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NON-ENERGY BENEFITS / NON-ENERGY IMPACTS (NEBs/NEIs): ANALYSIS OF ALTERNATIVES FOR UPDATES FOR THE STATE OF NEW JERSEY

FINAL DOCUMENT

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Contents

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ABSTRACT

This report provides research to inform decisions about possible near-term updates to NJ's existing NEB/NEI adders for use in Triennium 2 filings. The current multipliers in place in NJ are the lowest for those states with multiplicative NEB/NEI adders (5% adder, and 10% extra add-on for low income), and a review was requested. The report provides information and quantitative values based on two sets of analysis: review of "overall" percentage NEB/NEI multipliers in other states across the US, and results of a literature-review-based analysis aggregating NEB/NEI estimates for individual categories of NEB/NEI effects. The multipliers in other states also drill down on the multipliers used by states around and above NJ in the ACEEE State Scorecard.

*This report compares alternatives, and provides pros and cons associated with the potential values. Multiplier values range from 11% to 49%, with 0% to 33% extra adders for low income, depending on the types of NEBs/NEIs included in the multiplier. It also notes that in the NJ regulatory context, the adoption of higher NEB/NEI multipliers generally **need not affect program budgets**, at least for non-low-income programs. Although some states require funding of all programs that are cost-effective (pass the relevant test), NJ specifies that utilities are required to reach a savings target, but is not required to build everything that is cost-effective.*[1]

The analyses in the report develop a set of defensible values for NEI/NEB multiplicative adders that the New Jersey Cost Test (NJCT) committee may consider as it works to update the values used in the NJCT for Triennium 2 filings. The values are summarized in Figures 0.1 and Figure 0.2. The high-level pros and cons associated with the various sources and value levels are provided in Figure 0.3. The details of the derivation of the various NEB/NEI Multiplicative "adders" are provided in the remainder of this document.

Figure 0.1: NEB/NEI Multiplier Results by Fuel, by Source / Derivation

Multipliers by Fuel, and Extra LI adders	Elec	Gas	LI additional over fuels
Current NJ Multiplier	5%	5%	10%
All States, existing % adders (avg)	12%	11%	13%
Top 16 ACEEE Scorecard States with Adders (avg)	13%	13%	12%
Top 16 ACEEE Scorecard State (excl. NJ) (avg)	14%	14%	15%
Maximum State adder	30%	30%	15%
Literature-BASE Program, no hardship*	20%	20%	0%
Literature- with HVAC & Water, no hardship*	49%	49%	0%
Literature - Adding Hardship*	49%	49%	33%
Average	23%	23%	13%
Median	17%	17%	13%

Source: SERA Calculations / NEB-It Database.
Average & median counts higher literature value only once except for LI.
Table Note: (*)Some rounding, interpolations from sector-based NEBs derived in study; used conservative values
(*) To convert multipliers of supply or Wholesale to Retail cost: Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.

[1] *See Clean Energy Act: https://pub.njleg.gov/bills/2018/PL18/17.pdf There is some ambiguity about whether it will affect low-income programs, and the NJCT committee may wish to further explore this issue. In addition, although there is one Performance metric in the Performance Incentive Mechanism related to cost-effectiveness, but it relies on the Utility Cost Test Net Benefits, not the NJCT Net benefits, so most of the NEBs/NEIs will not affect the incentive mechanism directly. Finally, the effect of NEBs/NEIs on the portfolio is no different than the effect of other adders included by policy intent in New Jersey's Cost Effectiveness Test (e.g., greenhouse gas emissions). NEB/NEI adders, like other adders considered in the NJCT, should be assessed based on research and evidence associated with their estimation.*

Figure 0.2: NEB/NEI Multiplier Results by Program Sector, by Source / Derivation

Multipliers by Sector, and Extra LI adders; includes each incremental equipment class, unlike fuel-based table above.	Residential	C&I	LI additional add-on over Residential
Current NJ Multiplier	5%	5%	10%
All States, existing % adders (avg)	12%	11%	13%
Top 16 ACEEE Scorecard States with Adders (avg)	13%	13%	12%
Top 16 ACEEE Scorecard States (excl. NJ) (avg)	14%	14%	15%
Maximum State adder	30%	30%	15%
Literature-BASE Program, no hardship (est. values)	12%	20%	6%
Literature- BASE program, ("rounder") figures	10%	20%	10%
Literature- with HVAC ("rounding")	45%	58%	0%
Literature - with HVAC & Water ("rounding")	49%	58%	0%
Literature - Adding Hardship	49%	58%	33%
Average	26%	31%	12%
Median	14%	20%	12%

Source: SERA Calculations / NEB-It Database.
Average & median counts higher literature value only once except for LI.
**Some rounding for low income, which is sometimes slightly* less *than non-low income residential*
Table Note: (*) Conversion of supply or Wholesale to Retail cost. Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.

Figure 0.3: Pros and Cons of Alternative Values / Sources for Updates to NJ NEB/NEI Adder

	Advantages	Disadvantages
Sourced from State Multipliers	• Simple / straightforward, Comparable • Moves NJ forward (out of basement)	• Old sources that might be higher if re-assigned now that more literature exists to support values • Doesn't directly link to any specific benefits that could be updated and logically link to the next update when new research is conducted. Vague justification for numbers / values / what they are proxies for. • Not NJ research basis
Sourced from Literature	• Clear link to effects included • Rationale to update when (specific) research completed • Specific to program types	• Higher numbers in these cases; "shock" to key stakeholders • More complicated • Not yet NJ research basis • Concern that state is locked into "expensive" NEB study cycles for updating values
Higher vs. lower estimates	• Literature implies support for higher estimates • Neither higher nor lower values affect budgets for NJ programs	• Lower "shock"; can increase over time • Neither higher nor lower values affect budgets for NJ programs

1. EXECUTIVE SUMMARY

1.1 Introduction and Background

Objective and Context: New Jersey is working to implement updates to its various planning documents in the short term, in order to provide updated values for use in the Triennium 2 utility and states program filings. Because NJ already has and allows "percentage adders", this study focuses on possible updates to these values; detailed work potentially revising NJ's cost test(s) and incorporating NEB influences is deferred to Triennium 2 work by the committee.

This internal[2] study was tasked with developing defensible results for updated values for near-term non-energy benefit or non-energy impact (NEB / NEI)[3] "adder" values for use in the New Jersey's six cost-effectiveness (C/E) tests;[4] and their application to measure / program / portfolio screening. The study develops potential updates for NEB/NEI multipliers based on two main sources:

- The study provides information on NEB/NEI adders based on estimates developed from the literature.
- The study provides a review of the existing percentage adders in place in other states across the US.

The study also identifies priority "next steps" of research to fill gaps in continually improved NEB values that reduce bias in C/E assessment for energy efficiency programs in the State. The study was undertaken to help support the EM&V Working Group's New Jersey Cost Test (NJCT) subcommittee's review to update its near-term strategies. NEBs/ NEIs, and specifically NJ's percentage NEBs/NEIs adder, was identified as an early-priority literature-based update needed for the NJCT. The adders of interest covered residential, low-income, and commercial programs.

Methods: The study reviewed data from quantitative NEB / NEI studies conducted from 1998-2022, and identified ranges and typical results for NEB / NEI categories. Only NEB/NEI categories with multiple studies, and strong estimates and underpinnings with particular relevance to applications of cost-effectiveness testing were included. NEBs/NEIs with application largely related to marketing, and non-cost-test applications were excluded. The selected studies are strong studies, and include values consistent with the preponderance of studies in the literature, and are largely from studies adopted or conducted in nearby states. The sources for these estimates are identified in the document and bibliography.

The study reviewed the structure, content, and values of NEB / NEI adders in place in states across the US for comparison and context. NJ's current values for its adder, language around its intended content, and NJ's Clean Energy Act (CEA) direction and goals were under review as well. Detailed tables underlying the derivation of these results are in Chapter 2.

[2] This report was prepared by a member of the BPU Statewide Evaluator (SWE) team, who serve as advisor and provide oversight to New Jersey evaluation efforts. The work was requested by the NJCT Committee, and the project was completed within a limited time, using available resources, without primary research.

[3] These terms are used interchangeably and jointly in this report. Both terms are defined as the (monetized) net of the positive and negative impacts beyond energy savings that accrue to beneficiaries (utilities, society, and participants) from the delivery of energy efficiency programs. NEB is retained because searches made only on the term NEI would omit a vast amount of relevant literature conducted before those operating in the field later shifted the name, and because "NEB" is easier to pronounce in discussions/speeches.

[4] Utility Cost Test (UCT), Participant Cost Test (PCT), Ratepayer Impact Test (RIM), Total Resource Cost (TRC), Societal Cost Test (SCT), and New Jersey Cost Test (NJCT).

1.2 Results from Literature-Based Analyses

Multiplier Values and How To Use Them: New Jersey, unlike most other states, requires computing a NJ test and all the other five standard tests. Figure 1.1 is a reminder that different cost tests represent different "perspectives". Therefore, only the NEBs/NEIs that are relevant for that perspective would be incorporated into the computation of that Benefit-Cost or Cost-effectiveness test.

The recommended values in Figure 1.2 and Figure 1.3 below are proposed for residential, low-income, and commercial programs for New Jersey identified as titles on the x-axis. New Jersey uses all five California Tests, plus the NJCT, which is a variant of the Total Resource Cost Test (TRC). Not all percentage adders in the analysis table are applied to all tests. What is included depends on the test's "perspective" identified on Figures 1.2's y-axis. Figure 1.1 shows the relevant "perspective" for multipliers to be included in each test being conducted. SCT includes the estimated NEBs from all three perspectives (utility, societal, and participant). TRC excludes the societal NEBs, and so on, based on the checkmarks. This is relevant, since NJ needs to estimate all of the tests included in Figure 1.1.

The multipliers are applied to the retail bill savings for the sector in the cost test being computed. If the test is more easily calculated at the level of the value of wholesale energy savings, an overall ratio (or tailored figures by sector) can be developed for the recommended values in Figure 1.2. In addition, any Net-to-Gross figure that applies to the program or measures, also applies to the associated NEBs/NEIs, given only program-attributable effects should be included. Note that Figure 1.3 provides the parallel translation of the literature-based multipliers into "wholesale" multiple terms for the convenience of NJ stakeholders.

Figure 1.1: NEB Categories Appropriate for the 5 Major Cost-Effectiveness Tests

C/E Tests across, perspective down	UCT/PAT	RIM	PCT	TRC*	SCT*
Utility NEIs	☑	☑		☑	☑
Societal NEIs					☑
Participant NEIs			☑	☑	☑

**The NJCT can be interpreted as either TRC and SCT*
Source: Skumatz and Gibbs EEDAL 2022, Skumatz and Vander Vliet 2021 and earlier

Figure 1.2: NJ NEB Results of the Literature-Based Work: Multiplier-based Values, Applied to Retail Bill Savings for the Sector

Sectors across, "Perspectives" down	Residential Low Income	Residential Non-Low Income	Commercial
Utility NEBs	• **4%;** from average of CT Apprise 2017 and RI TRM values (bad debt, arrearage, customer calls, notices, shutoffs/reconnects),	• **0%:** Omit payment-related NEBs for standard income participants (up to 13% from literature)	**0%:** No estimates in literature or TRMS
Societal NEBs	• Economic from separate source / modeling (using program measure mix) • Environmental & Societal illness NEBs from separate source (using energy savings & generation) • **0%** additional; no other strong NEBs to add	• Economic from separate source / modeling (using program measure mix) • Environmental & societal illness NEBs from separate source (using energy savings & generation) • No other strong NEBs to add	• Economic from separate source / modeling (using program measure mix) • Environmental & societal illness NEBs from separate source (using energy savings & generation) • No other strong NEBs to add
Participant NEBs	• **14%** multiplier from Total CT PSD value (NMR 2016) minus comfort and health benefits counted separately below (38%-17%-7%) • **+24%** additional multiplier added for programs with HVAC (comfort 17% from CT PSD) and CT PSD-based associated health / safety effects (7%) (NMR 2016) • **4%** extra for programs with water measures (from Apprise 2018, literature calculation) • **33%** extra for hardship mitigation (NEEP 2017 study, literature computation)	• **12%** multiplier from CT Apprise 2018 (Total minus O&M, noise; subtracting 6% health, omits lighting and prop value; 43%-31%) • **33%** additional multiplier added for comfort & health for HVAC measures (comfort from CT Apprise 2018 and RI TRM Health and safety effects, 31%+2.3%) • **6%** additional multiplier added for programs with water measures (from Apprise 2018, literature calculation)	• **23%** from NYSERDA/Summit Blue et.al. 2004 in literature for equipment operations and O&M without comfort. No strong health and safety estimates. (34% based on measure-based estimates in literature) • **26%** adder for programs with HVAC (comfort) based on literature (NYSERDA/Summit Blue et.al. 2004)*
If ALL included (only for SCT)	• **18%** without HVAC (4% Util+14%Partic) • **+24%** extra adder for HVAC and health/safety • **+4%** extra for programs with water measures • **+33%** extra for hardship mitigation • Plus Societal multiplier effects estimated separately	• **12%** without HVAC • **+33%** extra for programs with HVAC and health/safety • **+6%** extra for programs with water measures • Plus societal multiplier effects estimated separately	• **23%** without HVAC • **+26%** extra for programs with HVAC and health/safety • Plus societal multiplier effects estimated separately

*Table note (*) conservative; using literature measure-based calculations, adder would be **35%.***

Figure 1.3 summarizes the results of Figure 1.2. It shows that overall, including all types of NEBs / NEIs (utility, societal, and participant, for the SCT), the values are fairly similar across the three program types studied are fairly similar in total, with the exception of the hardship adder for low-income programs. Recall that the adders for tests other than the SCT, only the relevant subset of NEBs from Figure 1.2 would be included (indicated by the checkmarks in Figure 1.1). This Figure provides wholesale rate multipliers as well. [5]

Figure 1.3: Summary of Literature-Based Recommended Adders for Residential, Low Income, and Commercial Programs by Adder Element - Assuming the Societal Cost Test (SCT) and Total Resource Cost (TRC)* Test

Element of the Percentage Adder	NEB/ NEI value, multiplied times program's retail bill savings	Wholesale multipliers – Elec**	Wholesale multipliers – Gas**
Base Adder	~20% for low income and commercial, 10% residential non-low income	29% LI and Com'l; 14% res.	40% LI & Com'l, 20% res
HVAC & Health Adder	+24% - 33% added to the base adder for programs with HVAC measures	~41% (using average)	33%
Water Adder	+4-6% added for programs delivering water measures (0% for C&I)	7%	14%
Hardship	+33% for low-income programs	47%	66%
Combined all 3 perspectives, all adder elements	Excluding hardship, 45-52% for the 3 sectors Hardship adder 33%.	69%	97%

Table Note: (*) TRC is also covered by this table because the societal NEBs/NEIs estimated above are zero. Societal NEBs/NEIs are being measured elsewhere.
Table Note: (**) Conversion of supply or Wholesale to Retail cost. Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.

