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April 2, 2013

MEMORANDUM

TO: Power Committee Members

FROM: Tom Eckman and Massoud Jourabchi

SUBJECT: Residential Building Assessment Findings for Manufactured Housing

As part of our ongoing monitoring the regional research, staff has prepared a presentation on the topic of Residential Building Assessment. This presentation highlights some of the characteristics of the manufactured housing structures in the region. The data was collected through over 1,226 phone surveys and 321 onsite audits. This is the second report in a three part series updating the Council on state of residential buildings in the region. Part one of this series, a report on Single Family homes, was presented in September 2012. The third presentation will summarize the characteristics of multifamily dwellings.. The findings from this research activity will form the basis for both the assessment of conservation potential and load forecast for the 7th plan.

Data collected during the field surveys included general demographic information, occupant attitudes and participation in efficiency programs, a detailed lighting inventory, building envelope characteristics, and end-use characteristics for electronics, major appliances, and heating, ventilation, and air conditioning (HVAC) equipment.

RBSA sample design included all public and investor owned utilities in Washington, Oregon, Idaho, and western Montana. The final RBSA sample includes 100 utilities: 90 public power utilities, seven investor-owned utilities, and three gas-only utilities.

The report was prepared for Northwest Energy Efficiency Alliance, and is in response to one of the data gaps identified during NEET working group 1 "Measuring what matters" activities.

There are a few salient findings that can be drawn out of the analysis presented in the Manufactured Housing report:

Findings and Observations

The purpose of a characteristics study is to establish base case conditions in a wide variety of components that can provide the basis for program planning, resource planning, and program evaluation. There are a few salient findings that can be drawn out of the analysis presented in this manufactured home report:

- Characteristics of Northwest manufactured homes exhibit a high degree of uniformity across the four Northwest states. This uniformity is largely due to the preemptive federal standards and the region's energy efficiency programs, which also use common standards across all factories and thus all new manufactured homes in the region.
- The review of overall conductive heat loss rates across all vintages home shows surprisingly small differences between the states and climates. When reviewing the overall heat loss rate by vintages, however, considerable differences can be seen. Nearly 80 percent of the manufactured homes were built to the federal minimum standards or before 1976, when no standards existed. This group averages about twice the heat loss and twice the infiltration rate of the homes built under the utility programs.
- Approximately 17% of all lamps are exempt from the Energy Independence and Security Act (EISA). Upgrading the efficiency of these lamps could be the basis for utility programs aimed at these types of lamps and fixtures.
- The overall lighting power density (LPD) for manufactured homes across the region is about 1.27 Watts/sq.ft compared just over 1.4 Watts/sq.ft. for single family homes..
- About 38% of all lamps are compact fluorescent lamps (CFL) or other types of fluorescent lamps. This is slightly higher than the 35% of all lamps that are CFL or other types of fluorescent lamps.
- About 70% of manufactured homes report electricity as their primary fuel for space heating which is twice the 34% of single family homes reporting electricity as their primary fuel for space heating. About 11% of manufactured homes surveyed report gas as their primary heating fuel compared just under 50 percent of single family homes report gas as their primary heating fuel. The saturation of gas heat in Montana is about five times the saturation in the rest of the region combined.
- Domestic hot water (DHW) fuel source is dominated by electricity with approximately 90% of the water heating use supplied by electric DHW tanks compared to only 50% of single family homes.
- An average of 1.3 refrigerators were observed in each manufactured home which matches the saturation of this appliance in single family homes. About 58% of those refrigerators were manufactured since 2000.
- In the manufactured home sector, the saturation of horizontal axis clothes washers is about 20% of all clothes washers compared to 34 % in single family homes.
- About 40% of the clothes washers in both manufactured and single family homes were purchased in the last six years.
- Across the region, manufactured homes have about 2.0 TVs compared to 2.3 TVs per single family homes. Average televisions viewing time reported by the occupants of

manufactured homes was 7.2 hours per day compared to just over 5 hours per day reported by occupants of single family homes.

