Northwest Power and Conservation Council

April 29, 2009

MEMORANDUM

TO: Council Members

FROM: Tom Eckman and Charles Grist

SUBJECT: Model Conservation Standards and Surcharge Recommendation for Draft 6th Plan

The accompanying document sets forth the proposed Model Conservation Standards and Surcharge recommendations for the draft plan. The Act requires that the Council adopt "Model Conservation Standards" (MCS) for new and existing buildings, utility and government programs and other consumer actions. These standards are to be set at levels that achieve all regionally cost-effective power savings that can be shown to be economically feasible for consumers (taking into account financial assistance that may be provided by Bonneville). Staff is recommending that the Council retain the six MCS set forth in the Fifth Plan. These are the standards for:

1. New Electrically Heated Residential Buildings
2. Utility Conservation Programs for New Residential Buildings
3. New Commercial Buildings
4. Utility Conservation Programs for New Commercial Buildings
5. Buildings Converting to Electric Space Conditioning or Water Heating Systems, and
6. Conservation Programs not Covered by Other Model Conservation Standards

Of these six standards, only the standards for New Electrically Heated Residential Buildings and for New Commercial Buildings set forth specific levels of efficiency to be achieved. The Fifth Plan's standard for new electrically heated residential buildings was based on avoided costs that were lower than our current estimates. Similarly, the Fifth Plan's analysis of the economic feasibility of these standards used considerably lower retail electric rates and higher mortgage interest rates. Therefore, staff updated the Fifth Plan's analysis to determine whether the standards set forth in that Plan would still capture all regionally cost-effective power savings and be economically feasible for consumers. This analysis, which will be presented at the Council meeting, leads us to conclude that the MCS for new electrically heated residential buildings adopted in the Fifth Plan should be revised to require higher efficiency. In addition, in order to ensure that homes built to the MCS for new electrically heated residential buildings are

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economically feasible for consumers, financial assistance should be provided through utility or other programs targeted at new residential construction.

The Fifth Plan's MCS for New Commercial Buildings requires that these structures be designed and constructed to the better of 1) the most recent American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standard 90.1[1] or 2) the most efficient provisions of existing commercial building energy standards promulgated by the states of Idaho, Montana, Oregon and Washington. Staff recommends that the Sixth Plan retain this same approach where the new commercial building model conservation standard is a composite that includes the best of the existing operative standards for each component of the code. There are two primary reasons for using the composite approach. First, each of the existing state codes and the ASHRAE standard are currently being revised with a strong focus on improving energy-efficiency provisions. The processes in Oregon and Washington are scheduled to be completed in 2009. Further, the current proposals for code improvements under consideration are similar among the four Northwest states. Staff maintains that for commercial buildings, adopted codes and standards establish the most-efficient prescriptive standards achievable and meet the cost-effectiveness and economic feasibility standards set forth in the in the Regional Act. Second, additional savings in new buildings are available, but these savings require design practices and implementation strategies that are difficult to implement through the prescriptive language of codes and standards and their enforcement.

Therefore, in order to capture all power savings that are cost-effective for the region and economically feasible for consumers, staff recommends that utilities satisfy the requirements of the MCS for utility conservation programs for new commercial buildings.

The Act also requires the Council to determine whether to recommend that the Bonneville Administrator be authorized to surcharge utilities where the savings attributable to the standards have not been achieved. The Council's Fifth Plan did not recommend that the Administrator be so authorized. Staff recommends that the Council retain this policy in the Sixth Plan.

However, staff also recommends that the Council indicate that this recommendation is subject to modification if utilities are not aggressively pursuing conservation in new residential and commercial buildings. Although it is widely accepted that conservation represents the lowest life cycle cost option for meeting the region's electricity service needs, utilities face real barriers to pursuing its development aggressively. In particular, because of the current economic conditions, some utilities are experiencing significantly slower or negative load growth. Investments in conservation, like any other resource acquisition, will increase utility cost and place additional upward pressure on rates. Furthermore, there is some uncertainty regarding how public utilities will respond to Bonneville's implementation of rates that will result in at least some portion of their loads exposed to cost of new resources. Bonneville has committed to ensure that the "public system" meet its share of the Plan's conservation targets. It is working with its customers to put in place programs and rate structures that are designed to achieve this objective. However, should an individual utility fail to meet its share of the regional conservation goal, then Bonneville may need the ability to recover the cost of securing those savings. In this instance the Council may wish to recommend that the Administrator be granted the authority to place a surcharge on that customer's rates to recover those costs.

[1] The most recent ASHRAE standard is 90.1-2007.

Model Conservation Standards

Economic Analysis

for

New Single Family and Manufactured Home Construction

May 13, 2009

What Are the "Model Conservation Standards"?

- Act requires that Council's Plan set forth model conservation standards (MCS) for:
  - New and existing buildings
  - Utility and government conservation programs
  - Other consumer actions

Model Conservation Standards – Decision Criteria

- The Act requires that the MCS be set at levels that:
  - achieve ***all regionally cost-effective power savings*** (i.e., cost less than new generation); and,
  - that are ***economically feasible for consumers***, taking into account financial assistance that may be made available through Bonneville

What is the "Surcharge Policy"?

- The Council's Plan must contain a recommendation to the Administrator regarding whether the a utility's failure to achieve MCS savings should be subject to a surcharge on all of a its power purchases from Bonneville
- Surcharges may not be less than 10%, nor greater than 50% of Bonneville's rate.

The MCS - A Short History: Chapter 1

- Council adopted first MCS April 27, 1983
  - Established space heating performance targets for new electrically heated residences for three Northwest Climate Zones
    - Less than 6,000 Heating Degree Day (HDD)
    - 6000 – 8000 HDD*
    - More than 8000 HDD*
  - MCS requirements were 40% better than toughest existing energy codes in region
  - Recommended that MCS be adopted by January 1, 1986 or BPA impose 10% surcharge on utilities serving non-complying areas

*Now Zone 2 = 6000 – 7499 HDD, Zone 3 = 7500 HDD and greater

The MCS – A Short History: Chapter 2

- 1983 – 1991
  - Council sued by Seattle Master Builders contesting legality and level of the MCS
    - ***Conclusion – Ninth Circuit Rules for Council***
  - Utilities demand that Bonneville sponsor "R&D" project (RSPD) to test "cost-effectiveness" of MCS
    - ***Conclusion – Bonneville finds MCS cost-effective***
  - Bonneville, following Council's Plan, sponsors "early code" adoption and "energy efficient" new homes marketing program (Super Good Cents)
    - ***Conclusion – Tacoma adopts MCS, the Region follows . . .***

The MCS – A Short History: Chapter 3

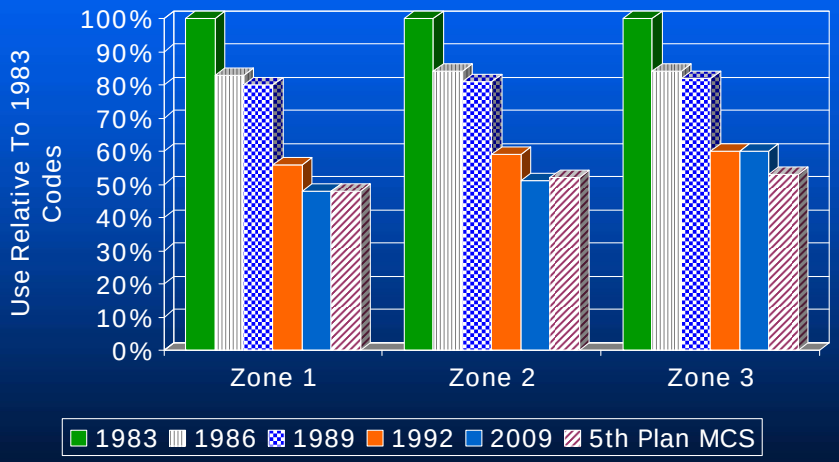
- Current Status
  - Oregon and Washington have energy codes that meet or exceed the original MCS
  - Montana has adopted the 2003 International Energy Conservation Code (IECC)
  - Idaho jurisdictions commenced enforcement of 2006 the International Energy Conservation Code (IECC) on January 1, 2008
  - The IECC codes require efficiency levels that are within 15% of the original MCS, meeting Council's 85% "achievability" target.

The MCS – It's Time for Another Cost-Effectiveness Review

Issues:

- Are there additional "cost-effective" and "economically feasible" thermal shell measures? (5th Plan did not identify any)
- Are there non-thermal shell measures (e.g. HVAC equipment, lighting, water heating, appliances) that should be considered for inclusion in the MCS?

Where Are We? (Thermal Shell Only)



Where Are We? Other Measures

- Oregon Code
  - Requires ~50% of lamps be "CFL" equivalent
  - Requires use of PTCS duct sealing or higher efficiency Heat Pump (HSPF 8.5)
- Washington Code (July 2010)
  - Requires ~50% of lamps be "CFL" equivalent
  - Requires "duct sealing" or interior ducts
- Montana & Idaho
  - "Scheduled" to adopt 2009 International Energy Conservation Code (IECC)
  - 2009 IECC requires
    - » Requires better insulated above grade and below grade walls
    - » Requires "duct sealing"
    - » Requires ~50% of lamps be "CFL" equivalent

Analytical Approach Regional Cost Effectiveness

- Use forecast of future market prices and load shape of savings to establish "energy value"
- Include T&D Benefits to establish "capacity value"
- Include 10% conservation credit
- Incorporate "risk" by adjusting future market value (+/-) based on portfolio analysis modeling results (current analysis assumes $50/MWh)

Analytical Approach Economic Feasibility

- Compares "Life Cycle Cost" of home ownership of dwelling meeting current codes to one built to higher levels of efficiency
- Includes Present Value of:
  - Downpayment
  - Mortgage Principal & Interest (including private mortgage insurance when downpayment less than 20%)
  - Property Taxes
  - Homeowner's Insurance
  - Energy Cost
- Taxes and Interest Payments Adjusted for Income Tax Effects

Economic Feasibility = Lowest Life Cycle Cost

- Step 1 – Identify the "lowest life cycle cost" code compliant home for each heating zone as "base case," *independent of space conditioning system type and including lighting and water heating.*
- Step 2 – Identify the "lowest life cycle cost" package of energy efficiency improvements to the code home for each heating zone *independent of space conditioning system type and including lighting and water heating.*
- Methodology: Use a "Monte Carlo" model to identify lowest average "life-cycle" cost package for each climate zone by testing multiple (1500+) combinations of values for major financial input assumptions, e.g. mortgage rates, retail electric rates, marginal tax rates and alternative packages of thermal shell efficiency, HVAC equipment efficiency, lighting efficiency, etc.

