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# NEW HAMPSHIRE NON-ENERGY IMPACTS – SENSITIVITY ANALYSIS

## 1 EXECUTIVE SUMMARY

This memo provides an overview of the effects of including measure-level non-energy impacts (NEIs) on the New Hampshire benefit-cost (BC) results for Eversource, Liberty, New Hampshire Elec Co-op (NHEC), and Unitil, collectively called the program administrators (PAs). The measure-level NEIs were assembled by DNV GL into the New Hampshire NEI database through a jurisdictional scan and the application of a number of adjustment factors, described in a previous methodology memo. The effects were studied through a sensitivity analysis that looked at 6 scenarios: one scenario without measure-level NEIs, one scenario with a standard 10% NEI adder, and 4 scenarios with measure-level NEIs (without the 10% adder) at various levels of net annual energy savings. All scenarios incorporate the same original costs. The results of the sensitivity analysis are reported by PA for the program years available in the provided BC models. These program years were 2018-2020 for Eversource and Liberty, 2017 for NHEC, and 2019 for Unitil.

The introduction of database NEIs generally increased BCRs; however, the impact was inconsistent across PAs, sectors, and programs. Eversource, NHEC, and Unitil showed an increase in BCR with NEIs compared to the No NEIs scenario. Generally, these PAs saw an increase in BCR even in the 50% savings reduction scenario across sectors and most programs. Liberty saw a small increase in BCR with the introduction of NEIs which was maintained in the 90% savings scenario, but the scenarios with more reduced savings did not maintain the increase. Liberty was the only utility that consistently showed lower BCRs with the database NEIs than the 10% adder scenario. (The NHEC analysis did not include the 10% adder scenario.)

Across PAs, the residential sector showed a greater impact from NEIs than the C&I sector. In general, the Home Energy Report and Energy Star Products programs showed more impact. (Liberty did not see the same result for Energy Star Products. Since the database depends on the measure name for matching, inconsistencies between utility terminology may be the reason for the differences.) For NHEC, the greatest impact was with the Home Energy Assistance program.

Across PAs, the C&I sector showed results that were more mixed. Most programs did not sustain an improved BCR for the 50% reduced savings when compared to the No NEIs scenario. Where there were

strong improvements, the Small Business program was most likely to see the benefit. Liberty and NHEC showed less improvement with C&I NEIs than Eversource and Unitil.

## 1.1 Methodology

In determining sensitivity to NEIs, DNV GL used the NH TRC Test, which is similar to the Secondary Granite State Test (GST-2), because it was the test in effect during the 2018-2020 period and it was the test in the calculators that were provided by the PAs. Some of the differences between the two tests are that the following utility system benefits are included in GST-2 but not the TRC test:

- Avoided ancillary services
- Avoided collection and credit costs
- Increased reliability
- Market transformation

The remaining differences are that the following non-utility system impacts are included in GST-2 but not the TRC test:

- Societal effects of income eligible participation
- Other externalities (not NH fossil fuel proxy) related to environmental impacts.

Given the limited differences between the two test, DNV GL does not believe that using the NH TRC test produces materially dissimilar results from what would be viewed with the GST-2.

The NH NEI database reports NEI values by measure and NEI category. Each measure has as many NEI values as it has applicable NEI categories. For example, a measure may have one NEI value for operations and maintenance savings and another for improved production<sup>1</sup>. The units on each NEI value vary as follows:

- Annual \$ per unit
- One time \$ per unit
- Annual \$ per kWh
- One time \$ per kWh
- Annual \$ per MMBTU
- One time \$ per MMBTU

To calculate the lifetime measure-level NEI values, the appropriate number of units and/or energy savings were multiplied by each NEI value. The annual values were multiplied by the measure life and added to the one-time NEIs to determine the total NEI value, in dollars, for that measure across NEI categories.

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<sup>1</sup> For application of NEIs from the database to the BC model, please see the application memo delivered to the NH NEI working group on 8 April 2020.

For example,<sup>2</sup> consider a lighting measure that produces 60 kWh savings per year over a 6 year measure life. Within a program year, 100 units were installed. There are NEIs in three different categories, shown in Table 1. Each NEI for each category has different units; one is annual \$ per kWh, one is annual \$ per unit, and one is one-time \$ per unit. By multiplying by the appropriate measure information (60 kWh and 6 years, where applicable), the values can be summed across categories to produce a lifetime NEI of \$84.20 per unit. Multiplied by 100 units, the program benefit is \$8,420 for that measure.