1.3 Results from Review of NEB/NEI Multipliers from Other States

Figure 1.4 provides a high-level summary of the results of the review of existing state multiplicative NEBs / NEI adders across the US. The adders for the states based on their rank in the ACEEE rankings in the 2022 State Scorecard (© ACEEE) were also examined.

- Figure 1.4 shows 26 states have monetized or percentage adders for NEB/NEI elements.
- The average adders for electric and gas programs are 11-12%; for the share of states that have extra adders for low-income programs, the additive factor is an additional 14%.
- A review of the NEB/NEI adders for the top 16 ACEEE ranked states shows 7 used multiplicative adders, and 8 used monetized or TRM adders and 1 didn't have NEB/NEI adder (rank 15). NJ was rank 14.
- New Jersey's adders were the lowest of any state with NEB/NEI multipliers (5% for electric and gas, and a 10% extra adder for low income). No other state had figures this low. The next lowest state had a 10% adder for electricity and a 7.5% adder for gas. Both minimum and maximum numbers are shown in Figure 1.4.
- Considering the top 16 ranked ACEEE states, the averages were a little higher than the all-inclusive averages (13%, 12%, and 13%, or 14%, 13%, and 15% with NJ numbers excluded).

[5] *Wholesale / retail multipliers adjusted as follows: If multiplier was 10% on a $10 retail, the goal is to represent the addition of the same $1 on the wholesale side. Assume the wholesale as a percent of retail is 70%. Use the original 10% multiplier and divide by 0.7. That results in a new wholesale-based multiplier of 14.3%. Since 14.3% times 70% of $10 is $1, the $1 of monetized value is held stable, whether wholesale or retail.*

Figure 1.4: Counts and Averages for All States with NEB / NEI Adders

SUMMARY TABLE	Electric	Gas	Extra adders for Low Income Programs
1. Total Number incl. NEBs=26			
2.States with percent % adders	14	14	5
3.Average Percent Adder	12%	11%	13%
4.Minimum Percent Adder	5%	5%	10%
5.Maximum Percent Adder	30%	30%	15%

1.4 Key Results and Options

Figure 1.5 shows a graphic of the Current NJ Adder, the Average NEB/NEI multiplier for 50 states, the average NEB/NEI multipliers for the top 16 ACEEE states, and the NEB/NEI adders from the literature-based, NJ-adapted research. Figure 1.5 shows the values by fuel; Figure 1.6 shows the values by program sector. In each case, the low income (LI) value is added on top of the fuel or the residential sector adder value.

Figure 1.5: NEB/NEI Multipliers by Fuel

Multipliers by Fuel, and Extra LI adders	Elec	Gas	LI additional over fuels
Current NJ Multiplier	5%	5%	10%
All States, existing % adders (avg)	12%	11%	13%
Top 16 ACEEE Scorecard States with Adders (avg)	13%	13%	12%
Top 16 ACEEE Scorecard State (excl. NJ) (avg)	14%	14%	15%
Maximum State adder	30%	30%	15%
Literature-BASE Program, no hardship*	20%	20%	0%
Literature- with HVAC & Water, no hardship*	49%	49%	0%
Literature - Adding Hardship*	49%	49%	33%

Table Note: (*) Conversion of supply or Wholesale to Retail cost. Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.
**Some rounding, interpolations from sector-based NEB estimates derived in study; used lower values*

Figure 1.6: NEB/NEI Multipliers by Program Sector

Multipliers by Sector, and Extra LI adders; includes each incremental equipment class, unlike fuel-based table above.	Residential	C&I	LI additional / add-on to Residential
Current NJ Multiplier	5%	5%	10%
All States, existing % adders (avg)	12%	11%	13%
Top 16 ACEEE Scorecard States with Adders (avg)	13%	13%	12%
Top 16 ACEEE Scorecard States (excl. NJ) (avg)	14%	14%	15%
Maximum State adder	30%	30%	15%
Literature-BASE Program, no hardship (est. values)	12%	20%	6%
Literature- BASE program, ("rounder") figures	10%	20%	10%
Literature- with HVAC ("rounding")	45%	58%	0%
Literature - with HVAC & Water ("rounding")	49%	58%	0%
Literature - Adding Hardship	49%	58%	33%

Table Note: (*) Conversion of supply or Wholesale to Retail cost. Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.

Rounding for low income, which is sometimes slightly less *than non-low income residential*

Figure 1.7: NEB/NEI Multiplier Results by Fuel and Method

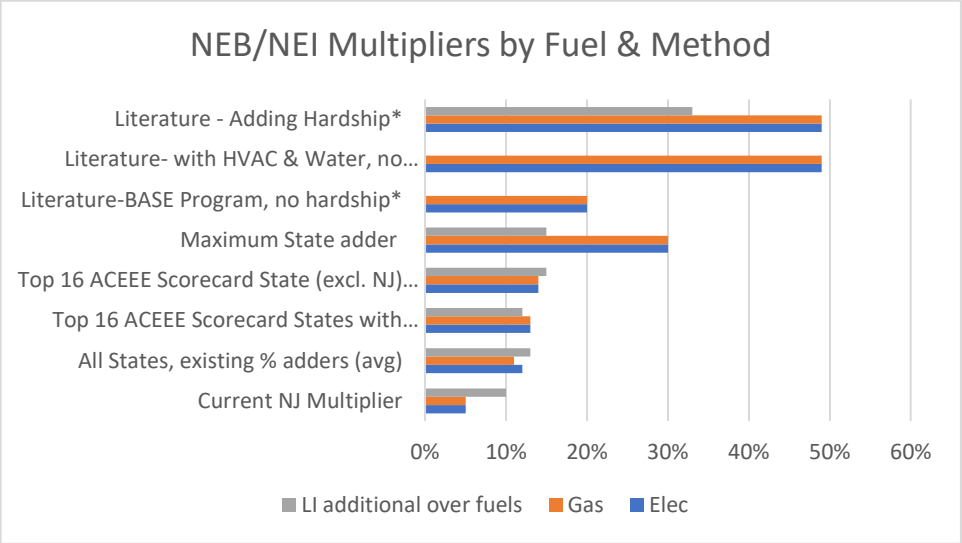
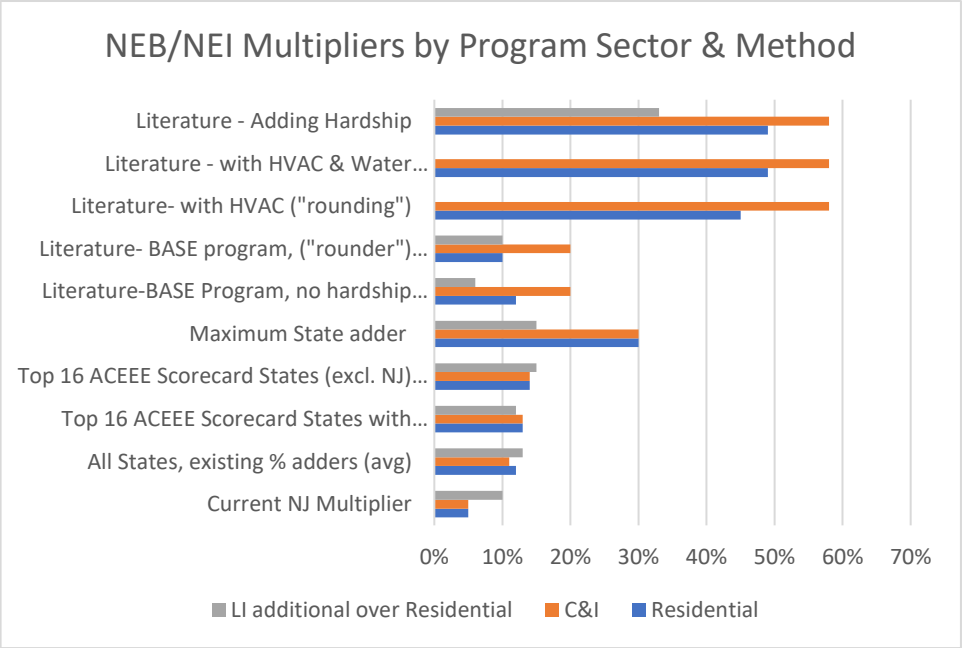


Figure 1.8: NEB/NEI Multiplier Results by Program Sector and Method



1.5 Important Considerations / Concerns Related to Selection and Use of NEBs/NEIs Adders

There are pros and cons associated with each of the research values shown in Figure 1.2 – 1.8. Brief descriptions are included in Figure 1.9. Each of these will be a factor in the discussions regarding selection of a final recommended multiplier value for NJ.

Figure 1.9: Pros and Cons of Alternative Values / Sources for Updates to NJ NEB/NEI Adder

	Advantages	Disadvantages
Sourced from State Multipliers	• Simple / straightforward, Comparable • Moves NJ forward (out of basement)	• Old sources that might be higher if re-assigned now that more literature exists to support values • Doesn't directly link to any specific benefits that could be updated and logically link to the next update when new research is conducted. Vague justification for numbers / values / what they are proxies for. • Not NJ research basis
Sourced from Literature	• Clear link to effects included • Rationale to update when (specific) research completed • Specific to program types	• Higher numbers in these cases; "shock" to key stakeholders • More complicated • Not yet NJ research basis • Concern that state is locked into "expensive" NEB study cycles for updating values
Higher vs. lower estimates	• Literature implies support for higher estimates • Neither higher nor lower values affect budgets for NJ programs	• Lower "shock"; can increase over time • Neither higher nor lower values affect budgets for NJ programs

Small-to-Zero Impact on Program Budgets in NJ

As discussed in detail later in the report, there are several concerns that commonly arise when considering introducing or updating NEB/NEI values. These include concerns about the quality of values, and the transferability of research values from other states to NJ use. However, one of the keyholder Sers largest concerns the stakeholders in the NJ committee will consider is impact on budgets for NJ filings – and the potential impact on ratepayers.

Simple analysis: In general, the Benefit-Cost analysis result for any program divides "energy savings times 1+NEB/NEI multiplier" by "relevant program costs".[6] If the NEB/NEI multiplier doubles, the resulting BCA will increase, but the denominator will remain the same, making more programs pass the benefit-cost screen, so budgets will increase to fund the programs.

Special NJ Conditions Mitigate All / Most Program Budget Effects: In the NJ regulatory context, the adoption of higher NEB/NEI multipliers will not affect program budgets, at least for non-low-income programs. Although some states require funding of all programs that are cost-effective (pass the relevant test), NJ specifies that utilities are required to reach a savings target, but is not required to build everything that is cost-effective.[7]

There is some ambiguity about whether it will affect low-income programs, and the NJCT committee may wish to further explore this issue. In addition, although there is one Performance metric in the Performance Incentive Mechanism related to cost-effectiveness, but it relies on the Utility Cost Test Net Benefits, not the NJCT Net benefits, so most of the NEBs/NEIs will not affect the incentive mechanism directly.

Finally, the effect of NEBs/NEIs on the portfolio is no different than the effect of other adders included by policy intent in New Jersey's Cost Effectiveness Test (e.g., greenhouse gas emissions). NEB/NEI adders, like other adders considered in the NJCT, should be assessed based on research and evidence associated with their estimation.

1.6 Next Steps

The study's key focus was near-term percentage-based "adders" for NJ to use for its updated NJCT. The study developed near-term, mid-term, and longer-term recommendations including each phase's NEB/NEI estimates.[8]

- **Immediate / Near-term:** The NJCT Committee deliberates and selects / negotiates a recommendation for updates to the existing NJ adders. This report provides results supporting

[6] This is simplified, of course. Other factors include NTG, measure lifetimes, and other factors. However, the principles from the math are identical without these enhancements, so we opt for the simpler version to illustrate the point.
[7] See Clean Energy Act: https://pub.njleg.gov/bills/2018/PL18/17.pdf
[8] Each of these values assumes studies of emissions and associated public / societal health, and economic studies will be conducted using well-vetted third-party models using NJ-relevant data will be conducted separately. Longer term recommendations suggest considering peak/off-peak refinements for emissions-related effects.

values from the literature and from existing multipliers in other states). Each source and method provide defensible, quantitative values for percentage adders for NJ, which are included in Figures 1.2 – 1.8 above.

- **Medium term recommendations:** Many of the NEB/NEI values can be improved and tailored in very short order (and for low budget). Each of these studies is in the tens of thousands of dollars. The medium-term plan include:
    - Conducting a survey of participant households and businesses as part of key programs to refine and "localize" prioritized participant side NEBs/NEIs or inputs (including incidence factors) for NJ's programs. Review Health and safety results, as research has progressed, indicating these impacts may support higher estimates.
    - Consider conducting an arrearage study for low-income customers to provide a more localized set of values for this effect.
    - Conduct a study that uses a NEBs/NEIs model to develop more local NJ-based NEBs/NEIs to update the multipliers or include additional omitted NEBs/NEIs into the multiplier.

- **Longer term recommendations:** Longer-term recommendations build on and expand the medium-term improvements, and work to incorporate NEB/NEI research on an on-going basis. The longer-term plan would include:
    - Incorporating NEB/NEI questions into process (or impact) surveys for major programs with at least every other evaluation cycle, using state-of-the-art measurement practices. The incremental cost of the survey is very low. Where feasible, make a transition to measure-based NEBs.
    - Consider adding arrearage studies periodically to other program evaluations and use to update figures. They are inexpensive.
    - In the longer run, consider incorporating NEB/NEI values (rather than multipliers) into the TRM, largely on a measure basis, and transition from a multiplier approach to an approach that recognizes more granularity for the inclusion of NEBs/NEIs into benefit-cost equations.

2. SUMMARY OF NEBS/NEIS RATIONALE AND RESEARCH

Objectives: This study develops defensible candidates for updated values for near-term non-energy benefit or non-energy impact "adder" values for use in the New Jersey's six cost-effectiveness (C/E) tests[9] for their application to measure / program / portfolio screening. The study also identifies priority "next steps" of research to fill gaps in continually-improved NEB values that reduce bias in C/E assessment for energy efficiency programs in the State.

2.1 Rationale for NEBs / NEIs in Cost-Effectiveness Tests

NEBs or NEIs are the net (positive and negative) effects delivered by measures and interventions as part of energy efficiency programs. Usually expressed as monetized effects[10], these NEBs / NEIs provide a very clear demonstration of the importance of the program or measure-attributable effects beyond energy savings. NEBs/NEIs are experienced to the three beneficiaries or perspectives, associated with the programs; utility or program administrators, participants, and society. Given the fact that the effects are positive and negative, NEBs/NEIs are most properly expressed as "changes in" a NEB / NEI. However, most quantification work on NEBs / NEIs have found positives outweighing the negative effects.

