ENERGY TRUST PROPOSAL FOR GAS WEATHERIZATION COST-EFFECTIVENESS

Introduction

Eight gas home retrofit measures and the entire existing homes gas program as currently implemented do not appear to pass the societal cost effectiveness test based on a simple calculation approach. This is a result of three factors: lower-than-expected savings from evaluations, higher than expected project costs for several measures, and lower avoided cost forecasts due to changes in market fundamentals. To acknowledge the problem while maintaining stable programs and learning whether we can better manage these three factors, Energy Trust proposes a four-pronged approach. First, discontinue one measure and to consider whether to retain another based on additional evaluation later this year. Second, pursue several strategies to improve the savings and moderate the total cost of measures. Third, based on the considerations for exceptions listed in UM-551, the Oregon PUC's guidance for cost-effectiveness analysis, and based on other stated considerations, allow an exception for the societal test for several gas home efficiency measures for 2 years- and at that time revisit the cost-effectiveness of these measures. Fourth, for the gas component of the Existing Homes program, Energy Trust proposes to design its 2013 budget to move the societal B/C ratio toward 1, with the expectation of achieving that level in 2014.

The first four sections of this memo (1) summarize the issue, (2) assess program implications, (3) review Oregon PUC cost-effectiveness policy, and (4) for each of the eight measures, describe planned measure and program improvements and request an exception based on specific provisions of UM-551

Four attachments provide more context and detailed analysis.

- A thematic presentation of possible arguments for retaining the measures
- Data on variation in measure cost and the relationship to cost effectiveness,
- The impact of changes to avoided costs on the findings
- And, finally, two scenario-based sensitivity analyses considering possible changes in cost, savings, and avoided costs.

The Issue

Based on the last three impact analyses for the Home Energy Savings program, the following gas home weatherization measures do not pass the Societal Test using current Energy Trust cost-effectiveness analysis practices:

- Floor insulation
- Wall insulation
- Duct sealing[1]
- Air sealing

[1] Energy Trust is performing a pilot of a new prescriptive duct sealing procedure which may prove cost-effective. However, results are far from certain, and we will not have conclusive evaluation until late 2013 at the earliest.

In addition, if the comparison point is NW Natural's 2011 IRP modified avoided costs, the following measures are no longer cost-effective,

- Ceiling insulation,
- ENERGY STAR (EF>.67) water heaters
- Multi-family boiler replacement.
- Solar domestic hot water for homes.

If we apply the updated avoided costs, the societal B/C ratios for the eight measures range from 0.2 for duct sealing, to 0.9 for solar domestic water heat.

The savings results referenced in this memo for ceiling, floor and wall insulation and duct sealing are based on average savings and cost for the measures in multiple evaluations of hundreds of homes. Evaluation results have been fairly consistent and robust year-to-year, and have been subject to third party review. The savings estimates for air sealing are based only on a single year of evaluation with an adequate sample, and thus are not viewed as equally reliable. To date, multifamily boilers and solar water heating have not resulted in large enough savings to be a priority for evaluation.

This analysis focuses on measures in Energy Trust's standard track for existing homes, and excludes Home Performance and Clean Energy Works projects. We chose this focus because (1) this is the largest-volume track in terms of jobs, measures, cost, incentives and savings, constituting the majority of the program, (2) this track has the most extensive evaluation, and (3) its measure costs are on average the lowest of all tracks. Further study of savings is needed of the Home Performance and Clean Energy Works tracks before reaching conclusions on these issues.

In most situations these measures pass the Utility System benefit/cost test.[2] That means that the money invested in these measures through Energy Trust rebates is more than rewarded with benefits to the gas system. It is the societal test, where the entire cost of the measure is considered, that presents cost-effectiveness challenges.

The new avoided costs, should they become the official reference costs for Energy Trust use, will further result in a societal B/C ratio for the entire gas component of well below 1.[3]

Energy Trust has assessed in a speculative way how prospective changes in measure performance, cost, and avoided costs might impact cost effectiveness. Our tentative conclusion is that under some circumstances each of the measures in question could be cost effective, but this is more likely for ceiling insulation and water heating measures. Wall and floor insulation, and duct and air sealing, and solar water heat could become marginally cost-effective under optimistic conditions. However, many positive factors would need to be aligned positively for these measures to pass the societal test.

[2] We have not reviewed utility B/C ratios in detail. Duct sealing and perhaps air sealing may not pass the utility system test with the new avoided costs; if so, incentives will be reduced.