- Manufactured homes have 1.5 set-top boxes per home. About 20% of the set-top boxes have digital video recorder (DVR) capability.
- Although half of all televisions are cathode ray tube (CRT) types, only 5% of televisions purchased after 2009 are CRTs; the rest are flat screens.
- About 20% of all manufactured homes have an electronic gaming system. The average number of gaming systems in manufactured homes with gaming systems is 1.2.
- About 77% of all manufactured homes surveyed have at least one computer.
- The average weather normalized, electric and gas energy use index (EUI) is 53 kBtu/sq.ft. per manufactured home in the region. Occupants report supplemental fuel use (wood, propane, oil, etc.) of about 14,300 kBtu/home or about a 20% increase in the energy use beyond the metered electric and natural gas usage.

Jeopardy Questions:

Category: Manufacture Home Vintage

This State has the largest share of older manufactured homes

Category: Manufactured Home Size

This state has the *smallest* average size manufactured homes

Category: Primary Heating Fuel

This space heating energy type is used by more manufactured homes than any other

Category: Space Cooling

This state has the largest share of manufactured homes with air conditioning

Category: Water Heating

This fuel heats the most hot water in Manufactured homes

Category: Lighting Efficiency

This state's manufactured homes have the most CFLs

Category: Lighting Storage

Residents of manufactured homes in these two states store the most CFLs

Category: Lighting Efficiency

This home type has the highest share of energy efficiency lighting

Category: Appliances

Residents of manufactured homes do this nearly five times per week

Category: Appliances

Residents of manufactured homes say they do this just over twice per week

Category: Appliances

Residents of manufactured homes in this state have the most efficient clothes washers

Category: Air Tightness

The manufactured homes in this state lose more heat through air leakage than any other state

Category: Duct System Tightness

The manufactured homes in this state lose more heat through duct leakage than any other state

Category: Thermal Integrity

The energy efficiency of manufactured homes in the region is primarily a result of this factor

Category: Consumer Electronics

Residents in manufactured homes in this state own the fewest TVs

Category: Consumer Electronics

Residents in manufactured homes in this state spend one third of their day watching TV

Category: Energy Efficiency

Residents of manufactured in this state say they funded the most conservation on their own

Category: Energy Use

This state's manufactured homes that use electricity for space heating use more than any other state

Residential Building Stock Assessment (RBSA) Manufactured Housing

Tom Eckman

&

Massoud Jourabchi

March 12, 2013

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The Unknown

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.



*Donald Rumsfeld. Feb.
12, 2002, Department of
Defense news briefing*

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The Chances of Making A Better Decision Increase With Accurate Data

- Council's load forecast and assessment of conservation potential rely on current and detailed data about housing and appliance characteristics
- Conservation program planners rely on market data to inform program design and evaluations
- Acquisition of statistically meaningful data is both essential and expensive

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Data Sources on Manufactured Housing used in the 6th Power Plan

- **1992 Pacific Northwest Residential Energy Survey (PNWRES92)**
- **Residential Construction Demonstration (RCDP) 1986-1989**
- **Manufacturing Home Acquisition Project (MAP) 1995**
- **Super Good Cents (SGC) 1997-1998**
- **SGC Manufactured Homes 2000-2001**
- **Northwest Energy Efficiency Housing Program (NEEM) 2006**

