High Efficiency Window Replacements for the Existing Home Program Proposed Measure Revision for 2015

Conservation Advisory Council
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Measure Description

Energy Trust offers incentives for two tiers of windows measures installed in the Home Energy Savings, Home Performance with ENERGY STAR, and Existing Manufactured Homes programs in both Oregon and Washington. For both tiers, energy savings from reduced space heat use are measured against a market baseline of what homeowners would likely have purchased in the absence of the Energy Trust program. At the present time, Tier 1 is for new windows with a U-factor between 0.26 and 0.30; Tier 2 is for even more efficient windows with a U-factor 0.25 or less[1]. Since last updated in 2009, our assumption for the market baseline U-factor has aligned with the Regional Technical Forum at 0.35.

Multifamily Existing Buildings has windows retrofit measures, which calculate savings and costs from the existing condition. The difference between the multifamily and the single family measures is a result of market research that indicates that multifamily projects are less likely to have occurred without Energy Trust incentives, whereas single family homeowners are more likely to replace their windows without our incentive, but may be influenced to purchase more efficient windows than they would otherwise have done.

Need for Review

Since 2009, Energy Trust has observed indications that the market baseline has become more efficient than the 0.35 U-factor baseline we currently assume. ENERGY STAR released a draft windows specification change announcement in the summer of 2013 for a 2016 proposed change, which showed that 81% of the national windows market meets their current criteria of a 0.30 U-factor or better. Also, anecdotal evidence suggests that most new homes in the region are using 0.30 U-factor windows or better. Due to a lack of local market data to support these indications Energy Trust commissioned a market survey to inform any change to baseline U-factor assumptions.

The market survey consisted of interviews with regional window manufacturers, which were conducted by an independent contractor who has existing relationships with manufacturers in the area and who is considered an expert on this technology in the region. Participating window manufacturers represented 74.5% of sales in the region.

Interviews took place in October and November of 2013. Manufacturers were asked about their regional and Oregon market share, the percent of sales in each efficiency category, and the average incremental cost for each efficiency category for the time period Q3-2012 to Q3-2013.

[1] Heat loss through windows can be reduced with insulating gases or a vacuum between window panes, thermal breaks in the frames, low-E coatings, and other techniques. This measure specifies a desired level of energy performance, as described by its thermal conductance (U-factor) and Solar Heat Gain Coefficient (SHGC), not the way in which the window is constructed.

The data allow us to calculate sales weighted average baseline window efficiency and sales weighted average incremental cost of efficiency for the entire NW windows market.

Energy Savings

Calculation of market baseline

The results of the survey for the market share of windows at various efficiency levels are shown in Table 1.

Table 1: Percent of Sales by Efficiency Tier

U-Factor Tier	Relative Market Share
> 0.35	2.78%
.33 to .35	26.25%
.31 to .32	15.05%
.29 to .30	45.87%
.26 to .28	7.91%
.25 or lower	2.15%
Total	**100.00%**

These data include new homes and replacement windows as well as the portion of sales from participants in our program. To construct a natural market baseline to define the existing home, replacement market without our program influence, two adjustments were made. First, the new homes market was estimated to be approximately half of the overall market, based on NEEA's Long Term Monitoring and Tracking report and to be composed almost entirely of windows with a U-factor of 0.30 or less. Therefore, we removed fifty percent of the market share of new homes at 0.3 or less from the data. Second, approximately 6% of the overall market participated in the Energy Trust Existing Homes program. This proportion was also removed from the data.

The adjusted weighted average market baseline of replacement windows for Existing Homes was calculated, with a resulting U-factor of 0.334.

Proposed changes to tiers

Before working through adjustments to measure savings and cost assumptions due to this adjusted market baseline, it was important to look to market influences to help define what new measure tiers could be implemented going forward that would continue to drive the market towards higher efficiency levels. Energy Trust proposes to change the windows tiers at the beginning of 2015 in anticipation of expected changes to ENERGY STAR windows specifications for the Northern climate zone in 2016. For Energy Trust, the first tier will include windows with a U-factor of 0.28 to 0.30. The second tier will include windows with a U-factor equal to or less than 0.27 or with an equivalent energy performance, as defined by ENERGY STAR. The basic requirement will be a U-factor of 0.27 or better, though equivalent performance may be achieved with a higher SHGC, as shown in table 2. By shifting one year ahead of ENERGY STAR, we have time to better help prepare the market for 2016 changes.

Table 2: ENERGY STAR Qualification Criteria for Windows, version 6.0

Climate Zone	U-factor	SHGC
Northern*	≤0.27	Any
	=0.28	≥0.32
	=0.29	≥0.37
	=0.30	≥0.42

***** The effective date for the Northern Zone prescriptive and equivalent energy performance criteria for windows is January 1, 2016.

Calculation of savings

Gas savings estimates are based on billing analysis from installations completed in the program from 2005 to 2008. Electric savings are taken from earlier years, as in later years not enough homes with electric space heat installed windows to produce a statistically valid sample. The impact analysis from 2005 and 2006 done by EcoNorthwest found 564 kWh per year savings. The impact analysis from 2007 and 2008 done by Opinion Dynamics Corporation found 39 annual therms, which was corroborated by billing analysis done by Energy Trust evaluation staff for gas heated homes that installed windows in 2009. The average area of windows replaced was 151 square feet, so that the savings per square foot are 3.76 kWh per year and 0.26 annual therms for windows with a U-factor equal to or less than 0.30.