[3] A full analysis of the compounded effect of the lower avoided costs and reduced estimates of measure savings has not been conducted. This analysis will be conducted as part of the 2013 budget process.

Energy Trust is continuing to provide incentives for these measures pending a discussion with the OPUC of the options for policy and for program action.

Implications

The majority of Oregon homes are heated with gas. Eliminating the measures in question would leave a residential gas efficiency program focused largely on shower heads, aerators, efficient hearths, and upgrading windows at the time of their replacement. The concept of "deep retrofit" supported by Energy Trust incentives for the broad home market would become problematic in that the majority of the measures offered for deep retrofits would no longer receive incentives. A consequent contraction in the market for weatherization could create a significant reduction in the market for contractors. There could be market confusion if only electrically heated homes were eligible to receive certain incentives.

The gas component of the existing homes program as a whole currently passes the societal test due to a mix of highly cost-effective measures and others that perform less well. With new gas avoided costs, the program as it exists today would have a societal B/C ratio of less than one. This indicates that some shift in emphasis toward improved cost performance is needed in the program. Energy Trust will develop a specific strategy to improve the societal B/C ratio of the gas component of the program as it develops 2013 budgets.

PUC Policy

Oregon PUC Docket UM-551, Order 94-590 provides a number of situations where the PUC may make exceptions to the standard societal test calculation[4]:

A. The measure produces significant non-quantifiable non energy benefits. In this case, the incentive payment should be set at no greater than the cost effective limit (defined as present value of avoided costs plus 10%) less the perceived value of bill savings, e.g. two years of bill savings
B. Inclusion of the measure will increase market acceptance and is expected to lead to reduced cost of the measure
C. The measure is included for consistency with other DSM programs in the region
D. Inclusion of the measure helps to increase participation in a cost effective program
E. The package of measures cannot be changed frequently and the measure will be cost effective during the period the program is offered
F. The measure or package of measures is included in a pilot or research project intended to be offered to a limited number of customers
G. The measure is required by law or is consistent with Commission policy and/or direction

[4] OPUC UM551 (OR 94-590) Section 13

Proposal

Energy Trust proposes the following combination of program adjustments and requests that the PUC grant the following exceptions consistent with UM-551. We propose that these exceptions be revisited two years after your decision date. This will give the program improvements described below time to engage and be evaluated.

Single family duct sealing. As of January 1, 2013, Energy Trust Incentives would discontinue existing incentives for duct sealing in single family homes. Consistent with UM-551- paragraph F, Energy Trust proposes to continue plans for a prescriptive duct sealing pilot, to proceed in two phases; the first, in winter 2012-13 to test and refine the procedure and assess savings and costs. If Phase 1 is successful, Phase 2 would be a market test, to assess whether the protocol could effectively and cost-effectively be delivered by Energy Trust's network of trade allies. This second phase would proceed at a limited scale in the summer of 2013-14.

Ceiling insulation. Consistent with UM-551 paragraphs B, we believe that we can improve the measure cost with improved information to consumers about paybacks. Consistent with paragraph F, we plan to improve average performance by adjusting the eligibility requirements to eliminate some low-yield installations, and therefore request an exception.

Wall insulation. Consistent with UM-551, paragraph B, we believe that we can improve measure cost with improved information to consumers about paybacks and therefore request an exception.

Floor insulation. Since the last year with an impact evaluation, 2009, Energy Trust has increased emphasis on requirements to seal the floor area as insulation is installed. We do not have a good idea how much this increases savings. For this reason we recommend additional evaluation before reaching conclusions regarding this measure. Also, consistent with UM-551 paragraph B, above, we believe that we can additionally improve the measure cost with improved information to consumers about paybacks. Consistent with UM 551 paragraph F, we believe we can improve average performance by adjusting the eligibility requirements to eliminate some transactions with existing insulation. For these reasons we request an exception.

Air sealing. Since program procedures have been evolving with the intent of increasing savings, we think it appropriate to wait until 2010 and 2011 evaluations are complete, later this year, before considering changes regarding this measure. Energy Trust will submit an update to the OPUC on cost-effectiveness once the 2010, and if possible 2011 evaluations are completed. If performance improves, we will request an exception consistent with UM-551 paragraph B. We believe that we can improve the measure cost, and thus the societal B/C with improved information about paybacks. If evaluation of 2010-11 installations does not show increased savings, we will propose to terminate incentives for this measure in mid-2013. The time line proposed above is intended to ensure an orderly market transition. If we can develop a promising plan for an alternative approach, such as prescriptive air sealing, then, consistent with UM-551, paragraph F, we will propose a pilot to test the approach.

