	12
WA	550.7	264.5	8
Region	528.1	90.3	69
PSE	627.8	408.4	5

Weather-Normalized Annual Therm Usage per Single Family Home by Region

State	Therms per Home		
	Mean	EB	n
ID	726.9	68.3	46
MT	848.0	113.5	57
OR	677.2	83.7	139
WA	693.4	41.5	235
Region	702.8	34.4	477
PSE	745.3	86.6	37

Average Number of Occupants per Manufactured Home by Region

State	Occupants per Home		
	Mean	EB	n
ID	2.58	0.29	85
MT	2.34	0.30	84
OR	2.48	0.28	108
WA	2.38	0.25	134
Region	2.44	0.15	411
PSE	2.13	0.56	31

Average Number of Occupants per Single Family Home by Region

State	Occupants per Home		
	Mean	EB	n
ID	2.8	0.3	121
MT	2.2	0.2	129
OR	2.5	0.2	282
WA	2.6	0.1	568
Region	2.6	0.1	1,100
PSE	2.7	0.3	73

Average Number of Occupants by Age Group per Manufactured Home in PSE Service Territory

Age Category	Number of Occupants		
	PSE		n
	Mean	EB	
18 Years or Younger	0.50	0.40	31
Between 19 and 64	1.19	0.30	31
65 Years or Older	0.44	0.16	31
All Ages	2.13	0.56	31

Average Number of Occupants by Age Group per Manufactured Home by Region

Age Category	Number of Occupants										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
18 Years or Younger	0.67	0.26	0.59	0.24	0.48	0.24	0.58	0.18	0.56	0.12	411
Between 19 and 64	1.40	0.17	1.14	0.20	1.21	0.18	1.22	0.17	1.24	0.10	411
65 Years or Older	0.51	0.14	0.61	0.16	0.80	0.15	0.58	0.10	0.64	0.07	411
All Ages	2.58	0.29	2.34	0.30	2.48	0.28	2.38	0.25	2.44	0.15	411

Average Number of Occupants by Age Group per Single Family Home by Region

Age Category	Number of Occupants										
	ID		MT		OR		WA		Region		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
18 or Younger	0.79	0.22	0.44	0.13	0.51	0.11	0.60	0.09	0.59	0.06	1,100
19 to 64	1.26	0.17	1.25	0.14	1.38	0.14	1.44	0.12	1.38	0.08	1,100
65 or Older	0.59	0.12	0.54	0.12	0.57	0.09	0.56	0.07	0.57	0.05	1,100

Average Number of Occupants by Age Group per Single Family Home in PSE Service Territory

Age Category	Number of Occupants		
	PSE		n
	Mean	EB	
18 Years or Younger	0.66	0.18	73
Between 19 and 64	1.43	0.26	73
65 Years or Older	0.64	0.16	73
All Ages	2.72	0.30	73

Percentage of Manufactured Homes by Ownership Type in PSE Service Territory

Ownership Type	Percentage of Homes		
	WA		n
	%	EB	
Occupy without rent	0.0%	0.0%	0
Own / buying	95.3%	5.2%	29
Prefer not to say	0.0%	0.0%	0
Rent	4.7%	9.0%	2

Percentage of Manufactured Homes by Ownership Type by Region

Ownership Type	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Occupy without rent	0.0%	0.0%	0.9%	5.7%	0.6%	4.0%	0.5%	3.0%	0.5%	0.7%	3
Own / buying	90.5%	4.9%	84.5%	7.2%	95.3%	3.6%	90.0%	4.1%	91.3%	2.4%	370
Prefer not to say	1.1%	6.6%	0.0%	0.0%	0.0%	0.0%	2.0%	2.7%	1.1%	1.2%	4
Rent	8.4%	5.2%	14.6%	7.5%	4.1%	4.4%	7.6%	4.1%	7.2%	2.3%	34

Percentage of Single Family Homes by Ownership Type in PSE Service Territory

Ownership Type	Percentage of Homes		
	WA		n
	%	EB	
Occupy without rent	0.0%	0.0%	0
Own / buying	80.7%	8.0%	60
Prefer not to say	0.0%	0.0%	0
Rent	19.3%	8.4%	13

Percentage of Single Family Homes by Ownership Type by Region

Ownership Type	Percentage of Homes										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Occupy without rent	0.8%	5.2%	0.0%	0.0%	0.7%	4.4%	0%	0.4%	0.4%	0.5%	4
Own / buying	79.3%	6.1%	80.3%	5.9%	84.0%	4.4%	84.4%	3.6%	83.4%	2.4%	916
Prefer not to say	0.8%	5.2%	1.0%	6.1%	0.3%	1.7%	0.1%	0.9%	0.3%	0.3%	4
Rent	19.0%	6.1%	18.7%	6.0%	15.0%	4.3%	15%	3.6%	15.9%	2.4%	176

Household Income Levels for Manufactured Homes in PSE Service Territory

Household Income Level	Household Income		
	WA		n
	%	EB	
Less than $25,000	44.2%	14.7%	13
$25,000 or more, but less than $50,000	39.0%	16.3%	11
$50,000 or more	16.8%	12.6%	5

Household Income Levels for Manufactured Homes by Region

Household Income Level	Household Income										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Less than $25,000	48.4%	9.7%	52.6%	10.8%	41.0%	8.9%	37.3%	7.6%	41.2%	4.7%	155
$25,000 or more, but less than $50,000	25.1%	8.4%	27.3%	10.0%	32.4%	8.5%	40.7%	8.0%	34.9%	4.7%	114
$50,000 or more	26.5%	8.8%	20.1%	8.9%	26.6%	8.2%	22.0%	6.4%	23.9%	4.1%	82

Household Income Levels for Single Family Homes in PSE Service Territory

Household Income Level	Household Income		
	WA		n
	%	EB	
Less than $25,000	14.3%	8.1%	9
$25,000 or more, but less than $50,000	17.5%	8.3%	12
$50,000 or more	68.1%	9.8%	45

Household Income Levels for Single Family Homes by Region

Income Level	Household Income										
	ID		MT		OR		WA		Region		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
$0 to under $25,000	20.4%	6.8%	13.7%	6.1%	13.0%	4.4%	16.8%	3.7%	15.9%	2.5%	159
$25,000 to under $50,000	34.6%	7.8%	31.7%	7.9%	20.7%	5.2%	18.9%	3.8%	22.3%	2.7%	227
$50,000 or more	44.9%	8.2%	54.6%	8.3%	66.3%	6.1%	64.3%	4.7%	61.7%	3.2%	522

Manufactured Homes Reporting Recent Self-Funded Conservation Improvements by Region

State	Households Reporting Recent Self-Funded Conservation Improvements		
	%	EB	n
ID	51.2%	9.3%	85
MT	59.4%	9.6%	84
OR	60.0%	8.1%	107
WA	54.5%	6.8%	134
Region	56.2%	4.3%	410
PSE	56.1%	13.5%	31

Single Family Homes Reporting Recent Self-Funded Conservation Improvements by Region