NEBs / NEIs Suitability in C/E tests: Benefit cost or cost-effectiveness tests are an assessment of value of a stream of attributable benefits compared to the stream of attributable costs. Although the regulatory tests are designed to assess costs and benefits, many protocols omitted enumerating all benefits, because reliable values were not available (or "hard-to-measure" / HTM) presumably. This leads to computational bias in benefit-cost ratios from the omission of net benefit categories, but not omission of costs. As a result, a bias in decisions was made using these ratios. Research has identified zero as the wrong proxy value, and the results for a number of subcategories of NEBs can be properly reintroduced into these regulatory tests. Revising the tests (TRC, Societal Tests, or whichever others best reflect the state's energy goals) and incorporating subsets of NEBs reduce sources of bias in program and portfolio decision-making, and more appropriately directs the investment of millions of public or shareholder dollars. More than twenty-five years of research and measurement of traditionally-omitted program impacts, or non-energy benefits (NEBs), have provided increasingly robust and consistent results which can support defensible updates in these omitted values.

Concerns about incorporating NEBs in C/E Tests lagged for four key reasons:

- **Chicken and egg issues**: High quality values lagged because there was very limited funding of NEBs estimation work. Funding wasn't available due to NEBs not being incorporated into use in applications with real value to the utilities or regulators. Concerns about the quality of studies and strength of values led to lags in the use of NEBs in key applications like C/E Tests. However, over the years the body of research has grown to include more than 800 studies with NEB values available to support application to important uses like C/E Tests.

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[9] Utility Cost Test (UCT), Participant Cost Test (PCT), Ratepayer Impact Test (RIM), Total Resource Cost (TRC), Societal Cost Test (SCT), and New Jersey Cost Test (NJCT).

[10] Or monetized-adjacent. NEBs/NEIs expressed as percentages of the bill savings are turned into dollars by simply multiplying the percentage times the dollar value of the bill savings.

- **Accuracy of NEB values**: There is not a centralized resource for the savings from any universal energy efficiency program or measure. Similarly, there is not a centralized database of universally applicable NEB values. They vary by target group, measure mix, climate, housing mix and other factors, so in some cases local, program-specific estimates are needed (similar to program-specific impact evaluations and NTG calculations). NEBs also vary in character. Some are financial by measuring life or carrying cost on arrearages. Some are model-based (emissions) or engineering-based (water savings), but others are less so. Some NEBs are transferable, especially, those related directly to financial savings and emissions. NEBs for some programs may include attributable changes in effects like comfort or noise. Although there are defensible survey-based methods for monetizing these effects, economists have expressed concerns that these effects aren't accurate enough to include in an application as important as a million-dollar Benefit-Cost (B/C) Tests implications. The response to this is that the (B/C) Tests regularly use several values with survey-based underpinnings (net-to-gross) or values that are based on aged information (measure lifetimes or incremental measure cost) or "consensus" decision-making (measure lifetimes). In the near term, *inclusion of some* reasonably-well estimated NEBs is better than *exclusion* of NEBs. Each value helps reduce bias in tests.[11]

- **Cost of NEB studies**: NEBs are perceived as expensive to estimate.[12] Some types of studies are more expensive than others (large treatment / control studies), but many NEB studies are very inexpensive. Examples include free or inexpensive third-party models to estimate local / regional avoided emissions and their impacts on societal health, and also inexpensive modes to estimate economic impacts. NEB questions are easily added to impact or process evaluations to ascertain changes in incidence or values associated with of certain impacts. Well-researched third-party sources for valuing impacts (e.g., insurance tables, MEPS health survey, and other data) are available and have been used for decades. NEB calculation models and extensive databases accumulating existing literature values exist. Other NEBs can be estimated with straightforward financial calculations. Very few of these sources are expensive and calculation methods are well-known, having been widely published and evolving since the late 1990s.

- **Program budget concerns**: Program administrators are concerned that NEBs will lead to approval of more programs and exceed available budgets. It is likely, that legislation will rule that all programs that pass (B/C) Tests must be funded, this is likely. If this is undesirable, the state's (C/E) Test with NEBs can be used to better rank the total C/E performance of alternative programs Then the reordered programs can be funded in turn until the allocated budget is exhausted. Other approaches can also be designed. This concern does not have to be a barrier to better, less-biased decision-making.

  However, as mentioned above, in the NJ regulatory context, the adoption of higher NEB/NEI multipliers need not affect program budgets, at least for non-low-income programs. Although some states require funding of all programs that are cost-effective (pass the relevant test), NJ specifies that utilities are required to reach a savings target, but is not required to build everything that is cost-effective.

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[11] In addition, even if a precise point estimate isn't available, if the high and low ranges of a NEB don't change the program decision, the information is improved over using a zero value (perfect as enemy of the good issues).

[12] Considering for value-based decision-making, this may not be true. Many of the most important NEBs can be incorporated into existing process evaluations with marginal cost increases. Arrearage studies are already conducted. Comparing the "bang for the buck" for possible improvements in the overall accuracy of benefit-cost tests, another impact evaluation on a mature or little-changing program might change the benefits (savings) estimate a few percent. Deferring an impact evaluation and conducting a NEBs study would lead to benefits estimate improvements and reduction of bias many times that amount, based on the "math" of a B/C test.

Zero is the wrong number: A few additional concerns include the cumbersome collaborative processes that are sometimes needed to change values, inputs, and other issues. Overall, these concerns led to continued use of "zero" as the value used for a variety of omitted[13] benefits, rather than computing with parallel treatment benefit-cost ratios Including NEBs, even subsets of NEBs, would reduce bias in billions of dollars that are invested in energy efficiency programs across the nation.

Domino Effect: An inventory of state regulatory procedures has shown clear and distinct progress and a domino effect has resulted when incorporating NEBs/NEIs adders. As one state makes progress in including NEBs (and reducing bias), another directly incorporates that progress into their next round of deliberations. Improved values for New Jersey's NEBs can be used to help improve the allocation of funds among the State's energy efficiency programs, and generation alternatives.

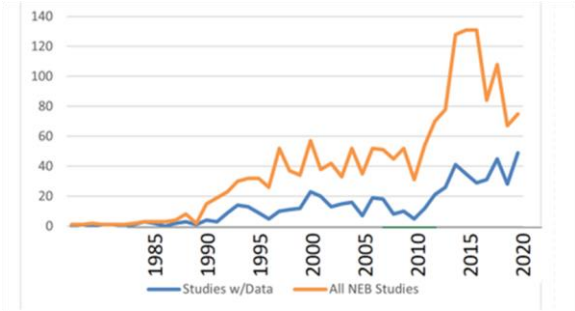
2.2 Brief Background on Monetization of NEB/NEI Effects

NEB / NEI research has been a significant research area in evaluation since the early 2000s, with particular surges in quantitative work since 2015 (see Figure 2.1).

Range of NEB Effects: NEBs/NEIs include a wide range of effects. The high-level categories cover positive and negative "changes: related to:

- **Utility perspective** – changes in: financial / customer payment performance and customer service, avoided low-income subsidies, service and reliability related, and other.
- **Societal perspective** – changes in: economic output / multiplier effects, environmental / emissions effects, health care effects related to reduced emissions, water / wastewater infrastructure effects, and others.

Figure 2.1: NEB/NEI Studies by Year



*Source: SERA **"NEB-It"** Database, Skumatz Economic Research Associates Research 2020-21*

- **Participant Perspective (Residential and Commercial)** - changes in: water and wastewater bills, financial and customer service, hardship (for low income), equipment operations and maintenance, comfort / noise related, health and safety, education/understanding and bill control effects, profitability, property improvements, service reliability, and other effects.

"Tiers" of NEBs / NEIs Categories: There are multiple individual NEBs / NEIs that are rolled up into these larger categories. Publications[14] identify more than 140 specific NEB/NEI effects for the utility, participant (residential and commercial) and social perspectives that have been proposed or estimated. These are sorted into three tiers based on extensive literature review by SERA involving an assessment of their estimate status.[15]

- **Tier 1**: Those commonly and reliably quantified.

[13] NEBs were often called "hard to measure" (HTM) effects.
[14] Skumatz, 2019, IEPEC , and Skumatz 2006 EEDAL for an earlier list.
[15] Skumatz 2019, IEPEC.

- **Tier 2**: Those quantified with increasing research on methods and increasingly defensive estimates.
- **Tier 3**: Those mostly "proposed", some with strong primary impact rationales (others with more secondary rationales), that have not had extensive estimation efforts to date.

Methods for Monetizing NEBs/NEIs: Quantification efforts started in earnest with very comprehensive work for California's low-income programs in 2000[16], and has continued ever since. There are five major quantification approaches for developing monetized NEBs, with each used for different types of NEBs, based on stability and data (and resources) available.[17]

- **Direct measurement**: Some NEBs are directly measured. For instance, a business may measure and monetize the sick days taken before vs. after installation of measures. Other examples include tenant complaints, reductions in worker time or injuries replacing light bulbs, repair calls, or other effects.

- **Incidence -based**: This method uses two inputs: the change in incidence of an effect times the value of each change in that effect. Two of the earliest uses of this approach (from 1995 and 2001) provide good examples. The 1995[18] example used data on the number of explosions avoided due to the gas checks (fixing gas connections on appliances) conducted as part of low-income weatherization. The number of these found within the population was turned into a percentage. That percentage (or incidence of reduction) was multiplied times the property damage and life loss value per fire from insurance tables (a reliable secondary source on values). Similarly, the 2000[19] example used data on the incidence of residential fires caused by specific types of older / faulty equipment that would be replaced by the program, and multiplied that by the insurance table values. Newer examples combine survey-based data with secondary sources on valuation, for instance, household-reported changes in specific illnesses like asthma attacks pre/post program intervention (incidence change) times values for treatment (hospitalization, doctor, medicine, etc.) from the Medical Expenditure Panel Survey (MEPs)[20] survey, which provides values at the state level. These calculations are based on a change (delta) in occurrence that can be associated with a program or measure, times the value of that change. Examples include changes in specific illness occurrences times the cost of hospitalization or doctor visits or other appropriate valuations, changes in fire risk avoided from measures or interventions times the values in terms of property damage or injury or death, or as simple as the change in number of phone calls related to non-payment of bills times the minutes spent per call times the wage rate for utility staff making those calls. Many of the NEBs included in the database were calculated in this manner.

- **Model-based**: Model-based estimation is most prevalent in the societal side. Strong third-party models are available for estimating the economic output and job creation benefits from the manufacture, delivery, and installation of additional energy efficiency measures (IMPLAN™, REMI, and RIMS II™ are some of the most-used examples).[21] The US also has strong and very

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[16] *TechMarketWorks, SERA, and Megdal, , 2001.*

[17] *Elements of this section are derived from multiple previous work by the author, most recently, Skumatz 2022, IEPEC*

[18] *Magouirk 1995.*

[19] *TechMarketWorks, SERA, and Megdal, 2001.*

[20] *https://www.meps.ahrq.gov/mepsweb/*

[21] *Three commonly-used input-output models to estimate used to develop estimates of net job creation or net induced economic effects (output, jobs, tax, etc.) include the private IMPLAN (https://implan.com/) and REMI models (https://www.remi.com/models/), and the BEA's Regional Input-Output Modeling System RIMS II model. https://www.bea.gov/resources/methodologies/RIMSII-user-guide*

simple-to-use models for estimating changes in emissions[22], and societal health effects from emissions reductions[23] (EPA's COBRA™ and AVERT™ models). These third-party models were the source of many estimates, and their use has grown over time. In addition, some utility or government studies (particularly international work, or early studies in the field) relied on local or tailored models for emissions, economic, or societal health effects.

- **Survey valuations**: Some NEBs can only be derived from surveys. Comfort and noise might be able to be externally measured in some way (temperatures, draft/infiltration metrics, noise sensors) but that does not provide a measure of "comfort", or noise that matters to participants. Studies conducted since 2000 have relied on sophisticated methods of valuing these effects through participant surveys (labeled scaling methods)[24], asking them to value these effects relative to the savings or through other methods. A large and increasing number of studies use these methods to measure changes in comfort, internal and external noise, aesthetics, control over bills, and other NEBs with application to some benefit-cost perspectives, and to marketing applications. A large study conducted extensive pre-post-control group work on incidence of illnesses and fires and other effects that have been used to estimate the incidence-based computations of NEBs/NEIs.[25]

- **Financial or engineering calculations**: Financial calculations may overlap somewhat with incidence times value calculations, but examples include lower operations and maintenance (O&M) from installation of LED vs. CFL or other non-LED baseline bulbs using longer lifetime years times lower custodial staff costs per year, or similar calculations. For low-income homes, whose baseline is old equipment replaced by a program before failure, the legitimate value from longer lifetimes would be a financial calculation: the remaining useful lifetime (RUL, often estimated using a proxy of 1/3 of total expected useful lifetime, EUL) times the cost of the measure, discounted. The household can set aside less money for its replacement, saving up over, say, 15 years instead of five years.

Program- vs. Measure-Based NEBs/NEIs: Program-based NEBs/NEIs reflect (and often estimate) the values across the entire population of participants, and the values vary based on the mix and frequency of measures installed. When *estimated* at the program level, these studies sample across the entire population of those that participated, and ask about the NEBs associated with whatever measures the household may have received. The studies then develop estimates of, for instance, the value of comfort and other individual NEBs /NEIs, and total NEBs/NEIs, based on the average participant (household or businesses, per year)[26]. Other studies, and particularly commercial programs, monetize NEBs/ NEIs at

[22] For example, the very easy-to-use, free, Avoided Emissions and generation Tool (AVERT) model, from the US EPA. https://www.epa.gov/avert. This model is used to estimate the regional, state, and county PM2.5, NOX, SO2, CO2, NH3, and VOC emissions impacts of energy efficiency. The combination of AVERT and COBRA are straightforward and easy to run and can take less than half an hour to run. They also bring together a great deal of vetted and reliable literature on these valuations.
[23] For example, the easy-to-use COBRA model. EPA's CO–Benefits Risk Assessment (COBRA) screening model is a free tool that estimates the effects of economic value of the health benefits associated with air emissions reductions (particulate matter (PM2.5), sulfur dioxide (SO2), nitrogen oxides (NOX), ammonia (NH3), and volatile organic compounds (VOCs)) from energy efficiency and renewable programs at the county, state, regional, or national levels. https://www.epa.gov/cobra/what-cobra.
[24] Skumatz 2000-2020, Summit Blue and SERA 2004, NMR Group 2023 and others. Skumatz and Gardner 2002, in ACEEE, showed the significantly better performance (on multiple criteria) from this approach than from willingness to pay, willingness to accept, or bounded WTP and other approaches. Skumatz et. al., 2009 also provides one of the most extensive summaries of the relative results of eight other survey-based methods that have been applied, indicating contingent valuation.
[25] Apprise, 2018.
[26] By the way, the NEBs/NEIs are generally assumed to last as long as the (savings-weighted average) measure lifetimes.

the measure level. These studies sample from the participants having that measure installed, and ask about the NEBs/NEIs reasonably attributable to that measure. Then program-wide NEB/NEI values are calculated by multiplying the results for each measure times the number of that measure installed across the program. Generally, measure-based values are preferred, because they are more flexible and can be recomputed over time as the program measure mix changes. The estimation costs are higher because sample sizes need to be higher. More information on this topic is provided in the literature.[27]

Dollar vs. Percentage NEBs/NEIs: Some studies express the NEB/NEI results in dollar terms, and others express the results in percentage terms, meaning the dollar value can be calculated by multiplying the percentage ties the program's (or measure's) customer bill savings. At the time of estimation, the NEBs can be translated readily from one to the other value, using the customer bill savings as the bridge. However, once studies are conducted, and if this value is not provided in the document, that bridge is lost. Many early studies may have focused on the immediate use of the study (NEBs/NEIs for a particular utility's program at a particular point in time) and may not have foreseen its potential use in other programs or times. The dollar-based values need to be updated based on price inflation since the study, but dollar values also suffer because more needs to be known about the measure mix, size of program (number of types of measures installed) etc. in order to consider transferring the value to use in another situation. Percentage-based values already update for prices (they are multiplied times the current program's bill savings, which are current), but they also help normalize to some degree on the measures or size of program; they vary based on the average participant kilowatt hours saved, which reflects the program size. Certainly, best results are obtained by program- and location- and measure-specific NEBs, but given a choice, percentage-based NEBs/NEIs are likely a more robust source, if only the values, and not much about the underpinnings, are known from the study.