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What is a Manufactured Home



Living in a Manufactured Home



What Most People Think It Means



What Some People Think it Means



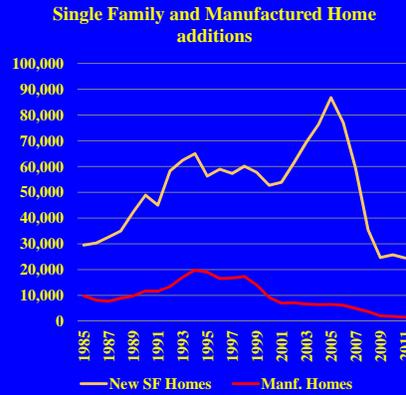
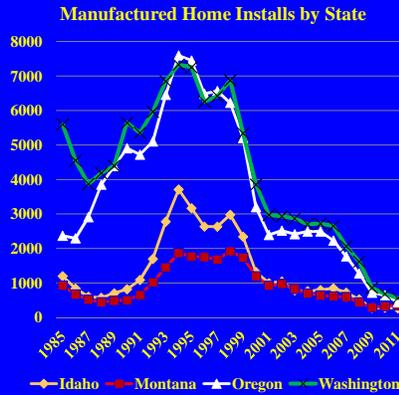
What People That Have Never Been Around
A Manufactured Home Think It Means



What It Really Means

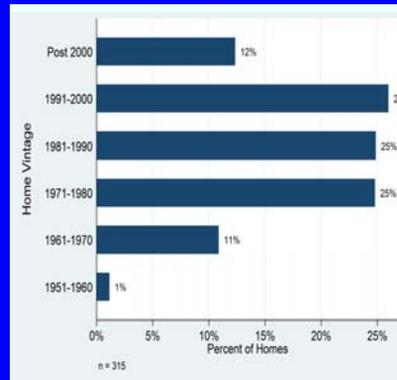
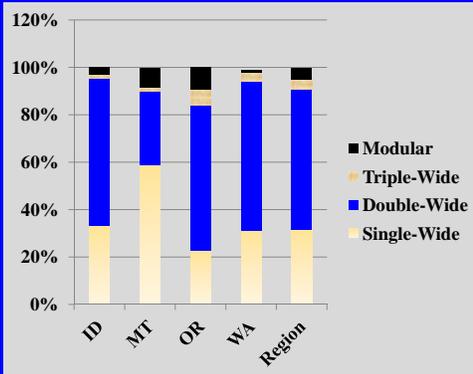
MobileHomeLiving.org

Additions to Single family and Manufactured Homes



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Distribution of Homes by Vintage and Type



Currently there are about 550,000 MH customers in the region.
 44% in Washington, 31% in Oregon, 15% in Idaho and 10% in Western Montana
 Over 62% of Mhomes can be improved... built before any utility programs

RBSA Study Objectives

Characterize Residential Sector

- Single-family homes (SF)
- Manufactured homes (MH)
- Multifamily buildings and units (MF)

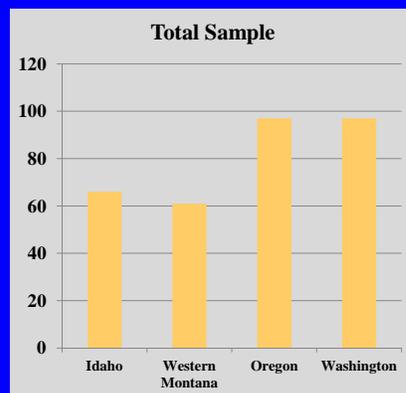
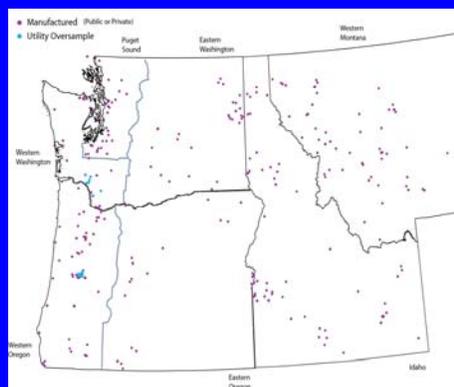
Provide Representative Sample

- Characterize the region and each state
- Provide characterization for BPA customers
- Provide a framework for individual utility oversamples.

