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**X1942C Cross-cutting NEI Study – HES & HES-IE NEIs**

REVIEW DRAFT

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Connecticut Energy Efficiency Board

SUBMITTED BY:  
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# Executive Summary

## Purpose

As part of the X1942 Non-Energy Impacts (NEIs) study, the NMR study team conducted an analysis to quantify NEIs for program participants who participated in the Home Energy Solutions (HES) and Home Energy Solutions – Income Eligible (HES-IE) programs and installed air sealing and insulation. This study conducted primary data collection via web surveys that collected data to quantify NEIs associated with air sealing and insulation. The analysis applied algorithms used in past studies to establish NEI values for each measure and NEI category. This report, which is part of the larger X1942 study, uses the same methods described in the X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs[[1]](#footnote-2) and discusses the results from this analysis and presents the air sealing and insulation NEIs the study was able to quantify.

## Background

The 2016 HES/HES-IE Process Evaluation study (R4) found participants experienced positive net NEIs from participating in the program.[[2]](#footnote-3) They highly valued NEIs such as comfort, safety, and property value improvements. The study recommended the program consider structuring future evaluation efforts to estimate measure specific NEI values that could be added to program BCRs to increase program total resource benefits. This study applies a modified version of the calculation methodology used in the R4 study to quantify NEIs from air sealing and insulation measures associated with the HES and HES-IE programs.

## Goal

The goal the X1942C study is to quantify NEIs from insulation and air sealing measures. This study aims to fill gaps and provide measure-specific NEIs not currently included in the Connecticut PSD or not used in cost effectiveness (C/E) testing.[[3]](#footnote-4) This study includes the following high priority NEIs:

* Comfort in the summer
* Comfort in the winter
* Outdoor noise heard inside the home
* Indoor noise heard inside the home
* Air quality in the home
* Change in humidity or dampness
* Change in mold

## Findings

**Table 0‑1 presents the NEIs that the study was able to quantify using information from end-user surveys.** Currently, none of these NEIs are included in Appendix Six (Non-Energy Impacts) in Connecticut’s 2022 Program Savings Document (PSD) for use in the Total Resource Cost (TRC) Test, which is used as a secondary test to provide a broader perspective of program performance, except for the HES-IE program, which uses the TRC test as the primary B/C metric.[[4]](#footnote-5) Currently, the HES-IE NEIs in the PSD are at the program-wide level. The NEI values presented in Table 0‑1 and Table 0‑2 are per participant perspective annual values specific for air sealing and insulation, which are expected to last through the life of the measures.

**Participants who received incentives for air sealing and/or insulation through the program experienced positive net impacts from the program.** For most of the NEIs studied, the positive NEIs outweighed negative NEIs. The HES program had a net average annual value of $202 ($231 including health NEIs) or 113% of the value of their expected energy savings (average expected annual savings is 8.5 MMBtu kWh per participant).[[5]](#footnote-6) Although not statistically different from HES, the HES-IE program had a net average annual value of $235 ($265 including health NEIs). This was also 113% of the value of their expected energy savings (average expected annual savings is 8.2 MMBtu per participant), as shown in Table 0‑1 and Table 0‑2.

## Recommendations

**Recommendation 1: HES-IE participant NEIs for air sealing and insulation should be used in cost-effectiveness tests as allowed now and in the future.[[6]](#footnote-7)** For the TRC test, adding the NEIs derived from this study to current estimates of total program benefits relative to costs increases benefit-cost ratios (BCRs) for all fuels and Companies and would inform program planning. It will not impact BCRs for the Modified Utility Cost Test (MUCT), which is the primary test for electric programs that save fossil fuels, because the MUCT does not include participant NEIs (the TRC is the primary test for only the HES-IE program and includes participant NEIs).

**Recommendation 2: This study recommends using combined values for air sealing and insulation.** It is common practice for air sealing and insulation to be installed together and this was the case for most respondents in this study. A regression analysis did not find insulation and air sealing values to be statistically different.

Table 0‑1: Summary of Monetized NEIs 1,2

(Annual NEI Value per Average Participant that Installed Air Sealing and/or Insulation)