State	Households Reporting Recent Self-Funded Conservation Improvements		
	%	EB	n
ID	56.3%	7.5%	117
MT	62.8%	7.1%	129
OR	65.9%	5.8%	272
WA	65.5%	4.2%	564
Region	64.2%	3.0%	1,082
PSE	72.8%	8.8%	72

Manufactured Homes Reporting Recent Use of Utility Incentives by Region

State	Households Reporting Use of Utility Incentives		
	%	EB	n
ID	10.2%	5.3%	78
MT	6.7%	4.0%	80
OR	8.4%	4.3%	100
WA	12.9%	5.1%	119
Region	10.6%	2.8%	377
PSE	16.7%	12.8%	26

Single Family Homes Reporting Recent Use of Utility Incentives by Region

State	Households Reporting Use of Utility Incentives		
	%	EB	n
ID	10.5%	5.0%	105
MT	16.0%	5.7%	118
OR	16.3%	4.8%	245
WA	15.2%	3.5%	504
Region	14.9%	2.4%	972
PSE	15.8%	7.8%	62

Manufactured Homes Reporting Recent Use of Conservation Tax Credits by Region

State	Households Reporting Recent Conservation Tax Credits		
	%	EB	n
ID	8.0%	7.7%	44
MT	4.8%	4.5%	49
OR	6.4%	5.1%	65
WA	11.6%	6.3%	74
Region	8.9%	3.5%	232
PSE	13.6%	15.3%	16

Single Family Homes Reporting Recent Use of Conservation Tax Credits by Region

State	Households Reporting Recent Conservation Tax Credits		
	%	EB	n
ID	16.0%	7.6%	67
MT	18.2%	6.8%	78
OR	26.8%	6.9%	168
WA	15.6%	3.9%	333
Region	19.2%	3.0%	646
PSE	12.6%	7.5%	52

Manufactured Homes Reporting Recent Use of Utility Incentives and Conservation Tax Credits by Region

State	Households Reporting Use of Utility and Tax Credit Conservation Programs		
	%	EB	n
ID	1.1%	1.9%	78
MT	0.0%	0.0%	80
OR	2.7%	2.7%	100
WA	4.8%	3.2%	119
Region	3.2%	1.7%	377
PSE	3.7%	6.2%	26

Single Family Homes Reporting Recent Use of Utility Incentives and Conservation Tax Credits by Region

State	Households Reporting Use of Utility and Tax Credit Conservation Programs		
	%	EB	n
ID	1.9%	2.2%	105
MT	2.3%	2.1%	118
OR	7.6%	3.5%	245
WA	3.0%	1.5%	504
Region	4.2%	1.3%	972
PSE	2.9%	3.4%	62

Public-Use Microdata Areas

Thirty public use micro-areas, identified by U.S. Census Bureau geographic identifiers, were used in the American Community Survey analysis (as shown in the following table).

Public Use Micro Areas Used to Match American Community Survey Data to PSE's Service Territory

Public Use Micro Areas		
5310100	5310200	5310800
5311401	5311402	5311505
5311606	5311607	5311608
5311609	5311610	5311611
5311612	5311613	5311614
5311615	5311616	5311701
5311702	5311703	5311704
5311705	5311706	5315501
5315503	5315504	5315506
5315507	5318801	5318802

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Online Customer Survey Instrument

Research Objectives	Corresponding Question Numbers
Determine age characteristics of manufactured home.	A7
Determine space and water heating fuel sources.	A3, E8, E12, E14
Determine conservation measures that have been installed in last five years.	E2-E17
Determine household demographics characteristics for customers living in manufactured homes (age, income, household members, education level, etc.).	F1-F3
Determine percent of manufactured homes rented versus owned, and percent where land is rented versus owned.	A4-A6
Understand barriers to participating in PSE conservation programs.	C1-C6

Target Audience: Residents of manufactured homes in Puget Sound Energy's service territory.

Expected number of completions: 300

Estimated timeline for fielding: 10 minutes

Email Invitation

To: [EMAIL]
From: pse_survey@qualtrics-research.com
Subject: Please tell us about your manufactured home – receive a 10$ gift card

Dear [FIRSTNAME AND LASTNAME],

Puget Sound Energy is conducting research about manufactured homes in its service territory. Our objective is to better understand these homes and their residents, so that we can better serve you with energy conservation services. To find out more about energy efficiency services for manufactured homes, please click here.

You are receiving this email because our records indicate that you live in a manufactured or mobile home. This survey has questions about your home and about your household. The survey should take about 10 minutes to complete. Your input is very important to us, will be kept confidential, and only be used to improve our programs for customers like you.

To thank you for completing the survey you will receive a $10 gift card. In order to qualify for this gift card you must live in a manufactured home and you must complete the survey. You can redeem this gift card at the completion of the survey. The survey will expire on **[INSERT EXPIRATION DATE]**.

Click the link below to take the survey:

[AUTO-GENERATED LINK]

Or you may copy and paste the URL below into your internet browser: **[AUTO-GENERATED URL]**

If you have any questions about this research, or any difficulties taking the survey, please contact Bradley Jones at The Cadmus Group, the national research firm conducting this survey on our behalf. You can reach Bradley Jones at (207) 536- 3104 or bradley.jones@cadmusgroup.com.

Thanks again,

Bill Hopkins
Manager Strategic Planning, Evaluation and Research
Puget Sound Energy
EESEvaluations@PSE.com

Survey Introduction and Screener

[RECOMMENDED: CLIENT-APPROVED LOGO TO APPEAR ON START SCREEN]

Welcome! This survey will take approximately 10 minutes to complete. Your responses will remain confidential and will only be used fora research purposes. Be sure to enter your name and email address at the end of the survey in order to receive your $10 gift card. The survey will begin with a brief screener

question to determine if you are eligible to participate in our survey. This survey will expire on **[INSERT EXPIRATION DATE]**.

A. Screener/General Home Details

A1. Do you currently live in a manufactured home? A manufactured home is a factory-built home that can be transported in one or more sections and is affixed to a permanent foundation. It includes plumbing, heating, and electrical systems, normally contained within the structure of the building. Manufactured homes are sometimes referred to as mobile homes but are not RVs.

[INCLUDE FOLLOWING IMAGE ALONG WITH THIS QUESTION AND OPTION RESPONSES]

1. Yes
2. No **[ASK A2, THEN SKIP TO TERMINATION MESSAGE]**

A2. Our records indicate that your home is located at **[INSERT ADDRESS FROM SAMPLE]**, is that correct?

1. Yes
2. No **[SKIP TO TERMINATION MESSAGE]**
98. **I PREFER NOT TO ANSWER AND END THE SURVEY [SKIP TO TERMINATION MESSAGE]**

[SCREEN OUT TERMINATION MESSAGE:] Unfortunately you are not eligible to take this Puget Sound Energy survey. Thank you for your interest.

A3. Do you have natural gas service provided by Puget Sound Energy at your home?

1. Yes
2. No, natural gas service is provided by another utility
3. No natural gas service
98. I don't remember

A4. Do you own or lease your home?

1. Own home/making mortgage payments on home
2. Rent/lease
3. Live in home rent-free
98. I prefer not to answer

A5. Do you own or rent the land on which your home is located?