**Table 1. Example NEI calculation**

| NEI Category                  | Initial NEI by Category | Energy Savings | Measure Life | Lifetime NEI per Unit |
|-------------------------------|-------------------------|----------------|--------------|-----------------------|
| Lighting Quality and Lifetime | \$0.02/kWh/yr           | 60 kWh         | 6 years      | \$7.20                |
| Operations and Maintenance    | \$5.00/unit/yr          |                | 6 years      | \$30.00               |
| Health and Safety             | \$47.00/unit            |                |              | \$47.00               |
| <b>Total</b>                  |                         |                |              | <b>\$84.20</b>        |

Once the NEI values were applied to all relevant measures in each PA's BC model (which included the rest of the inputs), cost effectiveness was calculated at the program level.

Several scenarios were employed to determine the effect of the NEIs on the program cost effectiveness, as summarized below. Each scenario uses different levels of NEIs or gross energy savings, but all have the same costs.

- BCR at the program level without NEIs
- BCR at the program level with a standard 10% NEI adder<sup>3</sup>, which reflects that BCR that was most likely reported for that program year
- Four tests without the 10% adder:
  - BCR at the program level with NEIs and 100% of gross energy savings
  - BCR at the program level with NEIs and 90% of gross energy savings
  - BCR at the program level with NEIs and 80% of gross energy savings
  - BCR at the program level with NEIs and 50% of gross energy savings

The scenarios that use net annual energy savings reductions represent situations where the energy savings are less than originally anticipated by the amount indicated. This would, in turn, decrease the effect of the NEI tied to energy savings. The reduction in energy savings were conducted by reducing all energy savings fields tied to NEI calculations in the BC model by 10%, 20%, and 50% to create various scenarios of

<sup>2</sup> Note: this example does not use "real" database results. It was designed to clearly illustrate how an NEI value can be produced across NEI categories with different units.

<sup>3</sup> The NHEC BC model did not include the standard 10% NEI adder, and is not reflected in this analysis

decreased energy savings. The costs portion of the BCR test was unaffected in these scenarios. The energy savings fields reduced include:

- Net Annual MWh Savings
- Net Annual Gas Savings (MMBTU)
- Net Annual Oil Savings (MMBTU)
- Net Annual Propane Savings (MMBTU)
- Net Annual Kerosene Savings (MMBTU)
- Net Annual Cord Wood Savings (MMBTU)
- Net Annual Wood Pellet Savings (MMBTU)

The results of each scenario for each program and sector are presented in subsequent sections to show the effect NEIs have on program cost effectiveness.

Where data were available, cost effectiveness was evaluated for 2018, 2019 and 2020. The exceptions were NHEC and Unitil where data were only available for 2017 and 2019 respectively.

## 2 EVERSOURCE COST EFFECTIVENESS

In 2018, 2019, and 2020 projections, NEIs initially increase the total resource BCR compared to the No NEIs baseline scenario. As savings decrease incrementally, the BC ratio lowers slightly but overall remains more cost effective than the No NEIs scenario, even when savings drop to 50%. Individual programs or sectors, such as commercial and industrial (C&I) sector, do not show the same effect (greater BCR with 50% energy savings compared to no NEIs).

NEIs affected the Residential sector more than C&I, with Energy Star Products contributing roughly 60% to overall benefits, Home Performance with Energy Star comprising 15%, and Home Energy Reports accounting for 12%. The remaining benefits from the Home Energy Assistance and Energy Star Homes programs contribute the remaining 13%.