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Life Cycle Cost Input Assumptions

- Mortgage Rate and Term (Based on 1985 – 2007 data)
- Consumer Discount Rate
- Downpayment (Based on 1985 -2005 data)
- Private Mortgage Insurance (for less than 20% down)
- Retail Electricity Price (2007 utility specific average revenue/kWh)
- Retail Electricity Escalation Rate (6th Plan/Global Insights)
- State and Federal Income Tax Rate (2009 Rates)
- State Property Tax Rate (2008-09 rates)
- Homeowner's Insurance Rate
- Measure Incremental Cost
- Measure Incremental Savings

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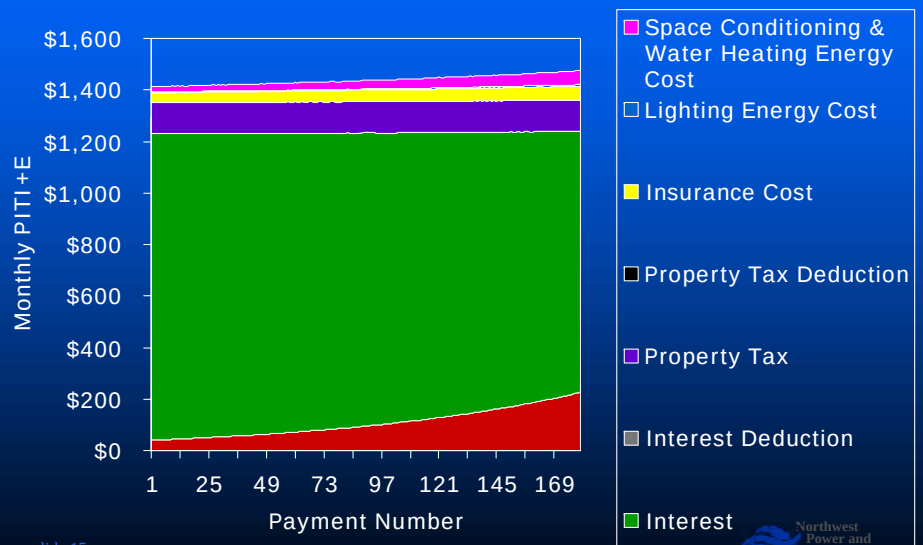
Illustrative Annual "Cash Flow"



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Consumer Life Cycle Cost Model Considers Uncertainty

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Life Cycle Cost
Why Use An "Uncertainity" Model?

- Problem
  - All of the major input assumptions (e.g., retail rates, mortgage rates, house size, etc.) are known to vary over a range, yet each new homebuyer will face unique combination of financial conditions
  - "Point estimates" for each assumption result in "Yes/No" answers, when the real conclusion is "sometimes OK, sometimes not so OK"
- Solution
  - Use distributions of input assumptions that represent the "probability" that a specific value for each input will occur to compute the likelihood that a specific level of efficiency is economically feasible

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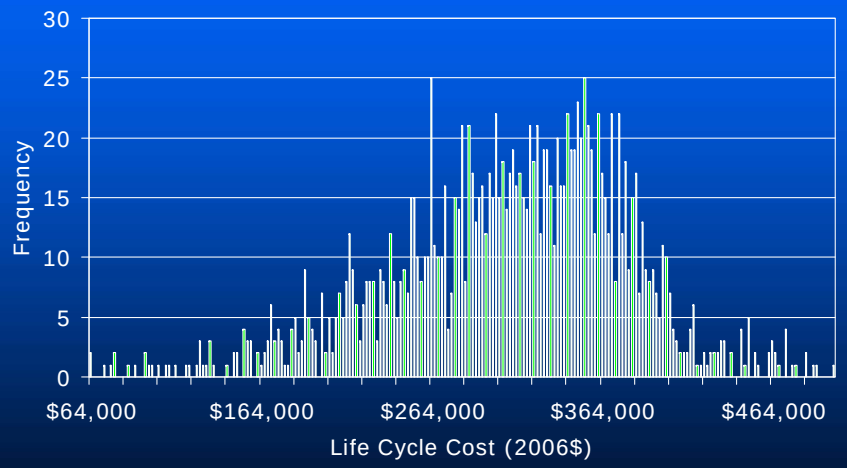
Sample Distribution of Life Cycle Cost for Heating Zone 1 Base Case



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Scope of Analysis

- New Site Built Family and Manufactured Home Construction
- Analysis covers thermal shell, HVAC, Hot Water Heating & Lighting improvements to homes with:
  - Zonal Electric Heat
  - Air Source heat pumps
  - Electric Force-air furnaces with and without central air conditioning
- Tested:
  - Eleven shell efficiency levels for site built homes and ten shell efficiency levels for manufactured homes
  - Three HVAC equipment efficiency levels
  - Three HVAC duct efficiency levels
  - Four Water Heating Efficiency Levels
  - Four lighting efficiency improvement levels

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Efficiency Packages
Site Built Homes

Thermal Shell Option	HVAC System Option	Duct System Option	HVAC Commissioning Option	Lighting Power Density (W) Option	DHW System Option
Above Grade Wall R19 Std - R21 Adv	Zonal	Standard	No	1.75	EF 0.90
Above Grade Wall R21 Std - R21 Std w/R5	Electric FAF w/o AC	PTCS	Yes	1.1	EF 0.92
Above Grade Wall R21 Std w/R5 - R30 (SSP)	Electric FAF w/ Central AC	Interior		0.8	EF 0.94
Above Grade Wall R30 SSP - R33 (DBL)	Heat Pump HSPF 7.7/SEER 13	None		0.6	EF 2.2
Attic R38 - R49 Advanced	Heat Pump HSPF 8.5/SEER 14				
Attic R49 Advanced - R60 Advanced	Heat Pump HSPF 9.0/SEER 14				
Below Grade Wall R21 Std to R21 w/R5					
Floor R30 - R38 w/12" Truss					
Infiltration 0.35 ach - 0.20 ach w/Heat Recovery Ventilation					
Slab R0 - R10 Full Slab w/R5 TB					

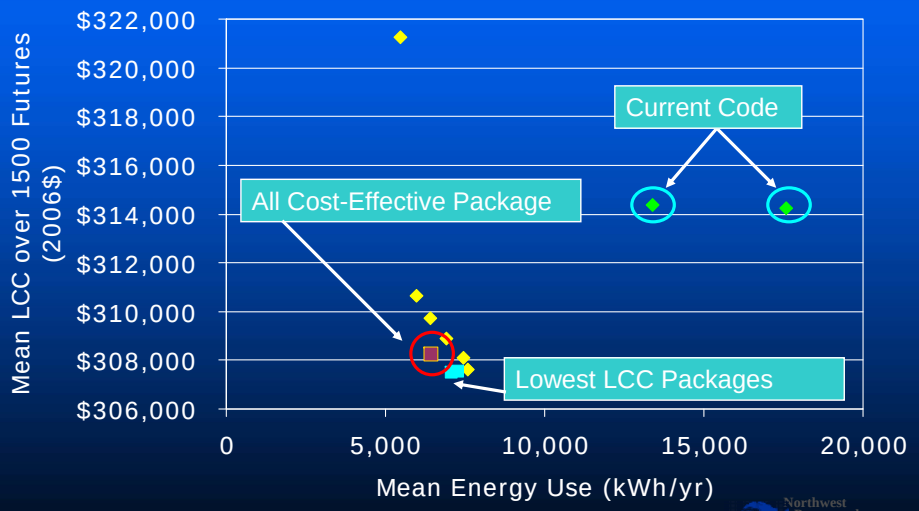
Efficiency Packages Manufactured Homes

Thermal Shell Option	HVAC System Option	Duct System Option	HVAC Commissioning Option	Lighting Power Density (W) Option	DHW System Option
Attic R19 - R25	Zonal	Standard	No	1.75	EF 0.90
Attic R25 - R30	Electric FAF w/o AC	PTCS	Yes	1.1	EF 0.92
Attic R30 - R38	Electric FAF w/ Central AC	Interior		0.8	EF 0.94
Attic R38 - R49	Heat Pump HSPF 7.7/SEER 13	None		0.6	EF 2.2
Floor R22 - R33	Heat Pump HSPF 8.5/SEER 14				
Floor R33 - R44	Heat Pump HSPF 9.0/SEER 14				
Wall R21 Adv					
Window Class 30 - Class 25					

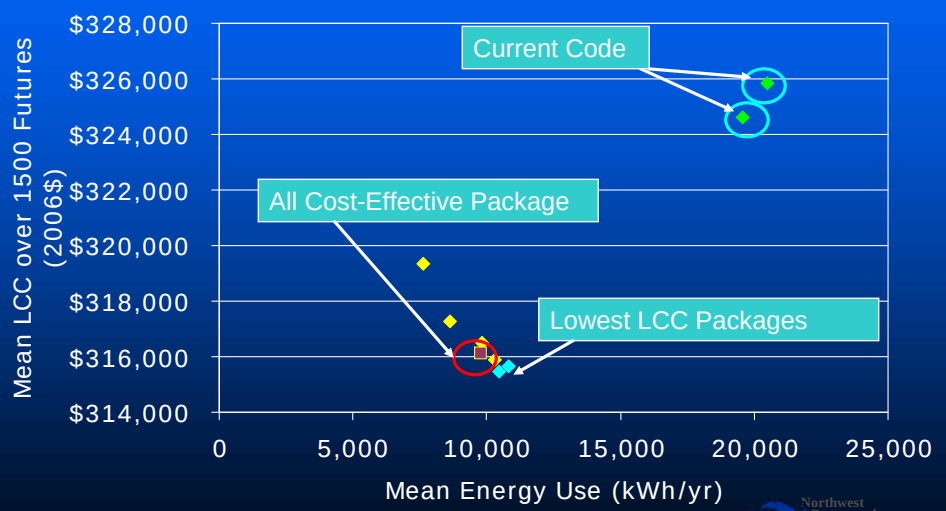
Analytical Process

- Tested nearly 8000 unique packages for site built and 6,000 unique packages for manufactured homes against 1500 “futures”
- Best performing packages (i.e., lowest average life cycle cost packages with the lowest average annual use) were selected
- These were then compared to each zones package with “all cost-effective” measures