Transferability of NEBs: A key reason literature reviews of NEB studies are conducted is to identify whether there are NEBs that have been estimated in other programs that can be applied to a new program so that research money can be saved. This is transferability.[28]

Of course, NEBs estimated for a specific program are preferred, but transferability, and the chance to compare the consistency of results also has value. Generally, measure-based analysis enhances transferability of NEBs[29] because the NEB/NEI and its cause are directly linked; it allows for changing mix of measures; amount other benefits. However, the transferability is also enhanced if the climate zones are similar, and if the target audience for the program is similar. In addition, generally "normalized" NEBs/NEIs are more transferable than those that are not. Results that are normalized by savings (the percentage vales), or by square foot or other metrics.[30] Importantly, the transferability is also very much affected by type of NEB/NEI, as illustrated in Figure 2.2.

Figure 2.2 Factors affects NEB/NEI Transferability

FACTORS AFFECTING TRANSFERABILITY	
Measures included / Mix	Economic, H&S, Water, Participant effects
Savings-dependent	Payment-related, hardship, other bills, some H&S
Participant targets	Payment-related, hardship, H&S
Housing type	Payment-related, noise
Climate zone & Geog area	Comfort, Payment-related, Economic
Fuel Type	Safety, Comfort
Time of Day	Emissions effects peak/off-peak
FACTORS NOT AFFECTING TRANSFERABILITY	
Measure-invariant NEBs	Emissions, payment-related (purely savings)

Source: SERA 2012, updated

[27] Gardner and Skumatz, 2002, Skumatz and Gibbs EEDAL 2022, Skumatz and Vander Vliet IEPEC 2021 and others.

[28] A detailed discussion of which NEBs can be transferred between different studies is included in Skumatz 2019. This addresses NEBs that are measure-independent (emissions, etc.), location-dependent (economics, comfort, and others), and so on. The study also discussed dependent factors, possible adjustment methods and other topics related to transferability.

[29] See Skumatz and Vander Vliet IEPEC 2021 or Skumatz and Gibbs EEDAL 2022 or Skumatz, Santulli and D'Souza 2019 for recent work in a substantial literature on this topic.

[30] One published study normalized NEBs/NEIs for commissioning by type of building, dollars spent, square foot affected, percentage, incentive provided, and other metrics. See Jennings and Skumatz 2006.

Important Best Practices in Estimating NEBs/NEIs: Basic BMPs for NEBs. From early on, the literature[31] presented information on best measurement practices (BMPs) for NEBs.[32] A review of methods and values from the hundreds of sources examined for the database work provided an opportunity to observe the array of measurement and reporting practices in published reports. Resulting conclusions and recommendations from comparing strong studies to weak studies follow. Core practices include;

1. Most important is to estimate "net" (and attributable) NEBs, meaning:
    a) Net of Positive and negative NEBs,
    b) Net of Net-to-gross (NTG) to avoid taking credit for NEBs not caused by the program.
    c) Net of standard efficiency equipment, meaning program-attributable NEBs should only take credit for the NEBs associated with the extra move to energy efficient equipment, net of any NEBs that would be delivered by installation of the alternative - baseline standard efficiency equipment.

2. Reporting and measurement recommendations for best practices allow for better transparency of the work, and better transferability of the results. These best practices include:
    a) Clearly identify and present NEBs using three perspectives – utility, participant, and societal, using valuation methods appropriate to the beneficiary perspective. These three perspectives make it clear which NEBs are appropriate to include in the major Benefit-Cost Tests.
    b) Use consistent units (usually dollars per participant per year or dollars per measure per year[33]), which can be added, summed, and most importantly, compared among NEBs to readily identify and compare relative sizes of NEBs. This metric supports computation of lifetime NEBs using weighted average measure lives (EULs).
    c) Use appropriate discount rates for present value calculation based on perspective.
    d) Where possible, estimate NEBs by measure to allow for the NEBs to be linked to the causal measures, and to provide NEB values that could be re-weighted as needed during evolution of program measure mix. This makes the NEB values more transferable across and between programs and to other jurisdictions. The most useful and transferable approach is to report the NEB value per participant receiving the measure, separate from the program-wide impact for that measure.
    e) Where possible, examine NEBs by business type (and large and small) for C&I, and by key residential customer groups (including vulnerable groups, for residential measures and programs), in order to allow the NEB calculations to vary as programs may vary targets, or find and allow for revised NEBs estimates as participation patterns evolve over time.
    f) Present NEB results in multiple terms to allow better transferability to the program over time, to be used by other programs, or to allow better comparisons between programs. Present "normalized" results and the underlying elements such as program mix, spending, savings, etc.

Leveraging Previous Work - Model-vs. Literature-Based Sources: Given the choice, using program-wide values "straight from a literature review" of data from other programs and states – particularly dollar

[31] Early work includes Magouirk 1995; Skumatz 1997; Skumatz and Dickerson 1998; TechMarketWorks, Skumatz, and Megdal 2001; Gardner and Skumatz 2002, now augmented by many other studies in the literature.
[32] Based on Skumatz and Gibbs, EEDAL 2022, which abbreviates and summarizes earlier work.
[33] Some are measured percent of the energy savings per year per participant

values - is not ideal. The values are not normalized, and post-work to try to normalize and apply the results to a program is rarely satisfactory. Literature-based results on measure-based NEBs/NEIs will have better outcomes; however, measures are missing.[34] Perhaps the best way to use results from the literature is to use the literature to populate a model that uses a combination of literature and local-based data to estimate tailored NEBs for the program or utility's portfolio.[35] This approach serves two benefits: it provides credible information for the near term, and can identify those NEBs/NEIs or inputs most in need of updating by primary research at the local level. Using dollar figures from a literature review is a weak substitute; percentages are better (normalized), modeling is better yet, and primary work is best.

2.3 Appropriate NEBs / NEIs Depending on Application

NEBs have multiple applications: It is clear, from the breadth of the list of NEB/ NEI categories hinted at above, that NEBs have multiple uses. These are illustrated in Figure 2.3 and include:

- **Marketing and participant ROI**: NEBs/NEIs provide information on beneficial effects to customers that can be easier to market than "energy efficiency".[36] They also help refine calculations of customer ROI from monetized effect beyond energy savings.

- **Program design/refinement**: NEBs/NEIs provide information that can help identify the optimal program measure mix as well as inform the development of optimal measure incentive levels. Negative NEBs are particularly important, as they monetize program barriers, and the information can be used to identify priority barriers in an actionable way, and highlight incentive changes needed to bring customers to participation or installation.

Figure 2.3: Key Uses of NEBs/NEIs

Source: SERA 2015

- **Aligning stakeholders**: The results can be used to clarify to stakeholders along the important "chain" those positive and negative factors affecting customer decision-making regarding measures

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[34] SERA's NEB-It database, which includes measure-based data, was used to match to all the measures in a client utility's portfolio. SERA successfully matched 77% of residential measures, about 40% of commercial measures (the literature is less robust), and up to 70% of upstream/ midstream measures. However, this database is very extensive, including results from hundreds of studies. Measure gaps in the literature remain.

[35] Based on recent experience by the authors, this can take a few weeks (depending on the number of programs) and can cost in the tens of thousands of dollars (well under $100K) to accomplish, depending on the number of programs in the portfolio, for locally-tailored NEBs/NEIs. NEBs/NEIs do not have to be expensive or slow.

[36] Although used for marketing programs by a number of utilities, there are still program administrators that focus outreach on "energy efficiency" or savings. Using specific NEBs/NEIs as a message can appeal to those customers that may not trust delivery of substantial savings. Note that some industry manufacturers have apparently found it effective to use NEBs in their marketing. Specific examples include LG (appliances) and Hunter Douglas (insulating cell-based window coverings). See Skumatz ACEEE 2014.

- **Policy / goals achievement**: NEBs/NEIs are especially important for low-income programs, where policy and goals are rarely only about energy savings. NEBs/NEIs are often direct reflections of these policy goals (e.g., reducing hardship, etc.).
- **C/E tests**: Benefit-cost tests are improved through the inclusion of NEBs/NEIs, as they reduce the bias in these tests.

Note that, beyond these uses, some studies have also applied NEB/NEI results to providing recommendations for market / manufacturer R&D for new measures[37], and other applications.

Negative NEBs/NEIs are Valuable for Examining Barriers: The definition of NEBs / NEIs includes positive *and negative* effects. Negative NEBs / NEIs are a very important type of result. Negative NEBs/NEIs represent barriers for the measure or program, and monetized values provide a great deal more information about the size and importance of barriers – and the level of effort needed for remediation – than does the traditional process evaluation barriers analysis that simply asks scores (1-4, based on Likert Scales).[38]

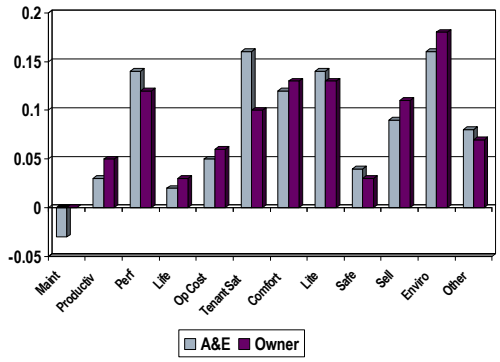
The monetized values, collected from surveys, can provide information on the overall barrier, but also on the distribution of the negative effect among participants, partial participants and non-participants. Unlike score-based barriers analyses, these monetized values provide implementable recommendations,[39] including what it will take – specific incentive levels, warranty visits, etc.) to bring the average (or 75% or other thresholds) respondents from among potential participants to "neutral" or better, preferring to participate in the program or selecting a specific measure.

Figure 2.4: Negative NEBs/NEIs for Residential Solar Programs (NZ)

Negative NEB values / cost of barrier	Solar Water Heat NZ$ / Euros	Solar Design NZ$ / Euros
Appearance (NZ$ / Euros)	-14 / -7	- 3 / -2
Maintenance (NZ$ / Euros)	-9 / -5	- 5 / -3
Other (NZ$ / Euros)	-	- 3 / -2
Total value of Negative NEBs for Measure (and share of energy savings)	-23 / -12 (0.79)	-11 / -6 (.06)

Source: SERA Research 2005

Figure 2.5: NEBs for Commercial Program, including Negative NEBs/NEIs



Source: SERA research 2004

Negative NEBs have been found since the first commercial NEB studies in 1998[40] found negative effects for high-tech HVAC equipment maintenance, up to the present. Figure 2.4 provides a residential example, noting the negative appearance and maintenance values associated with two solar programs in New Zealand. Figure 2.5 provides a commercial example, indicating most NEBs/NEIs for a commercial

[37] See Skumatz EEDAL 2022 and Skumatz ACEEE 2020

[38] The authors have published multiple ACEEE, IEPEC, and other studies – and protocols (in NJ and CT) – that recommend using NEB/NEI approaches for process evaluations analyses of barriers rather than simple scale-based scores.

[39] A barrier score of, for instance, 3.2 does not provide implementable program information, and even information about a decrease in barriers scores from a 3.2 to a 3.0 doesn't provide information on next steps. This battery of questions in the traditional process evaluation is not generally meaningful or useful.

[40] See summary in Skumatz ACEEE 2006.

new construction program were positive, except for maintenance of HVAC equipment, a result found regularly.

The monetized values, collected from surveys, can provide information on the overall barrier, but also on the distribution of the negative effect among participants, partial participants and non-participants. Unlike score-based barriers analyses, these monetized values provide implementable recommendations,[41] including what it will take – specific incentive levels, warranty visits, etc.) to bring the average (or 75% or other thresholds) respondents from among potential participants to "neutral" or better, preferring to participate in the program or selecting a specific measure.

Another example of negative NEBs/NEIs was published in 2022[42], and finds negative NEBs/NEIs associated with smart thermostats. Nearly all NEB studies find some negative NEBs, which are usually overshadowed by positive effects. In this case, the comfort, noise, and aesthetics NEBs/NEIs had a share of negative effects, specifically comfort (harder to control directly/override/get immediate response from); noise from equipment (cycling on/off more often, depending on settings); and aesthetics (more visible, lighting up). Even if the total NEB/NEI value across all participants is not negative findings and values for those experiencing the effect can be useful in identifying R&D or program or marketing priorities.

Uses of NEBs / NEIs: Figure 2.6 shows the array of uses to which NEBs / NEIs are being put. All of these are valid and useful applications of NEBs, and the associated NEBs values warrant estimation; however, this report is focused on NEBs applied to cost-effectiveness tests.