Characterize Buildings

- Energy audit
- Lighting survey
- Survey of appliances and electronics
- Demographics

RBSA Study MH Coverage



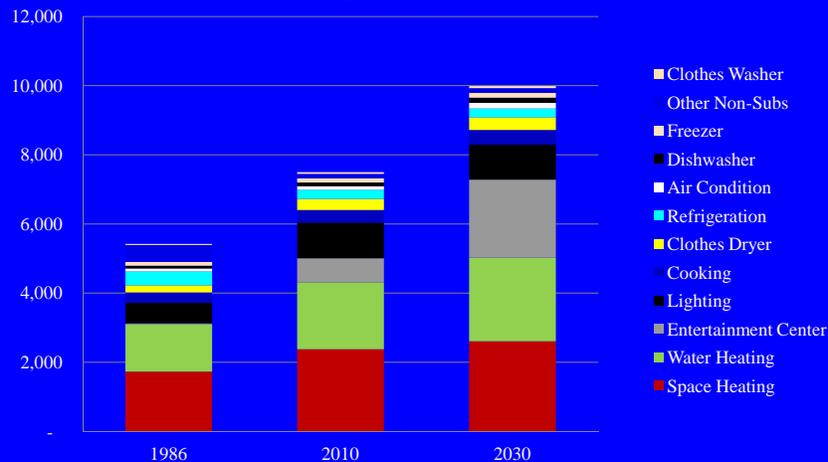
Last Comprehensive Regional Survey of Residential Customer Characteristics Was Conducted in 1992

How This Data Will Be Used

- Supports both Load Forecasting and Assessment of Conservation Potential
 - Provides Baseline Building Characteristics
 - Updates Heating and Cooling Equipment Market Shares
 - Revises Appliance Saturations and Characteristics
- Key input into determination of “non-programmatic” efficiency improvements (i.e., what consumers did on the own)
- Assist in program design & implementation

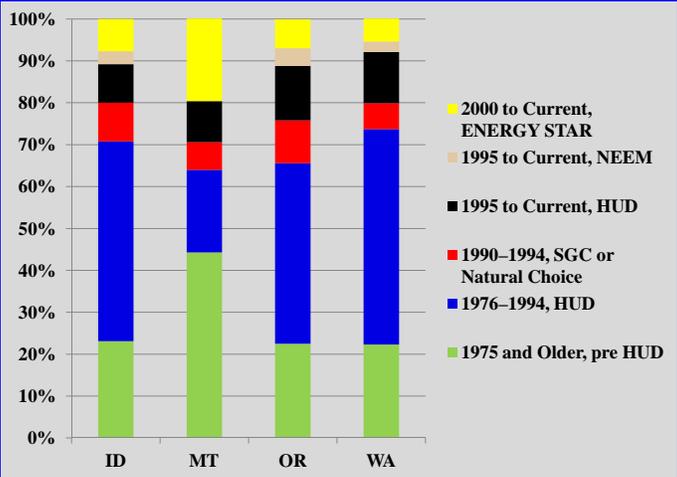
11

Estimated Load in Residential Sector Prior to Conservation initiatives or Federal Standards



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Distribution of Homes by Age/Standards and State



2013 Manufactured Home Jeopardy

Category: MH Characteristics

This state has the Smallest average size MH

Category: Attic Insulation

Nearly 60 % of MHs have less than this level of attic insulation

Category: Duct Leakage

This state's ducts "leak" the most.

Category: Air Tightness

More air blows through this state's Mhomes than any others

Category: Heat Loss

This mechanism is most responsible for driving down MH heat loss rates since 1990s

Category: Primary Heating Fuel

This space heating fuel has the dominant share of Manufactured homes

Category: Space Cooling

54%

2012 RBSA : 42% of Single Family homes have AC



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Category: Lighting

This state has the largest number of lamps per home

Opportunity: Over 60% of lamps are incandescent, conversion to other more efficient alternatives.