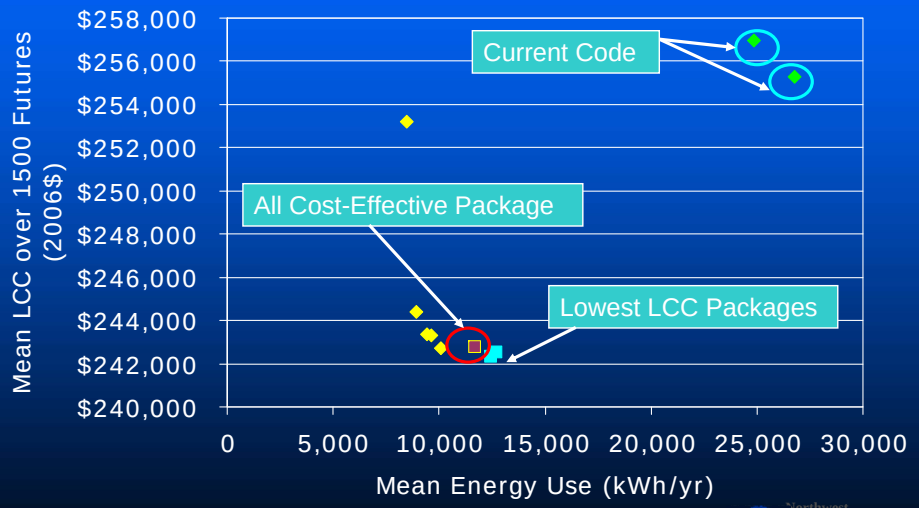
Heating Zone 1 - Site Built Homes Efficient Frontier Lowest Energy Use @ Lowest Life Cycle Cost



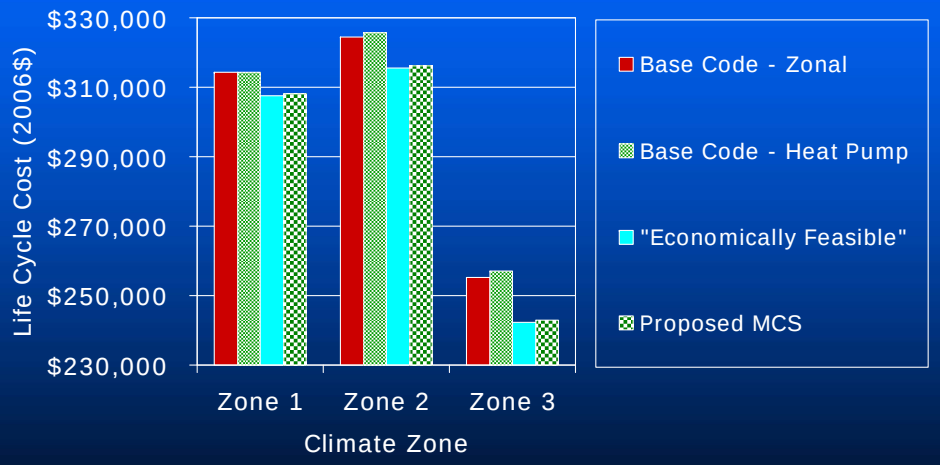
Heating Zone 2 - Site Built Homes Efficient Frontier Lowest Energy Use @ Lowest Life Cycle Cost



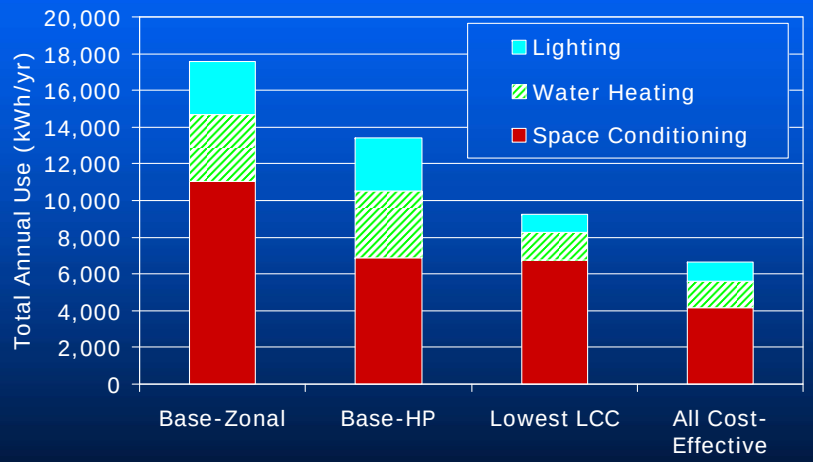
Heating Zone 3 - Site Built Homes Efficient Frontier Lowest Energy Use @ Lowest Life Cycle Cost



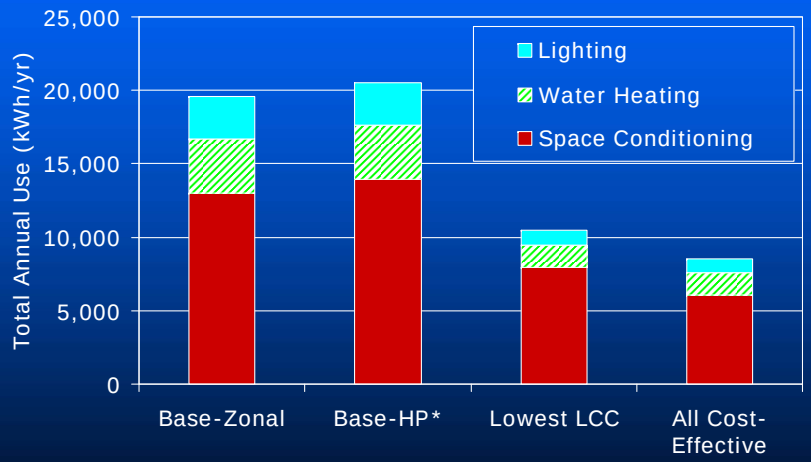
Site Built Life Cycle Cost Comparison



Single Family – Zone 1 Energy Use

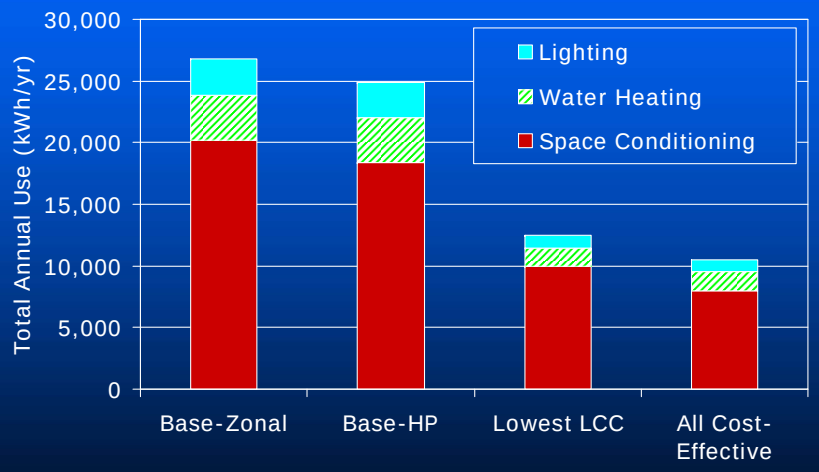


Single Family – Zone 2 Energy Use

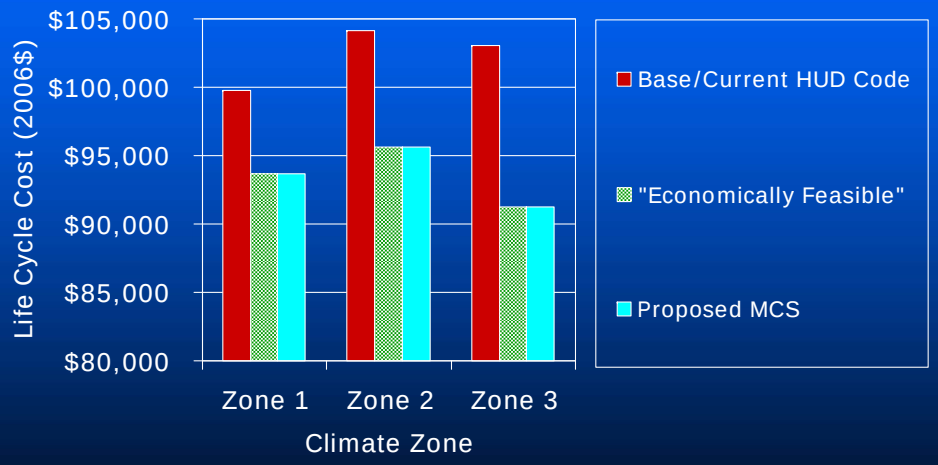


*Zone 2 HP higher than zonal due to addition of air conditioning

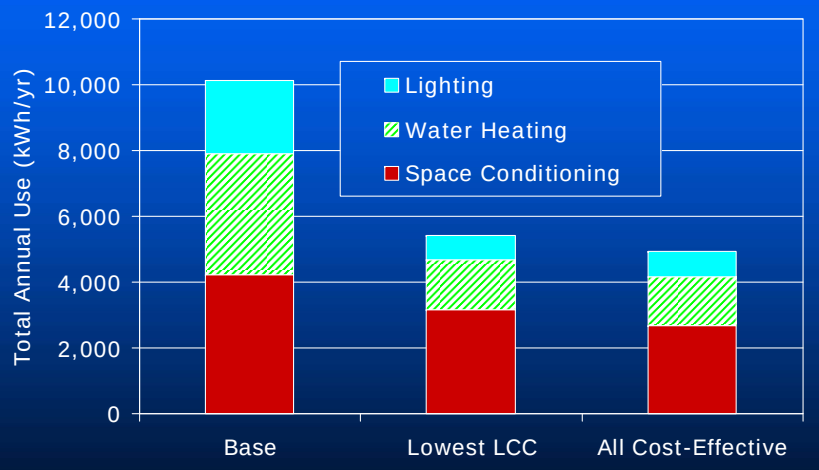
Single Family – Zone 3 Energy Use



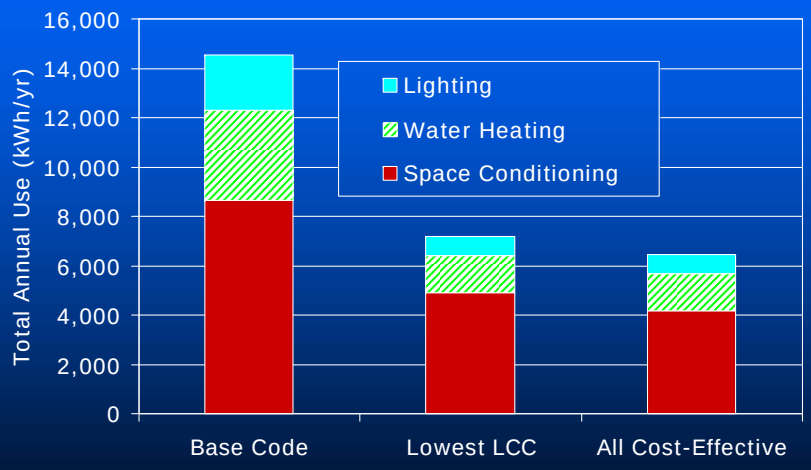
Manufactured Home Life Cycle Cost Comparison