Figure 2.6: Summary of Current Uses for NEB Values (from Skumatz 2009)

	Utility NEBs	Societal NEBs	Participant NEBs
Marketing & targeting		Suitable	Yes
Program refinement	Yes	Yes	Yes
B/C internal customer		Suitable	Yes
Portfolio development	Yes	Yes	Yes
B/C tests	Yes, all tests	Yes, depending on test	Yes, depending on test

Not all NEBs should be used in cost-effectiveness tests: The list of attributable NEBs that have been estimated for the variety of residential, low income, and commercial / industrial energy efficiency programs[43] is very long. It includes more than 140 effects accruing to the utility / program administrator, society, and program participants. Some have been well-estimated, and others are still evolving.[44] However, not all NEBs – even those that have been well-estimated – are appropriate to include in C/E tests. The five standard cost-effectiveness tests are described in detail in Figure 2.7, included later in this document. Not all beneficiaries belong in any particular C/E test (participant NEBs don't belong in the UCT), and not all NEBs accruing to appropriately-included beneficiaries may belong in C/E tests (e.g., increased knowledge). Policy goals also affect what is appropriate in a particular state's C/E test. Only *subsets* of the available NEBs are relevant, depending on the test used. The five

[41] A barrier score of, for instance, 3.2 does not provide implementable program information, and even information about a decrease in barriers scores from a 3.2 to a 3.0 doesn't provide information on next steps. This battery of questions in the traditional process evaluation is not generally meaningful or useful.

[42] Skumatz and Vander Vliet Gibbs, 2021 IEPEC

[43] As well as for demand response, real-time pricing, electric vehicle, R&D, and other programs

[44] A list of "Tier 1", "Tier 2", and "Tier 3" NEBs, including those that have been well and frequently estimated (Tier 1), to those that have not yet been estimated well, is included in Skumatz IEPEC 2019.

tests and their perspectives are described briefly below, and Figure 2.7 identifies the general categories of NEBs that are candidates to be included for each test. The NJCT is a version of the TRC. The most used tests include:

- Total Resource Cost tests (TRC) is meant to represent the utilities and their customers;
- Societal test, a variant of the TRC meant to represent broader social views of cost-effectiveness (adding environmental costs and potentially other elements to the test)
- Participant test is meant to represent the perspective of the participating customers;
- Utility Cost Test (UCT), or Program Administrator Cost Test (PAC), measures costs and benefits to the utility;
- Ratepayer Impact Measure test (RIM), measuring impacts on rates;
- and many other tailored or local variations.

Figure 2.7: NEB Categories Appropriate for the 5 Major Cost-Effectiveness Tests

Beneficiary	UCT/PAT	RIM	PCT	TRC*	SCT*
Utility NEIs	☑	☑		☑	☑
Societal NEIs					☑
Participant NEIs			☑	☑	☑

**The NJCT can be interpreted as either TRC and SCT*
Source: Skumatz and Gibbs EEDAL 2022, Skumatz and Vander Vliet 2021 and earlier

3. CALCULATION OF NJ NEBS USING TWO METHODS

3.1 Approach 1: Review and Analysis of NEB / NEI Adders Used Across the US

Current NEB "adder" values used in NJ: New Jersey has recognized NEBs at least since the 2020 Board Order.[45] The State of NJ applies a proxy 5% adder for NEBs for all non-low-income programs, and a 10% adder is applied for low income (LI) programs. The NEB adder for low-income accounts for additional hard to measure benefits (including health and safety). The NEB adder for non-low-income programs accounts for NEBs not already accounted for in the NJCT that are difficult to quantify including public health, water and sewer benefits, economic development, etc. The TRC cost test accounts for other fuel savings, and water, but the values are not incorporated in practice. Specific values for health benefits from emissions avoided were sourced from COBRA / EPA studies. The LI programs don't need to pass cost-effectiveness (C/E) screening. All 5 standard (California) tests, plus the NJCT are used, with a focus on the TRC and PCT. This study reviews whether more defensible updated values may be available for use in NJ going forward.

NEB Adders in Other States: The literature on NEBs has evolved through several levels of maturation,[46] and now consists of more than 800 studies of various types with quantitative NEB values including results from programs around the country. Estimation methods[47] and consistency of values for many utility-, societal-, and participant-perspective NEBs has improved, and NEBs have become more familiar, through their use in marketing and other applications across North America. As a consequence, nearly two dozen states have already come to include some NEBs-related treatment in their regulatory benefit-cost testing procedures. Some take the form of "adders", and effectiveness others allow inclusion of subsets of "readily measured" or specific NEBs in benefit-cost tests, and the list is growing.

The NEB / NEI adders for states across the US are included in Figure 3.1. This table also provides the primary tests used in each state. Figure 3.2 shows that half the states incorporate adders into their tests. Figure 3.2 below analyzes the range and average values for these adders around the US.

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[45] Source for NJ values: NJ BPU Order for Clean Energy and Energy, Order Adopting the First New Jersey Cost Test, Docket Number QO19010040, Docket Number Page QO20060389, Non-Energy Impacts section, page 29, Agenda date 8/24/20, Agenda item 8A.

[46] The evolution included four stages. Stage 1 (1994-1998) involved background organizing NEBs into perspectives, identify measurement principles for "net" NEBs, and preliminary estimations of two dozen categories. Stage 2 (1998-2001) included early rounds of documented derivations / estimates of NEBs, suggested incorporation into B/C tests, refinement of three main NEB estimation methods (models, incidence times valuation, and survey-derived estimates), and work on academic basis for survey approaches. Stage 3 (2001-present) included continuing expansion of estimates to more types of programs, enhancements of best practices, increasing familiarity of NEBs among stakeholders, application to marketing, and peer reviewed publications of results. Stage 4 (2008 to present) includes a period of refocus on the role of NEBs in regulatory and benefit-cost test applications.

[47] Estimation methods described earlier in this report.

Figure 3.1: NEB / NEI Adders in States Across the US

NEB/NEI Incentives or Adders in State Cost Tests – All sectors / All-inclusive[48]

(Source: SERA 2021-2023 research)

Incentives & Adders for NEBs in State Cost Tests (sorted by ACEEE State Scorecard Rank)

Omitted states do not have adders

Full Societal Cost Test (SCT) uses Utility(U), Participant (P), and Societal (S) NEBs. Total Resource Cost Test (TRC) uses U and P NEBs; Participant Cost Test (PCT) uses P NEBs.

State	ACEEE Rank	% Elec	% Gas	Extra for low income	Inventory comments	Primary Test
CA	1	Monetized enviro			$30/T attrib. GHG reductions	TRC
MA	2	Monetized extensive list			Reliably measured and with real economic value; extensive list included in TRM	TRC
NY	3	Monetized enviro			$15/ton adder for carbon; (NY/NYSERDA)	SCT
VT	4	15%	15%	15%	15% adder, 10% cost reduction for risk and flexibility, +15% low income. Also value of $100/ton of CO2 for RGGI	SCT
ME	5	Measured values allowed			TRC accounts for AvC fossil fuel, supply water/wastewater. Economic development, job creation, productivity, environmental benefits allowed IF they can be quantified and valued. Also target 10% of program funds for LI.	State-Specific TRC
DC	6	30%	30%	Incl.	10% adder, 10% risk, 10% environment, + NEIs in goals / measured	SCT
MD	7	Monetized NEI; others encouraged			1.115 cents/kWh; + measured per Order 87082 + List / values included in TRM	TRC
RI	7	Monetized in TRM			TRM includes estimated values.	State-Specific
CT	9			Monetized LI	Low-income NEBs in TRM used; other Residential & C&I NEBs not used	UCT
MN	10	Monetized enviro			Monetized enviro damanges include, values include federal social cost of carbon.	SCT
OR	11	10%	10%	incl.	10% adder plus "easily measured" and $15/ton carbon	TRC, UCT
WA	11	10%	10%	Incl.	10% adder plus measured plus monetized elements. Howeer, adder is no longer used in overarching regulatory cost-effectiveness submittals.	TRC
CO	13	10%	5%	15%	10% electric, 5% gas, 25% low income	TRC
NJ	14	5%	5%	10%	Proxy 5% adder for NEBs for all non-low-income programs; 10% adder applied for low-income programs.	TRC, PCT
IL	16	10%	10%	Incl.	10% electric, 7.5% gas (Ameren) DCEO 10% adder; ComEd NA + emissions $0.0139/kWh red'n	TRC
DE	18	Monetized enviro		Monetized LI	Quantified LI NEIs $182/home/yr; Values for carbon & water available.	TRC
NH	19	Monetized enviro			Granite State Test, NEBs only in secondary test; <10% adder recently removed>; values included in TRM.Cost of enviro compliance incl.	TRC
NV	21	10%	10%	15%	Nevada accounts for numerous avoided environmental compliance costs, incl water, and program economic benefits. Includes NON-ENERGY benefit riders for NTRC test using adders: Non- low-income programs, low-income programs, and combined programs use 10%, 25%, and 15% multipliers respectively.	TRC
NM	23	15%	15%	10%	NEEP 2017 and CPUC 2012 report 15% adder; low-income weatherization has multiplier of 1.25 for benefits.	UCT
UT	23	10%	10%	Incl.	Low-income environmental adder of 10% if regulators allow. One source says 10% LI; other doesn't call out Low income. 10% adder to benefits to account for non-quantified enviro & NEBs for conservation resources over supply-side alternatives.	UCT
WI	26	Monetized enviro			$30/ton carbon; participant: water conservation, property values; Societal: economic, emission, water, purchase deferral, property values; values included in TRM.	TRC
MO	29			NEBs allowed if measured, LI	NEBs can be included if they result in avoided utiltiy costs that can be calculated with confidence. Also can include: participant economic well-being (property value), O&M, water. Utility well-being can be included: payment behavior (arrearage, term/reconnections, collection/notices). LI programs do not have to pass C/E test.	TRC
MT	29	10%	10%	Incl.	10% environmental adder. Though not included in the primary total resource cost test, a 10% environmental adder incorporated into the societal cost test is intended to account for the NON-ENERGY benefits of EE. The adder functions as an upward adjustment to utility avoided costs. The adder approach is generally considered easy to apply and an effective way to account for external environmental benefits.	TRC
ID	33	10%	10%	Incl.	Percent & Measured. Utilities use 10% conservation benefit adder to calc C/E of DSM including low income; PLUS in area of participant health benefits, readily quanitifed NEBs with 10% adder for HTM NEBs. Utilities can claim $1 of NEBs for each dollar of federal funds invested in H&S and repair measures.	UCT
IA	35	10%	7.5%	Incl.	10% electric, 7.5% gas	SCT
WY	51	10%	10%		10% Enviro adder for Low Income C/E if regulators allow	TRC

[48] Note that the State of Maryland has probably adopted the most progressive, but logical, language. In 2015, Order 87082 suggested that the test should include the NEBs that had been estimated in the most recent NEBs study, and going into the future, as additional NEBs estimates are developed that are for the relevant perspectives(s), they should be incorporated. See Malmgren and Skumatz 2014, Skumatz 2014, Skumatz ACEEE 2018.

Figure 3.2: Range and Average of State NEB / NEI Adders

SUMMARY TABLE	Electric	Gas	Extra add-on for Low Income
Number incl. NEBs=26			
Number with % adders	14	14	5
Average Adder	12%	11%	13%
Min Adder	5%	5%	10%
Max Adder	30%	30%	15%

Source: SERA research, 2023

Note that existing state multipliers are conservative and are not based on recent literature. Many of the existing NEBs/NEIs from other states have been in place for perhaps a decade. They are not based on the most recent data, which would tend to support addition of the broader array of NEBs/NEIs that have received significant attention in the interim. Use of existing state multipliers for setting new NJ values will, therefore, tend to lead to a conservative value. NJ's 2020-adopted values (5%), and any update based on the state multipliers around the US, are both likely more conservative than the literature from today or 2020 would support.

3.2 Approach 2: Literature-Based Analysis and Results for NEB / NEI Values

This Study's Methods and Areas of Focus: This study updates previous SERA work[49] reviewing the "state of NEBs" across three program sector areas:

1) low income (mostly weatherization programs);
2) residential (a variety, but largely focused on weatherization), and
3) commercial programs (a variety of program types).

The analytical work in this study relied on SERA's ***"NEB-It"*** database, which accumulates the NEB values (in dollar or percentage multiplier terms) from more than 600 national and international studies conducted from 1998 through 2022. The entries for each NEB were reviewed in detail.[50] The NEB values – in dollar and percentage terms – were estimated using a large number of programs in each of the sectors above. In each case, the NEBs / NEIs in dollar terms are presented on the left, and the percentages are on the right.

The Figures below provide summaries of:

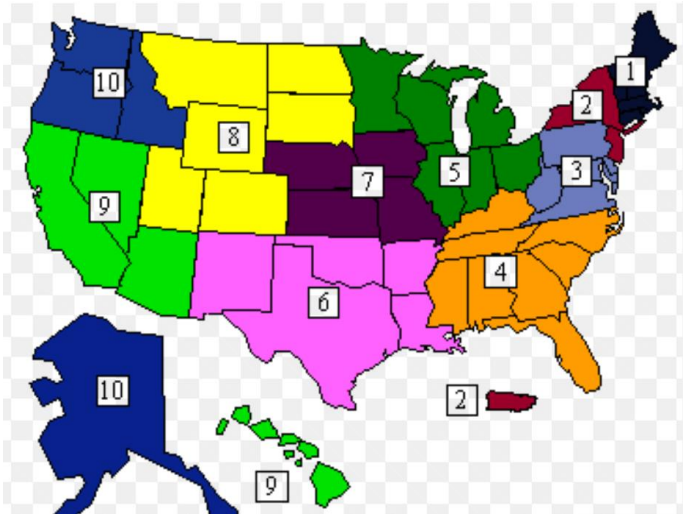
- The ranges and average values for the NEB categories nationally.[51]

[49] *Skumatz, ACEEE 2014, Skumatz ACEEE 2018, Skumatz, Santulli and D'Souza 2019, Skumatz and Vander Vliet EEDAL 2022.*
[50] *The authors reviewed the values, distributions of values, ranges, etc., and deleted outliers, based on knowledge of the literature, methods applied, reliability, etc.*
[51] *The table includes ranges and "typical values" for major NEBs categories. Some studies provided only dollar values; others provided values in terms of multiples of bill savings; other provided both. However, the studies available for the two comparisons (percentage multiplier relative to bill savings, vs. dollar adders) were not the same. For this reason, the ranges and "typical" values will not quite translate between the two treatments. Percentage adders may be the simpler treatment, allowing computation of a multiplicative adder onto existing bill savings in the B/C ratio computation, simpler translation to scaling of program sizes, and more direct translation to an "adder". However, both provide valuable information.*

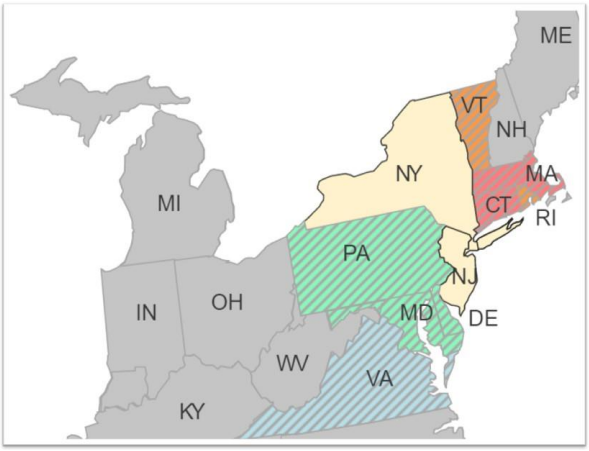
- A "best-suited" NJ value. The preference was for NJ studies, then studies from the EPA region or nearby states, and then data from other states or national studies are considered, but are a lower priority. Note that NJ did not have any studies in the literature. The next nearest states (adjacent or near-adjacent) in order of adjacency are NY, PA, DE, CT, MD, VA, MA, and RI. NY is in the same region; however, recent NY studies are largely measure-based and program-wide studies are older and the non-environmental studies are not used in official tests.[52] PA and VA, generally do not have NEB/NEI studies, and DE largely uses values from other states (MA, MD). CT, MA, MD, and RI all have strong, vetted, NEI studies that are applied and/or included in their TRMs/PSDs. Even the most distant of these states is only about 200-250 miles from NJ's border.
- The figures for each sector also include values included as "accepted" values in TRMs for various states.