|  |  |  |  |
| --- | --- | --- | --- |
| NEI | HES  (n=77) | HES-IE (n=63) | Average  (n=140) |
|
| Air quality in the home | $16  ($6, $25) | $29  ($6, $52) | $22  ($10, $33) |
| Change in humidity or dampness | $27  ($13, $40) | $49  ($24, $75) | $37  ($23, $51) |
| Change in mold | $16  ($5, $27) | $26  ($3, $49) | $20  ($9, $32) |
| Comfort in the summer | $105  ($56, $155) | $54  ($27, $80) | $82 ($52, $112) |
| Comfort in the winter | $114  ($65, $164) | $63  ($37, $90) | $91  ($62, $121) |
| Noise heard from inside the home | $19  ($0, $39) | $36  ($14, $57) | $27 ($13, $41) |
| Noise heard from outside the home | $19  ($6, $32) | $41  ($19, $64) | $29 ($17, $42) |
| **Sub Total** | **$202.18  ($120.95, $283.40)** | **$235.38 ($109.65, $361.10)** | **$217.12**  **($145.78, $288.45)** |
| Asthma |  |  | $0.75  ($0.02, $1.52) |
| Allergies |  |  | $11.40 ($3.11, $19.65) |
| Colds/Viruses |  |  | $1.86 ($0.48, $3.22) |
| Sinusitis |  |  | $1.42 ($0.25, $2.55) |
| Missed work | $2.99 ($1.20, $4.78) | $3.78 ($1.51, $6.04) | $3.35 ($1.34, $5.35) |
| Missed school |  |  | $10.78 ($-1.39, $22.96) |
| **Sub Total** | **$29.20** | **$29.99** | **$29.56** |
| **Total Value** | **$231.38** | **$265.37** | **$246.68** |

1 NEIs are for participants who received incentives for air sealing and/or insulation through the program. NEI values are in 2020 dollars.

2 90% confidence intervals in parentheses

Table 0‑2: Summary of Non-health NEI Percent of Measure Savings 1

| NEI | HES  (n=77) | HES-IE (n=63) | Average  (n=140) |
| --- | --- | --- | --- |
| Air quality in the home | 11%  (7%, 15%) | 16%  (5%, 28%) | 13%  (7%, 19%) |
| Change in humidity or dampness | 13%  (9%, 17%) | 15%  (10%, 20%) | 14%  (10%, 17%) |
| Change in mold | 7%  (3%, 10%) | 15%  (3%, 27%) | 11%  (5%, 16%) |
| Comfort in the summer | 32%  (27%, 36%) | 21%  (14%, 27%) | 27%  (23%, 31%) |
| Comfort in the winter | 36%  (32%, 41%) | 24%  (18%, 29%) | 30%  (27%, 34%) |
| Noise heard from inside the home | 5%  (2%, 8%) | 9%  (5%, 13%) | 7%  (4%, 9%) |
| Noise heard from outside the home | 10%  (6%, 13%) | 14%  (5%, 23%) | 11%  (7%, 19%) |
| **Total Value** | **113%**  **(95%, 130%)** | **113%**  **(76%, 150%)** | **113%**  **(94%, 132%)** |

1 NEIs are for participants who received incentives for air sealing and/or insulation through the program.

# Methodology

## Participant End-user Surveys

This study conducted primary data collection via web surveys from HES/HES-IE program participant end-users to quantify NEIs associated with air sealing and/or insulation in Connecticut. See Appendix A.1 for additional details on the methodology and the targets and achieved completes for this research task.

## Identifying NEIs

This study identified specific NEIs to be quantified for particular air sealing and insulation installation scenarios. The following list breaks down the rationale for the NEIs identified in this study:

* **Comfort in the summer –** Adding air sealing and insulation can provide cooling-related comfort by keeping cold air from escaping or hot air from entering.
* **Comfort in the winter –** Adding air sealing and insulation can provide heating-related comfort by keeping heat from escaping or cold air from entering.
* **Outdoor noise heard from i and inside the home -** Adding insulation can reduce the amount of noise traveling through the walls within the home as well as outside noise coming into the home. Air sealing can also reduce the amount of outside noise entering the home.
* **Air quality in the home –** Air sealing and insulation tighten up the home by reducing air flow which can lower the air quality in a home but also reduce the infiltration of outdoor air pollutants into the home.
* **Change in humidity and dampness –** Reduced air flow in a home can lead to an increase in humidity and dampness when moisture gets trappedwithout adequate ventilation.
* **Change in mold –** Reduced air flow in a home can also lead to an increase in mold when moisture gets trapped without adequate ventilation.
* **Household member’s health –** Changes in air quality and increased comfort from air sealing and insulation can increase or decrease incidences of illnesses such as asthma, colds/viruses, allergies.
* **Missed work and school –** Increased or decreased incidence of illnesses from air sealing and insulation can reduce loss of earnings from days of missed workand school.

## Quantifying NEIs

This study uses a combination of a contingent valuation approach where respondents are asked to place a value on the NEIs they experience using a labeled magnitude scale on non-health related impacts, such as reduced noise and improved comfort, and self-reported direct measurement of health impacts, such as impacts on asthma triggers and other ailments. Figure 1‑1 shows the NEIs by their measurement approach.

