



Synapse
Energy Economics, Inc.

KEEA
Keystone Energy Efficiency Alliance



June 29, 2012

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street
Harrisburg, PA 17120

Re: Total Resource Cost (TRC) Test – 2012 Phase II of Act 129
Docket No. M-2012-2300653

Dear Secretary Chiavetta:

Enclosed please find the comments of PennFuture and KEEA on the above-referenced proceeding.

Sincerely,

Courtney Lane
Senior Energy Policy Analyst
Citizens for Pennsylvania's Future (PennFuture)
Energy Center for Enterprise and the Environment

Liz Robinson
President
Board of Directors
Keystone Energy Efficiency Alliance
(KEEA)



**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION:**

Total Resource Cost (TRC) Test – : Docket No. M-2012-2300653
2012 Phase II of Act 129

JOINT COMMENTS OF

**CITIZENS FOR PENNSYLVANIA’S FUTURE (PENNFUTURE) AND KEYSTONE
ENERGY EFFICIENCY ALLIANCE (KEEA)**

I. Introduction

These comments are filed jointly by the Keystone Energy Efficiency Alliance (KEEA) and Citizens for Pennsylvania’s Future (PennFuture). We received analytical support and policy advice to develop these comments from Synapse Energy Economics, Inc. We appreciate the opportunity to submit comments on the Total Resource Cost (TRC) Test - 2012 Phase II of Act 129, Docket No. M-2012-2300653.

Act 129 of 2008, 66 Pa. C.S. § 2806.1 (Act 129), requires the Pennsylvania electric distribution companies (EDCs) to adopt an Energy Efficiency and Conservation (EE&C) plan, subject to approval by the Pennsylvania Public Utility Commission (Commission), to reduce electric consumption. Act 129 directs the Commission to use a total resource cost (TRC) Test to analyze the benefits and costs of the Energy Efficiency and Conservation (EE&C) plans that certain EDCs are required to file. Act 129 defines a TRC Test as “a standard test that is met if, over the effective life of each plan not to exceed 15 years, the net present value of the avoided monetary cost of supplying electricity is greater than the net present value of the monetary cost of energy efficiency conservation measures.” 66 Pa. C.S. § 2806.1(m).

While the Pennsylvania TRC Test methodology for the most part comports with industry standards, its asymmetrical inclusion of all participant costs in the TRC Test without including non-

energy benefits, creates a fundamental bias in regulatory decision-making regarding investment in energy efficiency. This bias significantly reduces the measures that can be included in EE&C plans and limits the realization of savings from energy efficiency programs.

II. Comments on TRC Test

A. Costs and Benefits in TRC Test

We urge the Commission to include non-energy impacts (NEIs) in the TRC Test. As detailed below, many of these NEIs are real, quantifiable impacts that should be included as “monetary” benefits and costs to be factored into the TRC Test (66 Pa. C.S. § 2806.1(m)) as is being done in other states across the country detailed in Appendix B.¹

The Importance of Accounting for Non-Energy Impacts

The energy costs and benefits of energy efficiency programs are relatively well-understood, and have historically been accurately applied by energy efficiency program administrators when conducting cost-effectiveness tests. On the other hand, the non-energy impacts (NEIs) from efficiency programs (i.e., those costs and benefits that are not part of the cost or avoided cost of energy) have a history of incomplete application.

Non-energy impacts are categorized in terms of those that are experienced by a utility, those that are experienced by an efficiency program participant, and those that are experienced by society in general.

- Utility-perspective non-energy impacts include: reduced customer arrearages, reduced bad debt write-offs, reduced customer terminations and reconnections, and other customer service benefits.
- Participant-perspective non-energy impacts include: improved comfort, increased property value, improved health, increased safety, reduced maintenance costs, improved equipment performance, improved indoor air quality, improved aesthetics, reduced water consumption, reduced consumption of other fuels, reduced tenant turnover, improved worker productivity, and increased control over utility bills. Many of these benefits are particularly relevant and significant for low-income customers.

¹ TRC 2012 Tentative Order pg. 5

- Societal-perspective non-energy impacts include, for example, reduced environmental impacts, reduced health care costs, reduced national security costs, and economic impacts.

In theory, these impacts should be included in energy efficiency cost-effectiveness tests where they are relevant. The TRC Test should include the utility and the participant non-energy impacts at a minimum and we would urge the Commission to reconsider including societal impacts. These impacts can make a significant difference in energy efficiency cost-effectiveness results.

The primary rationale for including NEIs in the TRC Test is to ensure that the test is internally consistent. By definition, this test includes the participant cost of the energy efficiency measure. In some cases, this cost can be quite large. In order for this test to be internally consistent, it must also take into account the participant benefits associated with the energy efficiency measure, including non-energy benefits. Excluding the participant perspective NEIs from the TRC Test will provide cost-effectiveness results that are skewed against energy efficiency, which will result in under-investment in energy efficiency programs.