Multi-family boiler replacements. Multifamily boilers are custom measures, with a separate benefit/cost analysis on every specific project. Based on review of five recent projects, some will be cost-effective with the new, lower avoided costs, and some will not. However, most projects will be close to a B/C of 1. We propose to exempt projects for low and moderate income housing on the grounds that they meet the additional test provided in UM-551, paragraph A, above. We believe that by contributing to the financial stability of limited income housing agencies by stabilizing their long-term operating costs, these measures provide a significant non-energy benefit.

Home solar domestic water heat. Consistent with UM 551 paragraph B, we are working to demonstrate lower-cost approaches to home solar water heat. These include a revised installation requirement which may result in lower costs for installation while assuring project performance and longevity, and a new lower-cost Oregon- made system. Additionally, we have trained a new cadre of plumbers to install solar thermal in 2012 and hope that this leads to higher volume and more competition. On this basis we request an exception.

0.67 energy factor water heaters. Consistent with paragraph B of UM-551, we believe that the costs of this recently-introduced measure will drop with increased competition. There is also an opportunity for this measure, along with similar initiatives nationwide, to influence Federal manufacturing standards for water heaters. Experience with other measures indicates that once a measure becomes standard, the added cost drops significantly due to economies of scale, experience in manufacture, and changes in market positioning from a "premium product" to "standard product". We request an exception on this basis.

Manufactured home duct and air sealing. We propose an exception so that we can retain duct and air sealing measures in manufactured homes consistent with UM-551 paragraph D. Gas-heated homes constitute less than 5% of homes treated by Energy Trust's manufactured home offering, with the rest being electric. Maintaining the small fraction of gas heated homes simplifies implementation for Energy Trust and contractors, and constitutes a tiny fraction of the overall gas existing homes program.

Gas funded component of Existing Homes program, as a whole. If gas avoided costs are at the levels filed by Northwest Natural in 2011, Energy Trust would need to make additional significant changes to the gas component of Existing Homes program to achieve a societal B/C of 1. Energy Trust suggests that while this is important, we move with caution in order to avoid excessive disruption of the business of our trade allies and allow time to reflect on the considerations listed below. Thus, we propose to budget for a 2013 gas existing homes program with a targeted societal B/C ratio of .8, with the intent of bringing the B/C ratio above 1 in 2014. This would get us roughly "halfway" to 1 in a single year.

In addition to the program improvements described above,

- Energy Trust plans to review all measure specifications to identify and remove any requirements that may add to costs in ways that do not provide commensurate quality or savings benefits. This may further reduce costs of measures.
- Energy Trust will explore ways to target high energy users for program marketing without significantly increasing program marketing costs. This may increase savings per site.

Other issues regarding how avoided costs and benefits that we recommend the PUC consider:

1) Current avoided costs are drastically lower than even two or three years ago and are highly uncertain. We recommend caution in reacting to the latest forecasting shift, because costs could shift again in 2-3 years time. Nobody was anticipating the depth of this price drop 3 years before it happened, or the price spike that preceded it. UM-551 includes program continuity as a reason to make exceptions to cost-effectiveness procedures.

2) To date avoided cost forecasts have not considered the value of efficiency in dampening and stabilizing gas prices, if carried out nationwide, nor in the value of efficiency as a hedge resource against price instability. It may be wise to not move to quickly to change programs while these issues are considered.

3) Non-energy benefits such as comfort and health impacts of weatherization, while not universally acknowledged by customers as a key issue, are thought to be important motivators for some customers.

4) Measure costs are based on contractor invoices, which sometimes include costs for other home improvements. It is difficult for Energy Trust to discern the magnitude of this effect. We are working with weatherization contractors to better understand invoicing practices, common non-energy costs, and ways to more clearly document energy-related costs.

We look forward to the Oregon PUC's response to the requests for exceptions in this proposal, within the context of the improvements planned by Energy Trust.

ATTACHMENT I- POSSIBLE ARGUMENTS FOR RETAINING MEASURES

For reference, this attachment discusses reasons for retaining measures in more detail than the text of the memo.