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Category: Lighting 2

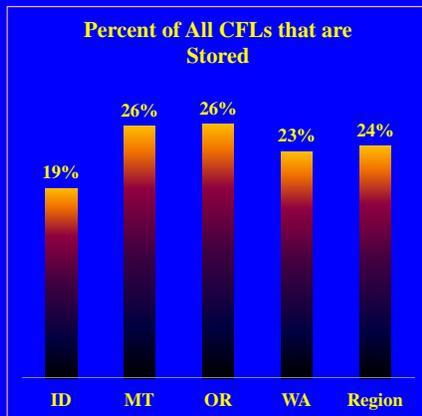
This state has the fewest share of CFLs per home

Category: Lighting 3

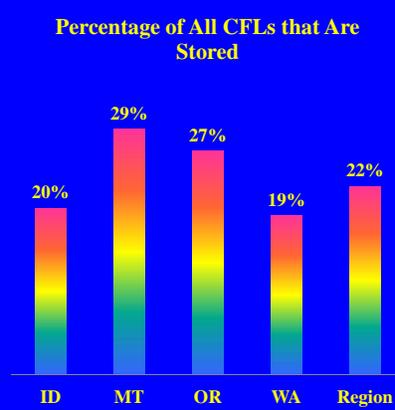
These two states are tied for storing most CFLs.

Comparison of lighting CFL Single family and Mhome

Single Family



Manufactured Homes



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Category: Appliances 1

The average NW MHome resident does this nearly 5 times per week.

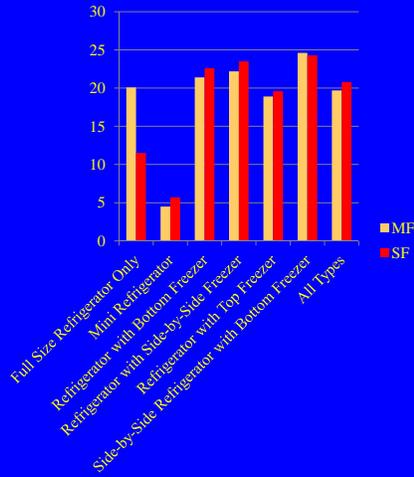
Category: Appliances 2

The share of homes with this appliance has grown the most since 1992.

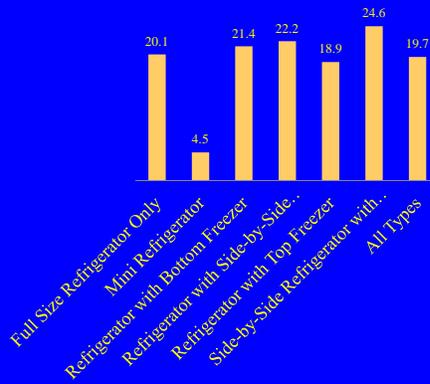
Category: Appliances 3

Early replacement of this appliance has the largest potential savings

Refrigeration Volumes



Average Refrigerator Volume (cu.ft.)



Category: Water Heating

This fuel heats the most hot water in Manufactured homes in the NW

Category: Water Heating 2

**This state's consumers use
the most water for showers**

Category: Consumer Electronics

**Just over 74% of the
Mhomes in the region own
one.**

Category: Consumer Electronics 2

The average home has at least 2 of these devices.

Category: TV

This state's MH occupants spend more 1/3 of their day watching TV.

Category: Energy Efficiency

**Consumer's in this state say
they funded the most
conservation on their own**

Category: Energy Efficiency 2

**This state's Manufactured
Homes used the least
electricity**

Category: Electric Energy Use

This state's electrically heated
Mhomes use the most electricity

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Final Jeopardy

Answer: Many areas

**Question: what is impact of
RBSA on Council's Planning**

Special thanks to:

NEEA team

Utility teams

NEET (working group 1)

Measuring what matters

Better Baseline for 7th plan

Load Forecasting

Conservation assessment

Program design &
implementation