Figure 3.3: EPA Regional Offices

EPA Regional Offices - National



Close-Up of EPA Regions 1, 2, 3



National NEB Ranges by Sector, and Rationale for Including / Not Including Specific NEBs/NEIs

Figures 3.4, 3.5, and 3.6 show the estimated ranges of NEBs/NEIs for the low-income, residential, and commercial sectors, respectively. **It is very important** that the reader understands that the population of studies used for the dollar side of the table vs. the multiplier side of the table are separate and distinct. They are not the same list of studies. Some studies in the literature opt to estimate NEBs in dollar terms; others choose to present the results in terms of the value of the NEBs as a multiple of the participant bill savings (retail). Therefore, the numbers are not translatable "across the line".

The following summary tables of data from the literature were assembled and analyzed by the authors. These results were used to develop the values included in the next section of this report. The Figures below provide summaries of the ranges and average values for the NEB categories nationally for the three sectors. Clearly, NEBs vary by many factors, but overall, societal and participant NEBs/NEIs can be large.

[52] *Including work by the author*

Figure 3.4: Residential Low-Income NEBs per Participant per Year ($ and % Values from Literature / SERA NEB-It Database)

Residential Low Income NEB/NEI Values per participant/yr ($ & %)

Subtotals by major categories Weatherization Programs	Selected	$ NJ Best Fit	Dollar NEB Values Nat'l Range Low-High		National Average	Selected	% NJ Best Fit	Percentage NEB Values Nat'l Range Low-High		National Average	Average TRM Value (CT %)
UTILITY PERSPECTIVE											
Payment-related	$10.59,4.6%	$15.18	$0.99 -	$82.61	$16.05	3.4%	3%	3% -	18%	10%	0.0%
Added if Low Income subsidies avoided		$18.09	$3.00 -	$91.96	$24.87		0%	0% -	0%	0%	0.0%
Service Related		$8.29	$0.08 -	$20.13	$8.07		19%	12% -	24%	19%	0.0%
Other Primary Utility		$7.21	$2.20 -	$11.25	$7.21		7%	3% -	10%	7%	0.0%
TOTAL UTILITY NEBs		$48.77	$6.26	$205.95	$56.21						
UTILITY NEBs MULTIPLIER (NJ Savings $228.02)		21%	3%	90%	25%		29%	17%	52%	36%	0%
SOCIETAL PERSPECTIVE - ECONOMIC											
Economic		$350.37	$36.49 -	$510.7	$216.30		842%	332% -	1144%	817%	0.0%
TOTAL SOCIETAL NEBs		$350.37	$36.49	$510.74	$216.30						
SOCIETAL NEBs MULTIPLIER		154%	16%	224%	95%		842%	332%	1144%	817%	0%
SOCIETAL PERSPECTIVE - NON ECONOMIC											
Environmental / Emissions		$53.93	$0.84 -	$534.00	$68.90		25%	15% -	35%	25%	0.0%
H&S equipment / fires		$43.80	$27.73 -	$64.61	$44.44		20%	20% -	20%	20%	0.0%
Health Care		$486.52	$85.19 -	$760.38	$488.22		0%	0% -	0%	0%	0.0%
Water / Wastewater infrastructure		$13.97	$2.32 -	$32.48	$13.97		0%	0% -	0%	0%	0.0%
			-					-			
TOTAL SOCIETAL NEBs		$598.22	$116.07	$1,391.47	$615.52						
SOCIETAL NEBs MULTIPLIER		262%	51%	610%	270%		45%	35%	55%	45%	0%
PARTICIPANT PERSPECTIVE											
Water and Other bills	$9.12,6%	$8.70	$3.31 -	$109.36	$24.48		0%	0% -	0%	0%	0.0%
Financial / customer service		$19.74	$15.86 -	$31.57	$20.82		0%	0% -	0%	0%	0.0%
Hardship	$75.50,33%	$73.32	$21.19 -	$277.42	$74.10		44%	10% -	89%	44%	0.0%
Equipment O&M, performance		$173.88	$32.88 -	$409.72	$155.08		8%	2% -	28%	13%	8.0%
Comfort, Noise, Related		$259.53	$63.05 -	$456.36	$226.94	46%	46%	26% -	60%	45%	36.0%
Health / Safety		$163.08	$9.11 -	$289.68	$131.09		0%	0% -	0%	0%	0.0%
Control / Education and Contributions		$60.52	$12.39 -	$96.43	$57.72		0%	0% -	0%	0%	0.0%
Property Improvements		$54.39	$11.82 -	$284.14	$74.95		12%	4% -	26%	14%	11.5%
Special / reliability / other		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0.0%
TOTAL PARTICIPANT NEBs		$813.15	$169.61	$1,954.68	$765.17						
PARTICIPANT NEBs MULTIPLIER		357%	74%	857%	336%		110%	42%	203%	116%	56%

Figure 3.5: Residential Non-Low-Income NEBs per Participant per Year ($ and % Values from Literature / SERA NEB-It Database)

Residential Non-Low Income NEB/NEI Values per participant/yr, $ & %

Subtotals by major categories Weatherization Programs	Selected	$ NJ Best Fit	Dollar NEB Values Nat'l Range Low-High		National Average	Selected	% NJ Best Fit	Percentage NEB Values Nat'l Range Low-High		National Average	Average TRM Value (% CT)
UTILITY PERSPECTIVE											
Payment-related		$7.48	$2.97	$11.56	$7.48		0.00%	0.00%	0.00%	0.00%	0.0%
Added if Low Income subsidies avoided		$0.00	$0.00	$0.00	$0.00		0%	0%	0%	0%	0.0%
Service Related		$4.77	$0.60	$9.78	$4.77		0.00%	0.00%	0.00%	0.00%	0.0%
Other Primary Utility		$0.00	$0.00	$0.00	$0.00		7%	6%	7%	7%	0.0%
TOTAL UTILITY NEBs		$12.25	$3.57	$21.34	$12.25						
UTILITY NEBs MULTIPLIER (NJ Savings $145.37)		8%	2%	15%	8%		7%	6%	7%	7%	
SOCIETAL PERSPECTIVE - ECONOMIC											
Economic		$9.59	$2.61	$20.56	$9.59		0%	0%	0%	0%	0.0%
TOTAL SOCIETAL NEBs		$9.59	$2.61	$20.56	$9.59						
SOCIETAL NEBs MULTIPLIER		7%	2%	14%	7%		0%	0%	0%	0%	
SOCIETAL PERSPECTIVE - NON ECONOMIC											
Environmental / Emissions		$69.81	$0.18	$258.72	$69.81		0%	0%	0%	0%	0.0%
H&S equipment / fires		$0.00	$0.00	$0.00	$0.00		2%	1%	2%	2%	0.0%
Health Care		$0.00	$0.00	$0.00	$0.00		0%	0%	0%	0%	0.0%
Water / Wastewater infrastructure		$0.00	$0.00	$0.00	$0.00		0%	0%	0%	0%	0.0%
TOTAL SOCIETAL NEBs		$69.81	$0.18	$258.72	$69.81						
SOCIETAL NEBs MULTIPLIER		48%	0%	178%	48%		2%	1%	2%	2%	
PARTICIPANT PERSPECTIVE											
Water and Other bills	6%	$8.12	$3.45	$18.15	$8.12		0%	0%	0%	0%	0.0%
Financial / customer service		$5.80	$0.25	$8.47	$4.45		0%	0%	0%	0%	0.0%
Hardship		$0.00	$0.00	$0.00	$0.00		0%	0%	0%	0%	0.0%
Equipment O&M / Performance		$228.97	$40.92	$415.88	$221.30		16%	5%	19%	13%	0.0%
Comfort, Noise, Related		$243.75	$44.99	$478.16	$237.63		40%	34%	51%	42%	0.0%
Health / Safety		$17.30	$0.02	$43.74	$17.77		0%	0%	0%	0%	7.0%
Control / Education and Contributions		$45.34	$15.56	$80.84	$48.65		11%	8%	13%	11%	43.0%
Property Improvements		$486.53	$67.76	$583.59	$257.54		19%	11%	28%	19%	0.0%
Special / reliability / other		$0.00	$0.00	$0.00	$0.00		10%	4%	15%	10%	0.0%
TOTAL PARTICIPANT NEBs		$1,035.81	$172.96	$1,628.82	$795.45						
PARTICIPANT NEBs MULTIPLIER		713%	119%	1120%	547%		96%	62%	126%	95%	50%

Figure 3.6: Commercial NEBs per Participant per Year ($ and % Values from Literature / SERA NEB-It Database)

Commercial NEBs/NEIs Values Per Participant/yr - $ and %

Subtotals by major categories	Selected	$ NJ Best Fit	Dollar NEB Values Nat'l Range Low-High		National Average	Selected	% NJ Best Fit	Percentage NEB Values Nat'l Range Low-High		National Average	Average TRM Value (%, CT)
UTILITY PERSPECTIVE											
Payment-related		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Added if Low Income subsidies avoided		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Service Related		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Other Primary Utility		$0.00	$0.00 -	$0.00	$0.00		7%	6% -	7%	7%	0%
TOTAL UTILITY NEBs		$0.00	$0.00	$0.00	$0.00						
UTILITY NEBs MULTIPLIER (NJ savings $324.71)		0%	0%	0%	0%		7%	6%	7%	7%	0%
SOCIETAL PERSPECTIVE - ECONOMIC											
Economic		$0.00	$0.00 -	$0.00	$0.00		160%	6% -	492%	160%	0%
TOTAL SOCIETAL NEBs		$0.00	$0.00	$0.00	$0.00						
SOCIETAL NEBs MULTIPLIER							160%	6%	492%	160%	0%
SOCIETAL PERSPECTIVE - NON ECONOMIC											
Environmental / Emissions		$0.00	$0.00 -	$0.00	$0.00		44%	3% -	80%	44%	0%
H&S equipment / fires		$0.00	$0.00 -	$0.00	$0.00		4%	2% -	7%	4%	0%
Health Care		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Water / Wastewater infrastructure		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
			-					-			
TOTAL SOCIETAL NEBs		$0.00	$0.00	$0.00	$0.00						
SOCIETAL NEBs MULTIPLIER		0%	0%	0%	0%		49%	5%	87%	49%	0%
PARTICIPANT PERSPECTIVE											
Water and Other bills		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Financial / customer service		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Economics, Profitability		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Equipment O&M / Operations		$54.98	$1.14 -	$130.20	$54.98	23%	21%	9% -	36%	23%	0%
Comfort, Noise, Related		$134.98	$83.37 -	$166.74	$134.98	26%	31%	21% -	57%	37%	0%
Health / Safety		$0.00	$0.00 -	$0.00	$0.00		0%	0% -	0%	0%	0%
Control / Education and Contributions		$35.75	$6.42 -	$65.10	$35.75		33%	12% -	95%	42%	0%
Facility Improvements		$0.00	$0.00 -	$0.00	$0.00		6%	2% -	11%	6%	0%
Special / reliability / other		$0.00	$0.00 -	$0.00	$0.00		9%	4% -	11%	9%	0%
TOTAL PARTICIPANT NEBs		$225.71	$90.93	$362.04	$225.71						
PARTICIPANT NEBs MULTIPLIER		70%	28%	111%	70%		100%	48%	210%	116%	0%

The next section walks through the various NEB categories, and considerations for pursuing assigning values for use in developing updated NEB/NEI estimates for NJ adders.

Utility Perspective Considerations (used in all tests)

- **Include utility arrearage / financial impacts for the low-income perspective**: Arrearage studies for low-income programs have been conducted since the 1990s. Lower bills lead to improvements in payment behavior, and the utilities benefit financially in several ways: reduced carrying costs on arrearages, lower bad debt, fewer bill-related calls and collection costs, fewer shut-offs, etc. These benefits are a well-accepted element in low-income NEBs/NEI work, and show quantified effects. Values of fairly similar magnitude were available from both the vetted TRM source and from the literature. Note that if the utility provides low-income subsidies, an adder associated with those savings may be considered, if not already incorporated elsewhere. Zero impacts from this source are included in the residential and the commercial programs.

- **Consider including reductions in low-income subsidies**: The utility and its non-participant ratepayers experience direct reductions in revenue requirements when program-installed measures reduce the energy use and financial subsidy received by low-income households. These NEBs/NEIs can be directly calculated. This effect is larger the larger the subsidy offered, and could be included in the adder if the subsidy offered by NJ utilities is substantial.

- **Omit include Utility-perspective T&D, or reliability estimates.** Transmission and Distribution (T&D)/ reliability / infrastructure[53] NEB/NEI effect are derived from lower generation and use of energy. However, quantitative NEB/NEI estimates are not yet strong, and elements of these factors are included in various other places in the NJCT.

Societal Perspective Considerations (used in Societal Cost Test)

- **Exclude societal emissions, economic, and health impacts from all perspectives:** These values are being derived through a separate modeling effort. The public health impacts and economic impacts are specifically called out in the intended NEB effects / adders list.

- **Do not include societal water/water estimates yet:** The NEB/NEI values associated with these factors are not well-estimated yet, and need very local data. This information was not readily available from the literature. "Next" water sources in NJ are also not as imminent a problem (and thus, not as costly) as some other areas of the country, like California.

Participant Perspective Considerations (Used in Participant test, RIM, TRC)

- **Include participant water / wastewater savings:** Reductions in water / wastewater bills from low-flow water-related equipment have been a long-standing NEB / NEI attributable to programs in low-income, residential, and commercial programs. They are substantial, directly

[53] The authors did not find extensive literature on the reliability factor, although this would be an appropriate addition to this base factor for the hybrid adder. Factors for T&D losses have been estimated and applied in a few locations. In some utilities, T&D, line loss, and environmental compliance values (or some subsets) are already included in avoided cost figures for energy, and should not be double-counted in those cases.

calculable, and a financial savings benefit to households. Although they may also be for businesses, there was not a substantial literature on this value. Water / wastewater benefits are specifically called-out in the description of effects intended to be reflected in the NEBs / NEIs adder. The values developed include a special adder to be included for residential and low-income programs that provide water measures. Commercial should be examined in the future.