**Labeled magnitude scale (relative valuations).** To develop NEI values, the web survey asked survey respondents if the installation had a positive, negative, or no effect on various non-energy related elements in their households or properties.

For any elements where respondents observed positive or negative impacts as a result of the program, the survey asked them to compare the value of that NEI to the energy savings associated with their participation in the HES or HES-IE program. The survey also asked respondents to identify overlapping NEIs to avoid double counting NEI benefits. Furthermore, the survey asked the respondents to consider the net impacts of the NEIs combined. The analysis used these inputs to estimate NEI dollar values. For more a detailed description of the methodology used to calculate NEI values, see Appendix A.2.1 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs.

**Self-report direct measurement of changes in occurrences.** For health impacts, the web survey asked respondents for the number of times they had to seek medical care for specific health ailments in the year before and the year after participating in the program. The survey also asked whether the number of days of work and school missed increase, decrease, or stayed the same.[[7]](#footnote-8) The analysis used these inputs to calculate the avoided cost per occurrence of specific illnesses and loss of earnings from missed work and school. Appendix A.2.2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs provides a more detailed description of the methodology used to quantify health NEI values.

Figure ‑: NEIs by Approach

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\* Measures excluded from main findings.

# Findings

## Non-health NEIs

### By Program

**The total dollar value of all non-health related NEIs is $217 for the average air sealing and insulation end-user.** Figure 2‑1shows the total dollar value of all NEIs per year by program for participants who received incentives for air sealing and/or insulation. While the HES-IE program has the higher overall NEI value at $235 compared to the HES program at $202, the differences in the total dollar value of the NEIs by program are not statistically significant at the 90% confidence level.

Figure ‑: Annual NEI Dollar Value by Program

(Annual NEI Value per Average Participant that Installed Air Sealing and/or Insulation)

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1 Bars show 90% confidence intervals.

Figure 2‑2 shows the corresponding percent of savings by program. On average, respondents value NEIs the same for HES and HES-IE (113%) when compared to the value of their expected energy savings.

Figure ‑: Percent of Savings by Program

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1 Bars show 90% confidence intervals.

Figure 2‑3 shows the average annual NEI dollar values per participant per year by for air sealing and/or insulation by program. On average, the NEIs with the highest values are comfort during winter ($114) and summer ($105) for HES. For HES-IE, the NEIs with the highest values included comfort during winter ($63) and summer ($54) and change in humidity or dampness ($49).

Noise heard from inside and outside the home, air quality, and change in the amount of mold had the lowest values for both HES and HES-IE programs. They were also the least experienced NEI. For example, only 12% of HES respondents and 19% of HES-IE respondents indicated they experienced reduced noise heard from inside the home.

Figure ‑: Annual NEI Dollar Value by Program 1

(Annual NEI Value per Average Participant that Installed Air Sealing and/or Insulation)

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1 90% confidence intervals shown in parentheses.

### By Measure

Figure 2‑4 shows the total NEI values by measure installed (air sealing only, insulation only, or air sealing and insulation). The values are not statistically different from each other at the 90% confidence level.[[8]](#footnote-9) The majority of respondents (69%) installed both air sealing and insulation. Since insulation is commonly installed with air sealing, it is likely that participants could have installed either air sealing or insulation at another time that was not included in the program tracking data.

Figure ‑: Annual NEI Dollar Value by Measure

(Annual NEI Value per Average Participant that Installed Air Sealing and/or Insulation)

Chart, timeline, bar chart

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1 Bars show 90% confidence intervals.

Figure ‑: Percent of Savings by Measure

Chart, bar chart

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1 Bars show 90% confidence intervals.

## Health NEIs

**Annual NEI values per participant attributable to avoided illnesses range from $0.75 to $11.40 ($8 to $118 lifetime).** Table 2‑1 provides the high-level calculation of the annual value per average participant attributable to asthma, allergies, sinusitis, and cold/viruses. The survey yielded very low levels of change in the number of incidences occurring per year. Survey respondents reported low levels of change for the other ailments. The analysis resulted in annual NEI values (per participant) of $0.75 for asthma, $11.40 for allergies, $1.42 for sinusitis, and $1.86 for colds and viruses. Appendix A.2.2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs provides a more detailed description of the methodology used to estimate these values.