- NEIs account for 91% of total benefits for Energy Star Products, and are derived from the subprograms ES Lighting (14%), ES Appliances White Goods (46%) and ES Appliances HVAC Systems (39%). Within Energy Star Products, ES Lighting accounts for 40% of lifetime savings, ES Appliances White Goods accounts for 32%, and ES Appliances HVAC Systems accounts for 27%, suggesting that the NEIs for Lighting are lower (proportional to savings) than the NEIs for White Goods and HVAC Systems. Within ES Appliances HVAC Systems, about 89% of the total NEI value is derived from the Domestic Hot Water Heat Pump measure, subsequently comprising about 32% of Energy Star Product's overall benefit value. For reference, the Domestic Hot Water Heat Pump measure accounts for 19% of HVAC System's lifetime savings. Within ES White Goods, 2<sup>nd</sup> Refrigerator Pickup/Turn-in accounts for about 33% of the total White Goods NEI value, and about 15% of Energy Star Product's overall benefit value. For reference, 2<sup>nd</sup> Refrigerator Pickup/Turn-in accounts for just 9% of the White Goods lifetime savings value. Fifteen other NEIs comprise the remaining value, with ES Refrigerators, Refrigerator CEE Tier 2+, and Washer CEE Tier 2+ each contributing around 12% of the program's NEI value. As a percentage of White Goods' lifetime savings, Washer CEE Tier 2+ contributes 43% of savings, Refrigerator CEE Tier 2+ contributes 3%, and ES Refrigerators also contributes 3%.
- Within Home Performance with Energy Star, NEIs account for 64% of the program's total benefits.
  - The Weatherization subprogram accounts for 99% of both the program's NEI value and the program's lifetime savings, and about 64% of the program's overall benefit value. Within Weatherization, Electric Wxn accounts for 79% of Weatherization's NEI value, and about 51% of the program's overall benefit value. The Refrigerator measure accounts for 12% of the Weatherization NEI, and about 8% of the Home Performance with Energy Star overall benefit value. For reference, Electric Wxn accounts for just about 2% of Weatherization's lifetime savings value, and Refrigerators account for less than 1%.
  - The remaining 1% of the Home Performance with Energy Star NEI value is derived from the HVAC Systems subprogram. HVAC Systems also account for less than 1% of Home Performance with Energy Star's overall lifetime savings value. Within the HVAC subprogram, 47% of the value is derived from the Oil Furnace Replacement measure (31% of HVAC lifetime savings), 36% from Propane Furnace Replacement (32% of HVAC lifetime savings), 13% from Oil Boiler Replacement (20% of HVAC lifetime savings), and 4% from Propane Boiler Replacement (17% of HVAC lifetime savings).

- The Home Energy Reports program consists of only one subprogram - US: Home Energy Reports. The NEI value accounts for 96% of the program's overall benefits, and is driven almost entirely (over 99%) by the Behavioral Savings measure with a measure life of 4 years. The remaining Behavioral Savings measures with measure lives 1-3 years account for the remaining ~1%.

Across the board, every Residential program resulted in an increased BCR even when savings were dropped 50%. This is due largely to behavioral savings associated with the Home Energy Reports program and Energy Star products including refrigeration, lighting, and HVAC. Every Residential program also showed a greater BCR at 50% NEIs than the BCR with the 10% NEI adder.

For the C&I sector, NEIs had much less influence. Large Business Energy Solutions contributes the highest percentage of C&I benefits, and only two NEIs matched in this category (LCI Retrofit and LCI New Equipment and Construction). Together, these 2 subprograms account for 100% of Large Business Energy Solutions' lifetime savings, and their corresponding NEIs account for about 15% of program benefits, suggesting that the NEIs are small relative to other benefits in the BC model. The BCR of the Energy Rewards RFP Program was unaffected by NEIs. The remaining programs witnessed an initial BCR increase due to NEIs in every scenario except when savings were reduced 50%. For the C&I sectors, the scenario with full NEIs showed a higher BCR than the scenario with the 10% adder, but when savings dropped to 90%, the two scenarios produced approximately equal results (except for Energy Rewards RFP, which was unaffected by NEIs). When savings dropped to the 80% and 50% levels, the 10% adder produced a higher BCR than the database scenarios.

Overall, including NEIs increased the total BCR by over 2 points in 2018, 2019, and 2020 when looking at the full savings scenario.

2.1 2018 Results

| 2018  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.29               | 1.41                              | 1.99                             | 1.97                             | 1.96                             |
| Energy Star Homes                             | 2.13               | 2.33                              | 2.56                             | 2.52                             | 2.49                             |
| Home Performance with Energy Star             | 1.70               | 1.87                              | 4.61                             | 4.31                             | 4.03                             |
| Energy Star Products                          | 1.56               | 1.69                              | 16.64                            | 15.43                            | 14.22                            |
| Home Energy Reports                           | 1.46               | 1.60                              | 37.58                            | 37.48                            | 37.37                            |
| Sub-Total Residential                         | <b>1.57</b>        | <b>1.72</b>                       | <b>7.67</b>                      | <b>7.25</b>                      | <b>6.83</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 2.05               | 2.25                              | 2.41                             | 2.24                             | 2.06                             |
| Small Business Energy Solutions               | 1.55               | 1.71                              | 1.85                             | 1.73                             | 1.61                             |
| Municipal Energy Solutions                    | 1.18               | 1.30                              | 1.48                             | 1.38                             | 1.27                             |
| Energy Rewards RFP Program                    | 1.62               | 1.78                              | 1.62                             | 1.53                             | 1.43                             |
| Sub-Total Commercial & Industrial             | <b>1.74</b>        | <b>1.92</b>                       | <b>2.06</b>                      | <b>1.91</b>                      | <b>1.77</b>                      |
| <b>Total</b>                                  | <b>1.69</b>        | <b>1.85</b>                       | <b>3.88</b>                      | <b>3.64</b>                      | <b>3.41</b>                      |
|   |                    |                                   |                                  |                                  | <b>2.70</b>                      |