To translate those energy savings into values that would apply for our new tier structure, a linear fit was assumed in relation to the change in U-factor. 2013 program average U-factors were then binned in the new tier structure. The resulting savings are 2.86 kWh per year per square foot or 0.198 annual therms per square foot for windows with a U-factor between 0.30 and 0.28. For windows with a U-factor of 0.27 or lower or equivalent energy performance, savings are 6.92 kWh per year per square foot or 0.478 annual therms per square foot.

Measure Cost

The market research used to set the new efficiency market baseline also indicated wholesale incremental cost for each efficiency bin.

Table 3: Incremental Cost by Efficiency Bin

U-Factor Bin	Incremental Wholesale Cost per square foot to the Next Efficiency Bin
.33 to .35	baseline
.31 to .32	$ 0.47
.29 to .30	$ 0.32
.26 to .28	$ 0.59
.25 or lower	$ 1.72

However, the cost for measure analysis is properly defined as the cost of efficiency, which is not reflected in the wholesale cost for two reasons. First, the costs should be retail, and second, many features of windows such as style and frame material affect the cost and are not related to efficiency. To determine the cost of efficiency, both the Regional Technical Forum and the

Energy Trust have previously used the 25th percentile cost of windows, in order to separate out the cost of other features. The 25th percentile cost is the cost at which one quarter of the windows are cheaper than the given amount, and three quarters are more expensive.

Using the 25th percentile of program cost data for windows installed in 2013, the incremental cost of efficiency from a maximum U-factor of 0.30 to an average U-factor of 0.24 is $3.40. The market research data indicated a wholesale incremental cost of $2.31. Therefore, the 25th percentile retail cost appears to be approximately 47% higher than average wholesale cost.

No program data exist for the baseline window, as they are less efficient than any windows that receive an Energy Trust incentive. To calculate the baseline cost, the mark-up was applied to the wholesale incremental cost between the baseline and the first efficiency tier, and the result subtracted from the average cost of an efficient window at that level to arrive at a baseline cost of $25.40. The incremental retail costs are then calculated from the baseline to the 25th percentile cost, as shown in Table 5.

Table 4: Incremental Retail Cost

Maximum U-factor	Minimum U-factor	Average U-factor	25th percentile cost ($/SF)	Calculated Incremental Retail Cost ($/SF)
Baseline		0.334	25.40	$0.00
0.30	0.28	0.296	26.56	$1.16
0.27	0.15	0.242	29.81	$4.41

The absence of market data on the baseline retail cost introduces some uncertainty into the calculation of measure cost. Unfortunately, this lack of data is unavoidable for the windows measure. Program data will not include products with the baseline efficiency and considerable effort to collect market cost data through a survey gathered only the wholesale cost. Planning staff consider the given baseline cost estimate to be the best achievable with the available data.

No state or federal tax credits are assumed to lower the cost.

Measure life

Measure life remains 45 years, consistent with previous Energy Trust windows measures.

Non Energy Benefits

Installation of new windows can provide several non-energy benefits for participants, including noise attenuation and comfort. However, because these benefits can largely be met with installation of market baseline windows, we don't attempt to quantify any incremental benefit from differing higher efficiency levels within the cost effectiveness review of the measure. Triple pane windows (U-factor of 0.25 or better) may bring additional non-energy benefits but quantifying those incremental benefits is significantly challenging.

Incentives

The current incentive for windows with a U-factor of 0.25 is $3.50 per sq ft. It compares to an incentive of $2.25 per sq ft for windows with a U-factor of 0.30. For 2015, the maximum cost effective incentive is $4.31 per sq ft. for products with a U-factor of 0.27 and less, and $1.78 for products with a U-factor between 0.28 and 0.30.

Cost Effectiveness

Project	Measure Lifetime (Maximum 70 yrs)	Annual Electricity Savings, kWh	Annual Gas Savings, therm	Incre-mental Cost	Max ETO Incentives	Combined Utility System BCR	Combined Societal BCR
U-value 0.30 to 0.28	45	2.86		$1.16	$1.78	3.0	4.6
U-value 0.30 to 0.28	45		0.196	$1.16	$1.78	1.0	1.5
U-value equal to or less than 0.27	45	6.92		$4.41	$4.31	3.0	2.9
U-value equal to or less than 0.27	45		0.475	$4.41	$4.31	1.0	1.0

Both windows measures in gas heated homes are marginally cost effective and most sensitive to the therm savings and avoided cost value.

Market and the Program Impacts:
Although the contribution to overall program savings is relatively small for windows measures, the Existing Homes program has seen the uptake for window measures increase over the last three years; growth was driven largely by the removal of a program requirement that windows must be installed as part of another energy savings improvement. The growth has been from less than 0.6% of electric savings in 2011 to 1.5% in 2013, and from 3% of gas savings in 2011 to 7% in 2013.

The defined strategy allows for a phased approach in transitioning the window tiers and allows for the continued momentum in engaging current market actors and contractors. The program anticipates that the baseline adjustment and incentive/tier restructuring will have a minimal impact on project volumes, but will impact overall savings in 2015.

Savings from windows in Existing Homes in 2013 was 737,223 kWh and 115,273 therms. Assuming project volume in 2015 is consistent with 2013 levels, the savings in 2015 will be approximately 660,000 kWh and 93,000 therms, a 10% and 19% decrease, respectively. In 2016, the decrease could be steeper, as a result of Energy Trust following ENERGY STAR to a higher efficiency level, unless the window industry also retools to meet the new specification, which historically it has done.