Table ‑: Annual and Lifetime NEI Values Per Participant for Reduced Illnesses

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Asthma | Allergies | Sinusitis | Colds/ Viruses |
| **Avoided cost per incidence, adjusted to 2021 dollars1 (A)** | $284 | $684 | $249 | $34.98 |
| **Avoided out of pocket cost per incident adjusted for insurance coverages2 (B)** | $108 | $259 | $95 | $13 |
| **Change in number of incidents per year3 (C)** | 0.007 (0.0002, 0.01) | 0.044 (0.01, 0.24) | 0.015 (0.003, 0.03) | 0.140 (0.04, 0.20) |
| **Annual value per average participant attributable to specific avoided illnesses (B×C)** | **$0.75 ($0.02, $1.52)** | **$11.40 ($3.11, $19.65)** | **$1.42 ($0.25, $2.55)** | **$1.86 ($0.48, $3.22)** |
| **Lifetime NEI attributable to program measures4, 5** | **$7.82 ($0.21, $15.76)** | **$118.36 ($32.31, $204.00)** | **$14.71 ($2.56, $26.50)** | **$19.26 ($5.02, $33.43)** |

1 *Source:* Agency for Healthcare Research and Quality.Medical Expenditures Panel Survey, 2021.[*https://www.meps.ahrq.gov/mepsweb/*](https://www.meps.ahrq.gov/mepsweb/)*.*

2 Avoided out of pocket cost per one incident adjusted for insurance coverages = avoided cost per incidence, adjusted to 2021 dollars × Percent of CT residents uninsured / not covered by health insurance for Northeast × Average percent out of pocket payment (from MEPs). E*xample Asthma: $284 (A) × 5.9% × 34% = $108 (B)*

3 Incidence calculated from survey responses.  
4 Lifetime NEI attributable to program measures = Annual value per average participant attributable to avoided illness × weighted average years lifetimes × discount rate. E*xample Asthma: $0.75 × weighted average years lifetimes × 15 years × 5% = $7.82*

5 90% confidence intervals in parentheses

**Annual NEI value per participant attributable to avoided missed work is $2.99 for average residential households and $3.78 for low-income households.** Table 2‑2 calculates the annual value per average participant attributable to missed work. Respondents reported an average of 0.03 fewer missed worked days after installing air sealing and/or insulation through the program which equates to an annual avoided cost of $2.99 and $3.78 for average residential and low-income households, respectively. Appendix A.2.2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs provides additional detail on the approach used to estimate the annual NEI value for missed days worked.

Table ‑: Annual NEI Values Per Participant for Missed Work

|  |  |  |
| --- | --- | --- |
|  | Average Residential | Low-income |
| **Wages per day for average residential household1 (A)** | $251.68 | $145.84 |
| **Wages lost per day for households with primary earner (corrected for without sick leave)2 (B)** | $55.37 | $70.00 |
| **Change in number of average workdays missed due to program effect (C)3** | 0.05 (0.02, 0.09) | |
| **Changes in household wages from change in sick days lost from work (B×C)4** | **$2.99 ($1.20, $4.78)** | **$3.78 ($1.51, $6.04)** |

1 Wages per day for average residential household = Median hourly wage for Connecticut for all occupations in 2020 is $31.46 × Hours per workday = *$31.46 × 8 = $251.68 (A)*

Wages per day for low-income household = Median hourly wage for Connecticut for all occupations in 2020 is $31.46 × Hours per workday = *$18.23× 8 = $145.84 (A)*

*Source: U.S. Bureau of Labor Statistics. “May 2020 State Occupational Employment and Wage Estimates*

*Connecticut,” May 2020,* [*www.bls.gov*](http://www.bls.gov)*.*

2 Wages lost per day for households with primary earner (corrected for without sick leave) = Percent of homes without sick leave in 2020 is 22% × hourly wage for average residential household. *$251.68 (A) × 22% = $55.37 (B)*

Wages lost per day for households with primary earner (corrected for without sick leave) = Percent of homes without sick leave in 2020 is 22% × hourly wage for low-income residential household. *$145.84 (A) × 48% = $70.00 (B)*

*Source: U.S.* Bureau of Labor Statistics. *“Employee Benefits in the United States – March 2021.”* News Release, September 23, 2021, <https://www.bls.gov/news.release/pdf/ebs2.pdf>, Table 6 (pg. 17).

3 Input from survey responses.

4 90% confidence intervals in parentheses.

**Annual NEI value per participant attributable to avoided missed school is $10.78.** The analysis found a very small (0.13 days) reduction in the average number school days missed, as shown in Table 2‑3, after program participation. See Appendix A.2.2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs for additional detail on the approach used to estimate the annual NEI value for missed school.

Table ‑: Annual NEI Values Per Participant for Missed School

|  |  |
| --- | --- |
|  | Missed School Values |
| **Savings from childcare from 1 day of reduced absences1 (A)** | $83.89 |
| **Change in number of average school days missed due to program effects2 (B)** | 0.13 (-0.02, 0.27) |
| **Participant value from changes in sick days lost from school (A×B)3** | **$10.78 ($-1.39, $22.96)** |

1 Savings from childcare from 1 day of reduced absences = Family Childcare Cost $15,100/year (June 2021) for one child divided by number of school days in a year- 180 day/year (2018) = *$15,100/180 = $83.89 (A).* Assumption based on an 8-hour day.