## 2.2 2019 Results

| 2019  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.39               | 1.53                              | 2.13                             | 2.11                             | 2.03                             |
| Energy Star Homes                             | 2.28               | 2.50                              | 2.74                             | 2.70                             | 2.54                             |
| Home Performance with Energy Star             | 1.87               | 2.05                              | 4.99                             | 4.67                             | 4.36                             |
| Energy Star Products                          | 1.57               | 1.70                              | 17.57                            | 16.29                            | 15.01                            |
| Home Energy Reports                           | 1.54               | 1.70                              | 37.22                            | 37.11                            | 36.99                            |
| Sub-Total Residential                         | <b>1.69</b>        | <b>1.85</b>                       | <b>7.80</b>                      | <b>7.41</b>                      | <b>7.03</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 1.98               | 2.18                              | 2.33                             | 2.16                             | 1.99                             |
| Small Business Energy Solutions               | 1.56               | 1.71                              | 1.86                             | 1.74                             | 1.62                             |
| Municipal Energy Solutions                    | 1.14               | 1.25                              | 1.42                             | 1.32                             | 0.92                             |
| Energy Rewards RFP Program                    | 1.59               | 1.75                              | 1.59                             | 1.50                             | 1.41                             |
| Sub-Total Commercial & Industrial             | <b>1.73</b>        | <b>1.90</b>                       | <b>2.02</b>                      | <b>1.88</b>                      | <b>1.74</b>                      |
| <b>Total</b>                                  | <b>1.71</b>        | <b>1.88</b>                       | <b>3.94</b>                      | <b>3.71</b>                      | <b>3.49</b>                      |
|   |                    |                                   |                                  |                                  | <b>2.82</b>                      |



## 2.3 2020 Results

| 2020                              |                    |                                   |                                  |                                  |                                  |
|-----------------------------------|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio |                    |                                   |                                  |                                  |                                  |
| Without NEIs                      | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |

### Residential Programs

|                                   |             |             |             |             |             |             |
|-----------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Home Energy Assistance            | 1.48        | 1.62        | 2.24        | 2.22        | 2.20        | 2.14        |
| Energy Star Homes                 | 2.44        | 2.68        | 2.92        | 2.88        | 2.84        | 2.71        |
| Home Performance with Energy Star | 2.00        | 2.19        | 5.27        | 4.94        | 4.61        | 3.62        |
| Energy Star Products              | 1.53        | 1.65        | 18.32       | 16.96       | 15.60       | 11.51       |
| Home Energy Reports               | 1.69        | 1.86        | 37.08       | 36.95       | 36.82       | 36.44       |
| <b>Sub-Total Residential</b>      | <b>1.81</b> | <b>1.98</b> | <b>8.09</b> | <b>7.72</b> | <b>7.35</b> | <b>6.23</b> |

|             |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|-------------|
| 1.48        | 1.62        | 2.24        | 2.22        | 2.20        | 2.14        |
| 2.44        | 2.68        | 2.92        | 2.88        | 2.84        | 2.71        |
| 2.00        | 2.19        | 5.27        | 4.94        | 4.61        | 3.62        |
| 1.53        | 1.65        | 18.32       | 16.96       | 15.60       | 11.51       |
| 1.69        | 1.86        | 37.08       | 36.95       | 36.82       | 36.44       |
| <b>1.81</b> | <b>1.98</b> | <b>8.09</b> | <b>7.72</b> | <b>7.35</b> | <b>6.23</b> |