Value of Efficiency

Caveat: Energy Trust is not expert on avoided cost forecasting- these are observations of issues that we have not seen addressed in gas IRP proceedings. We leave it to the PUC and utilities to assess whether and how these should be addressed.

1. **Unpredictable Avoided Cost.**
    a. ***Unpredictable prices*.** The dramatic changes in gas avoided cost forecasts over the past ten years have made it self-evident that future gas prices are difficult to predict. Neither the price peak over $10/therm nor the current low were forecast.
    b. ***Extrapolation.*** Utilities forecast avoided costs only for twenty years. Because insulation measures are forecast to last for 45 years, Energy Trust extrapolates the real price for the 20th year for the next 25. Given the lower 20 year avoided cost forecast, largely driven by short term gas surpluses, this method may no longer produce reasonable long-term extrapolations.
2. **Reduced Price and Volatility and Hedge Value.** Efficiency programs nationwide likely provide some dampening effect both on gas prices and price volatility which is not yet considered in filed avoided costs. Efficiency acquisition also provides a hedge against the possibility of high market prices. These are two distinct ideas; the first is the direct impact of lower loads on market price, and the second is about reducing risk by buying efficiency resources in advance instead of taking the risk of future gas prices.
3. **Non-Energy Benefits.** Energy efficiency programs provide some comfort benefits to participants, and possibly, in the case of duct and air sealing, some health benefits by addressing moisture and mold problems. While evaluation of Energy Trust's Home Performance with ENERGY STAR programs indicates that these values are not a primary driver of customer investment decisions for most participating homeowners, many of the homeowners appreciated and considered these aspects of efficiency measures.

Savings Improvements

4. **Improved Specifications Are Not Yet Reflected in Data.**
    a. ***Floor and ceiling insulation***. Energy Trust now requires air sealing of the floor area as part of the floor insulation measure. This change occurred too recently to be reflected in impact evaluations, and may improve the performance of the measures. Energy Trust is currently considering incorporating a similar requirement for ceiling insulation. Energy Trust also plans to eliminate floor insulation eligibility if there is any existing insulation, and reconsider reducing the existing insulation level which makes homes eligible for additional ceiling insulation. These actions should increase average savings by eliminating some low-savings projects.

b. ***Duct Sealing*.** Duct sealing's Benefit/Cost performance is particularly low, as discussed above. We believe that the solution could be a radical change in how this measure is delivered. Energy Trust is developing a pilot test for "prescriptive" duct sealing approach, where testing is left to the Program Management Contractor as a component of their quality assurance requirement, on a sample basis, allowing the training of contractors and the quality control to focus on the duct sealing itself. If successful, this might increase savings per home and, by taking the burden of testing off of contractors and reducing its frequency, reduce the price of duct sealing. The pilot will include a technical test that will run through winter of 2012-13. Indicative results will be available by mid-2013, and evaluation results by mid-2014. This will be followed, if successful, by a market test. We think it best to maintain the existing duct sealing measure until the test is complete so as not to damage the contractor infrastructure to deliver this measure during the test. However, based on the new benefit/cost information Energy Trust is also proposing to exclude from our incentive offer duct sealing in unconditioned basements with uninsulated floors, because some of the heat lost in those basements may be utilized in the home. By eliminating marginally productive sites, the average savings may improve.

c. ***Air Sealing*.** Air sealing training and quality procedures have evolved since the last year evaluated (2009) so further evaluation results will be informative. Energy Trust is exploring the feasibility of a similar "prescriptive" approach to air sealing as described above for duct sealing, which could reduce costs.

d. ***Solar Water Heat.*** Measure requirements have been simplified and streamlined. A new, lower-cost water heater model has been qualified for the program.

5. **Evaluation Uncertainty.**

a. ***Air Sealing.*** Due to sample limitations in prior years, Energy Trust has a statistically reliable evaluation of savings for air sealing for only one year (2009), whereas we are judging the other measure based on three years of statistically defensible results. Additional years of evaluation would help improve confidence in our conclusions for this measure. Furthermore, contractor training and program requirement have been improved progressively. It is possible that another 1-2 years of evaluation might result in higher savings estimates due to the improvements in the program.

b. ***Duct Sealing.*** The prescriptive approach has not yet been tested and evaluated.

c. ***Boiler Replacement.*** Evaluations have not yet been performed for multifamily boiler replacements as volume has only recently increased.

d. ***Floor Insulation.*** Energy Trust as increased emphasis on sealing the floor area as it is insulated since 2009, which is the last year with an impact evaluation. 2010-11 evaluations will indicate whether this increased savings.