1. Own land/making mortgage payments on land
2. Rent/lease
3. Live on land rent-free
98. I prefer not to answer

A6. Is your home in a mobile home park with other manufactured homes or in an independent location?

1. Located in a park
2. Located in an independent location
98. I prefer not to answer

A7. In what year was your home built? (If you don't know exactly, an estimate is fine)

1. **[RECORD RESPONSE: _____]**
98. I don't remember

A8. What type is your home?

1. Single wide
2. Double wide
3. Triple wide
98. I prefer not to answer

B. Awareness

B1. Before taking this survey, were you aware that Puget Sound Energy offered rebates for equipment and services to improve the energy-efficiency of your home?

1. Yes
2. No **[SKIP TO C1]**
98. Don't know **[SKIP TO C1]**

B2. How did you learn about Puget Sound Energy's energy efficiency services? **[MULTIPLE RESPONSES ALLOWED]**

1. Bill insert
2. Puget Sound Energy web site
3. Email from Puget Sound Energy
4. Postcard/mailing from Puget Sound Energy
5. Contractor
6. Manager of manufactured homes park/community
7. Word of mouth
8. Online (other than Puget Sound Energy web site)
9. Social Media (Facebook, Twitter)

10. Newspaper article
11. Television advertisement
12. Other (please describe) **[TEXT ENTRY BOX]**
98. I don't remember

B3. Which PSE energy efficiency services are you familiar with? **[MULTIPLE RESPONSES ALLOWED]**

1. Appliance rebates
2. Heating system rebates
3. Insulation and weatherization rebates
4. Free home energy assessments
5. Recycling old refrigerators and freezers
6. Discounts for LED light bulbs in retail stores
7. Smart thermostat rebates
8. Energy-efficient window rebates
9. Energy-efficient water heater rebates
10. Not familiar with specific services
11. Other (please describe) **[TEXT ENTRY BOX]**

B4. Has PSE provided any energy efficiency products, rebates or services to you in the past five years?

1. Yes
2. No, but I received energy efficiency services through another organization (please describe) **[TEXT ENTRY BOX]**
3. No **[SKIP TO B6]**

B5. What products, rebates or services did PSE or another agency provide? **[MULTIPLE RESPONSES ALLOWED]**

1. Energy-efficient appliances (clothes washer, dryer, refrigerator)
2. Energy-efficient heating system
3. Energy-efficient cooling system
4. Upgrades to ductwork
5. Insulation and weatherization
6. Free home energy assessment
7. Recycling old refrigerator or freezer
8. Discount for LED light bulbs and fixtures in retail stores
9. Smart thermostat
10. Energy-efficient windows
11. Energy-efficient water heater
12. Other (please describe) **[TEXT ENTRY BOX]**
98. I don't remember

B6. **[SKIP IF B4=1]** Why haven't you received any energy efficiency products, rebates or services from Puget Sound Energy? **[MULTIPLE RESPONSES ALLOWED]**

1. Cannot afford upfront costs
2. My home is already as efficient as possible
3. I need more information to make a decision
4. Don't own the property
5. Don't have enough time to plan improvements
6. Prefer to move or buy new home rather than invest in current home
7. Can't obtain financing for the project
8. I'm not aware of what energy efficiency products, rebates or services are available to me
9. Other **[RECORD_____]**

98. I prefer not to answer

C. Barriers to Energy-Efficiency Adoption

C1. What are the biggest challenges or obstacles you face in completing energy efficiency improvements in your home? **[MULTIPLE RESPONSES ALLOWED]**

1. Upfront cost
2. Unsure what improvements are needed
3. Difficulty finding qualified contractor
4. Don't own the property
5. Don't have enough time to plan improvements
6. Can't obtain financing for the project
7. Don't know what rebates are available
8. Not sure it's worth investing in improvements to my home
9. Other **[RECORD_____]**

98. I prefer not to answer

C2. What could Puget Sound Energy do to help you overcome those challenges? **[MULTIPLE RESPONSES ALLOWED]**

1. Nothing
2. Provide larger rebates for upgrades
3. Provide information about available programs/rebates
4. Provide education about home energy savings
5. Simplify the application process **[RECORD_____]**
6. Connect me with a qualified contractor
7. Provide information about financing
8. Other **[RECORD_____]**

98. I prefer not to answer

C3. **[ASK IF C2=2]** What percentage of an improvement's cost would need to be covered by a rebate for you to complete the improvement? Select the percentage for the following upgrade costs.

Cost of upgrade	0%-50% of cost	50%-90% of cost	Rebate covers full cost	Don't know
$100-$200	❍	❍	❍	❍
$200-$1,000	❍	❍	❍	❍
Over $1,000	❍	❍	❍	❍

C4. **[ASK IF C2=3 OR 4]** How would you prefer to learn about home energy savings? **[MULTIPLE RESPONSES ALLOWED]**

1. Information on Puget Sound Energy's web site
2. Other web sites (not Puget Sound Energy)
3. Direct mail/postcard
4. Email
5. Social media: Facebook and Twitter
6. Through manager of manufactured homes community **[DO NOT INCLUDE RESPONSE THIS OPTION IF A6=2]**
7. Seminar/presentation from PSE representatives
8. Home visit followed by individualized suggestions
9. Through my contractor
10. Other **[RECORD_____]**

98. I prefer not to answer

C5. What information or assistance would be helpful to you when considering whether to seek financing for energy-efficiency home improvement? **[MULTIPLE RESPONSES ALLOWED]**

1. I need to know what financing options are available
2. I want to be able to include monthly payments for improvements with my PSE bill
3. I need better rates than I have been offered so far
4. I need help getting approval for financing
5. I am unable to obtain financing, since I lease the land where my home is located
6. I am not interested in financing an energy-efficiency improvement

98. I prefer not to answer

C6. How much more likely would you be to complete an energy-efficiency improvement in your home if you qualified for financing (paying off cost of improvement monthly)?

Not more likely at all 0	1	2	3	4	5	6	7	8	9	Significantly more likely 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D. Equipment Purchasing Decisions

D1. Under what circumstances would you replace your functioning heating equipment? (select all that apply) **[ALLOW MULTIPLE RESPONSES - RANDOMIZE ORDER 1-10]**

1. It had problems and the cost of repair was greater than the cost of a new unit
2. The efficiency of my existing unit declined and affected my energy bills
3. I was concerned that my existing unit was not operating safely
4. I could save significantly on energy bills by replacing my equipment
5. I learned about rebates for replacing my equipment with a new and more efficient model
6. As part of a modernization or remodel of my home
7. I wanted to improve the comfort of my home
8. A contractor recommended the upgrade
9. A friend, family member, or acquaintance recommended the upgrade
10. A replacement system was available free of cost
11. I would not replace working equipment under any circumstances **[DO NOT ALLOW OTHER RESPONSES]**
12. Other **[RECORD_____]**
98. I prefer not to answer

D2. Under what circumstances would you replace or buy new equipment to cool your home? (Select all that apply) **[ALLOW MULTIPLE RESPONSES - RANDOMIZE ORDER 1-9]**