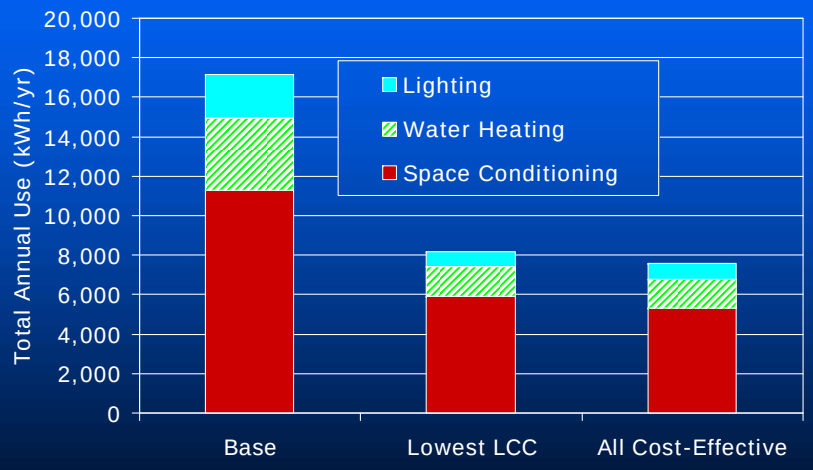
Manufactured Home – Zone 1 Energy Use



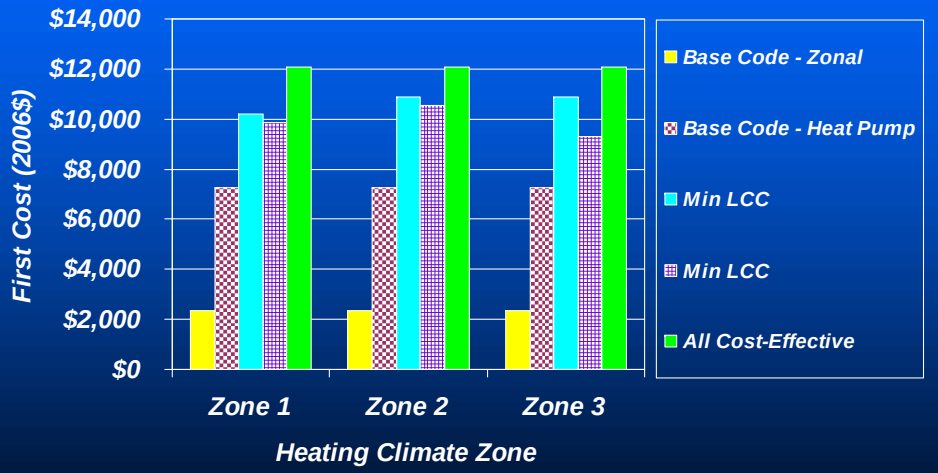
Manufactured Home – Zone 2 Energy Use



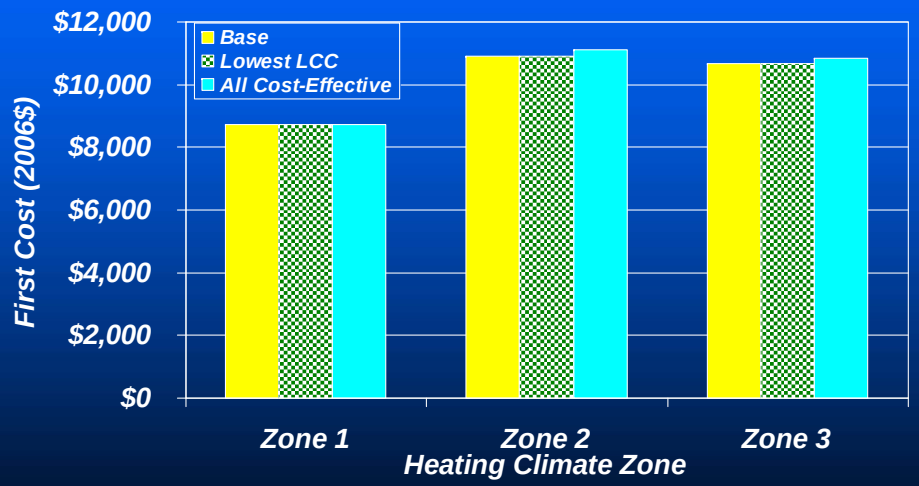
Manufactured Home – Zone 3 Energy Use



First Cost Impacts of Alternative Packages: Single Family



First Cost Impacts of Alternative Packages: Manufactured Home



Recommendations - MCS

- Revised the MCS for New Electrically Heated Residential Buildings to Reflect All Regionally Cost-Effective Measures, Including Space Conditioning, Lighting and Water Heating
- Maintain the Current MCS for New Commercial Buildings (calls for the States to adopt "best of the best" code provisions)
- Maintain the Current MCS for Utility Programs Targeted at New Residential and Commercial Buildings

Recommendations - Surcharge

- Maintain the Current Surcharge Policy
  - Do not recommend that the Bonneville Administrator be authorized to levy surcharge

Background Slides

Zone 1: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced Framing*	*R21 Advanced Framing*
Wall –Below Grade	R19	R19
Attic	R38 STD	R38 STD
Vault	R30	R30
Floor	R30	R30
Window	*Class 30*	*Class 30*
Door	R5	R5
Slab	*R10 Full Under Slab*	*R10 Full Under Slab*
Wall – Ext. Below grade	R10	R10
Infiltration	Air Sealing w/HRV	Current Practice

Zone 1: Life Cycle Cost Minimum HVAC, Lighting & DHW

- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 7,600 kWh/yr
- LCC = $307,500
- LCC Savings = $6,748 ($6870 over HP Base)
- First Cost Increase = $8,602 ($3,655 over HP Base)
- Energy Savings = 8,310 kWh/yr (4,120 kWh/yr over HP Base)

Zone 2: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced Framing*	*R21 Advanced Framing*
Wall –Below Grade	R19	R19
Attic	*R49 Advanced*	R38 STD
Vault	R30	R30
Floor	R30	R30
Window	*Class 30*	*Class 30*
Door	R5	R5
Slab	*R10 Full Under Slab*	*R10 Full Under Slab*
Wall – Ext. Below grade	R10	R10
Infiltration	*Air Sealing w/HRV*	Current Practice

Zone 2: Life Cycle Cost Minimum HVAC, Lighting & DHW

- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 10,460 kWh/yr
- LCC = $315,460
- LCC Savings = $9,150 ($10,380 over HP Base)
- First Cost Increase = $8,600 ($3,655 over HP Base)
- Energy Savings = 9,090 kWh/yr (10,040 over HP Base)

Zone 3: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced Framing*	*R21 Advanced Framing*
Wall –Below Grade	R19	R19
Attic	*R49 Advanced*	R38 STD
Vault	R30	R30
Floor	R30	R30
Window	*Class 30*	*Class 30*
Door	R5	R5
Slab	*R10 Full Under Slab*	*R10 Full Under Slab*
Wall – Ext. Below grade	R10	R10
Infiltration	*Air Sealing w/HRV*	Current Practice

Zone 3: Life Cycle Cost Minimum HVAC, Lighting & DHW

- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 12,455 kWh/yr
- LCC = $242,300
- LCC Savings = $13,070 ($14,640 over HP Base)
- First Cost Increase = $8,600 ($3655 over HP Base)
- Energy Savings = 12,300 kWh/yr (12,425 kWh/yr over HP Base)

Zone 1 – Manufactured Home Base Case Lowest Life Cycle Cost Code Compliant Package

Component	Base Case
Wall	R19
Attic	R25
Vault - Joisted	R25
Vault - Trussed	R25
Floor	R30
Window	Class 35
Door	R5

- HVAC System – Heat Pump HSPF 7.7/SEER 13
- DHW – EF90
- Average Use (kWh) = 10,130
- First Cost = $8,730
- Minimum LCC = $99,750

Zone 1: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced*	*R21 Advanced*
Attic	*R38*	*R38*
Vault	*R30*	*R30*
Floor	*R33*	*R33*
Window	*Class 30*	*Class 30*
Door	R5	R5

Zone 1: Manufactured Home Life Cycle Cost Minimum HVAC, Lighting & DHW

- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 5,430 kWh/yr
- LCC = $93,705
- LCC Savings = $6,045
- First Cost Increase = $2,175
- Energy Savings = 4,700 kWh/yr

Zone 2 – Manufactured Home Base Case Lowest Life Cycle Cost Code Compliant Package

Component	Base Case
Wall	R19
Attic	R25
Vault - Joisted	R25
Vault - Trussed	R25
Floor	R30
Window	Class 35
Door	R5

- HVAC System – Heat Pump HSPF 7.7/SEER 13
- DHW – EF90
- Average Use (kWh) = 14,530
- First Cost = $8,730
- Minimum LCC = $104,170

Zone 2: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced*	*R21 Advanced*
Attic	*R38*	*R38*
Vault	*R30*	*R30*
Floor	*R33*	*R33*
Window	*Class 30*	*Class 30*
Door	R5	R5

Zone 2: Manufactured Home Life Cycle Cost Minimum HVAC, Lighting & DHW

- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 7,165 kWh/yr
- LCC = $95,625
- LCC Savings = $8,545
- First Cost Increase = $2,175
- Energy Savings = 7,360 kWh/yr

Zone 3 – Manufactured Home Base Case Lowest Life Cycle Cost Code Compliant Package

Component	Base Case
Wall	R19
Attic	R25
Vault - Joisted	R25
Vault - Trussed	R25
Floor	R30
Window	Class 35
Door	R5

- HVAC System – Heat Pump HSPF 7.7/SEER 13
- DHW – EF90
- Average Use (kWh) = 17,160
- First Cost = $8,730
- Minimum LCC = $103,075

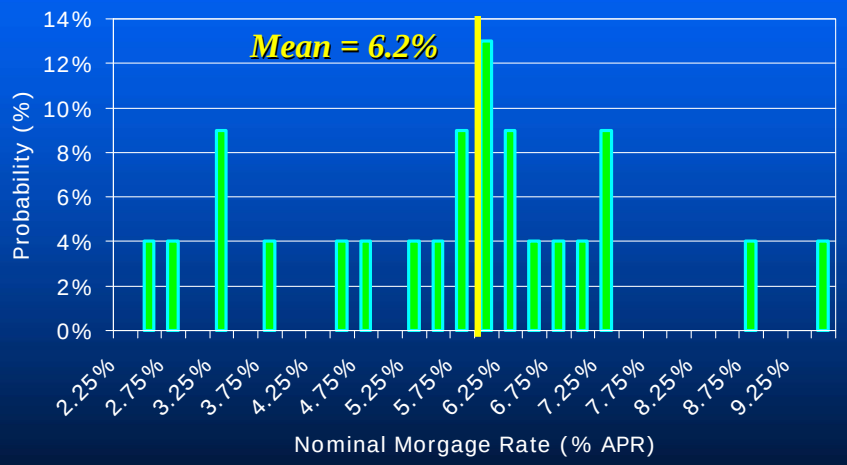
Zone 3: Life Cycle Cost Minimum & Regional Cost-Effective Thermal Shell Packages