Cost Improvements and Considerations

6. **Extraneous Costs.** Cost data for efficiency measures is based on contractor invoices. Sometimes there are home improvements unrelated to weatherization included in measure prices, such as

added heating vents, cosmetic improvements, and so on. It is impossible to know how often these things are included in invoices for installation of measures.

7. **Improved Competitiveness.**
    a. ***Weatherization.*** Residential customers have not yet been provided with clear, home-specific information regarding likely payback periods for measures to assist them in making investment decisions.[5] With more evaluation results in hand, Energy Trust now plans to provide this type of information. This may inspire contractors to improve the competitiveness of their pricing, and customers to ask for better bids.
    b. ***ENERGY STAR water heaters*.** The current generation of ENERGY STAR (EF=.67 or better) water heaters are newly introduced into the US market. Energy Trust is trying to increase the number of contractors and retailers that promote this technology. As they become more commonly and competitively sold, we expect to see the costs come down. This would narrow the increment between the cost for these efficient water heaters and standard water heaters.

Other Reasons to Continue.

8. **EEAST and Clean Energy Works Pilots.** The measures in question are important to the conclusion of the EEAST pilot efforts, and Clean Energy Works Oregon. Financing pilots rely on a large investment per home to cover transaction costs.

The relationship between these exception criteria and Energy Trust's reasoning is discussed below.

- Energy Trust points 1-2 are not based on the UM-551 points listed above, but arguments within the current cost-effectiveness policy that uncertainty about avoided costs is high, some of the values of efficiency have not yet been incorporated in IRP, so IRP should, within the context of UM-551, take some care in interpreting the meaning of avoided costs for efficiency value.
- Energy Trust point 3, 4, 7, and 8 are supported by UM-551 point F.
- Energy Trust point 5 is based on UM 551 point A.
- Energy Trust point 6 can be considered within the current cost-effectiveness policy and explains why problems with cost data may results in high stated measure costs.

[5] Typical payback periods for gas homes are 12 years for ceiling insulation, 24 years for floor insulation, 20 years for wall insulation, 28 years for duct sealing, and 13 years for air sealing. The measure lives are estimated as 45 years for insulation and 20 years for duct and air sealing.

ATTACHMENT II- VARIATION IN MEASURE COST

Energy Trust has used the median job cost in this analysis, reflecting our belief that the average is distorted due to a small percentage of extremely high-cost jobs. The high-cost sites may also include sites where customers simply accepted a high bid for reasons of their own. These reasons could include non-energy benefits.

We wanted to further explore the distribution of costs to see if the measures are at a cost-effective price for a significant fraction of the time (e.g., 25%).[6] That would be an indicator of whether competition could lead to improved cost-effectiveness through better pricing.

It is possible that measures could be lower in cost if customers asked for more competitive pricing. To further examine this issue, Energy Trust examined patterns of cost for the measures in question. We found that using either the average, median, or top of the first quartile of costs, these measures have a societal BCR less than 1, even prior to incorporation of new, lower avoided costs forecasts. We examine how much costs would be reduced if, instead of the average cost, we used the cost of the median participant, or the cost of the participant at the high end of the first quartile.

Results, *based on the avoided costs currently employed* by the Energy Trust, are shown below. The next section discusses changes in avoided cost which will further lower all B/C ratios, including first quartile.

Table 1- Impact of Cost Variation on Societal Benefit/Cost Ratio (note: based on avoided costs currently used by Energy Trust; NW Natural's 2011 filed avoided costs are about 45% lower)

Societal B/C Ratio Using:	Average	Median	First Quartile
Ceiling Insulation	1.0	1.2	1.6
Floor Insulation	0.6	0.6	0.8
Wall Insulation	0.6	0.7	0.9
Duct Sealing	0..3	0..4	0..4
Air Sealing	0.5	0.5	0.7
Solar Thermal- DHW	1.0		
Solar Thermal- Pool	1.5		
ENERGY STAR (EF=.67) Water heater*	.9		

Variation analysis was not performed for water heaters due to limited time. An analysis performed late last year for ENERGY STAR water heaters showed even higher variation in cost.

For the lowest quartile of costs, wall insulation is nearly cost-effective, while floor insulation, duct sealing and air sealing clearly are not.