*Source:* American Progress. *“The True Cost of High-quality Child Care Across the United States,” June 28, 2021,* <https://www.americanprogress.org/issues/early-childhood/reports/2021/06/28/501067/true-cost-high-quality-child-care-across-united-states/>.

Source: National Center for Education Statistics. *“Number of instructional days and hours in the school year, by state*,” 2018, <https://nces.ed.gov/programs/statereform/tab5_14.asp>.

2 Input from survey responses.

3 90% confidence intervals in parentheses.

1. Detailed Methodology
   1. Participant End-User Survey

The sample frame for the end-user survey included residential program participants who received air sealing and insulation incentives from the HES and HES-IE program between 2017 and 2020.

Recruitment letters were mailed to every potential respondent. Participants with email addresses included in the program tracking data were also sent emails. The letters and emails explained the purpose of the survey and provided contact information for participants to verify the legitimacy of the study and to complete the survey by phone. Respondents were sent a $20 digital gift card via email after completing the survey. Two reminder emails and one reminder postcard were sent to participants that did not respond to the survey.

The end-user survey for all measures yielded a total of 140 responses, including 77 HES and 63 HES-IE respondents (Table A-1). The number of responses did not meet the original study quota of 420 responses. The overall response rate was 3% after accounting 418 returned recruitment letters.[[9]](#footnote-10)

Table A-: End-user Survey Targets and Completes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Recruitment | | Survey results | | |
| **Measure Types** | **Mailers** | **Email** | **Target** | **HES Completes** | **HES-IE Completes** |
| Air sealing | 346 | 53 | 70 HES 70 HES-IE | 2 | 30 |
| Insulation | 1,179 | 45 | 70 HES  70 HES-IE | 10 | 1 |
| Air sealing and insulation | 2,368 | 494 | 70 HES  70 HES-IE | 65 | 32 |
| **Total (n participants)** | **3,893** | **592** | **210 HES 210 HES-IE** | **77** | **63** |

* 1. Non-Energy Impacts Methodology

For a detailed description of the study methodology, see X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs Appendix A.2.1.

* + 1. LMS Limitations

Survey respondents were not presented with information about their estimated savings in the survey. The study assumed that program implementor provided respondents with expected savings from their air sealing and insulation installations. The survey asked respondents to provide an estimate of their energy bill savings associated with air sealing and insulation measures. Approximately 28% of the respondents were unable to and another 30% indicated they did not observe any savings, suggesting that the majority may not have been aware of their savings from their measure installations.

Given that the value of the NEI was estimated relative to their expected energy savings, there may be a disconnect between what the respondents were thinking their bill savings were compared to the bill savings calculated from program-reported savings. This disconnect likely introduces uncertainty and bias into the estimates. The study addresses some of this discrepancy by applying a realization rate adjustment to the program-reported savings used to estimate bill savings and NEI values later discussed in Appendix B.1.

* + 1. Self-Report Direct Measurement Limitations

The survey used to calculate the health NEIs in this study asks the respondents to compare the number of times they experienced illness, missed work or school resulting from illnesses before and after their participation in the program. This method did not use a control group to account for weather and other unobserved year over year changes that may impact illness and missed work or school. The survey attempts to control for the pandemic by asking respondents to focus on the period prior to 2020. However, despite this, respondents may have a difficult time separating out the time periods given that it had been several years since they had participated in the program by the time the survey was fielded.

1. Detailed Results
   1. Participant Annual Savings

Table B-1 reports the average annual reported gross energy savings of the end-user survey respondents, the adjusted gross energy savings after applying a realization rate, and the corresponding energy bill savings resulting from the adjusted gross energy savings. The study applied realization rates obtained from the R1983 HES / HES&IE Impact and Process Evaluation Study to adjust the gross energy savings. HES participants had similar savings to HES-IE participants with an overall average of 23.3 MMBtu in savings or $184.94 in bill savings.

