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New Hampshire Non-Energy Impacts Database Methodology Memo

1 INTRODUCTION

The purpose of this memo is to provide a summary of the methodology used to create the New Hampshire (NH) Non-Energy Impacts (NEI) Database from existing literature. As discussed in the August 8, 2018 work plan for Phase 1 of the NH Cross-cutting research, the DNV GL evaluation team constructed a database of NEI values identified in published literature. DNV GL adjusted the identified NEI values to make them NH-specific using three factors: 1) Confidence (i.e. level of rigor used in the original study), 2) Plausibility (i.e. original study's relevance to NH programs), and 3) Economics (i.e. differences in economic factors between the jurisdiction in which the study originated and NH). This memo describes the approach used to identify NEIs from the existing literature, assign them to relevant NH programs, and adjust estimates based on plausibility, confidence and economic adjustment factors. While the scoring and factors discussed herein can be updated dynamically in the database, DNV GL feels the current methodology is the most appropriate option.

The memo is split into the following sections:

- Section 2- Conduct a review of completed NEI studies as part of the Jurisdictional Scan (JS)
- Section 3- Match JS measures to NH measure list
- Section 4- Develop Confidence Factors to assess the level of rigor of each JS study based on best practices for NEI research
- Section 5- Develop Plausibility Factors to measure of the relevance of NEIs taken from each study to the NH measure list
- Section 6 - Construct economic adjustment factors to make NEIs from other jurisdictions NH specific
- Section 7- Final calculation for database of adjusted NH NEI values

2 CONDUCT JURISDICTIONAL SCAN OF EXISTING NEI STUDIES

DNV GL reviewed 41 different NEI studies as part of the JS, including studies from recent literature reviews from Ohio and Ontario and those referenced by the Massachusetts NEI Framework project. [1] Three additional studies were provided by the New Hampshire program administrators (PAs). The jurisdictional scan was designed to collect the following information:

- Categories of NEIs

[1] For a list of studies reviewed in JS, see Section 9.1

- Quantified NEI values and their units
- Level of aggregation, specifically whether the NEI was identified by sector, program, end-uses or detailed measures
- Rigor and methodology used to calculate NEIs

The purpose of the JS was to gather NEI information for our database, using these 41 studies as the sole source of our data. Since all the studies in the JS come from jurisdictions outside of NH, and NEIs can be influenced by economic factors specific to a certain jurisdiction, we needed to adjust the NEI values from the literature to account for these differences. We also reviewed the studies to assess whether NEIs could plausibly be applied to NH programs, and our confidence in each studies' approach for estimating NEIs. Thus, the JS provided the foundation for gathering inputs not only for identifying NEI values, but also the inputs needed to adjust those values to create a database of conservative, NH-specific NEI values.

3 MATCH JS MEASURES TO NH MEASURE LIST

3.1 Observed vs. Standard Levels of Aggregation

NEI studies can vary considerably in how they aggregate information when reporting a quantified NEI value. Some studies may report NEI results for specific segment-program-measure level descriptions, such as "C&I-small business retrofit-4-ft linear LED lamp". Other studies may only report NEIs for C&I lighting retrofits, while some may simply report the NEIs that are associated with a prescriptive C&I program.

NEIs can also vary by the fuel that was examined as part of the study, such as electricity, natural gas, or kerosene. For example, an NEI study conducted for an electric-only utility might provide different values for insulation measures than one conducted for a gas and electric utility. In addition, the units in which the NEI are reported can be fuel-specific, such as $/kWh or $/therm.

DNV GL refers to the combination of the following classes of fuel saved, program participant populations, programs, and measure descriptions as the "level of aggregation" (LoA). Below is a list of the seven LoAs we classified for use in this study:

1. **Fuel:** Identifies the fuel studied in the jurisdictional scan report (electricity, gas, or both)
2. **Sector**: Identifies the population being served by the program (C&I or Residential)
3. **Program Level**: Designates the class of program within the sector (Low Income, New Construction, New Construction (Non-Low Income), Retrofit, Retrofit (Non-Low Income))
4. **Prescriptive/Custom**: Separates programs into Prescriptive or Custom.
5. **End-use Level**: High-level description of end-use systems modified through a program type (e.g. Lighting, HVAC, Motors and drives)
6. **Broad Measure Level**: High-level description of measure within an end-use (e.g. LED Lighting)
7. **Detailed Measure Level**: Detailed-level description of measure within an end-use (e.g. Linear LED)

All the studies in the JS had an original (observed) LoA, but they varied in terminology from study to study. Similarly, DNV GL reviewed the NH Benefit/Cost (B/C) models provided by the four PAs to identify the observed LoA in NH programs and measures. The result was a list of fuels, sectors, programs, sub-programs, end-uses and measures in NH, which we refer to as the **New Hampshire Measure List (NHML)**. After reviewing the original LoAs in the JS and NHML, we realized that we needed to create a standard LoA to apply to both datasets to facilitate information matching in our database.

To create this standard LoA, DNV GL engineers reviewed all original LoA across the JS and the NHML to develop a standard set of naming conventions. Each standard LoA has a unique identifier, called a “MapID”, that was applied to every NEI from every study in the JS, as well as the NHML.

See Section 9.2 for all of the standard LoA and their MapIDs.

3.2 Observed vs. Standardized NEIs

DNV GL also standardized the names of NEIs reported by each of the 41 JS studies. For example, many NEIs were similar in nature but were described differently (e.g. “Avoided Operation and Maintenance” vs “O&M avoided”). DNV GL created a list of standard NEI names that we assigned to the observed NEIs identified across all the studies in the JS.

DNV GL created 2 levels of impact names:

1. Original impact names – List of unique NEI names reported across the 41 studies;
2. Standard impact names –Standardized NEI naming convention containing distinct NEIs by sector and perspective (such as Societal or Participant). This is the category used when selecting NEI values to be included in the database.

The full list of the Standard NEI categories can be found in Section 9.3.

3.3 Match JS to NHML

DNV GL mapped JS measures to the NHML using an MS Excel based look-up formula. First, we created a concatenated matching ID from all seven standard LoA in the NHML and the JS, and looked for matches between the two at the most detailed level possible. If no match existed at this detailed level, we created another matching ID with one less level in the LoA. This was done multiple times, each time reducing the level of detail in the standard LoA matching ID to make it broader. For example, if a measure in the NHML was unable to find a match in the JS at a Level 6 match (the most detailed level), then the database would move on to the next lower level to see if a match could be identified (Level 5). Table 1 provides an example of standard LoA details for one measure in the NHML.