Component	Regionally Cost-Effective	Minimum Life Cycle Cost
Wall –Above Grade	*R21 Advanced*	*R21 Advanced*
Attic	*R49*	*R49*
Vault	*R30*	*R30*
Floor	*R44*	*R44*
Window	*Class 30*	*Class 30*
Door	R5	R5

Zone 3: Manufactured Home Life Cycle Cost Minimum HVAC, Lighting & DHW

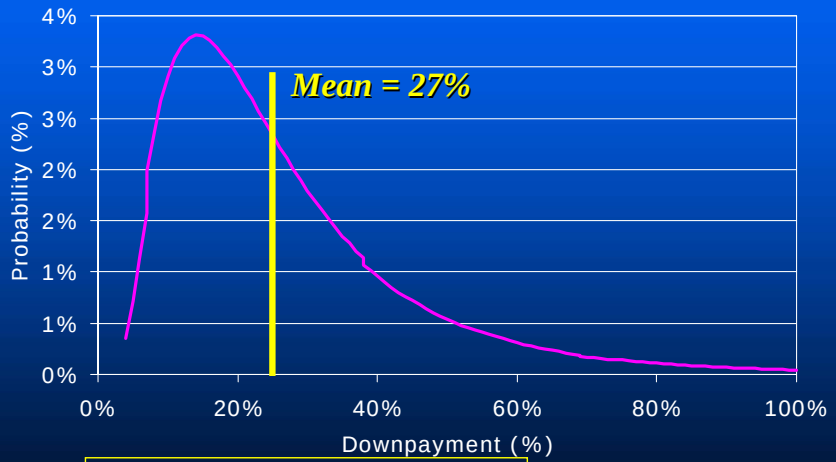
- HSPF 7.7 /SEER 13 Heat Pump w/ Interior Ducts & PTCS System Commissioning & Controls
- Lighting Power Density = 0.6 Watts/sq.ft.
- Heat Pump Water Heater
- Average Use = 8,175 kWh/yr
- LCC = $91,230
- LCC Savings = $11,845
- First Cost Increase = $2,375
- Energy Savings = 8,985 kWh/yr

Probability Distribution of Nominal Mortgage Rates*



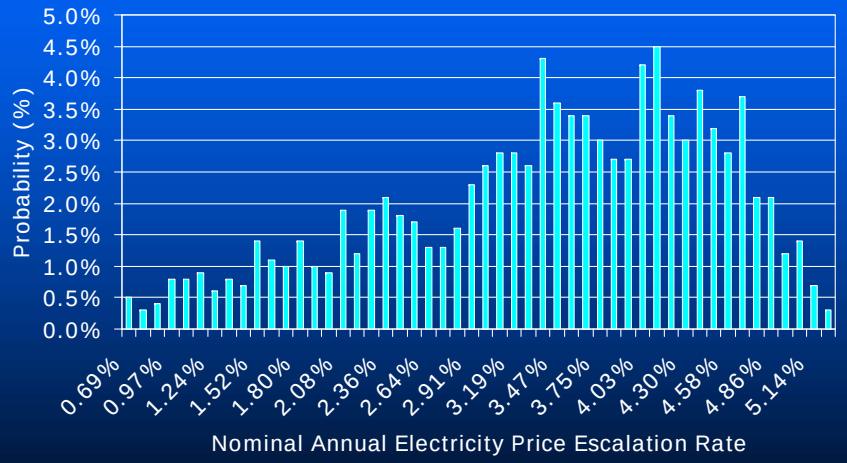
*Source: Federal Housing Finance Board Monthly Interest Rate Survey APR for new homes 1985-2007

Probability Distribution of Downpayment Amount*



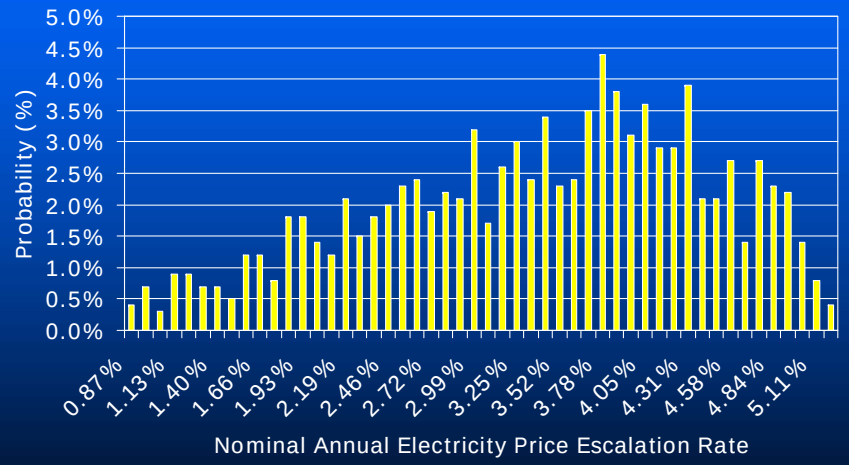
*Source: Federal Housing Finance Board Monthly Interest Rate Survey for Oregon

Probability Distribution of Electricity Price Escalation Rates – Zone 1



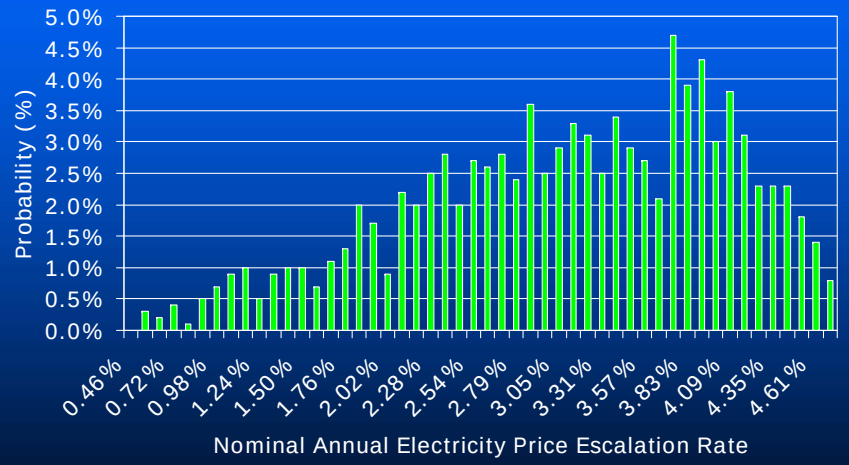
Source: Northwest Power and Conservation Council Draft 6th Power Plan

Probability Distribution of Electricity Price Escalation Rates – Zone 2



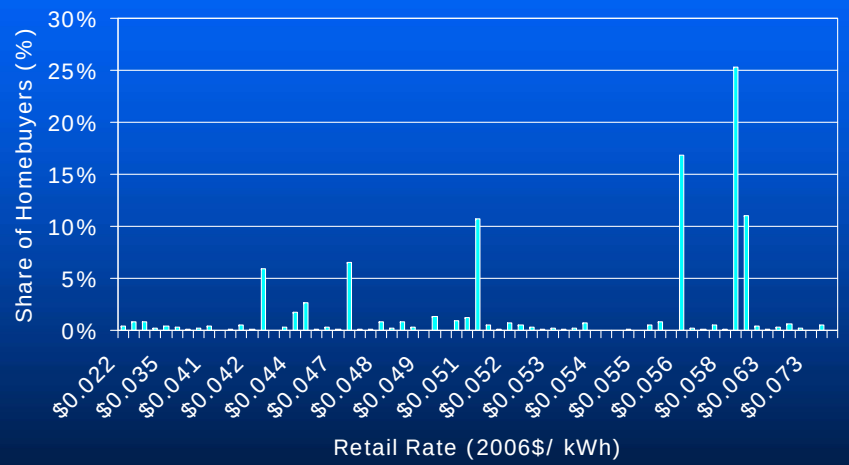
Source: Northwest Power and Conservation Council Draft 6th Power Plan

Probability Distribution of Electricity Price Escalation Rates – Zone 3



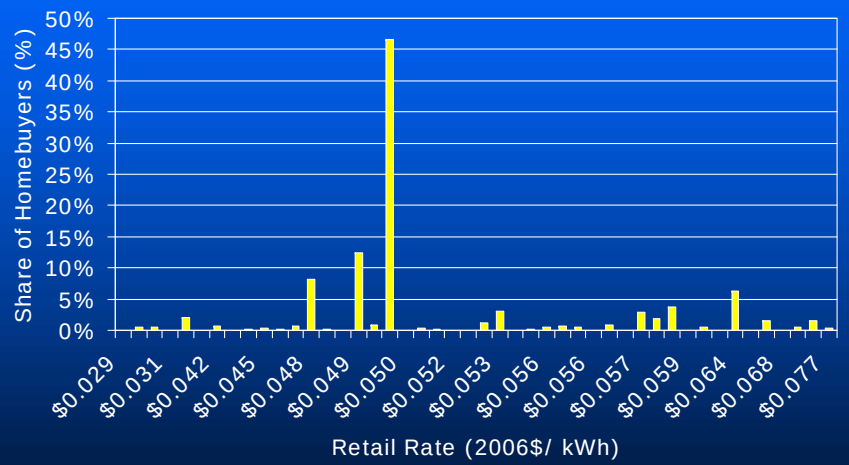
Source: Northwest Power and Conservation Council Draft 6th Power Plan

Probability Distribution of Base Year Electricity Prices – Zone 1



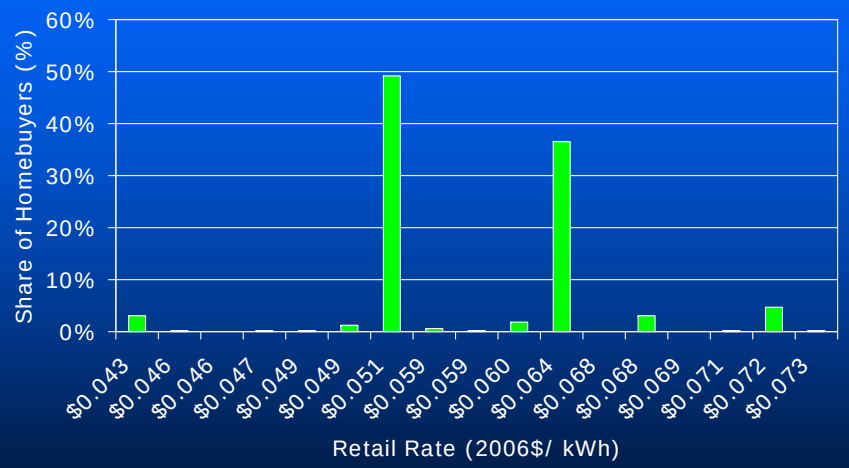
Source: Energy Information Administration residential retail revenue and customer count data for 2007. Shares based on share of new residential customers added between 2000 and 2007.