Recommendations for Accounting for Non-Energy Impacts

We recommend that the Commission require the Pennsylvania EDCs to include NEIs when applying the TRC Test. There are several options available for including NEIs in energy efficiency cost-effectiveness screening. These include the following.

- **Include all NEIs:** Develop quantitative estimates of all NEIs, with a focus on those NEIs that are expected to be most significant.
- **Readily measurable NEIs only:** Develop quantitative estimates of those NEIs that are readily measurable.
- **Sensitivity analysis:** Consider cost-effectiveness results with varying ranges of NEIs included.
- **Adder:** Apply an adder to the efficiency program benefits as a proxy for all the NEIs.
- **Hybrid:** A combination of the various options could be employed to create a hybrid approach. For example, a state could include all readily measurable NEIs, and use an adder for hard-to-measure NEIs.

We recommend that Pennsylvania (a) identify all of the NEIs that are relevant for the energy efficiency programs offered in the state; (b) develop quantitative estimates for all NEIs that can be readily quantified; (c) develop some methodology for addressing those NEIs that are not quantified; and (d) pay particular attention to the NEIs that are unique to low-income customers. Pennsylvania utilities should hire independent contractors to develop the best state-specific NEI estimates

possible. The money required for this type of research could come from each utility's evaluation, monitoring and verification budget, and is a cost of the overall energy efficiency effort.

If the Commission believes that more study is needed, an interim approach would be to at least require EDCs to include the avoided cost of other fuels in their cost-effectiveness screening. These savings are real, tangible monetary benefits that occur as a direct result of the efficiency programs and should therefore be included in the total resource cost test. Without these benefits, shell measures like air sealing and insulation, for example, will typically not pass the test. While it is the policy of the Commission to apply the TRC Test at the plan level rather than at the component, program, or measure level, it may become more difficult for full EE&C plans to pass the current TRC Test as programs go after deeper, more expensive measures.

Further, the Commission has already ruled that customer avoided operating and maintenance costs should be included as a TRC benefit even though it does not specifically fall under the umbrella of "avoided monetary cost of supplying electricity". It is inconsistent to allow for inclusion of operation and maintenance savings but not allow for fossil fuel or water savings to count. Pennsylvania is one of the few states that does not allow these benefits to be included in its cost-effectiveness test. This is true even for states and utilities that only run electric programs (see Appendix B).

The Rationale for Accounting for Non-Energy Impacts

The decision to include NEIs has significant implications for the cost-effectiveness of energy efficiency programs. As indicated in our example below, the inclusion of NEIs can sometimes make the difference between a program being cost-effective or not.

Using a typical Massachusetts utility, we examine the cost-effectiveness of the residential and commercial and industrial (C&I) programs, below. Figure 1 presents the cost-effectiveness of the typical utility's residential programs. Critically, for several programs -- including the multi-family retrofit, the behavior/feedback program, and the new construction program -- the NEIs make the difference between benefit cost ratio (BCR) of less than one and a BCR greater than one. It is important to note that some of the NEIs included by this utility include fuel savings, including oil and gas heating savings from weatherization programs. This is especially true for the MassSAVE program, which is the Massachusetts utility's residential retrofit program.

Figure 1: Cost-Effectiveness Analysis of Typical Residential Programs

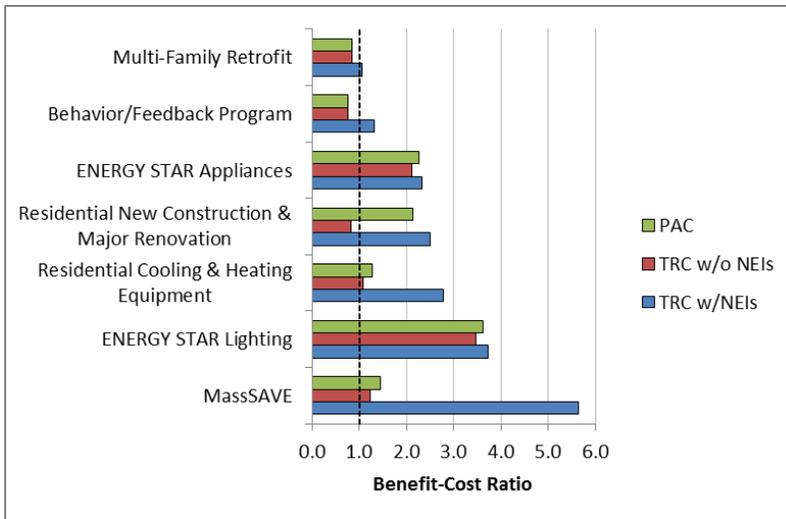
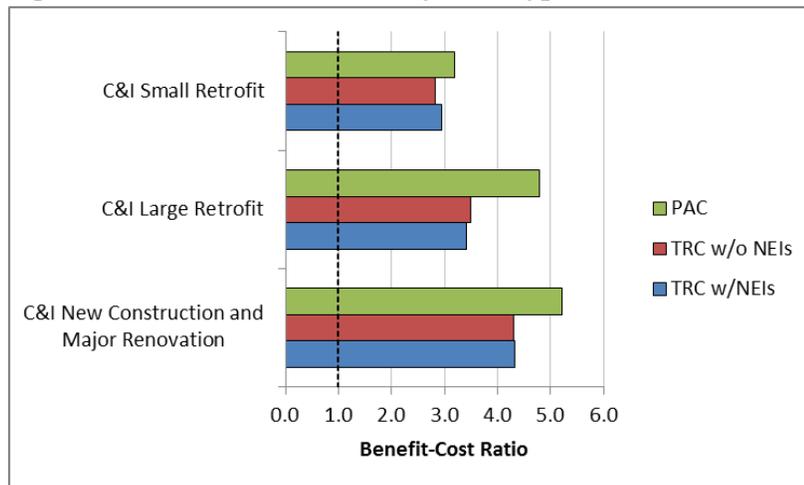