[6] Caveat: This analysis is based on variation in project costs per square foot of insulation, and per home for duct and air sealing. We did not have data to see how individual home savings vary with cost. Thus the cost variation in this analysis, with respect to savings, may be overstated.

ATTACHMENT III- IMPACT OF UPDATED AVOIDED COSTS

The above analysis is based on the avoided costs that Energy Trust employs internally for analysis and reporting, which are based on utilities' 2009 forecasts, based on an agreement reached with utilities and the PUC in 2010. Energy Trust updates these values only every few years to assure some program stability in the face of frequent fluctuations, because of differences in IRP cycles between the two gas utilities, and also because of the logistical difficulty of bringing together the PUC staff and utilities to reach agreement on updates. Over the past three years, utility avoided cost forecasts for the next 20 years have decreased dramatically. The analysis provided below shows the impact of Northwest Natural's updated avoided cost forecast filed in 2011.

Based on these avoided costs we expect most gas weatherization measures other than efficient hearths, shower heads and aerators to have benefit/cost ratios of less than one. In particular, solar water heat, custom boiler replacement in a portion of multifamily projects would, on average, not be cost-effective. With these reductions in avoided costs, the benefit/cost ratios for the median-cost job would be:

Table 2- Societal Benefit/Cost Ratios with Updated Avoided Costs

MEASURE	SOCIETAL BENEFIT/COST RATIOS	
	INITIAL	WITH UPDATED AVOIDED COSTS
Ceiling insulation:	1.2	.7
Floor insulation	.6	.4
Wall Insulation	.7	.4
Duct Sealing	.4	.2
Air Sealing	.5	.3
Solar Thermal- Domestic Hot Water*	1.0	.9
Solar Thermal- pool*	1.5	1.0
ENERGY STAR water heater	.9**	.5

*The reduction in societal benefit/cost is lower for these measures because, consistent with prior OPUC decisions, the proxy for non-energy benefits is employed. Pool measure is included in this memo to show that it *does* pass the societal test

**Included in the program on the expectation that costs will go down as the market builds.

Boiler retrofits are custom measures, with varying costs and savings. In a review of five transactions that are cost-effective with costs currently used by the Energy Trust, the new avoided costs would put 2 at a societal B/C level of approximately .9. The other three would pass.

ATTACHMENT V- SENSITIVITY OF FINDINGS TO DATA ISSUES, PROGRAM IMPROVEMENTS, AND UNCERTAINTIES

Sensitivity Analysis- Data Issues, Prospective Program Improvements, and Uncertainties

Energy Trust has developed a scenario to help assess the possible significance of these factors. The following hypothetical adjustments are not based on empirical study or detailed quantitative analysis, but are order-of-magnitude estimates intended to assess possible aggregate effect of different considerations in broad terms. The intent of this analysis is to provide an alternative perspective regarding what benefits *might* be, consistent with PUC cost-effectiveness rules. Also consistent with those rules, employment and state economic benefits were not included and considered. The adjustment values are simply our educated guesses- you could provide your own and develop a scenario.

- Adjustments to avoided cost include returning to a value similar to past forecasts (+100%), addition of a premium value for price volatility (~+10%), and incorporation of non-energy benefits value (~+10-20%, more where there may be reduced moisture as a benefit).
- Increases to savings estimates include improvements to project specifications (~+10%) and evaluation uncertainty (0-+20%, depending on status of evaluation).
- Project cost reduction factors include removal of extraneous costs (-10%) and increased competition from adjustments to program design (-20-40%, the higher number for measures which may move to a prescriptive approach)
- The potential impact of price competition is provided with a higher value for duct and air sealing compared to other measures due to the possible cost savings from a prescriptive approach.

Adjustments are summarized in Table 3. If all of these adjustments to costs and benefits were appropriate, the societal B/C ratios shown in Table 4 would be the result.

While ceiling insulation and water heater measures pass easily under these assumptions, floor and wall insulation and duct and air sealing can only achieve a societal B/C of 1.0 and 1.1 under extremely optimistic assumptions. With higher avoided cost assumptions or larger assumptions for any of the variables discussed above, they could pass by a larger margin. However, if each of the positive assumptions listed above does not bear out, duct sealing does not pass. Air sealing and floor insulation do not pass if cost or higher or savings are lower than the optimistic assumptions by 20%.