Table 1- Example of Standard Level of Aggregation details for one measure in the NHML

Standard Levels of Aggregation	Example of Standard Levels of Aggregation Details
Detailed Measure Level (Level 6)	Premium Efficiency Motor Installation
Broad Measure Level (Level 5)	Motors/Drives
End-Use Level (Level 4)	Process
Prescriptive/Custom (Level 3)	Prescriptive
Program Level (Level 2)	Retrofit
Sector (Level 1)	C&I
Fuel (Level 0)	Electricity
Standard NEI Category Example	O&M-Participant-C&I

Table 2 illustrates how these Standard LoA and the Standard NEI Categories come together to form the matching IDs.

Table 2-Example of Concatenated Matching IDs

Match Level	Concatenated Matching ID

Level 6 ID	Electricity_C&I_Retrofit_Prescriptive_Process_Motors/Drives_Premium Efficiency Motor Installation_O&M-Participant-C&I
Level 5 ID	Electricity_C&I_Retrofit_Prescriptive_Process_Motors/Drives_O&M-Participant-C&I
Level 4 ID	Electricity_C&I_Retrofit_Prescriptive_Process_O&M-Participant-C&I
Level 3 ID	Electricity_C&I_Retrofit_Prescriptive_O&M-Participant-C&I
Level 2 ID	Electricity_C&I_Retrofit_O&M-Participant-C&I

A match occurred when the concatenated Matching ID existed in both the NHML and in one or more studies in the JS.

4 DEVELOP THE CONFIDENCE FACTOR

At times, the NHML matched to more than one study in the JS. DNV GL developed a Confidence Factor (CF) to inform the selection of one study's NEI over another. The CF considered six different questions that relate to best practices in NEI research. Each question had a set of fixed responses, outlined in Table 3. After the six questions were answered for each study, a score was calculated from 0% to 100% to represent the level of confidence DNV GL had in the study results. The higher the score, the higher the level of confidence. Then, the JS studies and measures were sorted from highest confidence to lowest confidence, so that the matching look-up value would select the higher confidence values first. Finally, the CF was used to de-rate matched NEI values in the NHML to provide a conservative estimate of NEI values in our database when using NEIs from lower-confidence studies.

4.1 Confidence Factor scoring inputs

To assign a CF to each of the studies in the JS, DNV GL examined each report in the context of the following questions. Table 3 presents the possible responses to each of the confidence factor criteria, and their associated scores in parentheses, e.g. (3), (2), (1).

Table 3- Questions used to calculate Confidence Factor score, and the reasons for each question

Question	Possible Responses (scores)	Intention of question
1. Is the study measure specific?	a. Measures have specific NEIs associated with them (3) b. Measures are identified by the study, but in aggregate (2) c. Measures are not reported at all (1)	Studies providing values tied to specific measure groups are more robust than those that provide combined NEIs across multiple measures or do not distinguish which measures are included in the sample.
2. Is the study segmented by sector?	a. Study identified NEIs related to sample segments (3) b. Study identifies sample segments used to design sample frame, but NEIs are not specific to segments (2) c. Sample not segmented at all (1)	The impact of measures on participants varies by participant characteristics such as income level and industry. Studies that account for these differences are regarded as providing greater precision in results than those that do not.

Question	Possible Responses (scores)	Intention of question
3. Was the sample drawn using a statistical method?	a. Study reports statistically significant sample results with precision levels (3) b. Study uses statistical sampling, but results are not always statistically significant (2) c. Does not use statistical sampling (1)	Statistical sampling accounts for key differences in respondents and/or measures that create variance in NEI estimates. NEI studies that use stratified sampling and provide statistically-significant results are regarded as superior to those that do not.
4. Does the study incorporate identifiable economic factors?	a. Approach clearly isolates/identifies relevant economic factors (3) b. They used some economic factors based on theory, although not clearly identified in study (e.g. property values) (2) c. Economic factors are not identified, and cannot be inferred (1)	NEIs result from changes to either consumer or producer surplus. As such, they should relate to some aspect of the household or firm decision-making process such as improved costs, revenues, living conditions, etc. Studies that isolate NEIs that tie to identifiable economic factors provide greater confidence than those that are less specific about the factors that justify NEIs.
5. Does the study consider any of the following when appropriate: Open-ended questions, Additivity, Double Counting	a. All appropriate factors were considered (3) b. One appropriate factor was not considered (2) c. Two appropriate factors were not considered (1) d. Three appropriate factors were not considered (0)	Best practices in NEI research document the need for studies to tie NEI estimates to known factors (such as utility bills) or derive estimates from factors that are known, such as hours to do a task and wages. Research also clearly documents the need to account for non-additivity of multiple NEIs. Finally, more rigorous studies take steps to ensure that NEIs are distinct across NEI categories.

Question	Possible Responses (scores)	Intention of question
6.What unit of measure does the study use for NEIs?	a. $/kWh or $/therm (3) b. $/participant or $/household (2) c. $/unit or mixed units (1) d. % adder (0)	The unit of measure impacts the ability to apply NEIs from one study to another. DNV GL ranks the units of measure based on transferability of estimates from the original jurisdiction to NH.

4.2 Confidence Factor scoring

DNV GL applied the rating system presented in Table 3 to construct the confidence factor for each study as follows:

- DNV GL recorded the numeric score (0-3) for each of the six questions.
- The weighted score was calculated by multiplying the numeric score by the weight. In the DNV GL calculation, each of the six questions was given an equal weight; however, the weights can be adjusted in the final database.
- The weighted scores were summed to create an aggregate score for each study. The maximum possible score was 18, while the lowest score was six.
- The CF was calculated by dividing the aggregate score by the maximum possible score of 18. Studies with higher CFs typically contain more granular measure details and have more identifiable economic factors.
- The DNV GL method includes a CF “floor” of 50%, meaning no CF will drop below 50%, regardless of the answers to the six scoring questions. It is DNV GL’s best judgement that NEIs should not be discounted to zero, but some discounting is appropriate. DNV GL reasoned that reducing NEIs from studies with a low confidence factor by 50% allows some value of NEI to be recognized, while still reducing the value to reflect our lack of confidence in the estimate. The floor can be adjusted in the final database.

After a match is identified for a measure in the NHML, the database looks for the study with the highest CF score at that matching level and assigns the NEI value from that study to the NH measure. For example, if there are two studies that have a Level 5 match for a NHML measure, the database will determine which study has the highest CF, and then take the NEI value from that study. To allow the database to choose correctly, the CF score must be re-sorted in column AJ of the Jurisdictional Scan if the weights or other CF inputs are changed.

5 DEVELOP THE PLAUSIBILITY FACTOR

DNV GL developed a Plausibility Factor (PF) to further account for nuances in NEI research outside of the actual study methodology. The Plausibility Factor (PF) considers four variables:

1. Level of matching (Level 6, Level 5, etc.)
2. Age of the study matched to the NHML
3. Changes in energy consumption within an end-use category over time
4. Whether the NEI category is applicable to the NH end-use, called an Exclusion Factor

These inputs account for factors that impact NEI values that are not included in the CF, since the factors depend on data outside of the study. DNV GL calculated a PF score from 0% to 100%, with the higher the score representing a higher level of plausibility. This factor was also multiplied against matched values in the NHML to further ensure conservative estimates of NEI values in our database.