Table B-: Average Annual Participant Savings for Air Sealing and Insulation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Program |  | Gross Energy Savings (MMBtu) | | Adjusted Gross Energy Savings (MMBtu)1 | | Dollar Bill Savings2 | |
|  | **n** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** | **Mean** | **Std. Dev.** |
| HES | 77 | 22.1 | 16.6 | 8.5 | 7.4 | $193.21 | $195.00 |
| HES-IE | 63 | 24.7 | 23.2 | 8.2 | 9.6 | $174.83 | $198.79 |
| **Average** | **140** | **23.3** | **19.8** | **8.4** | **8.4** | **$184.94** | **$196.22** |

1 The study applied the following realization rates from the CT R1983 study to the gross energy savings:  
HES: 17% for air sealing and 51% for insulation; HES-IE: 10% for air sealing and 46% for insulation  
*Source:* Cadeo, NMR Group, and DNV. 2023. *CT R1983 HES & IE Impact and Process Evaluation*. For the Connecticut Energy Efficiency Board (Link after posting)

2 Bill savings were calculated by multiplying ex-ante savings with 2019 residential energy price data at $0.2187/kWh for electricity, $3.09/gal for heating oil, and $2.95/gal for propane. To update the dollar bill savings to 2020 dollars, the study applied the BLS CPI Inflation Calculator.  
*Sources:* U.S. Energy Information Agency. “Weekly Heating Oil and Propane Prices” [*https://www.eia.gov/dnav/pet/PET\_PRI\_WFR\_DCUS\_SCT\_W.htm*](https://www.eia.gov/dnav/pet/PET_PRI_WFR_DCUS_SCT_W.htm)

U.S. Energy Information Administration. “Natural Gas Prices”. [*https://www.eia.gov/dnav/ng/ng\_pri\_sum\_dcu\_sct\_m.htm*](https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_sct_m.htm)

U.S. Energy Information Administration. “Average retail price of electricity, annual.” [*https://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=008&endsec=o&freq=A&start=2001&end=2019&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=*](https://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=008&endsec=o&freq=A&start=2001&end=2019&ctype=linechart&ltype=pin&rtype=s&maptype=0&rse=0&pin=)

BLS CPI Inflation Calculator. *https://www.bls.gov/data/inflation\_calculator.htm*

* 1. LMS Inputs

This section describes the inputs from the end-user survey used to estimate LMS magnitude scales. For a detailed description of the study methodology, see X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs Appendix A.2.1.

* + 1. LMS Magnitude Scales

For each respondent who reported a positive or negative effect, the survey asked how the effect compared to their energy savings. The study used the responses to those questions, as described in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs Appendix A.2.1, to develop positive magnitude scales shown in Figure B-1. Negative magnitude scales not shown as the survey only collected 12 responses in total for the nine magnitudes (max zero to three responses for each).

Figure B-1: Average Positive LMS Magnitude Scales  
(You say that the positive effect on [NEI] was [NP1] than the energy savings from that [MEASURE]s. How much more or less value – in percentage terms – would you say you received?)?)

Chart, bar chart

Description automatically generated

Figure B-2 shows the NEI effects for respondents excluding respondents who said don’t know or not applicable. Comfort during summer, equipment reliability, comfort during winter, ability to sell the home, equipment reliability, and comfort during winter were the most frequently reported positive NEIs.

Figure B-2: Summary of Air Sealing and Insulation NEI Effects  
(For each of the items listed below, indicate if the installation of the [MEASURE] positively affected it, negatively affected it, or did not affect it at all.; n = 140)

Chart, bar chart

Description automatically generated

* + 1. Overlapping NEI Effects

The survey asked respondents whether they experienced overlap of effects and to indicate which effects overlapped. Nearly one-fifth (19%) of HES respondents indicated they had trouble separating out the effects compared to only 6% of HES-IE respondents (Table B-2). The most common overlapping NEIs were comfort in the summer overlapping with comfort in the winter. Other NEIS with overlap include change in humidity or dampness and noise heard from outside ethe home (Table B-3). These NEIs most frequently overlapped with each other as well as noise heard from inside the home and change in mold.

Table B-2: Percent of Respondents Who Reported Overlapping NEIs  
(Did you have trouble separating out the effects we asked about? Did any overlap for you? Which effects overlapped?)

|  |  |
| --- | --- |
| Measure | Percent with Overlapping NEIs |
| HES (n=77) | 19% |
| HES-IE (n=63) | 6% |
| **Average (n=140)** | **14%** |

Table B-3: Common Overlapping NEIs (n=140)  
(Did you have trouble separating out the effects we asked about? Did any overlap for you? Which effects overlapped?)

|  |  |  |
| --- | --- | --- |
| NEI | Percent with Overlapping NEIs | Common Overlapping NEIs |
| Comfort in the winter | 11% | Comfort in the summer  Noise heard from outside the home  Air quality in your home  Change in humidity or dampness |
| Comfort in the summer | 11% | Comfort in the winter  Noise heard from outside the home  Noise heard from inside the home  Change in humidity or dampness  Change in mold |
| Change in humidity or dampness | 3% | Comfort in the summer  Comfort in the winter  Noise heard from outside the home  Noise heard from inside the home  Air quality in your home  Change in mold |
| Noise heard from outside the home | 1% | Comfort in the summer  Comfort in the winter  Noise heard from inside the home |

* + 1. Normalized NEI Effects

Table B-4 the total qualitative value of individual NEIs with the qualitative value of the combined effects of all NEIs by program. The sum of the individual effects is, on average, more than twice as large as the combined effects. For detailed methodology on normalizing NEI effects, see Appendix A.2.1 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs.