### Commercial, Industrial & Municipal

|  |             |             |             |             |             |             |
|--|-------------|-------------|-------------|-------------|-------------|-------------|
| Large Business Energy Solutions              | 1.91        | 2.10        | 2.24        | 2.08        | 1.92        | 1.43        |
| Small Business Energy Solutions              | 1.51        | 1.66        | 1.80        | 1.68        | 1.56        | 1.21        |
| Municipal Energy Solutions                   | 1.10        | 1.21        | 1.36        | 1.27        | 1.18        | 0.90        |
| Energy Rewards RFP Program                   | 1.53        | 1.69        | 1.53        | 1.45        | 1.36        | 1.11        |
| <b>Sub-Total Commercial &amp; Industrial</b> | <b>1.69</b> | <b>1.85</b> | <b>1.97</b> | <b>1.83</b> | <b>1.70</b> | <b>1.29</b> |

|             |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|-------------|
| 1.91        | 2.10        | 2.24        | 2.08        | 1.92        | 1.43        |
| 1.51        | 1.66        | 1.80        | 1.68        | 1.56        | 1.21        |
| 1.10        | 1.21        | 1.36        | 1.27        | 1.18        | 0.90        |
| 1.53        | 1.69        | 1.53        | 1.45        | 1.36        | 1.11        |
| <b>1.69</b> | <b>1.85</b> | <b>1.97</b> | <b>1.83</b> | <b>1.70</b> | <b>1.29</b> |

### Total

|             |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>1.72</b> | <b>1.89</b> | <b>4.03</b> | <b>3.81</b> | <b>3.59</b> | <b>2.95</b> |
|-------------|-------------|-------------|-------------|-------------|-------------|

### 3 LIBERTY COST EFFECTIVENESS

In 2018, 2019, and 2020 projections, NEIs initially increase the total resource BCR compared to the No NEIs scenario but remains lower than the 10% adder scenario. The total BCR with NEIs remains higher than No NEIs at 90% of savings, but falls below No NEIs at the 80% and 50% savings scenarios.

NEIs had no impact on the C&I sector. Only two measures, Boiler: LP Condensing AFUE and Boiler: Oil AFUE, had NEIs in the C&I sector. The NEI values were low enough to barely impact the overall BCR. For all three programs and the sector overall, the No NEIs BCR and the BCR with NEIs were equal. As energy savings declined, the BCR also declined, as would be expected.

NEIs did have some impact on the Residential sector, driven by the Home Energy Reports program (23% of total residential gas benefits, and about 6% of total lifetime residential gas savings). Energy Star Homes did not show a change in the BCR with the introduction of NEIs, and Energy Star Products showed a very small increase.

- The only measure within residential gas Home Energy Reports is Behavioral Savings, accounting for all of the program's NEIs. NEIs account for 78% of the total benefit value for Home Energy Reports.
- Other measures with matched NEIs in the residential sector include Oil-Wxn, Propane-Wxn, WiFi Thermostat, ES Clothes Washers, Propane Furnace Replacement, Oil Boiler Replacement and Oil Furnace Replacement. The values of these NEIs are relatively low, contributing only about 3% of the sector's overall benefits. Collectively, this group accounts for about 31% of the sector's lifetime savings value.

For all programs (Residential and C&I) except the Home Energy Reports program, the 10% adder scenario produced a larger BCR than the With NEIs scenario from the database.

Overall, including NEIs increased the total BCR by less than 10% of benefits relative to costs in all three program years.

### 3.1 2018 Results

| 2018  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.11               | 1.22                              | 1.20                             | 1.19                             | 1.17                             |
| Energy Star Homes                             | 1.79               | 1.96                              | 1.79                             | 1.76                             | 1.72                             |
| Home Performance with Energy Star             | 1.39               | 1.51                              | 1.46                             | 1.44                             | 1.42                             |
| Energy Star Products                          | 1.01               | 1.10                              | 1.02                             | 1.00                             | 0.97                             |
| Home Energy Reports                           | 0.93               | 1.02                              | 2.24                             | 2.21                             | 2.18                             |
| Sub-Total Residential                         | <b>1.17</b>        | <b>1.28</b>                       | <b>1.30</b>                      | <b>1.28</b>                      | <b>1.26</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 1.62               | 1.77                              | 1.62                             | 1.57                             | 1.51                             |
| Small Business Energy Solutions               | 1.48               | 1.62                              | 1.48                             | 1.44                             | 1.39                             |
| Municipal Energy Solutions                    | 1.51               | 1.66                              | 1.51                             | 1.42                             | 1.33                             |
| Sub-Total Commercial & Industrial             | <b>1.54</b>        | <b>1.68</b>                       | <b>1.54</b>                      | <b>1.49</b>                      | <b>1.44</b>                      |
| <b>Total</b>                                  | <b>1.39</b>        | <b>1.52</b>                       | <b>1.44</b>                      | <b>1.40</b>                      | <b>1.37</b>                      |