5.1 Plausibility Factor scoring inputs

5.1.1 Level of Matching

We used the level of matching discussed in Section 3.3 to provide the first input to the PF. Higher level matches indicated that the study from the JS closely represented the measure in the NHML, and therefore received a higher score. Table 4 shows how the matching level translated into a PF input for matching.

Table 4-Level of Matching scoring table

Match Level	Score
Level 6 Match	6
Level 5 Match	5
Level 4 Match	4
Level 3 Match	3
Level 2 Match	2

5.1.2 Age of the study

The age of a study reflects several economic, programmatic, demographic, and research related factors that can change over time.

- Economic factors include, but are not limited to, prices, technologies (e.g. production processes) and concentration of industries/populations.
- Programmatic changes that may impact NEI values, in addition to changes to measures, include technical assistance, education and training.[2]
- Demographic changes include changes to the concentration of populations, industries, incomes, and wages.
- Research-related factors include improvements to NEI research based on 25 years of experience, as documented by Skumatz 2016.

DNV GL grouped the studies into the categories shown in Table 5, assigning higher scores for more recently published studies.

Table 5-Age of Study scoring table

Age of Study	Score
Five years or less	4
Six to ten years	3
11-15 years	2
Greater than 15	1

5.1.3 Change in end-use unit energy consumption

The third aspect of the PF calculation accounts for technological change in measure energy consumption over time. DNV GL assumed that if a study from the JS analyzed an end-use that has had a large change

[2] Changed in measure mix within a measure category is handled separately in the "Change in Unit Energy Consumption" factor discussed in the next section.

in energy consumption over the last several years, then the age of the study, in combination with the end-use category, provides important insight on whether the study's NEI results should be further de-rated. For example, a study published prior to 2013 (with energy efficiency data from 2012 or older) that analyzed lighting NEIs would almost certainly have little coverage of LEDs in the measure-mix of the study. Therefore, the NEIs in that study related to lighting measures should be de-rated to account for the large change in lighting energy consumption.

To calculate this value, DNV GL reviewed historical end-use energy consumption from the 2003 and 2012 Commercial Building End-Use Survey (CBECS) and the 2009 and 2015 Residential End-Use Consumption Survey (RECS) published by the Energy Information Administration[3]. CBECs and RECS provide tables reporting the unit energy consumption (UEC) of end-use technologies over time. DNV GL used the UEC/sq ft and UEC/household reported in CBECs and RECS, respectively, to measure change in energy consumption in each end use category over time. By calculating the Compound Annual Growth Rate (CAGR) between the earlier study and later study, DNV GL assumed that constant energy consumption over time for a specific end-use (indicated by a low CAGR %) showed that a study of that end-use would still be reliable today. Table 6 shows the scoring inputs for the different categories of CAGR, while Table 7 and Table 8 show the UEC numbers by end-use category in the CBECS and RECS study.

Table 6-End-Use UEC change Score

Compound Annual Growth Rate by end-use	UEC change score
CAGR <= 3%	3
CAGER >3% but <6%	2
CAGR >=6%	1

Table 7- CBECS end-use energy consumption scoring

	Electricity energy intensity (thousand Btu/square foot in buildings using electricity for the end use)										
	Total	Space heating	Cooling	Ventilation	Water heating	Lighting	Cooking	Refrigeration	Office equipment	Computing	Other
All Buildings- 2003	50.7	2.4	6.9	6.2	1.3	19.1	0.3	5.4	1	2.2	6
All buildings - 2012	50	1.7	8.3	8.1	0.5	8.7	3.7	9.1	2.1	5.2	9.1
Compound Annual Growth Rate (CAGR) in UEC	-3.2%	3.9%	-2.0%	-2.9%	11.2%	9.1%	-24.4%	-5.6%	-7.9%	-9.1%	-4.5%
CAGR % of Total Change		(1.21)	0.63	0.91	(3.47)	(2.83)	7.55	1.75	2.45	2.83	1.40
1-3 Score (3 is best, 1 is worst)		2.0	3.0	3.0	1.0	1.0	1.0	2.0	1.0	1.0	2.0

[3] RECS: https://www.eia.gov/consumption/residential/data/2009/index.php?view=consumption
https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption

CBECS: https://www.eia.gov/consumption/commercial/archive/cbecs/cbecs2003/detailed_tables_2003/2003set19/2003html/e06a.html
https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/e6.cfm

Table 8- RECs end-use energy consumption scoring

	Average site energy consumption1 (million Btu per household using the end use)					
	Total	Space heating	Water heating	Air conditioning	Refrigerators	Other
All homes-2009	89.6	38.7	16.0	6.8	4.3	26.7
All homes - 2015	77.1	35.3	14.8	7.1	2.6	20.2
Compound Annual Growth Rate (CAGR) in UEC	3.1%	1.6%	1.3%	-0.8%	8.6%	4.8%
1-3 Score (3 is best, 1 is worst)		3.0	3.0	3.0	1.0	2.0

5.1.4 Exclusion factor

The fourth aspect of the PF calculation accounts for the applicability of different NEI categories to different end-use measures in NH. Based on their knowledge of the programs, the PAs may know that certain categories of NEI values don't apply to certain end-use measures in their programs. In that case, the NEI category can be excluded from the NEI estimates for that end-use by assigning a "0" to the end-use/category cell in the sheet named Exclusion. The Exclusion Factor is given a score of "0" or "1" and is not assigned a weight in the Plausibility Factor scoring; rather, it's used as a "go/no go" variable that either allows or disallows a value.

As an example, lighting measures do not typically produce NEIs related to indoor air quality. However, if a study examined high efficiency light fixtures that include bathroom or kitchen exhaust fans, the study may report indoor air quality NEIs. Since the NH programs do not include such a measure, the PAs can exclude indoor air quality NEIs from residential lighting measures to prevent them from being considered for the benefit cost test.

5.2 Plausibility Factor scoring

DNV GL constructed the plausibility factor for each study, end-use, matching level, and exclusion combination as follows:

- DNV GL recorded the numeric score for each of the four factors.
- The weighted score was calculated by multiplying the numeric score by its weight. In the DNV GL calculation, each of the factors was given an equal weight; however, the weights can be adjusted in the final database. The Exclusion Factor is not considered in the weighting.
- The weighted scores (minus the Exclusion Factor) were summed to create an aggregate score for each study, end-use, and matching level combination.
- An Unadjusted PF was calculated by dividing the aggregate score (minus the Exclusion Factor) by the maximum possible score of 13. Studies with higher Unadjusted PFs are typically more recent and better match the measures in the NHML.
- The DNV GL method includes an Unadjusted PF "floor" of 50%, meaning no Unadjusted PF will drop below 50%, regardless of the scores attached to the three factors.
- The final PF is calculated by multiplying the Unadjusted PF by the Exclusion Factor. An exclusion factor of "0" will produce a PF of "0" which, when multiplied by the NEI from the JS, will produce an NEI of "0".