Probability Distribution of Base Year Electricity Prices Zone 2



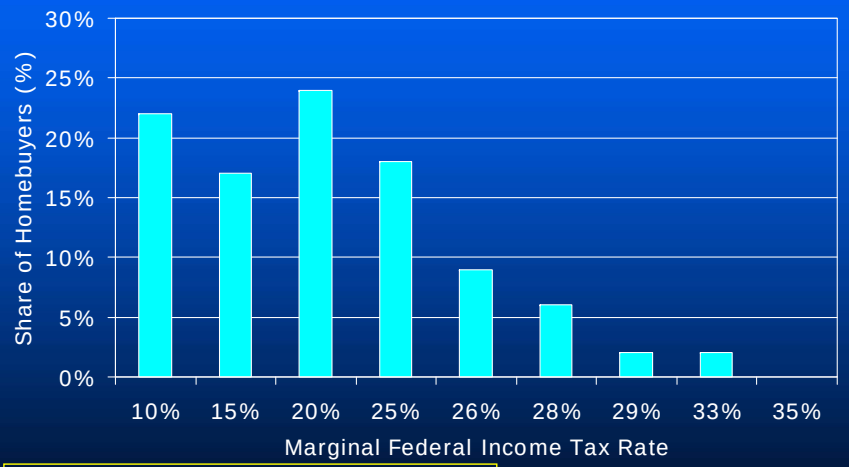
Source: Energy Information Administration residential retail revenue and customer count data for 2007. Shares based on share of new residential customers added between 2000 and 2007.

Probability Distribution of Base Year Electricity Prices Zone 3



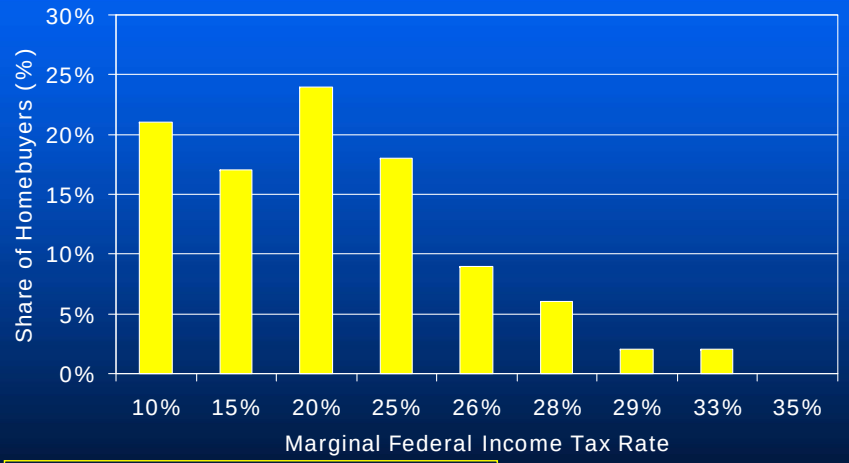
Source: Energy Information Administration residential retail revenue and customer count data for 2007. Shares based on share of new residential customers added between 2000 and 2007.

Probability Distribution of Marginal Federal Income Tax Rates – Zone 1



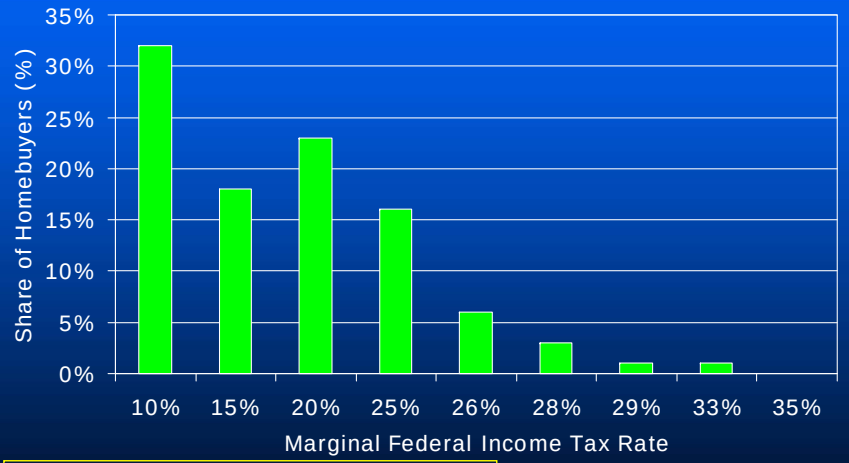
Source: Internal Revenue Service
Individual Tax Returns Data for 2007

Probability Distribution of Marginal Federal Income Tax Rates – Zone 2



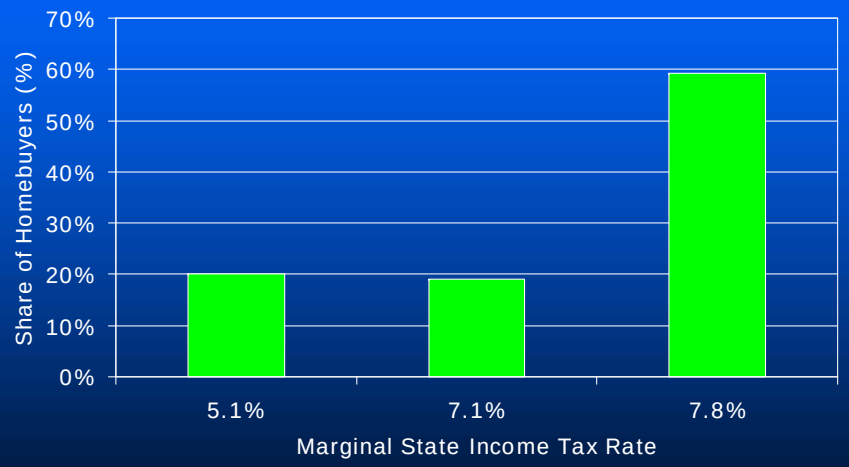
Source: Internal Revenue Service
Individual Tax Returns Data for 2007

Probability Distribution of Marginal Federal Income Tax Rates – Zone 3



Source: Internal Revenue Service
Individual Tax Returns Data for 2007

Probability Distribution of Marginal State Income Tax Rates - Idaho



Source: Based on Internal Revenue Service for Idaho Individual Tax Returns Data for 2007

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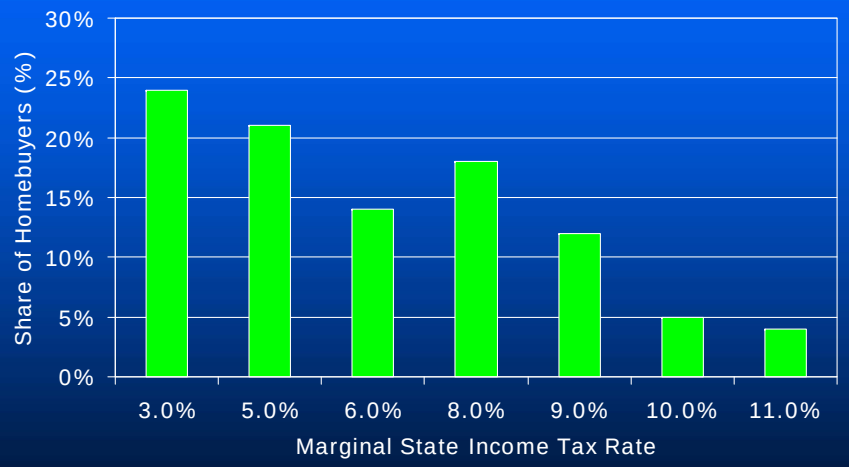
Probability Distribution of Marginal State Income Tax Rates - Montana



Source: Based on Internal Revenue Service for Montana Individual Tax Returns Data for 2007

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Probability Distribution of Marginal State Income Tax Rates - Oregon

Source: Based on Internal Revenue Service for Oregon Individual Tax Returns Data for 2007

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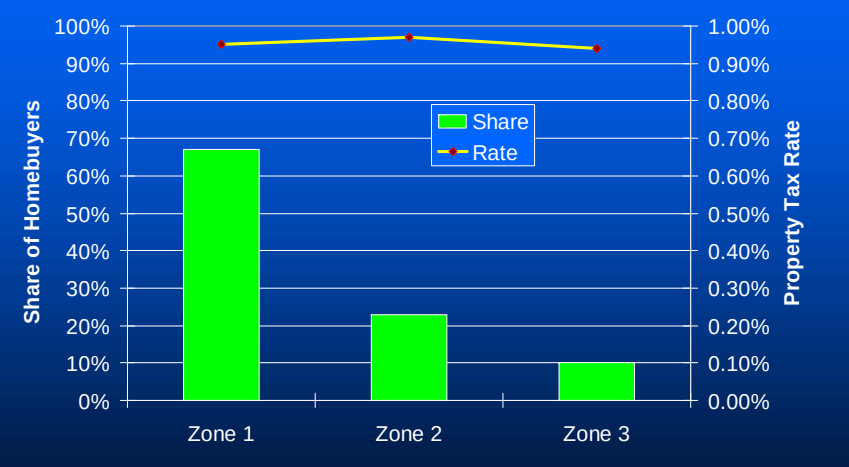
Probability Distribution of Property Tax Rates



Source: Idaho, Montana, Oregon and Washington Departments of Revenue Property Tax Statistics Fiscal Year 2008-2009