Figure 2 presents the cost-effectiveness of the typical Massachusetts utility’s C&I energy efficiency programs. There are few NEIs applied to C&I sector, mostly because this issue has not been studied as much as for residential and low-income customers. C&I programs tend to be highly cost-effective anyway.

Figure 2: Cost-Effectiveness Analysis of Typical Commercial & Industrial Programs



Experience in Other States

A recent survey by ACEEE provides a summary of how the cost-effectiveness tests are used across the states.² Nationwide, a total of 45 jurisdictions have ratepayer-funded energy efficiency programs in operation. All of these jurisdictions use some type of benefit-cost test in connection

² The ACEEE report provides the results of a comprehensive survey and assessment of the current “state of the practice” of utility-sector energy-efficiency program evaluations across the 50 states and the District of Columbia. The study examined many aspects relating to how states conduct their evaluations and the key assumptions employed, including the use of cost-effectiveness tests (ACEEE 2012).

with these programs.³ Most states have some type of requirement for the use of such tests, either by legislation or regulatory order (ACEEE 2012. p 30).

The study found that 14 states quantify environmental externality benefits, 12 states quantify customer “non-energy” impacts, and 5 states quantify other “societal” benefits (not including “environmental” benefits). The study probed deeper by asking about the specific customer non-energy benefits included by each state in their primary benefit-cost test. Responses to this question revealed that most of the non-energy participant benefits are confined to water and other fuel savings (ACEEE 2012. p 15-16). Only two states quantify a benefit for participant operation and maintenance savings, and no state quantifies benefits for things like comfort, health, safety, or improved productivity in their primary benefit-cost test (ACEEE 2012. p 32).

Several states have taken additional steps to incorporate NEIs into energy efficiency program screening.⁴ Some of the more interesting regulatory approaches are described below.

- California: The state investigated formal inclusion of participant-side NEIs in tests of low-income programs several years ago. Currently there have been discussions with regulators about indirect ways to incorporate NEIs into the current benefit-cost model. A few years ago, the state hired a consultant to construct a low-income program, which is now being updated (SERA 2010. p 34).
- Colorado: The Colorado Public Utilities Commission requires a 10 percent adder in TRC cost-effectiveness calculations to represent non-energy benefits. The percentage is applied to the sum of the other quantifiable benefits, and is used when calculating TRC values for specific DSM programs and the overall portfolio. The Colorado PUC also allows for the inclusion of specific non-energy benefits, on a program-by-program basis, when such benefits can be easily calculated. Further, in applying the TRC to low-income DSM programs, the benefits included in the calculation are increased by 20 percent, to reflect the higher level of non-energy benefits likely to accrue from DSM services to low-income customers (CO PUC 2008. p 26-27, 43).

³ This is not the case for demand response programs or renewable energy programs, where only 67 percent and 28 percent of states, respectively, report using benefit-cost tests for those ratepayer-funded programs (ACEEE 2012. p 30).

⁴ Skumatz Economic Research Associates, Inc. (SERA) recently published a paper that provides a comprehensive analysis of the “state of the art” in NEIs, and reports on the status and recommendations on estimation approaches for low-income programs in California (SERA 2010. p 1).