Table 9 shows all combinations of the three metrics described, minus the Exclusion Factor, and the associated Unadjusted PF score, assuming equal weighting among factors, a minimum of 50% PF, and a minimum of Level 2 matching.

Table 9-Plausibility Factor scoring table (assumes equal weighting)

Age of Study Score (A)	Unit Energy Consumption Change Score (B)	Matching Level Score (C)	Total Score (A+B+C)	% of Max Score (A+B+C)/13	Unadjusted Plausibility Factor (No PF below Min PF)
4	3	6	13	100%	100%
4	3	5	12	92%	92%
3	3	6	12	92%	92%
4	2	6	12	92%	92%
4	3	4	11	85%	85%
3	3	5	11	85%	85%
2	3	6	11	85%	85%
4	2	5	11	85%	85%
3	2	6	11	85%	85%
4	1	6	11	85%	85%
4	3	3	10	77%	77%
3	3	4	10	77%	77%
2	3	5	10	77%	77%
1	3	6	10	77%	77%
4	2	4	10	77%	77%
3	2	5	10	77%	77%
2	2	6	10	77%	77%
4	1	5	10	77%	77%
3	1	6	10	77%	77%
4	3	2	9	69%	69%
3	3	3	9	69%	69%
2	3	4	9	69%	69%
1	3	5	9	69%	69%
4	2	3	9	69%	69%
3	2	4	9	69%	69%
2	2	5	9	69%	69%
1	2	6	9	69%	69%
4	1	4	9	69%	69%
3	1	5	9	69%	69%
2	1	6	9	69%	69%
3	3	2	8	62%	62%
2	3	3	8	62%	62%
1	3	4	8	62%	62%
4	2	2	8	62%	62%
3	2	3	8	62%	62%

Age of Study Score (A)	Unit Energy Consumption Change Score (B)	Matching Level Score (C)	Total Score (A+B+C)	% of Max Score (A+B+C)/13	Unadjusted Plausibility Factor (No PF below Min PF)
2	2	4	8	62%	62%
1	2	5	8	62%	62%
4	1	3	8	62%	62%
3	1	4	8	62%	62%
2	1	5	8	62%	62%
1	1	6	8	62%	62%
2	3	2	7	54%	54%
1	3	3	7	54%	54%
3	2	2	7	54%	54%
2	2	3	7	54%	54%
1	2	4	7	54%	54%
4	1	2	7	54%	54%
3	1	3	7	54%	54%
2	1	4	7	54%	54%
1	1	5	7	54%	54%
1	3	2	6	46%	50%
2	2	2	6	46%	50%
1	2	3	6	46%	50%
3	1	2	6	46%	50%
2	1	3	6	46%	50%
1	1	4	6	46%	50%
1	2	2	5	38%	50%
2	1	2	5	38%	50%
1	1	3	5	38%	50%
1	1	2	4	31%	50%

6 CONSTRUCT THE ECONOMIC ADJUSTMENT FACTORS

Through the JS, DNV GL identified various economic factors on which NEIs from each study are based, either explicitly (stated in the study) or implicitly (assumed based on economic theory). DNV GL used publicly available data to develop factors that adjust the NEI based on the economic activity in the original jurisdiction relative to that of NH.

We identified eight economic factors that can be used to adjust the NEIs to be NH specific. The factors are broken into residential and C&I categories, and include the following.

Residential economic adjustment factors:

- **Property Value –** noise, visual, and air/temperature NEIs that are reflected in the differences in home values.
- **Income & Health Impacts (loss of income) –** economic development NEIs related to income, as well as health NEIs related to longer life or missed days at work can be adjusted using differences in income.
- **Health Impacts (avoided costs) –** health and safety NEIs related to avoided medical costs in hospitals. These NEIs are adjusted using the differential in medical costs between states.
- **Age of Home –** fire related NEIs using the differential in the age of homes between regions.
- **Utility Cost - Residential –** NEIs that result from changes to utility costs such as bad debt, arrearages, and hedging. These NEIs can be adjusted using the ratio of the average utility cost per MMBtu by sector (commercial, industrial, residential).

Commercial and Industrial economic adjustment factors:

- **Labor Costs (wage-based) –** Operations and maintenance NEIs are largely a function of the time spent to maintain, repair, or replace equipment. These NEIs are adjusted using wage differentials in C&I settings and income differentials in residential settings.
- **Revenue & Productivity –** Comfort changes in C&I applications result in productivity NEIs. They also take the form of noise, visual, air/temp. These NEIs can be adjusted using differentials in output or GDP.
- **Utility Cost - C&I –** NEIs that result from changes to utility costs such as bad debt, arrearages, and hedging. These NEIs can be adjusted using the ratio of the average utility cost per MMBtu by sector (commercial, industrial, residential).

The adjustment factors described in this memo reflect the Simple Economic Weights selection on the Input screen of the NEI database. Two other options are available:

- Turn Off Economic Benchmarks – This option should be selected if the user does not want to adjust the NEIs based on the economic activity in the original jurisdiction relative to that in NH.
- Energy Consumption Weighted – This option should be selected if the user would like to use a more complicated adjustment factor that includes a term that relates energy consumption between states as well as the relevant economic factor, such as property value or wages.

The subsequent sections discuss the economic adjustment factors:

- Section 6.1 presents the economic variables used for the adjustment factors
- Section 6.2 discusses economic adjustment factors for NEIs applicable to residential programs
- Section 6.3 discusses economic adjustment factors for NEIs applicable to C&I programs

6.1 Variables Used for Adjustment

Table 10 shows the variables, along with their description, year, and source, used to create the economic adjustment factors. These variables will be used in the formulas contained in the subsequent sections.