1. Existing equipment broke and needed to be replaced (it was unrepairable)
2. The efficiency of my existing equipment declined and affected my energy bills
3. If I could save significantly on energy bills by replacing my equipment
4. I learned about rebates for a combined heating/cooling system upgrade
5. To improve the comfort of my home
6. Part of a modernization or remodel of my home
7. Contractor recommendation
8. Friend, family member, or acquaintance recommendation
9. A new/replacement system was available free of cost
10. I would not purchase new cooling equipment under any circumstances **[DO NOT ALLOW OTHER RESPONSES]**
11. Other **[RECORD_____]**
98. I prefer not to answer

D3. Under what circumstances would you upgrade the efficiency of your home by adding insulation or installing high efficiency windows or doors? (select all that apply) **[ALLOW MULTIPLE RESPONSES - RANDOMIZE ORDER 1-7]**

1. Something broke and needed to be replaced (broken windows or doors)
2. If I could save significantly on energy bills by enhancing the efficiency of my home
3. I learned about rebates for making upgrades to my home
4. A contractor recommended the upgrade

5. I wanted to improve the comfort of my home
6. A friend, family member, or acquaintance recommended the upgrade
7. The insulation or doors/windows were available free of cost
8. I would not make these upgrades under any circumstances **[DO NOT ALLOW OTHER RESPONSES]**
9. Other **[RECORD_____]**
98. I prefer not to answer

D4. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is reducing your energy bills in your decision to make upgrades to your home?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D5. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is the cost of the equipment after rebates in your decision to make upgrades to your home?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D6. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is increased comfort in your decision to make upgrades to your home?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D7. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is a prescreened contractor referral in your decision to make upgrades to your home?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D8. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is knowing the approximate cost of an equipment or home upgrade, before contacting a contractor for a quote?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

D9. **[SKIP IF D1=11, D2=10 AND D3=8]** How important is knowing the rebate amount for an equipment or home upgrade, before contacting a contractor for a quote?

Not at all important 0	1	2	3	4	5	6	7	8	9	Extremely Important 10	Don't know
❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

E. Existing Equipment

E1. For about how many years have you lived in your current home?

1. **[RECORD RESPONSE: _____]**
98. I don't remember

E2. During the time you have lived in your home have you upgraded your attic insulation?

1. Yes
2. No
3. No, but I know it was upgraded before I moved in
98. I don't remember

E3. During the time you have lived in your home have you upgraded your wall insulation?

1. Yes
2. No
3. No, but I know it was upgraded before I moved in
98. I don't remember

E4. During the time you have lived in your home have you upgraded your floor/belly insulation?

1. Yes
2. No
3. No, but I know it was upgraded before I moved in
98. I don't remember

E5. During the time you have lived in your home have you added weather stripping to windows or caulked windows?

1. Yes
2. No
3. No, but I know this was done before I moved in
98. I don't remember

E6. Do you have any LED light bulbs or LED fixtures installed in your home?

1. Yes
2. No
98. I don't remember

E7. **[ASK IF E6= 1]** Approximately what percentage of the light bulbs in your home are LEDs? (Approximate guess is fine)

Less than 10%	10% - 50%	50% - 90%	100%	Don't know
❍	❍	❍	❍	❍

E8. What type of equipment do you use to heat your home? Please review the images below.

Furnace: has indoor vents	Electric baseboard	Electric wall heater	Ductless heat pump	Heat pump: has indoor vents	Portable space heater
					

[ALLOW MULTIPLE RESPONSES - RANDOMIZE ORDER 1-9]

1. Gas furnace **[DO NOT INCLUDE THIS OPTION IF A3=3]**
2. Electric furnace
3. Propane furnace
4. Electric baseboard heater
5. Electric wall heater
6. Wood-burning or pellet stove
7. Ductless heat pump
8. Heat pump
9. Portable electric space heater
10. Other **[RECORD_____]**
98. I don't remember

E9. **[ASK IF MORE THAN ONE RESPONSE SELECTED IN E8]** Of the equipment that you use to heat your home, which would you say is the primary source of heating?

1. **[LIST ALL RESPONSES SELECTED IN E8, ALLOW ONLY ONE RESPONSE]**
98. I don't know

E10. **[REPEAT FOR EACH RESPONSE FROM E8 ; IF E8=98 THEN SKIP TO E12]** About how old is your **[RESPONSE FROM E8]**?

1. 2 years or less
2. 3 to 5 years
3. 6 to 10 years
4. 11 to 15 years
5. Over 15 years

98. I don't remember

E11. **[IF THERE IS ONLY ONE RESPONSE TO E8 THEN SKIP TO E12] [ASK E11 FOR EACH RESPONSE FROM E8 EXCEPT FOR THE RESPONSE CHOSEN IN E9]** How often do you use the **[RESPONSE FROM E8]** to heat your home?

1. Never
2. Infrequently (less than half of the time that you use your **[RESPONSE FROM E9])**
3. Regularly (about half of the time that you use your **[RESPONSE FROM E9])**
4. Frequently (more than half of the time that you use your **[RESPONSE FROM E9])**
5. Always (use this equipment whenever you are using **[RESPONSE FROM E9])**

98. I don't remember

E12. What type of equipment do you use to cool your home? **[ALLOW MULTIPLE RESPONSES - RANDOMIZE ORDER 1-6]**

1. Central air conditioner
2. Room or window air conditioner
3. Ductless heat pump
4. Heat pump (ducted)
5. Whole-house fan
6. Fans (Ceiling, window, standing, or box)
7. Other [RECORD_____]
8. I don't have cooling equipment

98. I don't remember **[SKIP TO E14]**

E13. **[REPEAT FOR EACH RESPONSE FROM E12; IF E12=98 THEN SKIP TO E14]** About how old is your **[RESPONSE FROM E12]**?

1. 2 years or less
2. 3 to 5 years
3. 6 to 10 years
4. 11 to 15 years
5. Over 15 years

98. I don't remember

E14. What type of water heater do you have? **[SINGLE RESPONSE, RANDOMIZE ORDER 1-5]**

1. Electric water heater
2. Heat pump water heater
3. Gas water heater (with a tank) **[DO NOT INCLUDE THIS OPTION IF A3=3]**
4. Gas tankless water heater **[DO NOT INCLUDE THIS OPTION IF A3=3]**
5. Propane water heater
6. Other **[RECORD_____]**

98. I don't remember **[SKIP TO E16]**

E15. About how old is your **[RESPONSE FROM E14]**?

1. 2 years or less
2. 3 to 5 years
3. 6 to 10 years
4. 11 to 15 years
5. Over 15 years

98. I don't remember

E16. Do you regularly use an HVAC contractor to maintain or tune-up your heating or cooling equipment?

1. Yes
2. No

98. I don't remember

E17. What type of thermostat do you use to control the temperature in your home? **[SELECT ONE]**

1. Smart, internet-connected, or wi-fi thermostat (automatically adjusts the temperature based on your preferences and behavior)
2. Programmable thermostat (you provide temperature settings for specific times of the day or week)
3. Manual thermostat (you manually adjust the temperature every time you want to change it)
4. I don't have a thermostat in my home
5. Other **[RECORD_____]**

98. I don't remember

E18. Please identify how many of the following appliances/items you have in your home. **[ALLOW ONLY ONE RESPONSE IN EACH ROW OF TABLE]**

Item	0	1	2	3 or More	Prefer not to say
Electric Clothes Washer					
Electric Clothes Dryer					
Gas Clothes Dryer					
Refrigerator					
Stand-alone Freezer					
Dishwasher					
Dehumidifier					
Air Purifier					

F. Demographics

F1. Including yourself, how many people live in your home year-round?