### 3.3 2019 Results

| 2019  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.13               | 1.23                              | 1.33                             | 1.31                             | 1.22                             |
| Energy Star Homes                             | 2.67               | 2.92                              | 2.67                             | 2.60                             | 2.33                             |
| Home Performance with Energy Star             | 1.45               | 1.57                              | 1.53                             | 1.51                             | 1.42                             |
| Energy Star Products                          | 1.20               | 1.31                              | 1.20                             | 1.18                             | 1.06                             |
| Home Energy Reports                           | 1.06               | 1.16                              | 2.73                             | 2.69                             | 2.66                             |
| Sub-Total Residential                         | <b>1.40</b>        | <b>1.53</b>                       | <b>1.57</b>                      | <b>1.54</b>                      | <b>1.51</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 1.90               | 2.08                              | 1.90                             | 1.84                             | 1.60                             |
| Small Business Energy Solutions               | 1.55               | 1.69                              | 1.55                             | 1.50                             | 1.31                             |
| Municipal Energy Solutions                    | 1.24               | 1.36                              | 1.24                             | 1.17                             | 0.88                             |
| Sub-Total Commercial & Industrial             | <b>1.74</b>        | <b>1.91</b>                       | <b>1.74</b>                      | <b>1.69</b>                      | <b>1.63</b>                      |
| <b>Total</b>                                  | <b>1.61</b>        | <b>1.76</b>                       | <b>1.68</b>                      | <b>1.63</b>                      | <b>1.59</b>                      |

### 3.5 2020 Results

| 2020  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.25               | 1.37                              | 1.35                             | 1.34                             | 1.32                             |
| Energy Star Homes                             | 2.28               | 2.50                              | 2.28                             | 2.23                             | 2.19                             |
| Home Performance with Energy Star             | 1.57               | 1.71                              | 1.63                             | 1.61                             | 1.59                             |
| Energy Star Products                          | 1.15               | 1.26                              | 1.16                             | 1.13                             | 1.11                             |
| Home Energy Reports                           | 1.13               | 1.24                              | 3.07                             | 3.04                             | 3.02                             |
| Sub-Total Residential                         | <b>1.38</b>        | <b>1.50</b>                       | <b>1.51</b>                      | <b>1.49</b>                      | <b>1.47</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 1.58               | 1.73                              | 1.58                             | 1.52                             | 1.47                             |
| Small Business Energy Solutions               | 1.44               | 1.58                              | 1.44                             | 1.38                             | 1.32                             |
| Municipal Energy Solutions                    | 1.60               | 1.76                              | 1.60                             | 1.51                             | 1.42                             |
| Sub-Total Commercial & Industrial             | <b>1.51</b>        | <b>1.65</b>                       | <b>1.51</b>                      | <b>1.45</b>                      | <b>1.39</b>                      |
| <b>Total</b>                                  | <b>1.46</b>        | <b>1.60</b>                       | <b>1.51</b>                      | <b>1.47</b>                      | <b>1.42</b>                      |

## 4 NHEC COST EFFECTIVENESS

The NHEC results differed from the other three utilities for the Energy Star Products program. Once NEIs were applied, the database results produced BCRs of almost 70 with NEIs and over 40 with savings reduced by 50%. DNV GL reviewed the database, the jurisdictional scan, and the study and were unable to identify an error; however, the result was clearly implausible. DNV GL chose to completely remove the NEIs associated with Energy Star lighting and white goods (i.e. non-HVAC) from this program for the sensitivity analysis<sup>4</sup>.

Overall, NEIs initially increase the total resource BCR compared to the No NEIs baseline scenario. As savings decrease incrementally, the BC ratio lowers slightly but overall remains more cost effective than the No NEIs scenario even when savings drop to 50%. Home Energy Assistance, a residential low-income program, is particularly affected by the introduction of NEIs, with the BCR increasing from 1.4 to 19.53. This is largely due to the high measure life of weatherization measures as well as a relatively high annual per unit NEI value attributed to the electric direct install water measure within Weatherization.

- NEIs comprise 92% of the Home Energy Assistance program's benefits.
- Within Home Energy Assistance, HEA (Weatherization) accounts for 99% of the NEI value, and about 95% of the program's lifetime savings. Wxn Insulation and Direct Install Water Measures – Electric both count for about 23% of the HEA (Weatherization) NEI value, though together they account for less than 4% of the program's lifetime savings. The other half of the Weatherization subprogram's NEI value is comprised by LED Single Family, Wxn Air Sealing, Hot Water Heater Replacement, Wxn SF heating measures, and Electric Savings on Baseload Homes. Together, these measures account for about 96% of lifetime savings associated with the HEA Weatherization subprogram, and about 91% of the Home Energy Assistance program overall lifetime savings value.