Table 10- Variables with descriptions, years, and sources use to calibrate NEIs to a different state or region

Variable Name	Description	Year	Source
Median Home Value/Rent per Square Foot	The variable is equal to the median home value ($) divided by the square footage of the home. The value is the sum of the value per square foot of single-family attached houses, single-family detached houses, and mobile homes.	2018	Zillow, 2018
Square Foot	Total square footage of residency. These values are only available by the census regions[4] of (1) New England, (2) Middle Atlantic, (3) East North Central, (4) West North Central, (5) South Atlantic, (6) East South Central, (7) West South Central, (8) Mountain North, (9) Mountain South, and (10) Pacific. Individual states are imputed with the values from their region. Home types included in data: single-family attached houses, single-family detached houses, apartments in a building with 2 to 4 units, apartments in a building with 5 or more units, and mobile homes.	2015	EIA, 2018
Median Age of Structure	This variable is the median age of the structure.	2017	US Census Bureau, 2018
Average Health Care Spending	Health care spending ($) in a state divided by the population of the state. This amount includes both public and private health care spending for goods and services. The health care spending does not include operation and maintenance costs, construction, or research and development.	2014	KFF, 2014
Median (HH) Income by Age Group of Head of HH	Median (household) income ($). This data is broken out by the householder age group or by education.	2017	US Census Bureau, 2018
Age Bracket	Householder age groups: under 25 years old, 25 to 44 years, 45 to 64 years, and 65 years and over.	2017	US Census Bureau, 2018
Total Energy Price per	The cost of total energy per million Btu in (USD). This accounts for primary energy (coal, natural gas,	2017	EIA, 2018

[4] For more information about how states are divided into census regions, please visit https://www.eia.gov/consumption/residential/terminology.php

Variable Name	Description	Year	Source
Million Btu	petroleum, biomass) and retail electricity.		
Median Wage Dollar	Median hourly wage ($) by state.	2017	BLS, 2018
GDP	Gross domestic product is an economic measure for the value of output in a given area. The data are measured by 2-digit NAICS and by state.	2016	BEA, 2018
Industry	This represents non-residential entities that fall under the commercial, industrial, or transportation classification consistent with Table 11.	2016	EIA, 2016
Home Type	The classification of residential location: single-family attached house, single-family detached house, apartment in a building with 2 to 4 units, apartment in a building with 5 or more units, or mobile home.	2015	EIA, 2018
State name	Names of all 50 states, which are used to describe origins of other data variables.	N/A	N/A

6.2 Residential economic adjustment factor

In this section we discuss the economic adjustment factors used to adjust NEIs for residential programs. We first provide a brief review of the economic theory that is the basis for NEIs attributable to residential programs. We then describe the formulas used to create these economic adjustment factors.

6.2.1 Theory of NEIs for residential programs

A key concern for program evaluation is ensuring that the benefits claimed by utilities reflect true economic gains to New Hampshire. This theoretical background focuses on how incentivizing technological change through EE results in economic benefits that manifest through increased wellbeing for consumers and increased profit for producers. We then define the factors used to adjust different types of NEIs that apply to residential programs.

EE programs result in NEIs that impact consumer or producer surplus[5] [6] [7], which reflect changes to the economic efficiency of society. By incorporating NEIs into TRC cost-efficiency tests, policy makers can better measure the economic efficiency of EE programs on the population.[8]

[5] Consumer Surplus as defined by Nicolson (1995) is “the Difference between the total value consumers receive from the consumption of a particular good and the total amount they pay for the good. It is the area under the compensated demand curve and above the market price, and can be approximated by the area under the Marshallian demand curve and above the market price.”

[6] Producer Surplus as defined by Nicolson (1995) is “the additional compensation a producer receives from participating in market transactions rather than having no transactions. Short-run producer surplus consists of short-run profits plus fixed-costs. Long-run producer surplus consists of short-run producer surplus plus increased rents earned by inputs. In both cases the concept is illustrated as the area below market price and above the respective supply (marginal cost) curve”.

[7] Nicholson, Water. “Microeconomic Theory: Basic Principles and Extensions. Sixth edition. Dryden Press. Harcourt Brace College Publishing. 1995.

[8] The Total Resource Cost (TRC) Test measures the net cost of an energy conservation program, viewing the program as a utility resource option. Both utility and participant costs and benefits are included. The TRC Test reflects the impacts of a program on both participating and non-participating customers. The test provides a measure of the cost-effectiveness of a utility-sponsored EE program, per the California Standard Practice Manual. https://beopt.nrel.gov/sites/beopt.nrel.gov/files/help/Total_Resource_Cost_Test.htm

The concept of NEIs stems largely from the hedonic price theory of property values and wages developed by Rosen.[9] This theory states that "housing prices reflect differences in the quantities of various characteristics of housing and that these differences have significance in applied welfare analysis."[10,11] Rosen (1976) shows that house price is derived from the wellbeing (utility) that one receives from occupying a residence with a given set of attributes. One set of the attributes included in the individual's utility are the improved amenities, health, and well-being resulting from EE measures:

U(z, x, s):

Where

Hedonic z - measures the individual attributes of each housing unit

x – all other goods the household can purchase

s – measures the characteristics of the household residents (are they old, do they swim, how many people, how many cars)

The individual's utility function and budget constraints are then used to determine the individual's marginal utility (or demand) for the housing attributes at different prices, holding their income constant. The price function shows the bundles of housing attributes at which the household's willingness to pay for a property with that bundle of attributes is equal to its market price.

Given Rosen's theory, an individual's demand for housing represents the trade-off they are willing to make between receiving bundles of these attributes at different prices, given their income constraint and level of technology in the home. The maximum bundle of attributes they can afford is restricted by their income and a measure of their total wellbeing. Figure 1 shows an individual's demand for the housing attributes they receive at different prices before EE improvements (Demand no EE). The supply of housing attributes is measured by S, providing a market clearing price for housing of P. Notice that the demand curve extends above the market clearing price, P. This is because residents would be willing to pay incrementally more for the initial set of housing attributes from market clearing point C up to point A, but they only pay one price for each unit of housing they purchase. The amount measured by triangle ABC is called Consumer Surplus. It measures the additional benefit consumers receive for paying only one price for the housing attributes they receive, rather than separate prices for each unit they receive.

Introducing EE improvements into their existing home represents a technological change to the home that raises the level of attributes the homeowner receives at each price point. In economic theory, this is explained as increasing the homeowner's utility (or wellbeing) while holding their income constant. In other words, when a person invests in improved insulation for their home, they receive energy impacts through reduced costs, but they also experience greater comfort and possibly greater health. The impact of these added benefits to consumers is shown by shifting their demand curve up to the right. This means for all prices, they now receive additional housing attributes that were previously only attainable through increased income. This implies that investing in EE measures increases the value of a home because the overall bundle of attributes offered by the home increases. However, the resident does not have to pay any more for their home because their price is fixed (i.e. they have a mortgage or lease with

9 Rosen, Sherwin. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," Journal of Political Economy 82, no. 1 (Jan. - Feb., 1974): 34-55.