1. **[RECORD RESPONSE: _____]**
98. I prefer not to answer

F2. What is the primary language spoken in your home?

1. English
2. Spanish
3. Russian
4. Vietnamese
5. Somali
6. Arabic
7. Other **[RECORD RESPONSE]**
98. I prefer not to answer

F3. What is the highest level of education that someone in your household has achieved?

1. Some high school
2. High school diploma
3. Some college
4. Bachelor's degree
5. Associate's degree
6. Master's degree
7. PhD
98. I prefer not to answer

F4. Which category best describes your total household income in 2018 before taxes?

1. Less than $25,000
2. $25,000 to less than $35,000
3. $35,000 to less than $45,000
4. $45,000 to less than $60,000

5. $60,000 to less than $75,000
6. $75,000 to less than $100,000
7. $100,000 or more
98. I prefer not to answer

G. Closing

G1. Please enter the email address where you would like to receive the link you can use to redeem your gift card. Please look for an invitation from Tango, which will provide instructions on how to select your reward.
   1. Email address: **[ENTER TEXT]**

Those are all the questions we have for you today. Thank you for your participation – we appreciate feedback from customers like you!

Stakeholder Interview Guide

A. Introduction

Through in-depth interviews, Cadmus leveraged manufactured home stakeholders' expertise to identify barriers to program participation and opportunities for energy efficiency in the manufactured homes market. Findings from these interviews helped up refine the design of the customer survey.

Cadmus interviewed the stakeholders listed in the following table.

Stakeholder	Category
Puget Sound Energy	Utility
Franklin Energy Services	Implementer/Contractor
UCONS	Advocacy Group/Implementer
CLEAResult	Implementer/Contractor
Manufactured Homes Communities of Washington	Advocacy Group
Washington Department of Commerce	Government
Arrow Conservation	Contractor
Opportunity Council	Advocacy Group/Implementer
CAZ Energy	Implementer/Contractor
Association of Manufactured Home Owners	Advocacy Group

Cadmus asked each stakeholder for permission to record the interview, intended to ensure the accuracy of notes taken during the interview. Each interview lasted approximately 30 minutes. Cadmus informed each respondent that they (individually or by organization) will not be identified in the report or presentation to allow them to speak freely. We also provided each stakeholder with a list of the questions in advance of the interview.

B. Stakeholder Interview Questions

B1. To start, could you describe your current role and responsibilities with your organization?

B2. Can you please describe your experience and background related to energy efficiency in the manufactured homes market? [Probe: For areas where you have worked, what are the most effective practices for getting manufactured home residents to adopt energy-efficient measures?]

B3. What have been the most successful initiatives to increasing the energy efficiency of manufactured homes in Puget Sound Energy's service territory or elsewhere? What made these initiatives successful? [Probe for any additional examples from outside Washington.]

B4. What are the primary challenges and barriers to increased energy efficiency in the manufactured homes market? [Probe: What are the challenges for manufactured home residents versus the actual building? Are residents aware of Puget Sound Energy programs? Are there different challenges based on whether the home is location inside versus outside a mobile home park? Are there challenges related to specific measure adoption/application in manufactured home versus single family home market? What challenges apply to manufactured homes in general or to a segment of manufactured homes customers?]

B5. How can the challenges you identified be overcome?

B6. What are the greatest opportunities for energy efficiency in the manufactured homes market? [Probe: Are there specific measures to prioritize, recommended delivery mechanisms, effective program design, potential financing opportunities, or certain opportunities that apply to manufactured homes in general or to segment of manufactured homes customers?]

B7. Is there anything that we have not covered that is important to consider in relation to energy efficiency in manufactured homes?

Stakeholder Report Comments

See following pages for content.