Table B-4: Comparison of Combined Effects1, 2

|  |  |  |  |
| --- | --- | --- | --- |
| Program | Sum of Individual Effects2 | Combination of all Effects3 | Magnitude |
| HES (n=77) | 337% (279%, 395%) | 134% (111%, 156%) | 2.5 |
| HES-IE (n=63) | 271% (192%, 350%) | 136% (96%, 177%) | 2.0 |
| **Average (n=140)** | **307% (260%, 355%)** | **135% (113%, 156%)** | **2.3** |

1 Combined effects in table includes eight NEIs including ‘other’ NEIs as reported in the survey. These totals may not equal those reported in Figure 2‑2.

2 90% confidence intervals provided in parentheses. 3 Individual effects correspond to the survey question in Row *B* of Table A-2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs. 4 Combination of all effects corresponds to the survey question in Row *E* of Table A-2 in X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs

* 1. Health NEI Inputs

The end user survey asked respondents if anyone had to seek medical care for specific illnesses *prior to 2020*. Most respondents (77% to 91%) said they did not need to seek medical care for asthma, allergies, colds/viruses, sinusitis, and/or hot water scalding (Figure B-3).

Figure B-3: Medical Care for Specific Illness (n=140)  
(Prior to 2020, after installing [MEASURE]s, did anyone in your household need to seek medical care for asthma, allergies, colds/viruses, or sinusitis?)

Chart, bar chart

Description automatically generated

The survey asked respondents who reported they had to seek medical care for specific illnesses whether the number of times they had to seek medical care the year prior to installing air sealing and/or insulation had changed. Of the 13 respondents who said someone in their household needed to seek medical care for asthma, two said the number of times they had to seek medical care for asthma decreased and two said the number of times increased since installing the measure(s). The remaining nine said it stayed the same, don’t know, or refused (not shown).

Over one-third (34%) of the respondents said they had to seek medical care for allergies, colds/viruses, and/or sinusitis. Of those respondents, nearly one-fifth (17%) said the number of times they had to seek medical care decreased since installing air sealing and/or insulation (Figure B-4). Few respondents (4%) said the number of times they had to seek medical care increased.

Figure B-4: Change in Medical Care for Allergies, Colds/viruses, and Sinusitis (n=47)  
(Compared to the year before installing [MEASURE]s, did the need to seek medical care decrease, increase, or stay the same?)

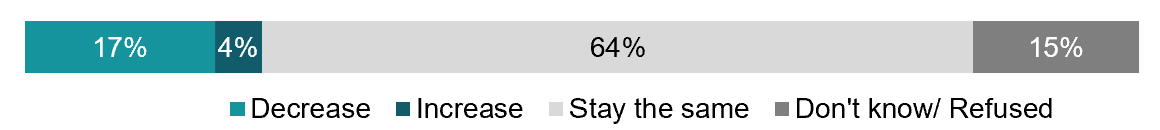


Figure B-5 shows the share of respondents who said they experienced a change in the number of missed workdays since installing air sealing and/or insulation. Five percent of respondents stated they experienced a decrease and two percent experienced an increase in the number of days worked. Similar for respondents who said they experienced a change in the number of missed school days, four percent of respondents said they experienced a decrease and three percent of respondents said they experienced an increase in missed school days (Figure B-6).

Figure B-5: Change in Number of Missed Days Worked (n=140)  
(Prior to 2020, did the number of days of work missed because of illness decrease, increase, or stay the same for you or a member of your household?)

Text

Description automatically generated with low confidence

Figure B-6: Change in Number of Missed School Days (n=140)  
(Prior to 2020, after installing [MEASURE]s, did the number of days of school missed because of illness decrease, increase, or stay the same?)

Text

Description automatically generated with low confidence

* 1. Regression Analysis

The study included linear regression analyses to determine whether results for air sealing and insulation were statistically significantly different from one another. The study regressed the NEI dollar value (independent variable) on air sealing and insulation dummy (dependent) variables. The air sealing variable was a one if the respondent had installed air sealing and zero if not. The same applies to insulation.