- **Include participant hardship improvements benefits for low-income**: Low-income programs often de-emphasize goals of energy savings and emphasize goals of reducing hardship. Hardship can be defined to include elements of financial hardship, quality of life, and maintaining the ability to stay in the home. A review of the literature focused on hardship found multiple quantitative studies, and the hardship NEBs/NEIs were substantial; hence, an adder for low-income is recommended.

- **Include participant O&M / equipment impacts**: The effects included in this category include changes in operating costs, maintenance costs, performance, lifetime, and similar impacts for program-installed efficient equipment compared to new/replacement standard efficient equipment. Studies estimating these effects include a combination of financial-based calculations and incidence and value computations. These effects are included in the values table provided.

- **Include participant comfort / noise impacts**: This category includes participant effects related to heat/cold comfort and thermal stress, and internal (equipment) and outside noise primarily associated with HVAC, appliance, and insulation measures. These factors for residential, low-income, and commercial weatherization, new construction, and retrofits programs are substantial and fairly consistent. Given that most of these impacts are caused by measures related to HVAC (or insulation), rather than overestimate NEBs/NEIs across the portfolio, the quantitative values provided include this as an "adder", for the programs where these measures occur.

- **Include participant health / safety impacts**: Health and safety impact to the households represent additional value. Rather than measuring broad (and hard-to-quantify, vague) "health" benefits, most recent studies focus efforts on using surveys or other sources to estimate incidence changes in specific illnesses (asthma, allergies, and cold symptoms are common), and multiplying attributable incidence changes times local / state cost values (doctor visit and other costs) from reputable sources. These health impacts tend to be associated with the HVAC (and insulation) measures, as they relate to indoor air quality (IAQ) and thermal heat stress. Health and safety effects (particularly for low-income) are called out as intended to be reflected in the NEB/NEI adder. This study recommends that factor be embedded into the extra incremental NEB/NEI percentage adder associated with programs that include "HVAC" measure.

- **Omit control / education and contributions**: Certain programs (behavioral, weatherization, and others) deliver other benefits to households, including improved knowledge in how to control their bills, which can sometimes be an objective of the programs. The other portion of this category relates to the positive energy that participating in "green" programs can have for participants, some of whom have limited abilities to provide green contributions in other ways (e.g., low-income). These two types of impacts are important, but are somewhat indirect in

their effects, and are therefore, excluded from the NEB/NEI values provided and used for cost-effectiveness test purposes. Note that this does not mean they aren't valuable for outreach / marketing or other purposes.

- **Omit property improvement impacts**: Some programs provide direct improvements like porch / window repairs or other upgrades. These are valued by individual households, but also neighborhoods at large (the societal portion of this impact has not been well/widely-estimated). The value of these impacts is best measured as the cost of the improvement, and these costs are generally included in the benefit-cost analysis. Other studies have estimated impacts related to improvements in property value or ease of selling / renting due to the program's interventions. Unless studies very carefully conducted, there can be concern that these impacts double-count the other NEBs/NEIs recognized in other categories (lower operating costs, etc.) and are therefore, omitted from the values provided regarding the cost-effectiveness adder.

Selecting Literature-Based Inputs and Values for NJ

The development of the values considered the following information, steps, and hierarchies:

- TRM values were given high priority; these are values that have gone through a strong vetting process.
- Percentage values were preferred over dollar values, because they are inherently normalized, and because the end product was to update a percentage (or multiplier)-based "adder" for the NJCT and because most state adders are conducted using this approach.
- NEBs that were related to the goals and statements related to NJ's NEBs and to the CEA goals were given preference. The terminology from the Board Order[54] generally includes:
    - The NEB adder for low-income accounts for additional hard to measure benefits (including health and safety). The NEB adder for non-low-income programs accounts for NEBs not already accounted for in the NJCT that are difficult to quantify including public health, water and sewer benefits, economic development, etc. The TRC cost test accounts for other fuel savings, and water, but the values are not incorporated in practice. Specific values for health benefits from emissions avoided were sourced from COBRA / EPA studies.
- NEBs that were most relevant to cost-effectiveness and direct benefits were given preference.
- NEBs that were known to have better estimation methods, or had narrower ranges or had local values were given preference.

Results, Sources, Derivation and Considerations

This section walks through the specific sources and computation of the NEB/NEI values, building up from individual NEBs. The following tables identify NEB/NEI categories selected in and out to develop the elements of the estimated NEBs. This section of the report includes the following:

[54] *Source for NJ values: NJ BPU Order for Clean Energy and Energy, Order Adopting the First New Jersey Cost Test, Docket Number QO19010040, Docket Number Page QO20060389, Non-Energy Impacts section, page 29, Agenda date 8/24/20, Agenda item 8A.*

- Figures 3.7-3.10. In these tables, research from the literature is represented as selected into the estimate. These values are all from TRMs from nearby states, and have been vetted via state processes. A "1" in the "selected" column in the table means "include" vs. "0" for exclude. The totals at the bottom are the values to be carried forward to the later aggregation table (Figure 3.13) for the NEBs for each sector. The tables walk through NEBs/NEIs for low income and residential subgroups.
- Figure 3.11 shows the assumptions about the template programs used for the calculations and adjustments, especially for translating dollar NEB/NEI amounts from the literature into multipliers for each sector.
- The large nationwide summary tales presented above are also used in selecting values, and recommended values use the hierarchy noted previously. Tables 3.9-3.12 address each sector. If there is a value in "selected", that value is an additional NEB to be included in the aggregator table of values by sector (Figure 3.13).

The sources for the numbers used follows. The final portion of this section addresses caveats associated with the selections and sources.

Figure 3.7: Residential Low-Income NEBs (% Values from CT) – Participant Comfort / Health / O&M / Noise NEBs

	Residential Low Income NEB Values (from CT TRM)			
Multiplier in TRM	Units	Incl(1)/Excl(0)	SERA NEB Name	NEB Description - Participant NEBs
0.03	Mult. % of Energy Savings	0	P_Aesthetic	More Attractive windows, appliances, // Ease of Selling Home / look of lighting
0.7	Mult. % of Energy Savings	0	P_Aggregate	For NEB values displaying overall program benefits
0.17	Mult. % of Energy Savings	1	P_Comfort	Comfort
0.07	Mult. % of Energy Savings	1	P_Health (aggregate	Health Benefits (aggregate)
0.14	Mult. % of Energy Savings	0	P_Lighting Quality	Lighting Quality
0.08	Mult. % of Energy Savings	1	P_O&M	Equipment Maintenance/Replacement//Customer O&M savings,
0.05	Mult. % of Energy Savings	0	P_Outside Noise	Noise Reduction (external) Less outside noise
0.06	Mult. % of Energy Savings	1	P_Overall Noise	Noise reduction not specifice or combined internal (appliance) /
0.07	Mult. % of Energy Savings	0	P_Property Value	Increased asset value// Property Value Increase
1.37		***0.38***	***38.0%***	Total NEB Multiplier

***Source for Values**: Participant NEBs Comfort / Health / O&M / Noise: NMR Group, Inc, 2016, "CT Project R4 HES/HES-IE Process Evaluation and R31 Real-time Research", prepared for CTEEB, New Britain, CT. Also included in Eversource, 2020, "CT Connecticut's 2020 Program Savings Document (PSD)". Values translated to 2022 Dollars.*

Figure 3.8: Residential Low-Income NEBs ($ Values from RI) – Utility Financial / Arrears NEBs

	Residential Low Income NEB Values (from RI TRM)				
Dollars in TRM	Units	Est. Multip.	Incl(1)/Excl(0)	NEB Name	NEB Description - Utility NEBs
$3.74	$/partic./yr	0.016	1	U_Bad Debt	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills
$2.67	$/partic./yr	0.012	1	U_Ar	Reduced carrying cost to utility from arrearages
$0.58	$/partic./yr	0.003	1	U_CustCalls	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments
$0.34	$/partic./yr	0.001	1	U_Notices	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations
$0.43	$/partic./yr	0.002	1	U_Shutoff/Reconn	Reduced costs associated with terminations and reconnections to utility due to nonpayment as a result of customers being more able to pay their lower bills
$7.76					Total dollar-based NEBs for Low Income Program (from RI TRM)
$228.02					Estimated savings from Low Income program (NJ)
0.034		0.034	***0.034***	***3.4%***	Estimated Multiplier using NJ program savings

Source: Values from: National Grid, 2022, "RI Rhode Island Technical Reference Manual 2022 Program Year". Original source for TRM is NMR Group and Tetra Tech, 2011, "Massachusetts Program Administrators: Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation," August 15, adjusted to 2022 dollars.

Figure 3.9: Residential Non-Low-Income NEBs (% Values from CT) – Participant comfort / Noise/ O&M NEBs

	Residential NON Low Income NEB Values (from CT TRM)			
Multiplier in TRM	Units	Incl(1)/Excl(0)	SERA NEB Name	NEB Description - Participant NEBs
0.31	Mult. % of Energy Savings	1	P_Comfort	Comfort
0.08	Mult. % of Energy Savings	0	P_Lighting Quality	Lighting Quality
0.07	Mult. % of Energy Savings	1	P_O&M	Equipment Maintenance/Replacement//Customer O&M savings,
0.05	Mult. % of Energy Savings	1	P_Outside Noise	Noise Reduction (external) Less outside noise
0.15	Mult. % of Energy Savings	0	P_Property Value	Increased asset value// Property Value Increase
0.66		***0.43***	***43.0%***	Total NEB Multiplier

Source: APPRISE, 2018, "R1709 Connecticut Non-Energy Impacts (NEI) Literature Review", August, prepared for CTEEB, New Britain, CT.
Also included in Eversource, 2020, "CT Connecticut's 2020 Program Savings Document (PSD)".

Figure 3.10: Residential Non-Low-Income NEBs ($ Values from RI) – Participant Health

	Residential NON Low Income NEB Values (from RI TRM)				
Dollars in TRM	Units	Est. Multip.	Incl(1)/Excl(0)	NEB Name	NEB Description - Participant NEBs
$47.53	$/partic./yr	0.327	0	P_Inside Noise	Less participant-perceived noise in the home
$0.02	$/partic./yr	0.000	1	P_Asthma	ERV/HRV reduction of formaldehyde
$3.28	$/partic./yr	0.023	1	P_Asthma	Combustion stove NOx
$91.50	$/partic./yr	0.629	0	P_Comfort	Greater participant-perceived comfort in home
$142.33					Total dollar-based NEBs for Non Low Income Program (from RI TRM)
$145.37					Estimated savings from Residential Wx Program (NJ)
0.979	Multiplier	0.979	***0.023***	***2.3%***	Estimated Multiplier using NJ program savings

Source: National Grid, 2022, "RI Rhode Island Technical Reference Manual 2022 Program Year"; Original source for TRM is Three3, Inc. and NMR Group, 2016, "Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study", August 5. Dollars adjusted to 2022.

Figure 3.11: NJ Estimated Program Savings for Translating Dollar NEBs to Energy Savings Multipliers

Sample Savings from NJ Programs - to translate $ NEBs to energy savings multipliers							
From PSE&G Q3 Report, and EIA Gas and Electric Rates							
	Electric Savings per Participant kWh	Gas Savings per Participant therm	Assumed Electric Retail Rate $/kWh	Assumed Gas Retail Rate $/therm	Electric Savings per Participant $	Gas Savings per Participant $	Total Savings per Participant $
Residential	117	4	0.17	1.23	19.50	4.34	$23.84
Multifamily	339	29	0.17	1.23	56.38	35.52	$91.90
C&I	4,014	3	0.13	1.25	519.25	3.52	$522.77
Comfort Partners	918	61	0.17	1.23	152.74	75.28	$228.02
Res Wx, existing ho	525	47	0.17	1.23	87.34	58.03	$145.37
C&I DI	564	199	0.13	1.27	72.96	251.74	$324.71

Specific Sources and Considerations for the Literature Values

Sources for Selected values for Residential Low Income, Figures 2.10, 2.11, 2.16

- Participant Hardship: Initial value=$65/hh/yr, updated to 2022 dollars=$75.40. Divided by $228.02 savings=multiplier of 33%. Source of initial value: NEEP, 2017, "Non-Energy Impacts Approaches and Values: An Examination of the Northeast, Mid-Atlantic, and Beyond". Based on analysis of 20 studies of low-Income programs.
- Utility Payment / Financial: One estimate=3.4% from RI TRM; Second estimate = $9.16/hh/yr from CT Study, updated to 2022 dollars=$10.59. Divided by $228.02 savings= multiplier of 4.6%. Average=4%, Residential Low Income Utility payment / financial NEBs: APPRISE, 2018, "R1709 Connecticut Non-Energy Impacts (NEI) Literature Review", August, prepared for CTEEB, New Britain, CT. Also included in Eversource, 2020, "CT Connecticut's 2020 Program Savings Document (PSD)". National Grid, 2022, "RI Rhode Island Technical Reference Manual 2022 Program Year" Values translated to 2022 Dollars. Value is in the range found in the literature and similar to range in Maryland sources (Itron, "Development and Application of Select Non-Energy Benefits for the EmPOWER Maryland Energy Efficiency Programs", 2015.
- Participant Water Bill: Original value $8/hh/yr, updated to 2022 dollars=$9.12. Divided by $228.02 savings=multiplier of 4%. Source for value: APPRISE, 2018, "Connecticut Non-Energy Impacts Literature Review: R1709", prepared for the Connecticut Energy Efficiency Board, December.
- Participant NEBs Comfort / Health / O&M / Noise, Figure 2.12: NMR Group, Inc, 2016, "CT Project R4 HES/HES-IE Process Evaluation and R31 Real-time Research", prepared for CTEEB, New Britain, CT. Also included in Eversource, 2020, "CT Connecticut's 2020 Program Savings Document (PSD)".

Sources for Selected Values for Residential, Non-Low Income, Figure 2.12, 2.13, 2.17

- Participant Water Bill: Original value $8/hh/yr, updated to 2022 dollars=$9.12. Divided by $145.37 savings=multiplier of 6%. Used same value of water savings as low income. Source for value: APPRISE, 2018, "Connecticut Non-Energy Impacts Literature Review: R1709", prepared for the Connecticut Energy Efficiency Board, December.
- Participant comfort, O&M, Noise (Figure 2.12): 43% and 31% inputs: APPRISE, 2018, "R1709 Connecticut Non-Energy Impacts (NEI) Literature Review", August, prepared for CTEEB, New Britain, CT.
- Participant health (Figure 2.13): 2.3% inputs: National Grid, 2022, "RI Rhode Island Technical Reference Manual 2022 Program Year"

Sources for Selected Values for Commercial Residential, Non-Low Income, Figure 2.18

- Participant Equipment performance and O&M = 23% from Summit Blue, SERA, et al., 2004, New York Energy $mart (SM) Program Evaluation and Status Report Final Report Volume 2, prepared for NYSERDA
- Participant comfort, noise, etc. =26%, Summit Blue, SERA, et al., 2004, New York Energy $mart (SM) Program Evaluation and Status Report Final Report Volume 2, prepared for NYSERDA

Important Notes and Considerations regarding the Selections, Sources, and Values:

- **Overarching**: Program-wide NEBs are the ones needed for estimating adders at the fuel or sector level. However, NEB values vary by measures included and their mix, and participant targets, (along with climate, etc.). However, the study tried to favor results from the general region, and used programs that were "typical" or programs generally similar to some of the most important contributors for NJ's portfolio.