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
UCONS, LLC	0. General	Cover Page		The cover page states the study is prepared for PSE. In the kick-off, PSE and the UTC were listed.	The cover should reflect both entities.	Adjusted language in Executive Summary to state that the report was co-managed by PSE and WUTC	Yes
AMHO	0. General	General Comment		Thank you for this very comprehensive report.		No edit needed	No
AMHO	0. General	General Comment		Very appropriate comments and conclusions from your surveys.		No edit needed	No
Commerce / WSUEP	0. General	General Comment		Overall – a solid report with useful information		No edit needed	No
Commerce / WSUEP	0. General	General Comment		Online survey - Should discuss how online clients match PSE MH profile.. Data suggests they are in newer units have lower incomes etc.. Implications for findings?		The comparisons between secondary data and online survey data are discussed in the Residents and Dwelling Characteristics sections of the study. While there are a few differences in characteristics these do not impact the overall findings.	No
Commerce / WSUEP	0. General	General Comment		It might help to more clearly articulate how issues like home age – repair - deferral – etc. are factored into potential estimates. Are applicability factors applied for specific measures? If so those adjustments might be included in the appendix. Is the 85% max achievable potential factor applied after? What is it supposed to account for. On its own it seems optimistic…		Because this is much more detailed methodology than what is included in the report, we are responding in this comment and not in the report. Applicability factors are applied for specific measures based on technical feasibility constraints as well as the percentage of applications for each measure that already meet the efficiency of the measure case. Issues such as home age, construction types/trends, and space constraints are examples of possible technical feasibility constraints. Cadmus does not account for repair or deferral when estimating conservation potential. The 85% max achievable potential factor is applied after the applicability factors. It is an assumption from the NWPCC meant to represent the maximum percentage of measure applications that can possibly be achieved. The 85% max achievability factor is consistent with the 7th Power Plan and all recent Northwest potential studies.	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
Opportunity Council	0. General	General Comment	N/A	how was LiWx ARRA distinguished from "standard" LiWx	provide clarification in document	If ARRA funding was used for implementing the program PSE designated the program as such in its tracking data. If the program was delivered with more standard funding mechanism, it was not designated as ARRA.	No
Public Counsel	0. General	General Comment		Overall, I think this is well done.		No edit needed	No
Public Counsel	0. General	General Comment			For clarity, you may consider stating what "n" is initially in the table and/or when you use "n="	Added table note to Table 4	Yes
UCONS, LLC	0. General	General Comment		The cover page states that this study is "Prepared for: Puget Sound Energy." However, the PowerPoint presentation used in the "Kick-off" listed both PSE and the UTC as "project sponsors." The report should reflect that UTC involvement. If something changed in the project sponsorship since the project kick-off, that should be explained.		Adjusted language in Executive Summary to state that the report was co-managed by PSE and WUTC	Yes
UCONS, LLC	0. General	General Comment		The draft fails to even mention Initiative 937 or the Energy Independence Act, which is the driver of much of the effort to secure all cost-effective conservation. We had thought that this study was driven in substantial part to help PSE, the Commission, and the various stakeholders so that the "all cost-effective conservation" mandate of I-937 can be met in the manufactured home sector.		Revised conservation potential study methodology section to clarify that Cadmus did not estimate economic potential, which provides screens for cost-effectiveness.	Yes
UCONS, LLC	0. General	General Comment		Many of the discussions and findings in the draft report are based on survey data. While survey data can be useful, there also is a body of hard data reported to PSE and to the UTC that we are not was analyzed and used. That data is not only extensive and rigorous, but likely is statistically more accurate		Cadmus used participation data extensively to describe participation and program achievements (Historical Program Participation). Data collected from program implementation is not appropriate to characterize the population due potential bias of that data.	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				than a small sample survey. That data differs in some material respects from the data presented in this report. To the extent that this data was used, it should be discussed in the report. If this data was not used, the report should so state.			
UCONS, LLC	0. General	General Comment		Over the past few years, there has been a dispute about whether the manufactured home sector has been "saturated" by conservation programs. The draft report appears to resolve that dispute – this market is not saturated. Table 10 on page 21 provides the percentage of manufactured homes served in the various counties in PSE's service territory, ranging from 24% in Kittitas County to 53% in King County. Even with a rate of 53%, that means that 47% of the homes were not served. And those that were served may have been served with only a subset of available, cost-effective measures. So, the conclusion is, and the report should so emphasize, that there is a significant untapped conservation potential in this market.		Removed editorial language about program accomplishments in conclusions section to only emphasize findings.	Yes
UCONS, LLC	0. General	General Comment		While the report does discuss some perceived barriers to providing conservation services to manufactured homes, it could go further to address those barriers and make recommendations to removing them. For example:• The study could have done more to evaluate how other states have addressed and overcome barriers to serving this market. For example, in California and Oregon there is a history of not requiring customer payments, making the provision of services fully funded by the utility (or in Oregon, the		California programs were not part of the benchmarking review. The study provides information on other utilities financing initiatives, including ETO's on-bill financing on p. 63. The study notes that a "specific program that targets manufactured homes" is a best practice for delivering successful manufactured homes program.	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				ETO) programs. • The study does not address current PSE practice to provide no cost and comprehensive services only to low-income customers in the manufactured home sector. (PSE made the statement that it serves the manufactured home customers through the various low-income agencies.) That overlooks the reality (as confirmed in the draft report on page 27) that there exist many manufactured homes not occupied by low-income customers, and there is nothing in the law that requires that low-income population to be served only by the agencies. It further ignores the real-world limits of the ability of low-income agencies to coordinate services to all low-income customers. • Put another way, the draft report does not address the barriers in the existing segmentation of the manufactured home program, with low-income customers being served in one way, and the remaining customers either not being served or served in a different way. Of course, I-937 requires that all cost-effective conservation be acquired, whether the customer is low-income or not.			
NWEC	1. Executive Summary	1		WUTC name correction	Washington Utilities and Transportation Commission	Corrected	Yes
NWEC	1. Executive Summary	1		Confusion in second finding - you say that program data shows that almost half of MH customers have participated in at least one program since 2010, but the second sentence says that 73% of customers have participated in a single year. Clarification please!		Clarified	yes

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
NWEC	1. Executive Summary	1		Overall, a table with how MHs had participated in programs would be useful		Graphics found in p. 22 - additional tables in the Appendix	Yes
UCONS, LLC	1. Executive Summary	1		The draft fails to mention Initiative 937 or the Energy Independence Act which has served as the driver for achieving all cost-effective conservation.	The draft should cite that the all cost-effective mandate of I-937 was the impetus for achieving all cost effective conservation in the manufactured home sector.	Revised conservation potential study methodology section to clarify that Cadmus did not estimate economic potential, which provides screens for cost-effectiveness.	Yes
UCONS, LLC	1. Executive Summary	1		What data was relied upon to note that 3% of customers receive gas service?	The PSE database reflects 7% and should be referenced as such.	PSE data indicates that 2097 of 69,381 MHs customers have gas service - which is 3% - report states that these customers receive PSE delivered natural gas service	No
UCONS, LLC	1. Executive Summary	1		Why is the 50% participation considered robust? Without ARRA PSE rebate programs had little participation after 2016.	Good program participation from 2004-2010 (pre ARRA rebate). Why discontinue programs that have worked when having 3 years of results showing lack of participation?	Removed editorial language	Yes
UCONS, LLC	1. Executive Summary	1		Overlooks the role of the Commission and its staff when outlining the scope and who contracted with Cadmus.	PSE & the Commission agreed on an initial scope which was then shared with the stakeholders. This should be included in the text.	Adjusted language in Executive Summary to state that the report was co-managed by PSE and WUTC	Yes
Commerce / WSUEP	1. Executive Summary	2		A bit confusing to combine in/out of park with urban/not urban in the same sentence. I would be helpful to footnote		Broke sentences apart - definition of urban/rural (method used) found on p. 9. Conducting further cross-tabs would	Yes

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				what definitions you are using for urban geographies – if it is a county based definition – it is not particularly meaningful (Bellevue and Carbonado are both urban). It would be helpful at x tab in/out parks vs urban/not urban as urban parks may be more vulnerable to closure etc.		require additional analysis. At this time there are no plans for additional analysis. If more extensive updates are made to the report, we will consider including this recommendation.	
UCONS, LLC	1. Executive Summary	2		What does "comprehensive set of measures" mean when having low customer participation past 3 years?		Customers continue to participate in a range of program offerings - benchmarking review shows a comparable set of measures available to MH customers - table 37	No
UCONS, LLC	1. Executive Summary	2		Customer participation nearly stopped when offering rebates without On bill financing	This finding should be recognized in the text.	Mixed feedback from stakeholders regarding financing - no consensus found from interviews regarding on-bill financing - additional context provide by Commerce Department /WSU EP on financing - see p. 43 of report for stakeholder feedback, see Commerce/WSU EP feedback below	No
UCONS, LLC	1. Executive Summary	2		Compared to site built sf homes, MH residents don't have gas but have far greater energy bills without the means to afford the rebates offered.	Include in the text	Unfortunately we were unable to compare overall energy bills due to the manner in which data was disaggregated (see p. 28)	No
NWEC	1. Executive Summary	3		suggest using more precise percentages (60.4% rather than over 60%)		Mentioned because looking at multiple data sources (ACS and RBSA -- and cannot average) - therefore provided general information - to report more precisely would need to pick one or the other data sources - this approach provides the general trend - the report provides further details in the Secondary Data section	No
NWEC	1. Executive Summary	3		Re: air conditioning - are MH more likely overall than site-built homes to have air conditioning, but less likely to have central AC? -I think you're saying that they are more likely to have room AC than single family. And less likely overall to have AC in general?		Correct - more likely to have window AC, less likely to have central AC - overall, there is a similar distribution of Air conditioning systems - clarified in report	Yes