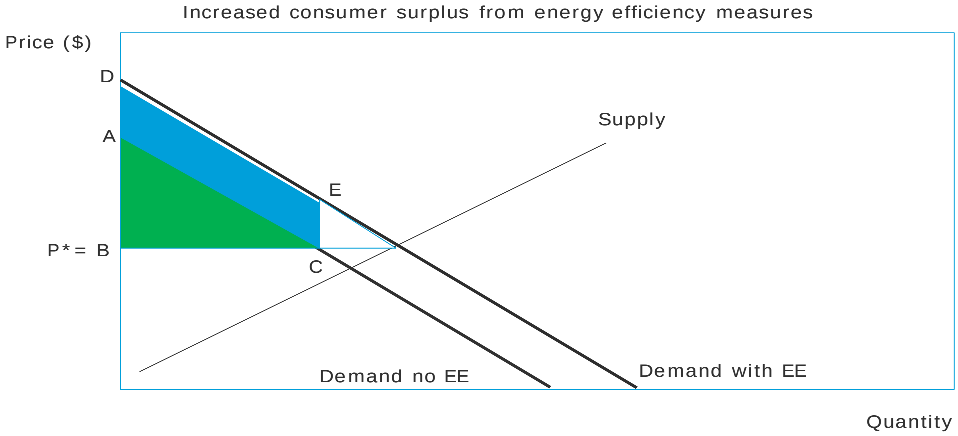
10 Freeman III, Merick A. "The Measurement of Environment and Resource Values: Theory and Methods." Resources for the Future. Washington D.C. 1993.

11 Rosen makes a similar case for the value of wages.

a fixed price). Therefore, they are seen to receive increased benefit, or wellbeing, beyond what they originally paid.[12]

In another example, an upgraded HVAC system can increase health and improve comfort. These benefits provide a range of benefits that were not included in price P, the price the homeowner paid for their home. This increase in benefits reflects an increase in that resident's demand for their home, shifting the demand curve out and to the right. This shift means that residents would be willing to pay more for each additional unit of housing they receive, however, the price they pay is fixed at point P* since they are most likely locked into a mortgage or lease. The additional benefits they receive can be measured by the area ACED. Residents will receive these benefits until they sell their home, at which time the benefits translate into an increase in property value and are included in the price of their home. The focus on NEI studies is to estimate these economic benefits absent the market transaction.[13]

Figure 1. Impact of NEIs on consumer surplus



6.2.2 Types of residential economic adjustment factors

Each adjustment factor will result in a single monomial represented by X_{State}, where "X" represents the specific economic adjustment being discussed. This holds for both the residential adjustment factors and the C&I adjustment factors in Section 6.3.2. Use of these monomials and interpretation will follow in Section 6.4.

DNV GL created five general adjustment factors for NEIs associated with residential programs:

- Property value related adjustments
- Income and Health Impacts (loss of Income) related adjustments
- Health Impacts (avoided costs) related adjustments
- Age of home related adjustments
- Utility costs related adjustments

The variables used to adjust NEIs can be found in Table 10.

Property Value

Most residential NEIs impact a home's value; therefore, differences in property value serve as the key variable for adjusting most residential NEIs. These NEIs will include, but are not limited to: comfort, aesthetics, noise, and home durability and improvements.

[12] Once they sell their home, this increased value will translate into an increase in price, but they still receive the increased value in terms of increased wellbeing prior to selling their home.

[13] The willingness-to-pay techniques outlined in 6.2.1 are well documented and used extensively to estimate such impacts

DNV GL created a property value adjustment factor based on single family attached houses, detached houses, and mobile homes. The general formula consists of a factor that relates the home value to the building stock in the state, calculated for each state in the U.S. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for property values[14].

$$Property\ Value_{State} = \left[\sum \left(\begin{matrix} Median\ Home \\ Value\ per \\ Square\ Foot \end{matrix} \times \begin{matrix} \%\ of\ Square\ Footage \\ within\ Each\ Home\ Type \end{matrix} \right)_{\substack{Non-Apartment \\ Home\ Type}} \right]_{State}$$

Income and Health Impacts (loss of income)

This adjustment factor considers two different categories of NEIs, both adjustable by income: 1) NEIs associated with the income adjustment relate to economic development benefits, both direct and indirect, and 2) monetization of health impacts, or lost income experienced by participants due to the illness or death. Consequently, the economic adjustment factor for both categories is determined using a formula that relates the income in NH to the income in the corresponding state from the JS. The general formula consists of a factor that accounts for the distribution of median household income by age of the head of household, calculated for each state in the U.S. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for Income and Health Impacts (loss of income) NEIs. The formula takes the following form:

$$Income\ and\ Health\ Impacts_{State} = \left[\sum \left(\begin{matrix} Median\ HH\ Income \\ by\ Age\ Group\ of \\ Head\ of\ HH \end{matrix} \times \begin{matrix} \%\ of\ Head\ of \\ HH\ Within\ Each \\ Age\ Bracket \end{matrix} \right)_{\substack{Age \\ Bracket}} \right]_{State}$$

Health Impacts (avoided costs)

Other healthcare impacts are derived from the value associated with avoided healthcare costs. The monetization of these impacts is measured by the avoided costs associated with medical treatment. The formula consists of one factor that represents the average health care spending per resident. This factor is determined for both NH and the state from which the respective study in the JS was completed. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for Health Impacts (avoided costs) NEIs. The formula takes the following form:

$$Health\ Impacts\ (avoided\ costs)_{State} = [Average\ Health\ Care\ Spending]_{State}$$

Age of Home

For NEIs related to fire damage, DNV GL investigated factors that are considered indicators of home fires. Of the variables we could track in the available economic data, we identified that incidence of fires corresponds most closely with the age of a home. Therefore, we constructed an economic adjustment factor that relates the distribution of the age of a home in NH to the corresponding state from the JS. The formula consists of one factor that represents the median age of residential homes. This factor is determined for both NH and the state from which the respective study in the JS was completed. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for Age of Home NEIs. The formula takes the following form:

$$Age\ of\ Home_{State} = [Median\ Age\ of\ Home]_{State}$$

[14] Note to the reader: This equation takes a similar form for many of these NEI category calibrations. The values within the summation will end up as the sum of monomials by home type (and later by NAICS code or industry). The final output for X_{State} will be a single monomial specific to that state. This is elaborated in the Section 6.4.

Utility Cost – Residential

The final residential NEI adjustment factor applies to utility NEIs, or NEIs that result from changes to utility costs. This adjustment factor can be applied to NEIs that include but are not limited to transmission and distribution savings, arrearages, and bad debt write-offs. These NEIs can be adjusted using the ratio of the average utility cost per MMBtu in NH to the corresponding state from the JS:

$$Utility\ Cost - Residential_{State} = Total\ Energy\ Cost_{State}$$

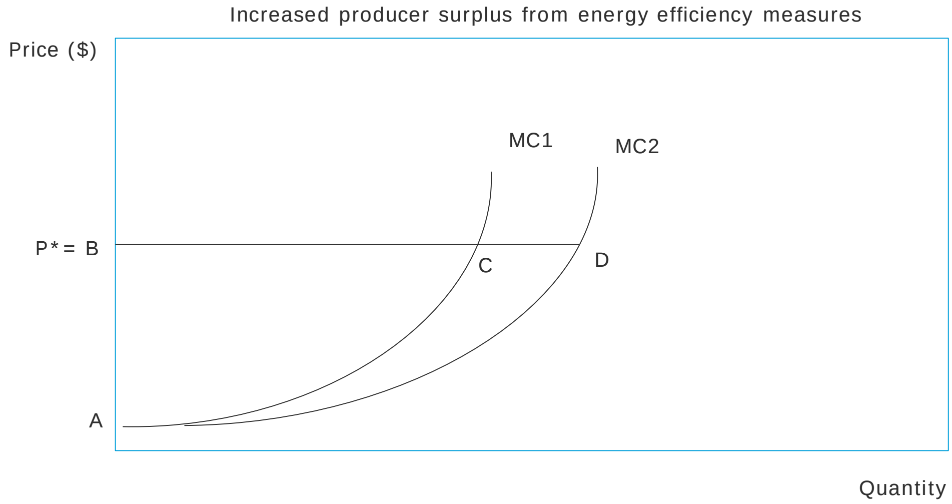
6.3 C&I economic adjustment factor

6.3.1 Theory of NEIs for C&I programs

For commercial and industrial (C&I) customers, NEIs reflect increased profitability resulting from EE measures. The increase in profitability can exist either because the installed measures decreased the cost of production (such as reduced O&M costs) or increased revenue (such as increased sales or production). Theoretically, a firm would be willing to pay more for a facility that either lowered its costs of production or increased revenues. Again, because rents typically do not change unless the firm renegotiates a lease or sells the facility, this provides increased profitability.

Figure 2 presents the impact of EE measures on the O&M costs and profitability of a firm. The figure shows that, prior to installing EE measures, the firm operates with marginal costs MC_1, which reflects the cost of producing each additional unit of a product, with market clearing price of P*, denoted by point B. The firm's profit can be measured by the area of the shape ABC. If the firm then installs EE equipment that reduces their marginal costs of production, this shifts the marginal cost curve out and to the right. This means they can produce more for each unit of cost they incur. This change in costs results in an increase in profitability that can be measured by the shape ACD. This increase in profit is one measure of NEIs resulting from the installation of EE measures. Other NEIs may impact profit through direct revenue increases resulting from increased sales.

Figure 2. Impact of EE on O&M costs and profit



Finally, firms may also experience an increase in revenue resulting from increased sales. For example, installing LEDs is argued to improve the visual display of showrooms. If this results in greater sales, this will increase the firm's revenue directly which can be measured by the formula:

$$Revenue = (Price\ of\ the\ good) \times (Quantity\ sold)$$

6.3.2 Types of C&I economic adjustment factors

As with the residential adjustment factors, each adjustment factor will result in a single monomial represented by X_{State}. Use of these monomials and interpretation will follow in Section 6.4.

Labor costs (wage-based)

Many C&I NEIs relate to cost savings such as O&M and other labor costs. These NEIs include, but are not limited to: operation and maintenance, administrative, material handling and material movement. The adjustment factor for these NEIs represents the variation in wages across states. This factor is determined for both NH and the state from which the respective study in the JS was completed. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for labor costs (wage-based) NEIs. The formula takes the following form:

$$Labor\ costs\ (wage - based)_{State} = [Median\ Hourly\ Wage]_{State}$$

Revenue & Productivity

NEIs that correspond to revenue and productivity increases are more appropriately adjusted using a measure of output than wages. We use GDP to reflect the level of output in a state. NEIs associated with this adjustment factor include, but are not limited to: energy savings, durability, product quality and life, sales revenue, and output. This factor is determined for both NH and the state from which the respective study in the JS was completed. Dividing the NH factor by the factor from the JS state provides the economic adjustment factor for revenue and productivity NEIs. The formula takes the following form:

$$Revenue\ and\ Productivity_{State} = [GDP]_{State}$$

Utility Cost – C&I

The final C&I NEI adjustment factor applies to utility NEIs, or NEIs that result from changes to utility costs such as bad debt, arrearages, and hedging. This adjustment factor is simply the ratio of average energy costs. These NEIs can be adjusted using the ratio of the average utility cost per MMBtu by sector (commercial, industrial, residential) in NH to the corresponding state from the JS. Sectors are determined using the NAICS system shown in Table 11. Assuming the average cost pricing, we use average energy price to represent the cost of service.

The formula takes the following form:

$$Utility\ Cost - C\&I_{State} = \left[\sum \left(\frac{C\&I\ Energy\ Price}{Total\ Energy\ consumption\ per\ Million\ Btu}\right)_{Sector}\right]_{State}$$

Table 11- NAICS industries separated into (1) commercial and (2) industrial classifications

NAICS	Description	Sector
11	Agriculture, Forestry, Fishing and Hunting	Industrial
21	Mining, quarrying, and oil and gas extraction	Industrial
22	Utilities	Commercial
23	Construction	Industrial
31-33	Manufacturing	Industrial
42	Wholesale trade	Commercial
44-45	Retail trade	Commercial
48-49	Transportation and warehousing	Transportation
51	Information	Commercial

NAICS	Description	Sector
52	Finance and insurance	Commercial
53	Real estate and rental and leasing	Commercial
54	Professional, scientific, and technical services	Commercial
55	Management of companies and enterprises	Commercial
56	Administrative and support and waste management and remediation services	Commercial
61	Educational services	Commercial
62	Health care and social assistance	Commercial
71	Arts, entertainment, and recreation	Commercial
72	Accommodation and food services	Commercial
81	Other services (except government and government enterprises)	Commercial
92	Public Administration	Commercial

6.4 Final economic adjustment calculation

The resulting output from the above calculations was a value specific to a state and NEI category. A ratio was created in which a value from NH served as the numerator and a value from the JS state served as the denominator. The equation took the following form:

$$Index = \frac{X_{State\,1}}{X_{State\,2}}$$

Where: $NEI_{Calibrated} = Index \times NEI_{Uncalibrated}$

The index was multiplied by the NEI to scale it from one region to another. For example, if the index was equal to 0.7 and the NEI was $10/unit, the calibrated NEI was $7/unit. This interpretation follows for all indexes created to calibrate NEIs.

7 ADJUST DATABASE VALUES

The final calculation in the database that accounts for all the factors described within the memo was:

$$NEI_{NH\ Adjusted} = (Index \times NEI_{Uncalibrated}) \times Confidence\ Factor\ (\%) \times Plausibility\ Factor\ (\%)$$

DNV GL's database of adjusted NEI values is the main deliverable for this project. Although we used the PF and CF as decision tools to identify which studies had the best NEI for a measure in the NHML, both factors were also used in the final calculation. This ensured that the uncertainty of using NEIs from a literature review (by considering factors both within and outside of how the study was conducted) were accounted for in the cost-effectiveness calculations. This deliberately reduced NEI values to account for uncertainty stemming from the methods used in the original study, as well as the transferability of that research to NH.

The database of NH adjusted NEI values will help us identify gaps in the existing research in the context of NH specific programs. It will also be used in the sensitivity analysis to estimate a conservative impact of these NEIs on NH benefit-costs tests.