- Massachusetts: NEIs that are readily quantified are included in cost-effectiveness screenings, including reduced operation and maintenance, increased health, safety, and comfort, increased property value, etc. An evaluation study published in August 2011 by NMR Group, Inc. (NMR) quantifies the NEIs applicable to the Massachusetts energy efficiency program administrators' residential and low-income programs (NMR 2011). The results of this study have been incorporated into the Massachusetts Technical Resource Manual to ensure that all program administrators include the same NEI assumptions.
- New York: Detailed evaluation of NEIs is conducted for many or all of the programs in the program administrator's residential, commercial, and industrial portfolio. NEIs such as comfort, safety, air quality, productivity, etc. are included in regulatory cost-effectiveness evaluations for informational purposes only, and are not used for specific decision-making with respect to cost-effectiveness. Program administrators present the benefit-cost results both with and without NEIs. Occasionally, program administrators use a scenario approach where regulators are shown the benefit-cost results including zero NEIs, 50 percent of NEIs, and 100 percent of NEIs (or similar). For utility NEIs, the program administrators generally rely on defaults and proxy values from the literature, adjusted for New York, and do not generally conduct arrears or similar studies. For participant NEIs, they generally use the survey method developed in the literature. For societal figures (emissions and jobs), they use specialized regional models developed by a consulting firm (SERA 2010. p 34-35; NYSERDA 2005; NYSERDA 2012).
- Oregon: The Public Utility Commission of Oregon has a long-standing policy that utilities (now the Energy Trust of Oregon) should calculate non-energy benefits if they are significant and there is a reasonable and practical method for calculating them (OR PUC 1994. p 15; SERA 2010. p 34-35).
- Vermont: In February 2012, the Vermont Public Service Board required that NEIs be accounted for in energy efficiency screening in several ways. First, several NEIs should continue to be directly quantified, including environmental externalities, water savings, and operations and maintenance savings. Second, a 15 percent non-energy benefits adder should be applied to the energy benefits across all fuels, in order to reflect those NEIs that are not already quantified. Further, the Board directed that an additional 15 percent be applied to the energy benefits across all fuels in the low-income programs to reflect the additional benefits

to low-income customers and society (including NEIs) from those programs (Vermont Public Service Board 2012).

- Washington – Puget Sound Energy: Puget Sound Energy categorizes NEIs as quantifiable and non-quantifiable. Where possible and easily quantifiable, Puget Sound Energy may include dollar values for non-energy benefits in its TRC Test, including values for water usage savings or maintenance savings. Non-quantifiable NEIs may include legislative or regulatory mandates, support for regional market transformation programs, low-income health and safety, low-income energy efficiency or experimental and pilot programs. Where there is a significant amount of non-quantifiable NEIs, then Puget Sound Energy is able to accept energy efficiency programs with a benefit-cost ratio of less than 1.0, as long as the ratio exceeds 0.667. (PSE 2012; SERA 2010. p 35).

Estimating Non-Energy Impacts

Methodologies for Quantifying Non-Energy Impacts

Some NEIs are priced by markets; many are not. Those NEIs that are market-based (e.g., other fuel savings, water savings) should be quantified using market prices to the extent possible.

There are two main approaches to quantify NEIs that are not priced by a market: computational and survey-based. Computational approaches use primary or secondary data assembled from program records or literature-based sources (SERA 2010. p 17).

Survey-based approaches rely on commonly used types of survey-based data gathering and estimation approaches, including stated preference surveys and revealed preference approaches. Revealed preference approaches include willingness to pay and willingness to accept contingent valuation studies, comparative or relative valuations, and other revealed preference and stated preferences approaches (SERA 2010. p 18).

Direct computation approaches have obvious benefits. Unfortunately, an extensive array of less tangible but potentially important benefits cannot generally be estimated directly by a computational approach, including comfort, aesthetics, and other factors. Thus, relying solely on computational methods is not sufficient in deriving overall estimates of participant-perspective NEIs. Economists, social scientists, and researchers in the environmental and advertising fields have used a variety of survey-based valuation methods to develop estimates of the monetary value of

externalities and intangible goods. Examples of a few methods with particular applicability to energy include the following:⁵

- Computational approach, using primary data;
- Computational approach using secondary data;
- Computational approach using statistical techniques, including regression analysis;
- Survey methods, including contingent valuation, willingness to pay and willingness to accept techniques; and
- Other survey methods, including relative scaling approaches, ranking approaches and customer motivation approaches.

Many NEIs are challenging to measure. However, not measuring NEIs means that decisions about programs are likely to be suboptimal because they ignore key effects. While measurement issues persist and will likely continue to persist, approximate estimates provide value to the energy efficiency screening process, and the improving sophistication of measurement methods implies that these approximations are getting better and better (SERA 2010, p 17-18; 43-44). We have included examples of recent estimates of non-energy impacts in Appendix A.

B. Use of TRC Test Assumptions for Other Matters

The Commission proposes that the EDCs and other parties continue not to be bound by TRC Test assumptions in prudence, cost of service, or other inquiries. If there are significant differences between the TRC Test assumptions and the assumptions or facts at issue in such other proceedings, parties may enquire into the validity of such differences in those, or in the TRC Test, proceedings.