- **Commercial numbers**: Most of the recent work on Commercial NEBs / NEIs has focused on measure-based NEBs. However, those are less helpful in developing NEBs for overarching, sector-wide adders. Therefore, the program-wide studies used tend to be a bit older. In addition, generally, more work has been conducted on the residential side than the commercial side.

- **Low-income numbers**: The selected multipliers for low-income are sometimes lower than those for standard income residential results. This seems counter-intuitive, but in fact, the dollar benefits for low-income customers are larger (and sometimes substantially larger). The rationale is that these multipliers act on the program's energy bill savings. The energy bill savings for the "typical" low-income program being used in this study is $228. The bill savings for the typical non-low-income residential program is $145. In simple terms, a 10% adder for residential, would need only a 6.4% adder to equal the same dollar savings ($14.50). Thus, somewhat smaller multipliers for low-income is not a source for substantial concern.

- **Gas numbers**: NEBs estimated specifically for only gas measures is less common. Combined information was used, and the values associated across both fuels. This is a topic that should be studied in detail in a follow-up study.

- **Wholesale vs. Retail**: As mentioned above, the estimates are multipliers relative to bill savings. For use in benefit-cost calculations that require application to wholesale values, the adjustment follows.
    - Conversion of supply or Wholesale to Retail cost: For Residential sector, electric wholesale is 70-80% of retail cost; for gas the figures is 50%. For the Commercial sector, wholesale is 65-70% for electric, and 45-50% for gas.[55]
    - Walk-through: If multiplier was 10% on a $10 retail, the goal is to represent the addition of the same $1 on the wholesale side. Assume the wholesale as a percent of retail is 70%. Use the original 10% multiplier and divide by 0.7. That results in a new wholesale-based multiplier of 14.3%. Since 14.3% times 70% of $10 is $1, the $1 of monetized value is held stable, whether wholesale or retail.

[55] *Source, Gabel & Associates, approximate range estimates, email 1/20/23.*

Summary of Development of Literature-based NEB / NEI Multiplier "Adders" for New Jersey

This study provides three sets of values from the literature-based research for NJ, with each phase improving the NEBs / NEIs estimates.

- Immediate/short-term quantitative adder improvement options are provided, based on a review of values included in the literature. The near-term estimates are included in Figure 2.20 below.

- Medium-term recommendations include updated values, and methods to provide greater localization of adders. These recommendations include conducting several low-cost, fast-turnaround studies to develop New Jersey-tailored values; suggestions for a participant-side survey, and a model-based approach using a combination of literature-based factors and local, New Jersey-based data to develop more tailored values for the key programs.

- Longer-term recommendations for primary and other research on NEBs/NEIs. The longer-term, recommendations include the mid-term recommendations plus incorporating participant-NEBs surveys into occasional, periodic process or impact evaluation studies, periodic arrearage studies, and updated literature values.

Near-term Quantitative Literature-based Values for NEBs for New Jersey: The short-term values in Figure 2.20 provides multiplicative "adder" factors for use in each of the 5 California Cost-effectiveness tests, plus the NJCT. Figure 2.19 provides a reminder regarding which NEB/NEI perspectives are appropriate for each of the California tests. It is clear that each value is substantially larger than the current NJCT value.

> *New Jersey's NEBs adder (from the 2020 Board Order)[56], applies a proxy 5% adder for NEBs for all non-low-income programs, and a 10% adder is applied for low income (LI) programs.*
>
> *Generally, the NEB adder for low-income accounts for additional hard to measure benefits (including health and safety). The NEB adder for non-low-income programs accounts for NEBs not already accounted for in the NJCT that are difficult to quantify including public health, water and sewer benefits, economic development, etc. The TRC cost test accounts for other fuel savings, and water, but the values are not incorporated in practice.*

The following items are of note regarding the results:

- None of the NEB/NEI values incorporate the full maximum values for estimated NEBs; a conservative approach was taken for the short term.
- The values allow for incremental adders to allow for whether particularly programs include key higher-level NEB/NEI values.

[56] *Source for NJ values: NJ BPU Order for Clean Energy and Energy, Order Adopting the First New Jersey Cost Test, Docket Number QO19010040, Docket Number Page QO20060389, Non-Energy Impacts section, page 29, Agenda date 8/24/20, Agenda item 8A.*

- Some NEBs/NEIs are omitted because they are measured outside this process, and that are invariant with respect to the particular program. This specifically includes the value of avoided emissions, and the value of social health costs associated with the lower emissions from avoided generation.
- Additional NEBs/NEIs are excluded that are being separately calculated, regarding program-specific economic output / jobs / multiplier effects that are based on program measures.
- As mentioned above, the study includes a preference for values that were vetted through TRM processes, and percentage-based NEBs/NEIs.

The values presented for New Jersey's residential, low-income, and commercial sector are presented in Figure 3.13. The following describes the rational for NEBs/NEIs included. Note that other values in the tables in the previous section, while not selected for the Cost-effectiveness adder, may be useful for marketing, program refinement, and other purposes.

Figure 3.12: NEB Categories Appropriate for the 5 Major Cost-Effectiveness Tests

C/E Tests across, perspective down	UCT/PAT	RIM	PCT	TRC*	SCT*
Utility NEIs	☑	☑		☑	☑
Societal NEIs					☑
Participant NEIs			☑	☑	☑

**The NJCT can be interpreted as either TRC and SCT*
Source: SERA 2016

Figure 3.13: NJ NEB/NEI Literature-Based Values - Multiplier-based, Applied to Retail Bill Savings for the Sector

Sectors across, "Perspectives" down	Residential Low Income	Residential Non-Low Income	Commercial
Utility NEBs	• **4%;** from average of CT Apprise 2017 and RI TRM values (bad debt, arrearage, customer calls, notices, shutoffs/reconnects),	• **0%:** Omit payment-related NEBs for standard income participants (up to 13% from literature)	**0%:** No estimates in literature or TRMS
Societal NEBs	• Economic from separate source / modeling (using program measure mix) • Environmental & Societal illness NEBs from separate source (using energy savings & generation) • **0%** additional; no other strong NEBs to add	• Economic from separate source / modeling (using program measure mix) • Environmental & societal illness NEBs from separate source (using energy savings & generation) • No other strong NEBs to add	• Economic from separate source / modeling (using program measure mix) • Environmental & societal illness NEBs from separate source (using energy savings & generation) • No other strong NEBs to add
Participant NEBs	• **14%** multiplier from Total CT PSD value (NMR 2016) minus comfort and health benefits counted separately below (38%-17%-7%) • **+24%** additional multiplier added for programs with HVAC (comfort 17% from CT PSD) and CT PSD-based associated health / safety effects (7%) (NMR 2016) • **4%** extra for programs with water measures (from Apprise 2018, literature calculation) • **33%** extra for hardship mitigation (NEEP 2017 study, literature computation)	• **12%** multiplier from CT Apprise 2018 (Total minus O&M, noise; subtracting 6% health, omits lighting and prop value; 43%-31%) • **33%** additional multiplier added for comfort & health for HVAC measures (comfort from CT Apprise 2018 and RI TRM Health and safety effects, 31%+2.3%) • **6%** additional multiplier added for programs with water measures (from Apprise 2018, literature calculation)	• **23%** from NYSERDA/Summit Blue et.al. 2004 in literature for equipment operations and O&M without comfort. No strong health and safety estimates. (34% based on measure-based estimates in literature) • **26%** adder for programs with HVAC (comfort) based on literature (NYSERDA/Summit Blue et.al. 2004)*
If ALL included (only for SCT)	• **18%** without HVAC (4% Util+14%Partic) • **+24%** extra adder for HVAC and health/safety • **+4%** extra for programs with water measures • **+33%** extra for hardship mitigation • Plus Societal multiplier effects estimated separately	• **12%** without HVAC • **+33%** extra for programs with HVAC and health/safety • **+6%** extra for programs with water measures • Plus societal multiplier effects estimated separately	• **23%** without HVAC • **+26%** extra for programs with HVAC and health/safety • Plus societal multiplier effects estimated separately

*Table note (*) conservative; using literature measure-based calculations, adder would be **35%.***

4. SUMMARY OF NEBS/NEIS RESULTS FOR NJ AND NEXT STEPS

This study was conducted to provide information for use in the possible update of NEB/NEI adder values for NJ. New Jersey currently applies *a proxy 5% adder for NEBs for all non-low-income programs, and a 10% adder is applied for low income (LI) programs.* This study represents the information source for "short term" or "near term" revisions that could be provided in time for meeting lockdown and filing deadlines associated with Triennium 2.

A conservative approach was taken for the short term. None of these values incorporate the high values for estimated NEBs, or the full list of NEBs available from the literature. Short versions of the results from the two approaches are shown below in Figures 4.1-4.3.

Of course, these values, based on secondary information, can be improved over time (see the recommendations for medium- and longer-term improvements. However, the information in these tables can be debated by the committee and used to develop defensible revisions to the current NJ adders, and improve (and reduce bias in) the estimates of the net benefits associated with the program's initiatives, efforts, and expenditures.

The medium and longer-term recommendations follow, as well as summaries of the results of the two estimation methods provided in this study.

Medium term recommendations:

Many of the NEB values can be improved and tailored in very short order (and for low budget). Each of these studies is in the tens of thousands of dollars. The medium-term plan would include:

- Conducting a survey of participant households and businesses as part of key programs to refine and "localize" prioritized participant side NEBs/NEIs or inputs (including incidence factors) for NJ's programs. A review of updated participant health effects is a potential priority, as this has been the focus of a great deal of recent research.
- Consider conducting an arrearage study for low-income customers to provide a more localized set of values for this effect.
- This recommendation assumes that estimations of emissions, societal health, and economic studies will continue, using vetted, well-documented third-party models estimated using NJ data.
- Conduct a study that uses a NEBs/NEIs model to develop more local NJ-based NEBs/NEIs to update the multipliers or include additional omitted NEBs/NEIs into the multiplier.

Longer term recommendations:
Longer-term recommendations build on and expand the medium-term improvements, and work to incorporate NEB/NEI research on an on-going basis. The longer-term plan would include:

- Incorporating NEB/NEI questions into process (or impact) surveys for major programs with at least every other evaluation cycle, using state-of-the-art measurement practices. The incremental cost of the survey is very low. Where feasible, make a transition to measure-based NEBs.

- This recommendation assumes that estimations of emissions, societal health, and economic studies will continue, using vetted, well-documented third-party models, estimated using NJ data. These studies should be program-based. The economic models, which are more complicated, may only be needed every few years; the other can easily be run more regularly. The emissions models can be refined by taking baseload vs. peak load program contributions into account.
- Consider adding arrearage studies periodically to other program evaluations and use to update figures. They are inexpensive.
- In the longer run, consider incorporating NEB/NEI values into the TRM, largely on a measure basis, and transition from a multiplier approach to an approach that recognizes more granularity for the inclusion of NEBs/NEIs into benefit-cost equations.

Figure 4.1: Range and Average of State NEB / NEI Adders

SUMMARY TABLE	Electric	Gas	Extra add-on for Low Income
Number incl. NEBs=26			
Number with % adders	14	14	5
Average Adder	12%	11%	13%
Min Adder	5%	5%	10%
Max Adder	30%	30%	15%

Source: SERA research, 2023

Figure 4.2: Summary of Literature-Based Recommended Adders[57] for Residential, Low Income, and Commercial Programs by Adder Element - Assuming the Societal Cost Test (SCT) and Total Resource Cost (TRC)* Test

Element of the Percentage Adder	NEB/ NEI value, multiplied times program's retail bill savings	Wholesale multipliers – Elec**	Wholesale multipliers – Gas**
Base Adder	~20% for low income and commercial, 10% residential non-low income	29% LI and Com'l; 14% res.	40% LI & Com'l, 20% res
HVAC & Health Adder	+24% - 33% added to the base adder for programs with HVAC measures	~41% (using average)	33%
Water Adder	+4-6% added for programs delivering water measures (0% for C&I)	7%	14%
Hardship	+33% for low-income programs	47%	66%
Combined all 3 perspectives, all adder elements	Excluding hardship, 45-52% for the 3 sectors Hardship adder 33%.	69%	97%

Table Note: (*) TRC is also covered by this table because the societal NEBs/NEIs estimated above are zero. Societal NEBs/NEIs are being measured elsewhere.
Table Note: (**) Conversion of supply or Wholesale to Retail cost. Residential electric 70-80% of retail cost; gas 50%. Commercial: 65-70% for electric, 45-50% for gas. Used 70% for electric, 50% for gas. Source, Gabel & Associates, approximate range estimates, email 1/20/23.

[57] *Wholesale / retail multipliers adjusted as follows: If multiplier was 10% on a $10 retail, the goal is to represent the addition of the same $1 on the wholesale side. Assume the wholesale as a percent of retail is 70%. Use the original 10% multiplier and divide by 0.7. That results in a new wholesale-based multiplier of 14.3%. Since 14.3% times 70% of $10 is $1, the $1 of monetized value is held stable, whether wholesale or retail.*

Wrap-Up

More than twenty-five years on, the literature can support reconsideration of benefit cost tests to better represent truer and more complete lists of benefit and costs, and support more optimal program investment. There has been clear and distinct progress toward addressing the bias inherent in cost-effectiveness tests through inclusion of NEBs/NEIs. There has been a domino effect; as one state makes progress, another directly incorporates that progress into their next round of deliberations. New Jersey has already opted for the *inclusion of some* NEBs/NEIs, which is better than *exclusion* of NEBs/NEIs. This report works to provide research to support new values using two methods, which can help make further progress in addressing the bias in tests and more fully reflect the utility, societal, and participant effects delivered by New Jersey's suite of programs. Value-based decision-making argues for investment in analysis of some key NEBs categories, with tradeoffs (or deferrals) made in studies that do not have as large a potential impact on benefit-cost results. Ratepayers, utilities, and most of all society, will benefit from enhanced metrics (NEBs inclusion in tests) that reduce bias in the billions of dollars that are invested in energy efficiency programs across the nation.
The references are provided at the end of this report.

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