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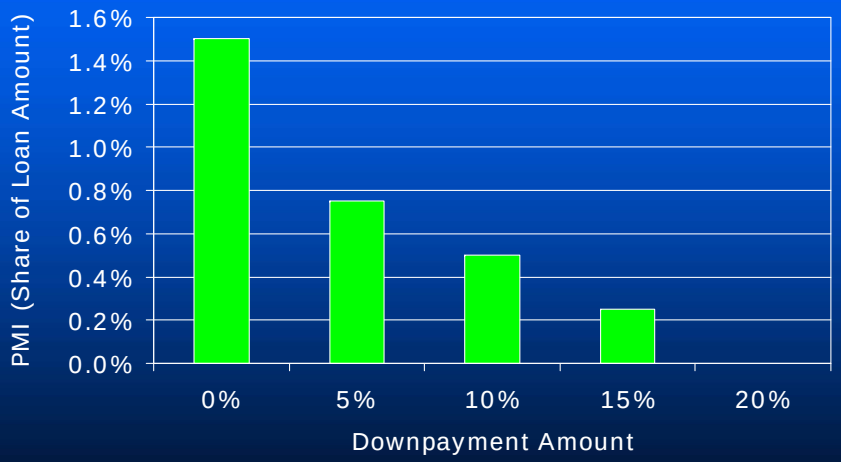
Private Mortgage Insurance Assumptions



http://www.westga.edu/~bquest/1997/costof.html

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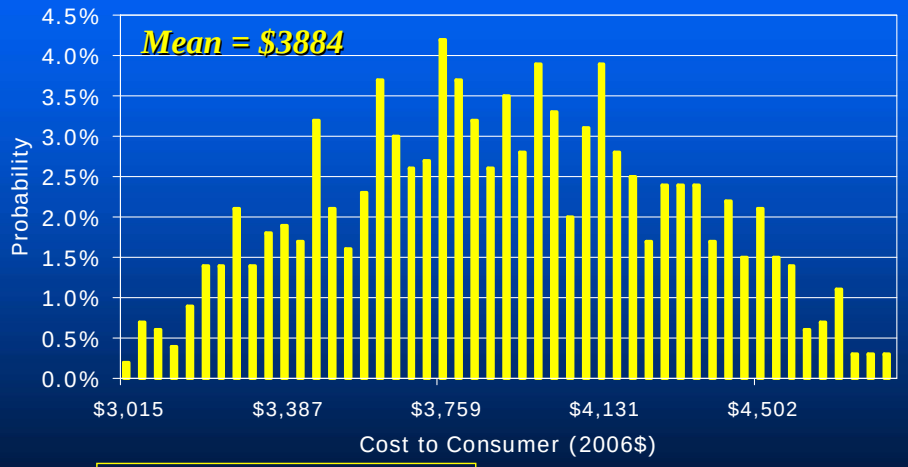
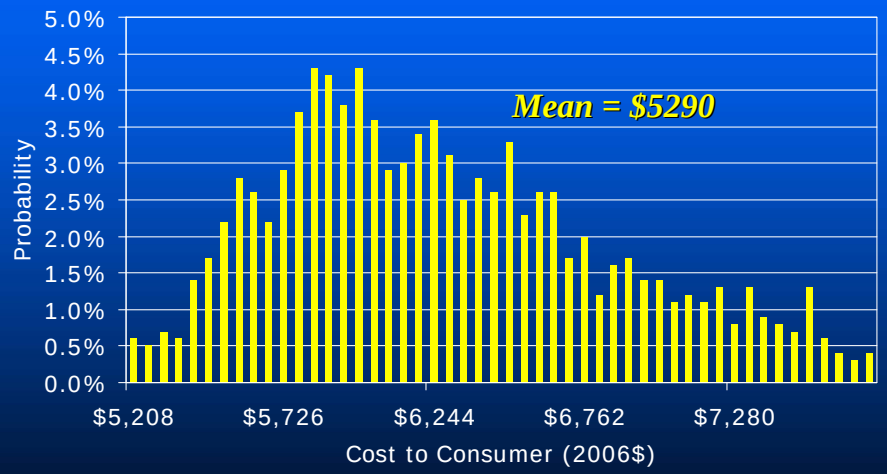
Probability Distribution of Incremental Cost for HSPF 7.7/SEER 13 Heat Pump



Source: Regional Technical Forum

Northwest Power and Conservation Council

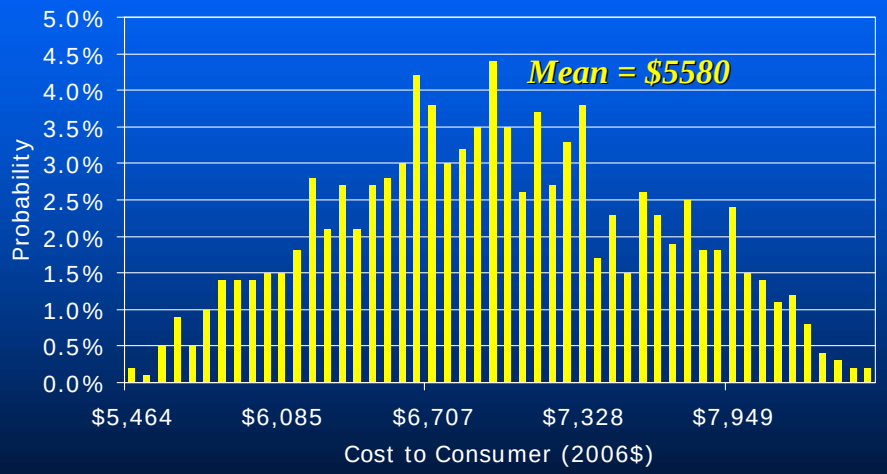
Probability Distribution of HSPF 8.5/ SEER 14 Air Source Heat Pump Cost



Source: Regional Technical Forum

Northwest Power and Conservation Council

Probability Distribution of HSPF 9.0/ SEER 14 Air Source Heat Pump Cost



Source: Regional Technical Forum

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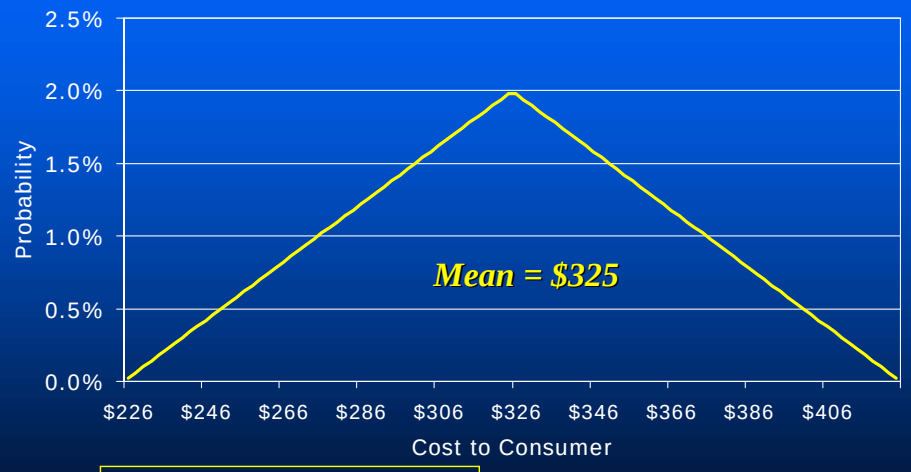
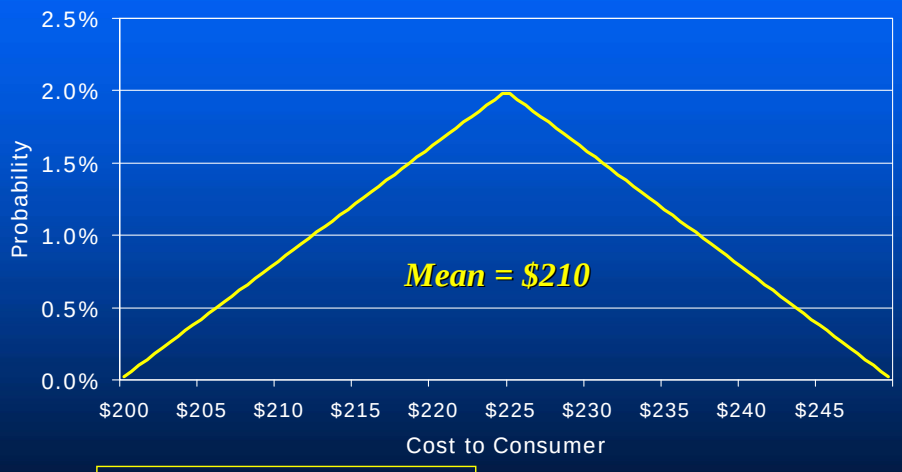
Probability Distribution of Duct Sealing Cost



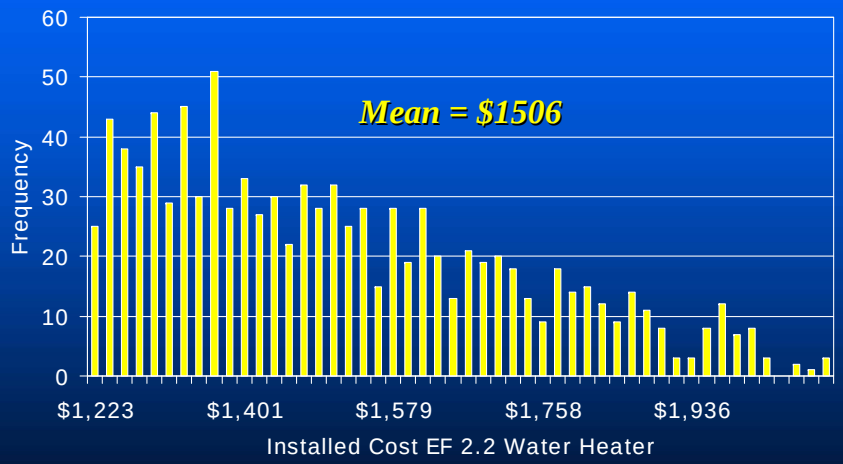
Source: Regional Technical Forum

Probability Distribution of Heat Pump System Commissioning Cost



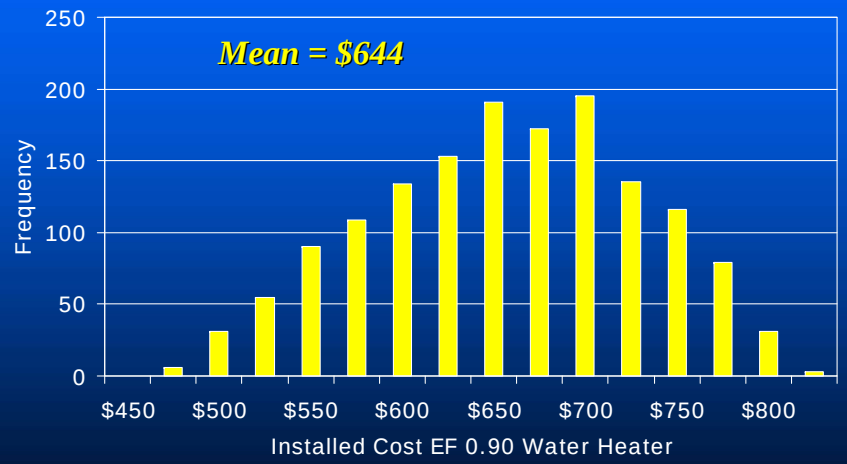
Source: Regional Technical Forum

Heat Pump Water Heater Installed Cost



Source: US Department of Energy, Technical Support Document On Direct Heating Equipment and Water Heating