Table 3- Benefit and Cost Adjustments for Sensitivity Test

Benefits adjustments:	**Celiing**	**Floor**	**Wall**	**Duct**	**Air**	**MF boiler**	**ES DHW[7]**	**Solar DHW[8]**
Avoided cost[9]	+100%	+100%	+100%	+100%	+100%	+100%	+100%	+100%
Lower price & volatility, etc.	+10%	+10%	+10%	+10%	+10%	+10%	+10%	+10%
Improved specifications	+10%	+10%		+10%	+10%		+10%	
Evaluation uncertainty					+20%	+20%	+20%	+20%
Non-energy benefits	+10%	+10%	+10%	+20%	+20%	+10%	+10%	[10]
Total Value Increase:	**+130%**	**+130%**	**+120%**	**+140%**	**+160%**	**+140%**	**+150%**	**+130%**

Cost adjustments:	**Ceiling**	**Floor**	**Wall**	**Duct**	**Air**	**MF boiler**	**ES DHW**	**Solar DHW**
Extraneous costs:	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
Increase competition:	-20%	-20%	-20%	-40%	-40%	[11]	-20%	-20%
Total Cost Reduction:	**-30%**	**-30%**	**-30%**	**-50%**	**-30%**	**0%**	**-30%**	**-30%**

[7] Energy Star (energy factor of at least .67) domestic hot water
[8] Solar domestic hot water
[9] For this scenario we doubled NW Natural's 2011 filed avoided costs.
[10] Already considered.
[11] Energy Trust already provides payback estimates for this measure, which is the basis for the "increased competitiveness" scenario.

Table 4. Impact of Sensitivity Test Adjustments

MEASURE	SOCIETAL BENEFIT/COST RATIOS		
	INITIAL	WITH UPDATED AVOIDED COSTS	WITH ALL ADJUSTMENTS
Ceiling insulation:	1.2	.7	2.3
Floor insulation	.6	.4	1.1
Wall Insulation	.7	.4	1.2
Duct Sealing	.4	.2	1.0
Air Sealing	.5	.3	1.1
Solar Thermal- Domestic Hot Water*	1.0	.9	1.2
Solar Thermal- pool*	1.3	.9	3.7
ENERGY STAR water heater	.9**	.5	1.8
*The changes in societal benefit/cost ratios are not linear with cost because, consistent with prior OPUC decisions, the proxy for non-energy benefits is employed. **Included in the program on the expectation that costs will go down as the market builds.			

Additional Sensitivity Analysis- Cost and Savings Trends

One reasonable critique of the draft analysis noted that we are using 2009 evaluation results (the latest available) and 2011 costs (also the latest available). Measure costs have increased in the interim, by:

- 49% for ceiling insulation
- 55% for wall insulation
- 75% for floor insulation
- 77% for duct sealing[12], and
- 38% for air sealing

Increases are measured on a per-square-foot basis for insulation, and on a per-home basis for duct and air sealing. At the same time, measure specifications have been refined. It's possible that savings have also increased. If we were to consider 2009 costs, the B/C ratios would improve, but the opportunities for further improvement would be less, so it was not appropriate to incorporate this consideration into

[12] Duct and air sealing are based on 2011 compared with 2010; 2009 data were not available without additional analysis.

the above scenario analysis. We have no basis to think that savings have increased at the same rate of costs- we can only hope that they have improved significantly. The savings for ensuing years will become clearer when 2010 and 2011 evaluations are complete.

Nonetheless, we thought it would be useful to explore an additional scenario where savings have increased in proportion to costs. To do this, in the table below, we adjusted the B/C ratios for the middle column of the above chart ("with updated avoided costs) to reflect 2010 measure cost for insulation measures (2009 were not available without further extensive analysis) and 2009 costs for duct and air sealing.

Table 5- Societal B/C ratios Under Scenario with 2009 Costs

MEASURE	SOCIETAL BENEFIT/COST RATIOS		
	INITIAL	WITH UPDATED AVOIDED COSTS	USING 2009 COSTS
Ceiling insulation:	1.2	.7	1.0
Floor insulation	.6	.4	.7
Wall Insulation	.7	.4	.6
Duct Sealing	.4	.2	.4
Air Sealing	.5	.3	.4
Solar Domestic Hot Water & Pool	Analysis not performed- cost trends not clear		
ENERGY STAR water heater	.9**	.5	Not available in 2009

This sensitivity analysis shows that, if savings were to have grown proportional to costs, and other factors discussed in the prior scenario analysis do not come into play, ceiling insulation would be marginally cost-effective and the other measures would be improved, but would still not pass the societal test.