The C&I sector also showed the influence of NEIs. All programs except for Smart Start showed an increase in BCR with NEIs which continued through the scenario with 50% lower gross savings. The Large Business Energy Solutions BCR was primarily driven by LCI retrofit measures, as well as the annual kWh NEI savings from LED lighting. The Smart Start BCR fell below the No NEIs scenario at 80% savings. Overall, NEIs accounted for 43% of the C&I sector's benefits.

- 57% of C&I NEIs come from the LCI (Retrofit) subprogram within Large Business Energy Solutions. For reference, LCI (Retrofit) accounts for 52% of overall C&I lifetime savings. The 6 measures below have NEIs within the LCI (Retrofit) subprogram, along with their relative percentages of the LCI (Retrofit) NEI value. LED Lighting accounts for the highest percentage of the subprogram's NEI value and about 48% of the subprogram's lifetime savings. The next highest contributors to the LCI (Retrofit) overall lifetime savings value are Snowmaking with 24% of savings, and Refrigeration Controls with 18%.
  - Lighting LED 78%
  - Snowmaking 9%
  - VFD Retrofit 8%

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<sup>4</sup> To remove the NEIs associated with Energy Star lighting and white goods, the values were removed from NEI application on the Inputs sheet in the BC Excel workbook

- Refrigeration Controls 5%
- Lighting OS Only 1%
- Parking Lot Lights <1%

Overall, including NEIs increased the total benefits by over 200% relative to costs for all scenarios.

## 4.1 2017 Results

| 2017                              |                                   |                                  |                                  |                                  |
|-----------------------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio |                                   |                                  |                                  |                                  |
| Without NEIs                      | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |

### Residential Programs

Home Energy Assistance  
 ENERGY STAR Homes  
 Home Performance with ENERGY STAR  
 ENERGY STAR Products  
 Sub-Total Residential

|             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|
| 1.40        | 19.53       | 19.48       | 19.42       | 19.25       |
| 3.06        | 6.59        | 6.40        | 6.21        | 5.64        |
| 1.42        | 7.36        | 7.22        | 7.08        | 6.66        |
| 3.83        | 3.83        | 3.66        | 3.50        | 2.99        |
| <b>2.50</b> | <b>9.37</b> | <b>9.23</b> | <b>9.10</b> | <b>8.69</b> |

### Commercial & Industrial

Large Business Energy Solutions  
 Small Business Energy Solutions  
 Municipal Energy Solutions  
 Smart Start  
 Sub-Total Commercial & Industrial

|             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|
| 2.19        | 3.85        | 3.53        | 3.20        | 2.24        |
| 1.53        | 2.80        | 2.58        | 2.35        | 1.67        |
| 1.09        | 1.71        | 1.61        | 1.51        | 1.22        |
| 2.30        | 2.72        | 2.45        | 2.17        | 1.36        |
| <b>1.71</b> | <b>2.91</b> | <b>2.67</b> | <b>2.44</b> | <b>1.74</b> |

### Total

|             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|
| <b>2.03</b> | <b>5.53</b> | <b>5.34</b> | <b>5.15</b> | <b>4.57</b> |
|-------------|-------------|-------------|-------------|-------------|

## 5 UNITIL COST EFFECTIVENESS

NEIs initially increase the total resource BCR compared to the No NEIs baseline scenario and when the standard 10% NEI adder is applied. As savings decrease incrementally, the BC ratio lowers slightly but overall remains more cost effective than both the No NEIs and 10% adder scenarios, even when savings drop to 50%.

NEIs affected the Residential sector more than C&I, driven by large NEIs from the Energy Star Products program. Specifically, electric products in the White Goods and HVAC subprograms accounted for high lifetime NEI savings due primarily to high measure lives.

- Electric Energy Star Products' NEIs, made up by roughly half White Goods and half HVAC Systems, accounted for 95% of the program's overall benefits and 100% of the program's lifetime savings.
  - Over 15 measures contributed to the White Goods' NEI value. The measures that account for the largest share of this value are Variable Speed Pool Pumps and Refrigerators, each about 20% of the total NEI value. For reference, Variable Speed Pumps account for about 7% of lifetime savings and Refrigerators make up about 10% of lifetime savings for White Goods.
  - Within HVAC Systems, DHW Heat Pump Water Heater 50 gal accounts for 76% of the total NEI value (and about 24% of the lifetime savings value). Other than that, the measures Mini Split HPs, DHW Heat Pump Water Heater 80 gal, Wifi Thermostats, ES AC (Central), ECM Motors for FHA Furnace Fans and for FWH Circulating Pump account for the remaining NEI value within HVAC Systems. These measure account for 24% of the subprogram's NEI value and 76% of the subprogram's lifetime savings value.