We support the Commission's position and recommends that the open approach exhibited in this particular instance be further applied to the Commission's wider-ranging reconsideration of the TRC methodology itself, as described above.

C. Level at Which to Measure TRC

The Commission proposes that the TRC Test continue to be applied at the plan level. While some programs may not pass the TRC Test, as long as all of the programs in an EDC's EE&C portfolio of plans pass the TRC Test, then the EDC's EE&C plan will be deemed cost-effective.

We support the Commission's proposal to apply the TRC Test at the portfolio or plan level. This is the most flexible approach to cost-effectiveness screening, allowing for experimentation with different program designs so that pilot programs, market transformation strategies, and

⁵ For a more detailed discussion of these options see SERA 2010, pp. 17-24.

emerging technologies can be developed and tested. We commend the Commission for adopting a key best practice in the application of screening tests, as set forth in *Measure it Right: Best Practices in the Selection and Implementation of Cost-Effectiveness Tests* (Robin Le Baron, 2012), a recent report issued by the National Home Performance Council.

While the Commission continues to reserve the right to reject any program with a low TRC ratio, we urge the Commission not to exercise that right. Such a move would obviate the benefits of the portfolio approach, which, as noted above, gives EDCs the necessary flexibility in designing their portfolios to meet the changing needs of the marketplace.

D. Maximum 15-Year Measure Life

The Commission proposes that all TRC calculations for EE&C program measures use up to 15 years' worth of benefits and costs, as applicable to specific program measures, regardless of the year of program implementation.

We assert that for the purposes of cost-effectiveness testing, an arbitrary cap such as 15 years for the effective useful life (EUL) of measures significantly reduces the value of measures with longer useful lives. Such measures include a number that are significant for whole-house upgrades, notably insulation. Rather, we consider it a best practice⁶ to remove arbitrary caps and instead adjust EULs as necessary to account for consumer replacement, burn rates or other factors.

E. Avoided Costs

The Commission discusses the data sources to be employed in calculating avoided costs but doesn't directly address how those avoided costs are to be determined. We endorse the approaches outlined by Synapse in a soon-to-be-published report, "Best Practices for Energy Efficiency Screening." There, authors Tim Woolf et al. recommend methodologies that fully capture the range of avoided costs achieved by energy efficiency programs, including avoided capacity costs, avoided energy costs, avoided transmission and avoided distribution costs. All such cost savings resulting from efficiency need to be directly counted as benefits to properly reflect program effects.

⁶ National Home Performance Council paper, *Measure it Right: Best Practices in the Selection and Implementation of Cost-Effectiveness Tests*, Le Baron

F. Inclusion or Exclusion of Customer Avoided Operating and Maintenance Costs in the TRC Calculation

The Commission proposes to continue to include avoided operating and maintenance costs, to the extent quantifiable. We commend the Commission for including this important benefit for larger buildings derived from energy efficiency improvements. Studies show that buildings can achieve up to 25 percent savings in energy bills from efficiency-related operating and maintenance best practices, post-installation of measures.

G. Compliance with AEPS Act⁷ and Carbon Issues

On the topic of avoided environmental compliance and other related costs, we point out that enhanced energy efficiency in Pennsylvania will increasingly lead to more avoided costs associated with anticipated regulation, and should be taken into consideration as a benefit in the TRC Test.

According to Woolf, et al in an upcoming Synapse study prepared for the Regulatory Assistance Project, failing to fully account for the costs of complying with forthcoming or future environmental regulations can skew cost-effectiveness evaluations against energy efficiency and result in higher costs for ratepayers down the road. The study outlines state-of-the-art efforts to account for the costs of compliance with new EPA regulations and climate change requirements, such as the Mercury/Air Toxics Standards (MATS), effective March, 2012, and Cross-State Air Pollution Rule (CSAPR), anticipated but still under review, and how to calculate them vis a vis cost-effectiveness tests. To the extent that new regulations are scheduled to come into effect within the time period under consideration, they will impose predictable, quantifiable costs that should be incorporated into the avoided cost calculation.

H. Conclusion and Regional Involvement

We thank the Commission for setting up congruent comment periods to consider both the TRC Test and the Tentative Order to ensure both issues are considered in a timely manner.

Finally, we ask the Commission to consider participating in an upcoming multi-state stakeholders forum on EM&V designed to develop guidance on cost-effectiveness testing based on the latest research in this area. The Regional EM&V Forum is a project managed and facilitated by Northeast Energy Efficiency Partnerships, Inc. (NEEP), steered by a committee of state PUC

⁷ Alternative Energy Portfolio Standards Act, 73 P.S. §§ 1648.1-1648.8.

commissioners and state energy offices from ten jurisdictions in the Northeast and Mid-Atlantic region, from Maine to D.C.. The Forum's purpose is to develop technical information and EM&V and reporting protocols that can assist states in developing evaluation, measurement and verification strategies and standards for energy efficiency programs. The overall premise for the EM&V Forum is that by combining the evaluation interests of the region along with the multi-state experience of staff from many states, all states benefit from sharing the research costs as well as overall expertise of the group. The Forum will soon begin its process to develop a 2013 project agenda, which involves surveying participating states. We urge the commission to get involved in this important Forum. For more information about the Forum, see www.neep.org/emv-forum.