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
NWEC	1. Executive Summary	3			"Were less than six years OLD"	Fixed	Yes
NWEC	1. Executive Summary	3		Do we have a comparison on LED lighting to site-built homes?		Yes - added	Yes
UCONS, LLC	1. Executive Summary	3		PSE billing history evaluations confirm >17,000 kWh for all electric MH	Explain departure from its 2 prior billing history studies.	Possible that findings differ from past studies due to the years passed since other studies were conducted. The UCONS consumption study was conducted in 2003 and was cited in the study on p. 36 (see footnote). Results may differ from the UCONS or DNVLG study (2012-2013) due to the age of the homes (i.e. homes have become more efficient over time).	No
UCONS, LLC	1. Executive Summary	3		PSE PM report today indicates that their free audits are giving 20 lamps per home	Explain why UCONS is finding on average only 7 lamps in a significant portion of MH homes.	Lighting saturations based on RBSA II and survey data. Unclear saturation found by UCONS.	No
NWEC	1. Executive Summary	4		re: financing - suggest including the ranges of responses (the middle numbers) if not done already		Hard to provide in the executive summary because the scale goes from 0 to 10 - see figure 22	No
UCONS, LLC	1. Executive Summary	4		Clarify the problem that leaving existing heating systems operational when installing a new DHP results in poor energy savings.	Current PSE DHP programs do not address having multiple heating systems and multiple controls. Utility specs can be enhanced by addressing why other states and manufacturers require removal of the original heating systems (when installing DHP).	Made clarification about multiple systems. Outside of scope to discuss internal PSE program rules.	Yes
UCONS, LLC	1. Executive Summary	4		PSE programs that worked did not use rebates but were fully funded to achieve	The report should address why the	Outside scope of study to discuss internal PSE decision making processes	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				I-937 goals the same as Oregon and California.	rebate program was continued after 3 years of low participation and inability to achieve either 7th Plan or I-937 goals		
NWEC	1. Executive Summary	5			"When THE COMPANY targeted programs and HAD access to federal dollars."	Made change	Yes
UCONS, LLC	1. Executive Summary	5		"Despite these challenges…reduced electric and gas bills for their customers" is an overstatement.	The data shows that fewer than half of the MHs received at least one measure and opportunity exists to achieve additional conservation in this sector, The study should state there is considerable untapped conservation potential.	Removed editorial content	Yes
UCONS, LLC	1. Executive Summary	5		PSE was successful from 2006 thru 2016 in reaching this market, address why PSE has not reinstated the successful elements of these programs		Outside scope of study to discuss internal PSE decision making processes	No
UCONS, LLC	1. Executive Summary	6		Address why surveys and RBSA data has not proven reliable for MH. Compare the difference with survey results from prior program data.		Discussed sample sizes of various surveys, including pros and cons (such as using site-visit data) in Methods section - See Table 2	No
NWEC	1. Executive Summary	2 and throughout		Suggest using "site-built" instead of "single-family" to represent non-MH homes		Added "site-built" in excusive summary and added footnote in to Table 2 stating that single family homes are assumed to be site-built	Yes

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
Commerce / WSUEP	2. Introduction and Acknowledgement	6		If you used the ACS data and approach for mapping PUMA to PSE service territory for characterizing the MH from WSU EP – it would be good to list WSU EP in the supporting org list		Updated	Yes
NWEC	2. Introduction and Acknowledgement	6			NW Energy Coalition (we do not use "Northwest", just NW)	Updated	Yes
Public Counsel	2. Introduction and Acknowledgement	6			We have been referred to in this group as "the Washington Office of the Attorney General", but we are usually just referred to as "Public Counsel" or "the Public Counsel Unit of the Washington State Attorney General's Office." Please update that to one of the two options.	Updated	Yes
NWEC	2. Introduction and Acknowledgement	7		An example picture of a MH home versus a modular home v. a site-built home would be nice. (and maybe a pre-1976 mobile home)		Added reference that a photo of a manufactured homes can be found in the appendix	Yes
NWEC	3. Methods	11		spacing in paragraph under table		Fixed	Yes
UCONS, LLC	3. Methods	13		When was it determined to use surveys instead of actual program data (when actual data was available)?		Program data was used extensively in the secondary data analysis to describe program accomplishments	No
Public Counsel	3. Methods	14			Insert space between "figure 1" and "illustrates"	Correction made	Yes
UCONS, LLC	3. Methods	14		Did Cadmus review the Conservation Potential Study requested by the UTC in	Revise Figure 33 to show existing	Figure 33 shows achievable potential, accounting for market barriers addressed	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				2016? This forecast was with audits of 30,000 PSE MH and used measures approved in the 7th Plan. It found 10 aMw achievable today under I-937.	conservation potential in 2019 when addressing market barriers that will allow this customer to be served under I-937	through program delivery - this study used MH home counts, as verified through the geospatial review (part of this study)	
UCONS, LLC	3. Methods	15		Lost opportunities arise in this sector by not being comprehensive and installing only 5 lamps and 1 or 2 other measures. Park Managers discourage multiple contractor visits.		Provided further clarification in report	Yes
UCONS, LLC	3. Methods	15		Saturation: was this based solely on survey data?	Please clarify any differences in saturation data between the surveys and audits.	Provided further clarification in report	Yes
Public Counsel	3. Methods	16			Inset space between "Table 5" and "shows"	Fixed	Yes
Public Counsel	3. Methods	16			In the tables, you use "compact fluorescent" but in the footnotes and narrative you use "CFL's". Could you include the full name with the acronym the first time you use it just for clarity?	Replaced CFL with compact fluorescent throughout report	Yes
UCONS, LLC	3. Methods	16	Table 5	Table 5 data is aggregated 2012-2018 and does not reflect trends over the following 3 time periods through today: 2006-10; 2010-16;2016-today.	Prepare a new table 5 showing trends in this data over 3 time periods: 2006-2010; 2010-2016 and 2016 through current time	Trends of energy savings by end use are shown in Figure 6	No

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NWEC	3. Methods	17			American Council for an Energy-Efficiency Economy (ACEEE)	Made correction	Yes
UCONS, LLC	3. Methods	17		Cadmus chose to interview and include Entergy Arkansas.	We suggest they interview the 4 California IOUs or Synergy companies.	Identified Entergy because it was listed as an exemplary MHs program - interviewing additional utilities not feasible at this time	No
AMHO	4.1 Findings - Secondary Data	25		one typo under Resident Characteristics: (last sentence) relies "on" data.		Made correction	Yes
Commerce / WSUEP	4.1 Findings - Secondary Data	27		Add a 201-300% FPL band to Figure 7 this will reinforce point that MH are low and low moderate income -- this also connects to discussion of financial barriers		Added income bands	No
NWEC	4.1 Findings - Secondary Data	28		type - ss		Made correction	Yes
NWEC	4.1 Findings - Secondary Data	28		confused by the footnote - did the survey not collect data on whether residents owned or rented the land or not? Is the first survey referenced the ACS and the second is the PSE - what is the percentage of those who do not own the land?		The ACS and RCS did not gather this data, while the online customer survey did - added clarification	Yes
Commerce / WSUEP	4.1 Findings - Secondary Data	31	Figure 11	It may be useful to compare age PSE MH to state MH --- is the lack of recent installations – a PSE territory issue or a state wide issue. Or an artifact of the RBSA methodology. How does RBSA and ACS data compare? Age should also be reported in categories aligned with energy codes… pre 1976 Pre HUD, 1976-1994 HUD compliant, possibly some current era divisions. This would be helpful in understanding markets for program MH replacement		Added verbal description of HUD timeline vintages	No
Commerce / WSUEP	4.1 Findings - Secondary Data	34	24	It would be helpful to look at this data by age or some other way to gauge replacement potential – need.		At this time there are no plans for additional analysis. If more extensive	No