Base Case Water Heater Installed Cost



Source: US Department of Energy, Technical Support Document On Direct Heating Equipment and Water Heating

Zone 1 - Base Case
Lowest Life Cycle Cost Code
Compliant Package

Component	Base Case
Wall –Above Grade	R21 STD
Wall –Below Grade	R19
Attic	R38 STD
Vault - Joisted	R30
Vault - Trussed	R38
Floor	R30
Window	Class 35
Door	R5
Slab	R10
Wall – Ext. Below grade	R10

- HVAC System – Zonal
- DHW – EF90
- Average Use (kWh) = 17,575
- First Cost = $2,333
- Minimum LCC = $314,247

Northwest Power and Conservation Council

Zone 2 - Base Case
Lowest Life Cycle Cost Code
Compliant Package

Component	Base Case
Wall –Above Grade	R21 STD
Wall –Below Grade	R19
Attic	R38 STD
Vault - Joisted	R30
Vault - Trussed	R38
Floor	R30
Window	Class 35
Door	R5
Slab	R10
Wall – Ext. Below grade	R10

- HVAC System – Zonal
- DHW – EF90
- Average Use (kWh) – 19,550
- First Cost = $2,300
- Minimum LCC = $324,610

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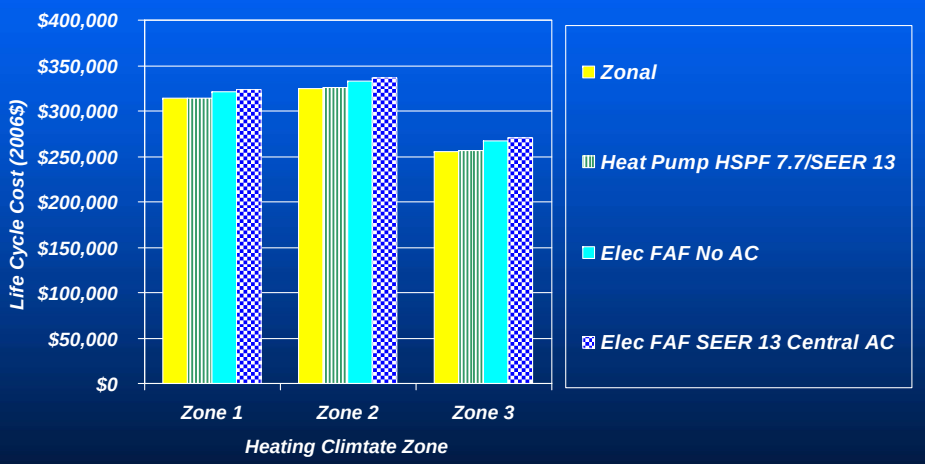
Zone 3 - Base Case
Lowest Life Cycle Cost Code
Compliant Package

Component	Base Case
Wall –Above Grade	R21 STD
Wall –Below Grade	R19
Attic	R38 STD
Vault - Joisted	R30
Vault - Trussed	R38
Floor	R30
Window	Class 35
Door	R5
Slab	R10
Wall – Ext. Below grade	R10

- HVAC System – Zonal
- DHW – EF90
- Average Use (kWh) – 26,750 kWh/yr
- First Cost - $2,300
- Minimum LCC = $255,370

Northwest Power and Conservation Council

Base Case Life Cycle Cost – Single Family



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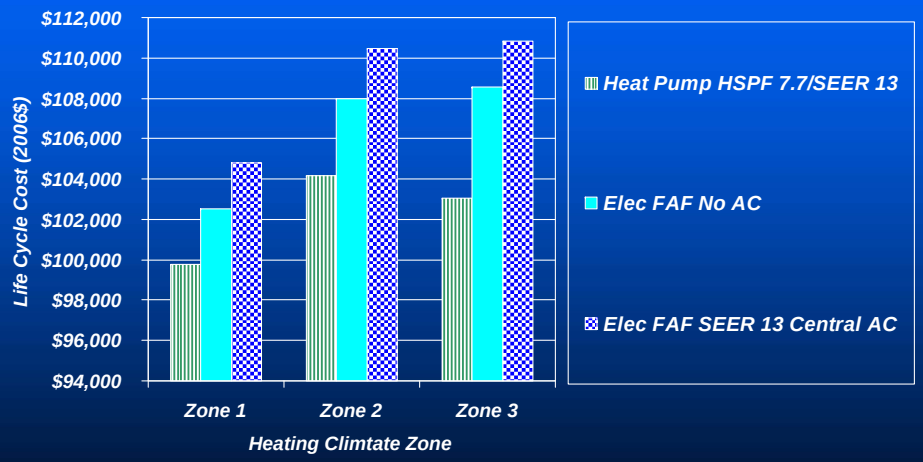
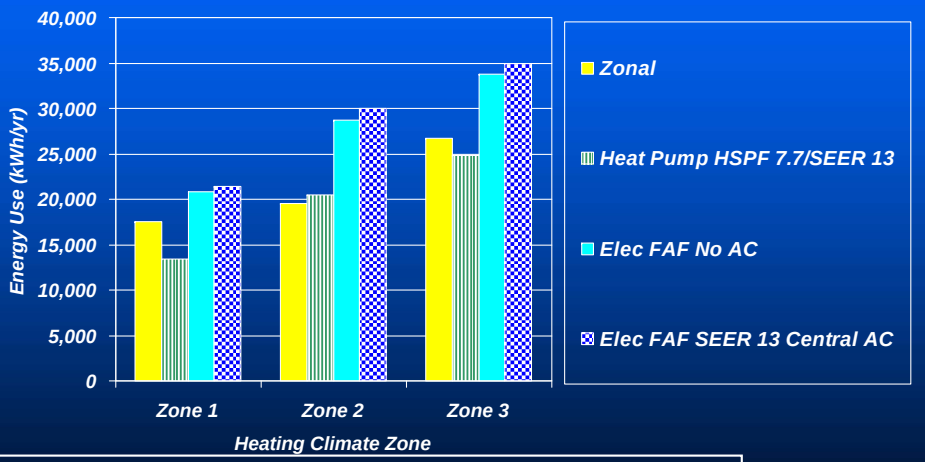
Base Case Life Cycle Cost – Manufactured Home

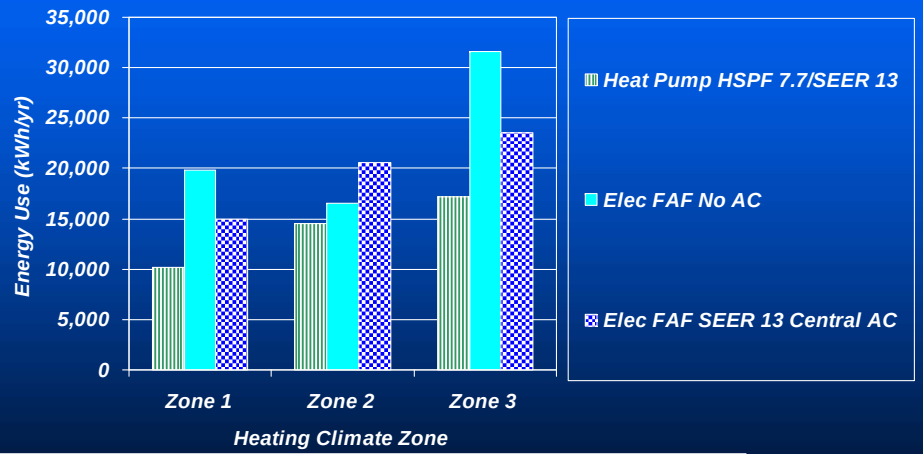


Base Case Annual Energy Use* – Single Family



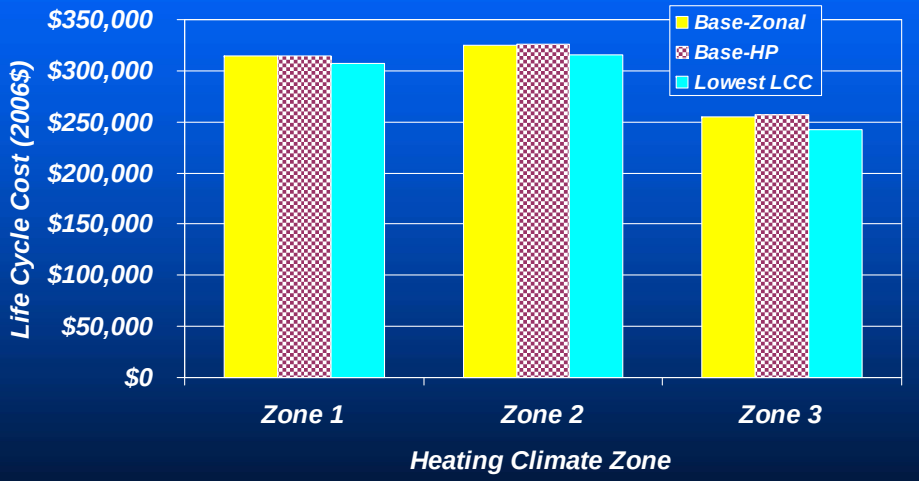
*Includes space conditioning, water heating & lighting

Base Case Energy Use* – Manufactured Home

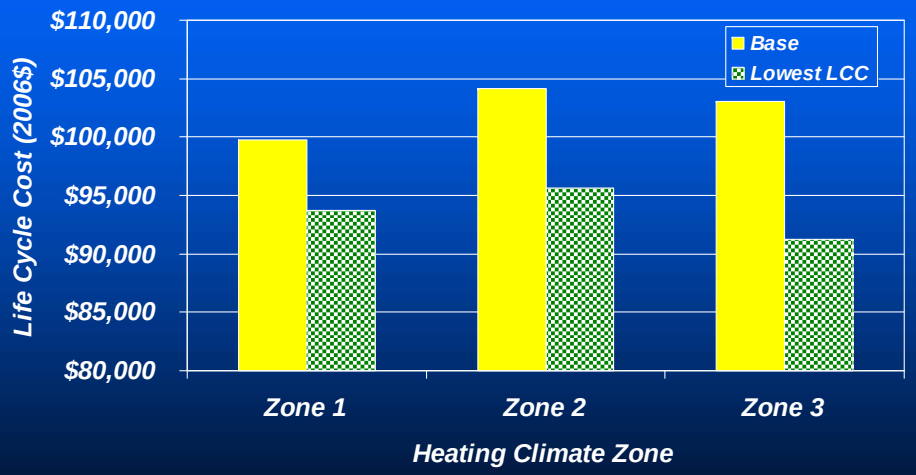


*Includes space conditioning, water heating & lighting

Base vs Lowest Life Cycle Cost – Single Family



Base vs Lowest Life Cycle Cost – Manufactured Home



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