APPENDIX A: EXAMPLES OF RECENT ESTIMATES OF NON-ENERGY IMPACTS

This section provides an illustrative list of the NEIs that have been quantified and recommended for inclusion in cost-effectiveness tests by recent studies.⁸ These studies focused on quantifying NEIs that apply to the residential and low-income programs. Most of the NEI values reported were derived from the existing literature or by developing modified algorithms from the literature, while some values were derived by surveys of program participants.

In some cases, quantifying an NEI is not recommended for one of several reasons, including: quantifying the NEI would amount to double counting; there is insufficient evidence for its existence; or the NEI is too intangible (NMR 2011, p 1-1-2; 2-1). On occasion, a case might be made that an NEI is too hard to quantify meaningfully.

For the discussion in this section, we have included only NEIs that have been quantified. It is important to note that the information below should not be seen as an exhaustive list of the most significant NEIs. Instead, these tables should be seen as an illustrative list of quantified NEIs, based on recent literature reviews.

Typically, NEIs are considered either a one-time or annual impact, and are applicable on either a per-housing unit (also referred to as per-participant) or per measure basis. The values presented are expressed in dollars per housing unit or dollars per participant on an annual basis, unless otherwise noted.⁹

Utility-Perspective NEIs

Utility perspective NEIs represent tangible benefits in the form of direct monetary savings, and are relatively easy to quantify. Most of the NEIs used are monetized from the literature or from

⁸ The results given in the tables are from NMR 2011 and SERA 2010. With regard to the recent NMR study, stakeholders have raised questions and concerns about the study's results. Specifically, certain stakeholders argue that: the health benefits to low-income participants are grossly underestimated at \$19 per participant per year, and instead should be \$150 per participant per year; the increased property value benefit is too low at \$20.73 for every dollar of energy savings, and instead should be \$30 per dollar of energy savings; estimated NEIs for reduced utility arrears, reduced forced mobility, the elimination of the need to replace a refrigerator, and benefits from replacing an inefficient air conditioner are all too low; and participant time saved, improved lighting quality, and price stability can and should be quantified. Other questions are raised regarding NMR's methodological work. These concerns are currently being addressed as part of an open proceeding with the Massachusetts Department of Public Utilities (see docket number D.P.U. 11-120).

⁹ The values presented in the tables below from NMR are in 2010 dollars. The SERA study does not explicitly state which year's dollars it uses. Since the report was prepared in 2010, we assume that the SERA values are also in 2010 dollars.

algorithms using inputs from utilities. In general, the utility perspective NEIs are relatively low in value, ranging from less than a dollar to nearly \$9 per participant (NMR 2011. p 1-3-6; 4-1). Table 1 below summarizes the range of values associated with utility perspective impacts.

Table 1: Utility Perspective Non-Energy Impacts

Impacts Quantified to Date	Value or Range of Values
Financial and accounting NEIs	
Reduced arrearages	\$2.61
Carrying costs on arrearages	\$2 or \$32
Bad debt written off	\$2-\$3.74
Customer Service NEIs	
Terminations and reconnections	\$0-\$50
Customer calls	\$0.58
Collection notices	\$0.34
Safety-related energy calls	\$0.50-\$8.43

Note: The values presented in this table are expressed in dollars per housing unit or dollars per participant on an annual basis.

Participant Perspective NEIs

When measured and monetized, participant NEIs have been found to be quite valuable, often exceeding the value of energy savings (NMR 2011. p 5-1). Some of these NEIs are quantifiable using data from the program administrators, secondary data, and algorithms found in the literature (NMR 2011. p 2-6). However, most of the participant perspective NEIs are challenging to quantify and require primary data collection through participant surveys (NMR 2011. p 2-6; 5-5). Due to the less tangible nature of many participant perspective NEIs, they can be quantified with only limited certainty. The ranges of values found in the literature for many of these NEIs vary considerably, and are summarized in Table 2, below (NMR 2011. p 2-6).