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						updates are made to the report, we will consider including this recommendation.	
NWEC	4.2 Findings - Billing Analysis	36		broken table/figure references		Made correction	Yes
Commerce / WSUEP	4.3 Findings - Stakeholder Interviews	38		Consider referencing sustainability index under financial barriers… This data suggests that in PSE service territory most which is high cost --- financing or making significant capital investments is not a viable option for households under 300% of FPL and in some higher cost areas the level may be as high as 350% of FPL. Tools like the Sustainability Index suggest that incomes levels between 250% of FPL and 350% of FPL are needed to meet basic living expenses for most counties in PSE service territory. Financing options and taking on debt are not a meaningful option at those income levels.		At this time there are no plans for additional analysis. If more extensive updates are made to the report, we will consider including this recommendation.	No
Commerce / WSUEP	4.3 Findings - Stakeholder Interviews	43		WSU EP Community Energy Efficiency Program has been informally testing rebate levels targeted to the near low income (under ~ 275% of FPL) at a number of agencies including a demonstration of incentives for floor insulation in MH via PSE -- and have established that programs targeting major measures don't start to get any traction – participation in moderate income households until rebate levels hit 60% and don't really move till they exceed 80%. This is consistent with the online survey results. We have extensive evidence and experience from ARRA era community-based programs (Seattle Community Power Works and at least four other CEEP programs that offered or attempted to launch energy efficiency financing programs. Two		Unable to incorporate additional findings at this stage in reporting. Stakeholder findings indicate that all stakeholders said that financing opportunities are typically beneficial in general, but differed on the whether currently offered opportunities were sufficient. (See p. 43). Note, this stakeholder comment spreadsheet will be attached into the appendix of the report. All comments included and not included will be captured and noted.	No

Responding Organization	Section	Page Number	Table/ Figure Number (If needed)	Requested Clarification	Requested Edit	Cadmus Comment	Addressed in Report (Yes/No)
				unequivocal findings o They are extremely costly and labor intensive to launch o Stand alone loans targeted high needs and specialized clients are costly to administer—they require lots of client hand holding and support. Loan value has to be high enough to justify the effort. o Current rates for existing loans such as PSCCU are 4 – 10% o Even with very advantageous rates (3.5%) for the near low income loans had little or no take up among lower income households. CPW 4 year effort partnership with Craft 3 which included extensive client support and hand holding netted about 100 loans to low – moderate income median household income. Almost all of which were single-family stick-built. Manufactured Housing is much harder. o All other CEEP demonstrations were either abandoned financing models or experience low overall take up and almost no take up for income qualified households o Loans are currently offered as an option – tool – for a number of local program including some current CEEP grant recipients -- take is very low (a handful a year). It may be useful. It would be helpful to check with PSCCU to and/or Craft 3 or Commerce and ask whether they track income qualification and if so how many/what proportion grants supported by Commerce are income qualified • Summary: A financing option such PSCCU's loan is ok to include in the tool			

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				kit or portfolio but it is not likely to achieve any meaningful impact or penetration in this sector			
NWEC	4.4 Findings - Customer Survey	44		Pierce County offers rebates?		Weatherization services are provide as per Pierce County website	No
UCONS, LLC	4.4 Findings - Customer Survey	44		Hard to believe that 44% of MH customers learned of PSE programs by email from PSE unless only those with email were in this survey.		Added footnote in text to clarify survey limited to customers with email addresses	Yes
NWEC	4.4 Findings - Customer Survey	45		Chart label on different page		Fixed	Yes
NWEC	4.4 Findings - Customer Survey	45		Could you make a chart of the "overcome challenge" responses?		At this time there are no plans for additional analysis. If more extensive updates are made to the report, we will consider including this recommendation.	No
NWEC	4.4 Findings - Customer Survey	48		Re: broken heating equipment - another interpretation is that they would use space heating equipment or other "temporary" measures		Added interpretation	Yes
NWEC	4.4 Findings - Customer Survey	52		re: gas service percentages - are those 8% served not by PSE being served by cascade natural gas, or is there some confusion between propane use and gas service?		Survey did not ask what the other gas providers are - likely another gas utility like Cascade - propane was provided as a response option, so unlikely that respondents were confused	No
NWEC	4.5 Findings - Potential Study	61		Can you expand on the replacement question - what measures encompass replacement?		Provided further clarification in report	Yes
NWEC	4.6 Findings - Benchmarking	61		one typo referring to Energy Arkansas rather than Entergy		Made correction	Yes
NWEC	4.6 Findings - Benchmarking	61		Without some denominator data, hard to understand what 1500 MHs for Entergy and 114 MHs for ETO means		The study did not have access to total number of MHS in these territories	No
NWEC	4.6 Findings - Benchmarking	62		"long searched..." is a little editorial rather than factual	"PSE first piloted a direct install offering for MH customers in 2010"	Made correction	Yes

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Commerce / WSUEP	4.6 Findings - Benchmarking	64		Best practice section -- should include a discussion of MH housing replacement as emerging practice – see ETO and CEEP – PSE pilots - Significant potential to leverage housing preservation and other funds at state and local level		Thank you. At this time there are no plans for additional analysis. If more extensive updates are made to the report, we will consider including this recommendation.	No
NWEC	4.6 Findings - Benchmarking	66		Table reference doesn't match table		Made correction	No
UCONS, LLC	4.6 Findings - Benchmarking	67		A dedicated contracting pool has not been achieved since 2016. Most contractors will no longer support the MH program due to low level of customer interest and Park Managers discourage having multiple contractor visits. Different prices are being charged by contractors and customers are confused.	A standardized set of approved costs should be developed and a pool f dedicated contractors similar to what the low income agencies have developed.	PSE's current program offerings are discussed in "Program Offerings". Cadmus did not collect data regarding challenges associated with developing a standardized contractor pool.	No
UCONS, LLC	5. Appendix	77		States that 88% of homes have 3 and 4 bedrooms. Can this be true? It would appear that 2 bedrooms is the norm.		Looked up a few floorplans for manufactured homes - single wide can have two bedrooms, most of the floorplans reviewed for double wide showed 4 bedrooms	No
Opportunity Council		25	11	no data for LiWx 2014	Is data available?	No gas savings were reported, although there were electric saving for Low Income Weatherization in 2014	No
Opportunity Council		25	11	no data for single family Wx for 2017	Is data available?	No gas savings were reported, although there were electric saving for Single Family Weatherization in 2017	No
Opportunity Council		36	30	error in citation in two locations under bill analysis		Fixed	Yes
Opportunity Council		58	first two paragraphs RE Table 33	should read "top 10" measures	or five more measures need to be added to table 33	There are 15 measures listed in the table	No