The linear regression analyses were used to determine whether NEI values were statistically different for air sealing and insulation for comfort in the winter (Table B-5a), comfort in the summer (Table B-5b), and the total NEI value (Table B-5c). Linear hypothesis testing showed that the differences in the values between air sealing and insulation were not statistically significant. [[10]](#footnote-11)

Table B-: Regression Analyses for Air Sealing and Insulation

a.



c.



b.



1. NMR Group, Inc. 2023. *X1942B Cross-cutting NEI Study – Residential HP & HPWH NEIs*. For the Connecticut Energy Efficiency Board. (Link after posting) [↑](#footnote-ref-2)
2. NMR Group, Inc. 2016. *Project R4 HES/HES-IE Process Evaluation and R31 Real-time Research.* For the Connecticut Energy Efficiency Board, Eversource, and United Illuminating. <https://www.energizect.com/sites/default/files/R4_HES-HESIE%20Process%20Evaluation,%20Final%20Report_4.13.16.pdf> [↑](#footnote-ref-3)
3. The Companies currently quantify and claim several NEIs for HES-IE only in the CTET and TRC Test: costs associated with “arrearages, debt write-off costs, or administrative costs”. See Appendix A of the [2023 PSD](https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/7059babc24eec078852588ee00496229/$FILE/Final%202023%20PSD%20(11-1-22).pdf). [↑](#footnote-ref-4)
4. See section five of the [2022-2024 Conservation and Load Management Plan](https://portal.ct.gov/-/media/DEEP/energy/ConserLoadMgmt/Final-2022-2024-Plan-to-EEB-1112021.pdf) and Appendix 6 of the [2022 PSD](https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/cf59b4f99ec97597852587fb00021000/$FILE/Final%202022%20PSD%20FILED%20(03-01-2022).pdf). [↑](#footnote-ref-5)
5. Bill savings are based off retail energy prices and not wholesale. [↑](#footnote-ref-6)
6. The approved 2022-2024 C&LM Plan uses three cost-effectiveness tests to compare the net present value of program benefits with the cost to achieve those benefits: (1) the Utility Cost Test, (UCT) (2) the MUCT, and (3) the TRC Test. The UCT includes the value of utility-specific benefits and program costs associated with those benefits but does not include NEIs. The MUCT includes all benefits and costs as the UCT as well as oil and propane-avoided costs, The MUCT is the primary test for electric programs that save fossil fuels. The study team notes that the [2023 Plan Update](https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/7059babc24eec078852588ee00496229/$FILE/Final%202023%20Plan%20Update%20to%202022%202024%20Plan%20Text%20(11-1-22).pdf) to the 2022-2024 C&LM Plan has been posted for public comment and includes several changes to cost-effectiveness testing. The 2023 Plan Update incorporates the new Connecticut Efficiency Test (CTET) that applies the principles of the MUCT to all programs and continues the supplemental use of the TRC test for HES-Income Eligible program. The new CTET includes benefits of the avoided costs of electricity, natural gas, oil, propane, and non-embedded gas emissions as well as low-income non energy impact (NEI) costs associated with “arrearages, debt write-off costs, or administrative costs” and all program costs associated with acquiring those benefits. The Companies currently quantify and claim several NEIs for HES-IE only. See Appendix 6 of the [2022 PSD](https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/cf59b4f99ec97597852587fb00021000/$FILE/Final%202022%20PSD%20FILED%20(03-01-2022).pdf) and Appendix A of the [2023 PSD](https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/7059babc24eec078852588ee00496229/$FILE/Final%202023%20PSD%20(11-1-22).pdf).

   See also Connecticut Department of Energy and Environmental Protection. April 2022. Updates to Connecticut Conservation and Load Management Cost Effectiveness Testing. <https://portal.ct.gov/-/media/DEEP/energy/ConserLoadMgmt/Attachment-B---Cost-Effectiveness-Testing-Update.pdf>

   [↑](#footnote-ref-7)
7. While the survey included residential program participants who received air sealing and insulation equipment incentives from the HES and HES-IE programs between 2017 and 2019, the period of survey fielding coincided with the pandemic that shifted the workforce to remote working and students to remote learning. This period of remote working and learning may influence responses that may not be reflective of times of regular in office work and in-person learning. [↑](#footnote-ref-8)
8. Linear regression analyses, discussed in Appendix B.4, showed that air sealing and insulation values were not statistically different from each other for comfort in the winter, comfort in the summer, as well as, total annual NEI value. [↑](#footnote-ref-9)
9. Response Rate = Responded ÷ (Mailed – Returned), 140 ÷ (4,485 – 418) = 3% [↑](#footnote-ref-10)
10. Hypothesis testing requires Prob >F = 0.10 or below for statistical significance. [↑](#footnote-ref-11)