Table 2: Participant Perspective Non-Energy Impacts

Impacts Quantified to Date	Value or Range of Values
Comfort NEIs	
Higher comfort levels	\$14 - \$125
Quieter interior environment	\$13 - \$40
Aesthetics / appearance	Few dollars to over \$20
Equipment/ NEIs	
Lighting quality & lifetime	\$3.50 per CFL fixture; \$3.00 per CFL bulb, one-time impact
Equipment maintenance	\$17 - \$124
Equipment performance	\$14 - \$18
Property value	
Increased housing property value	Few dollars to over \$2,000
More durable home and less maintenance	\$35 - \$149
Health & safety	
Fewer fire deaths, injuries, and property loss	\$0.03 - \$37.40
Improved safety (lighting)	about \$20
Health related NEIs	\$4 - \$19
Utility related NEIs	
(Bill-related) calls to utility	Roughly \$0.30
Control over bill	Roughly \$30
Termination and reconnection	\$0 - \$12
Resource NEIs	
Reduced water usage and sewer costs	\$3.70 - \$12
Economic stability NEIs	
Reduced need to move and costs of moving, including homelessness	under \$1 - \$60
Owners of Low-Income housing	
Marketability/ease of finding renters	\$0.96
Property value	\$17.03 one-time impact only
Equipment maintenance (heating and cooling systems)	\$3.91
Reduced maintenance (lighting)	\$66.73
Durability of property	\$36.85
Tenant complaints	\$19.61

Note: The values presented in this table are expressed in dollars per housing unit or dollars per participant on an annual basis, unless otherwise noted.

APPENDIX B: TOTAL RESOURCE COST TEST COMPARISON

Source: Optimal Energy, Inc., *Pennsylvania 2013 – 2018 Energy Efficiency Goals*, 2011.

Type of test (1)	Discount Rate	DRIPE	Externalities Included (Risk, Emissions, etc.)	Emissions Compliance Costs?	O&M benefits	Water / Fossil Fuel
Vermont(2)	SCT	5.7% (Real)	No	10% and about \$0.045 per kWh(3)	Yes	Yes
Massachusetts (4)	TRC	Yield from 10 year treasury note. Currently around 2%.	Yes	Yes, LI Only (5)	Yes	Yes
Connecticut	TRC	After-tax cost of capital (6)	Yes (7)	No	Yes	Yes
Rhode Island (8)	TRC	7.00%	Yes	No	Yes	Yes
Maine (9)	TRC	Yield from long-term US treasury (10 years or more). Currently around 2%.	No	To the extent they can be reasonably quantified	Yes	Yes
California (10)	TRC	Weighted average cost of capital (11)	Yes (12)	\$12.50/ton in 2008 and rising (12)	Yes	Yes
New Jersey (13)	TRC	Weighted average cost of capital	No	No	Yes (14)	Yes
Ohio (17)	TRC	???	No	No	Yes	No
Ontario (18)	TRC	After tax cost of capital	No	No	Yes	Yes
Oregon (19)	SCT	5.20%	No	10% Risk Adder and \$15/ton carbon	Yes	Yes
New York State(20)	TRC	5.5% (21)	No	\$15/ton	Yes	Yes
Pennsylvania (15)	TRC	Weighted average cost of capital (16)	No	No (16)	Yes	No

Sources

(1) See; "Savings Energy Cost-effectively: A National review of the Cost of Energy Saved through utility sector EE programs", ACEEE, Sept 2009, Report No. U092

(2) Efficiency Vermont Annual Plan 2009-2011. http://www.encyvermont.com/docs/about_efficiency_vermont/annual_plans/EVT_AnnualPlan2009-2011.pdf

(3) 10% Risk Adder to EE resources. Also a current environmental externality value of 4.5 cents per kWh.

http://www.narucpartnerships.org/Documents/krolewski_int_res_planning_en.pdf

(4) MA DPU Order 08-50-A. <http://www.ma-eeac.org/docs/DPU-filing/08-50-A%20Order.pdf>

(5) No environmental externalities may be added without legislative approval, but utilities are instructed to include the future costs of compliance with any state and federal regulations. There are externalities allowed for Low Income programs.

(6) 2010 CL&M Final Decision. Has been lower in the past, but Department will require a rate of no lower than 7% for 2011.

(7) 2008 CL&M Final Decision. Allows the inclusion of DRIPE, but needs to be separated out for reporting purposes.

(8) Rhode Island Energy Efficiency and Resources Management Council: Opportunity Report - Phase 1. [http://www.riermc.ri.gov/documents/OER-EERMC-OpportunityRept\(7-15-08\).pdf](http://www.riermc.ri.gov/documents/OER-EERMC-OpportunityRept(7-15-08).pdf)

(9) Efficiency Maine. 94-078. Chapter 2. <http://www.encymaine.com/docs/AgencyRules/Chapter2Update.pdf>

(10)California: <ftp://ftp.cpuc.ca.gov/puc/energy/electric/energy+efficiency/ee+policy/resource4.pdf>