Every individual residential program resulted in a higher BCR even with 50% savings as compared to the No NEIs scenario. Every individual residential program except Energy Star Homes resulted in a higher BCR even with 50% savings as compared to the 10% adder scenario.

For the C&I sector, NEIs had less influence. None of the programs showed a higher BCR for the 50% reduced savings scenario when compared to the No NEIs. The Municipal Energy Solutions Program does not show any NEI impact at all. Only one of the programs, Small Business Energy Solutions, shows a greater BCR at 90% savings than the 10% adder scenario.

Overall, including NEIs increased the total BCR more than 2 points when looking at the full savings scenario. Even with the 50% savings reduction, NEIs increased the total benefits by 75% relative to the costs.



## 5.1 2019 Results

| 2019  |                    |                                   |                                  |                                  |                                  |
|---|--------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Total Resource Benefit/Cost Ratio             |                    |                                   |                                  |                                  |                                  |
| Without NEIs                                  | With 10% NEI Adder | With NEIs and 100% energy savings | With NEIs and 90% energy savings | With NEIs and 80% energy savings | With NEIs and 50% energy savings |
| <b>Residential Programs</b>                   |                    |                                   |                                  |                                  |                                  |
| Home Energy Assistance                        | 1.23               | 1.46                              | 2.88                             | 2.87                             | 2.82                             |
| Energy Star Homes                             | 1.62               | 1.78                              | 1.82                             | 1.79                             | 1.71                             |
| Home Performance with Energy Star             | 1.45               | 1.59                              | 3.39                             | 3.19                             | 2.99                             |
| Energy Star Products                          | 1.53               | 1.67                              | 15.96                            | 14.80                            | 10.20                            |
| Home Energy Reports                           | 1.14               | 1.25                              | 3.18                             | 3.11                             | 2.82                             |
| Sub-Total Residential                         | <b>1.41</b>        | <b>1.57</b>                       | <b>6.57</b>                      | <b>6.18</b>                      | <b>4.65</b>                      |
| <b>Commercial, Industrial &amp; Municipal</b> |                    |                                   |                                  |                                  |                                  |
| Large Business Energy Solutions               | 1.75               | 1.92                              | 1.97                             | 1.86                             | 1.43                             |
| Small Business Energy Solutions               | 1.52               | 1.67                              | 1.85                             | 1.74                             | 1.28                             |
| Municipal Energy Solutions                    | 1.70               | 1.87                              | 1.70                             | 1.58                             | 1.06                             |
| Sub-Total Commercial & Industrial             | <b>1.64</b>        | <b>1.80</b>                       | <b>1.89</b>                      | <b>1.78</b>                      | <b>1.34</b>                      |
| <b>Total</b>                                  | <b>1.55</b>        | <b>1.71</b>                       | <b>3.80</b>                      | <b>3.58</b>                      | <b>2.69</b>                      |

## 5.2 Key Takeaways

The introduction of database NEIs generally increased BCRs; however, the impact was inconsistent across PAs, sectors, and programs. Eversource, NHEC, and Unitil showed an increase in BCR with NEIs compared to the No NEIs scenario. Generally, these PAs saw an increase in BCR even in the 50% savings reduction scenario across sectors and most programs. Liberty saw a small increase in BCR with the introduction of NEIs which was maintained in the 90% savings scenario, but the scenarios with more reduced savings did not maintain the increase. Liberty was the only utility that consistently showed lower BCRs with the database NEIs than the 10% adder scenario. (The NHEC analysis did not include the 10% adder scenario.)

Across PAs, the residential sector showed a greater impact from NEIs than the C&I sector. In general, the Home Energy Report and Energy Star Products programs showed more impact. (Liberty did not see the same result for Energy Star Products. Since the database depends on the measure name for matching, inconsistencies between utility terminology may be the reason for the differences.) For NHEC, the greatest impact was with the Home Energy Assistance program.

Across PAs, the C&I sector showed results that were more mixed. Most programs did not sustain an improved BCR for the 50% reduced savings when compared to the No NEIs scenario. Where there were

strong improvements, the Small Business program was most likely to see the benefit. Liberty and NHEC showed less improvement with C&I NEIs than Eversource and Unitil.