When combined with the information gathered by the jurisdictional scan, the PF, CF and Economic Adjustments discussed in this memo provided the backbone of our database. These factors created a conservative approach to NEI calculation when using secondary research, and an opportunity to identify future areas for primary NEI research in NH.

8 REFERENCES

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9 APPENDIX

9.1 List of studies in Jurisdictional Scan

Study_ID	Title	Primary Author	Date (Year only)	Location of Study (State)	Sectors Covered by Study
Study0001	AEP Ohio Non-Energy Impact - Final Report	DNV GL	2018	OH	C&I
Study0002	Final Report – Commercial and Industrial Non-Energy Impacts Study	DNV GL	2012	MA	C&I
Study0003	C&I New Construction NEI Stage 2 Final Report	DNV GL	2016	MA	C&I
Study0004	Non-Energy Impact Framework Study Report	TetraTech	2018	MA	C&I, Residential
Study0005	Non-Energy Impacts (NEIs) Final Report	DNV GL	2018	Ontario	C&I, Residential
Study0006	Non-energy Benefits to Implementing Partners from the Wisconsin Focus on Energy Program: Final Report	Nick Hall	2003	WI	C&I
Study0007	Non-Energy Impacts (NEI) Evaluation Final Report	Summit Blue Consulting	2006	NY	C&I, Residential
Study0008	Determining the Full Value of Industrial Efficiency Programs	Patrick Lilly, Regional Economic Research, Inc.	1999	WA	C&I
Study0009	Ancillary savings and production benefits in the evaluation of industrial energy efficiency measures	Lung, R.B. Resource Dynamics Corporation	2005	NY, IL, CA	C&I
Study0010	Capturing the Multiple Benefits of Energy Efficiency	IEA	2014	USA, EU	C&I, Residential
Study0011	Productivity benefits of industrial energy efficiency measures	Worrell	2001	USA	C&I
Study0012	Energy efficiency and carbon dioxide emissions reduction opportunities in the U.S. iron and steel sector	Worrell	1999	USA	C&I
Study0013	Non-Electric Benefits from the Custom Projects Program: A look at the effects of custom projects in Massachusetts	TeckMarket Works	2007	MA	C&I

Study_ID	Title	Primary Author	Date (Year only)	Location of Study (State)	Sectors Covered by Study
Study0014	Exploring the Application of Conjoint Analysis for Estimating the Value of Non-Energy Impacts	Wobus	2007	USA	C&I
Study0015	C&I Prescriptive Non-Electric Benefits	Optimal Energy	2003	USA	C&I
Study0016	Multiple Benefits of Business Sector Energy Efficiency: A survey of Existing and Potential measures	Russell	2015	USA	C&I
Study0017	Energy Conservation Also Yields: Capital, Operations, Recognition and Environmental Benefits	Woodroof	2012	USA	C&I
Study0018	Efficiency Vermont Annual Report 2012	Efficiency Vermont	2012	VT	C&I
Study0019	An Evaluation of the Energy and Non-energy impacts of VT's Weatherization Assistance Program, for VT State Office Of Economic Opportunity	TecMarket Works	1999	VT	Residential
Study0020	Low Income Public Purpose Test (LIPPT 2000)	TecMarket Works	2000	CA	Residential
Study0021	Washington Low-income Weatherization Program, for Pacific Power	Quantec	2007	WA	Residential
Study0022	Low-income Arrearage Study for PacifiCorp	Quantec	2007		Residential
Study0023	2004-2006 Oregon REACH Program	Quantec	2008	OR	Residential
Study0024	Energy Smart Program Evaluation, Oregon HEAT	Quantec	2008	OR	Residential
Study0025	Analysis of Low Income Benefits in Determining Cost-effectiveness of Energy Efficiency Programs	Howat	2004	MA	Low Income
Study0026	Review of Energy Efficiency Programs	Tellus Institute		USA	
Study0027	Program Progress Report of National Weatherization Assistance Program (Schweitzer and Tonn)	Oak Ridge National Laboratories	2002	USA	Low Income

Study_ID	Title	Primary Author	Date (Year only)	Location of Study (State)	Sectors Covered by Study
Study0028	Analysis of PG&E's Venture Partners Pilot Program, - PG&E Low Income Weatherization Assistance Program 1994	SERA	1994	CA	Low Income
Study0029	Evaluation of NU - MA ESP Program NEBs	SERA	2002	MA	Low Income
Study0030	Evaluation of NU - CT ESP Program NEBs	SERA	2002	CT	Low Income
Study0031	for PA Consulting for WI Department of Administration Division, Low income program evaluation	SERA	2005	WI	Low Income
Study0032	Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and their Role & Values in Cost-Effectiveness Tests: State of Maryland	Skumatz	2014	MD	Residential
Study0033	Memo from J. Oppenheim to Laura McNaughton"Low income DSM NEB	Oppenheim	2000		Residential
Study0034	An Update of the Impacts of Vermont's Weatherization Assistance Program, for VT State OEO Weatherization. Program	Dalhoff Associates	2007	VT	Low Income
Study0035	Low Income Pub Ben Evaluation, Non-Energy Benefits of Wisconsin Low Income Weatherization. Assistance Program, Wisconsin Dept of Admin, DOE	PA Consulting	2005	WI	Low Income
Study0036	Low Income Pub benefits, Wisconsin DOE	PA Consulting	2007	WI	Low Income
Study0037	Assessment of Green Jobs Created by the OPA Multifamily Buildings Programs, for Ontario Power Authority	The Cadmus Group	2009	Ontario	Low Income
Study0038	California Retrofit High Performance Program 2004-5	Lutzenhiser	2006	CA	Low Income
Study0039	Development and Application of Select Non-Energy Benefits for the EmPOWER Maryland Energy Efficiency Programs	Itron	2014	MD	Residential, Low Income, C&I

Study_ID	Title	Primary Author	Date (Year only)	Location of Study (State)	Sectors Covered by Study
Study0040	C1641: Impact Evaluation of the Business and Energy Sustainability Program (prepared for CT Energy Efficiency Board (EEB))	ERS	2018	CT	C&I
Study0041	New Jersey Natural Gas 2015 SAVEGREEN Evaluation Final Report	Apprise	2015	NJ	Residential

9.2 Standard Levels of Aggregation with MapIDs

The embedded file has a list of all of the standardized measure descriptions within the database, with each of the seven levels defined for each measure. Each measure is also assigned a MapID, which is a unique ID for that combination of descriptors. Some rows are blank because those MapIDs have been eliminated from the database.

Standard Measure
Definitions (MapIDs

9.3 Standard NEIs

The embedded file has a list of all of the standard NEI categories, the economic benchmark used to adjust that category, the perspective of the NEI recipient, and the sector to which it applies. It also includes a definition of each NEI category.

Standard NEI
Categories.xlsx