- (11) EE Policy: <http://docs.cpuc.ca.gov/efile/rulings/77462.pdf>
- (12) Avoided cost Rulemaking: http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/45284-03.htm#P245_42105
- (13) Conversation with Frank from CEEEP. August 11th.
- (14) New Jersey has recently dropped out of RGGI. However compliance costs from NOx, Sox, and other regulations are still included in the TRC.
- (15) Pennsylvania Public Utility Commission. Docket No. M-2009-2108601. Final Order 2011 Total Resource Cost Test Order. July 28, 2011.
- (16) Pennsylvania Public Utility Commission. Docket No. M-2009-2108601. Implementation of Act 129 of 2008 - Total Resource Cost Test.
- (17) Ohio Cod 4901. <http://codes.ohio.gov/oac/4901%3A1-39>
- (18) Ontario http://www.ontarioenergyboard.ca/documents/cases/EB-2008-0037/Board_Guidelines_for_CDM_20080328.pdf
- (19) Energy Trust of Oregon. 4.06.000-P Cost-Effectiveness Policy and General Methodology for Energy Trust of Oregon.
- (20) New York state. See DPS case 07-M-0548
- (21) Real Discount Rate. http://www.dps.state.ny.us/07M0548/07M0548_Staff_Proposal_initial.pdf

References

ACEEE (2006). American Council for and Energy-Efficient Economy. "Valuation of Non-Energy Benefits to Determine Cost-Effectiveness of Whole-House Retrofit Programs: A literature Review," Jennifer Thorne Amann, Report Number A061, May 2006.

ACEEE (2010). American Council for an Energy Efficient Economy. "Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis." Chris Neme, Marty Kushler, 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

ACEEE (2012). American Council for an Energy Efficient Economy. "A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs," Kushler, Nowak, and Witte, Report Number U122, February 2012.

CA PUC (2001). California Public Utilities Commission 2001. "California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects," October 2001.

CA PUC (2012). California Public Utilities Commission, Energy Division, "Addressing Non-Energy Benefits in the Cost-Effectiveness Framework," June 2012.

Center for American Progress (2012). "Power for the People: Overcoming Barriers to Energy Efficiency for Low-Income Families," February 2012.

CO PUC (2008). "In The Matter Of The Application Of Public Service Company Of Colorado For Authority To Implement An Enhanced Demand Side Management Program And To Revise Its Demand-Side Management Cost Adjustment Mechanism To Include Current Cost Recovery And Incentives, Order Granting Application in Part," Docket No. 07A-420E, Decision No. C08-0560, Adopted May 23, 2008.

Energy Futures Group and ACEEE (2010). "Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis," Chris Neme and Marty Kushler, 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

Hall, Riggert (2002). "Beyond Energy Savings: A Review of the Non-Energy Benefits Estimated for Three Low-Income Programs."

MA DPU (2011). MA DPU. "Investigation by the Department of Public Utilities on its own Motion into Updating its Energy Efficiency Guidelines," D.P.U. 11-120, November 29, 2011.

NAPEE (2008). National Action Plan for Energy Efficiency, "Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices Technical Methods, and Emerging Issues for Policy-Makers," Robin LeBaron, Energy and Environmental Economics, Inc., and Regulatory Assistance Project, November 2008.

NYSERDA (2005). "New York Energy Smart Program Evaluation and Status Report," May 2005.

NYSERDA 2012. "New York's System Benefits Charge Programs Evaluation and Status Report Evaluation and Status Report: Year Ending December 31, 2011." March 2012 (Revised April 2012)

NHPC (2011). National Home Performance Council, Robin LeBaron. "Getting to Fair Cost-Effectiveness Testing: Using the PAC Test, Best Practices for the TRC test, and Beyond," September 2011.

NMR (2011). NMR Group, Inc. "Massachusetts Program Administrators: Massachusetts Special and Cross-Sector Studies Area, Residential and Low Income Non-Energy Impacts (NEI) Evaluation," August 15, 2011.

NZ EECA (2012). New Zealand Energy Efficiency and Conservation Authority, Energy Wise: The Power to Choose. "Multiple Benefits of Energy Efficiency," March 14, 2012.

OR PUC (1994). Public Utility Commission of Oregon, Order No. 94-590 "In the Matter of the Investigation into the Calculation and Use of Cost-Effectiveness Levels for Conservation; Disposition: Guidelines Adopted," Entered April 6, 1994.

PA TRC Test Order (2011). Pennsylvania Public Utility Commission, Docket No. M-2009-2108601, "Final Order: 2011 Total Resource Cost Test Order," Entered August 2, 2011.

PSE (2012). Puget Sound Energy, "Electric Tariff G, Schedule 83, Electric Conservation Service," Effective January 1, 2012.

SERA (2010). Skumatz Economic Research Associates, Inc., "Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analyses in California," Revised Report May 11, 2010.

Vermont PSB (2011). Vermont Public Service Board. "Order Re: EEU Avoided Costs under Docket EEU-2011-02: Order Approving Updated Avoided Costs for Use by the Energy Efficiency Utilities," November 17, 2011