



Memorandum

To: North Shore Gas; Jennifer Morris, ICC Staff; Celia Johnson, Illinois SAG
From: Kevin Grabner, Sophie Gunderson, Ethan Young, Patricia Plympton, Guidehouse
Cc: Rob Neumann, Stu Slote, Guidehouse
Date: December 17, 2020
Re: Recommended Non-Energy Impacts for North Shore Gas' Cost-Effectiveness Tests

INTRODUCTION

In December 2016, the Illinois General Assembly passed the Future Energy Jobs Act, which contains language on including additional non-energy benefits (now described as non-energy impacts (NEIs)) in energy efficiency programs' total resource cost (TRC) tests¹.

Electric

"A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and participant in the delivery of those efficiency measures and including avoided costs associated with reduced use of natural gas or other fuels, avoided costs associated with reduced water consumption, and avoided costs associated with reduced operation and maintenance costs, as well as other quantifiable social benefits..."

Natural Gas

"The total resource cost test compares the sum of avoided natural gas utility costs, representing the benefits that accrue to the system and the participant in the delivery of those efficiency measures, as well as other quantifiable societal benefits, including avoided electric utility costs..."

FEJA also contains language regarding not requiring income eligible programs to meet the TRC test:

¹ FEJA (Illinois Future Energy Jobs Act). Public Act 099-0906. www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf. (passed December 7, 2016).



Electric

Demonstrate that its overall portfolio of measures, not including low-income programs described in subsection (c) of this Section, is cost-effective using the total resource cost test.

Natural Gas

The low-income programs described in item (4) of subsection (f) of this Section shall not be required to meet the total resource cost test.

Currently, the Illinois Technical Reference Manual² (TRM) includes deemed monetized values for societal and participant NEIs. The TRM quantifies the following NEIs to include in TRC tests:

- **Societal: Avoided use of water (water savings) from energy efficiency programs:** Water savings are based on measurements consistent with federal standards. The value of the savings is determined by what Illinois customers would have paid for the water saved.
- **Participant: Reduced or increased O&M costs:** This is a deemed value based on the estimated impact from reduced or increased labor and materials that occur once a building has received energy efficiency improvements. For example, a heat recovery grease trap filter may result in reduced cleaning frequencies, while new equipment such as adding controls or tankless water heaters may increase O&M costs.

North Shore Gas's current cost-effectiveness modeling includes two additional NEI values that were estimated from secondary sources.

- **Utility: Avoided environmental costs from reduced carbon emissions:** Environmental costs are the dollar per therm (\$/therm) quantification of the benefits North Shore Gas has achieved by reduced carbon emissions associated with reducing gas use through energy efficiency programs. A carbon reduction adder is included starting in 2020 for the TRC analysis.
- **Non-Energy Benefits Adder:** A Non-Energy Benefits adder of 7.5 percent is included in North Shore Gas TRC modeling to account for the value of all NEIs except carbon emissions, water savings, and participant O&M costs. The value is based on secondary research.

NEIs APPLICABLE TO NATURAL GAS UTILITIES' COST-EFFECTIVENESS TESTS

Guidehouse conducted a literature search to determine which states or natural gas utilities use quantified and monetized NEIs for cost-effectiveness tests. The research included identifying methodologies previously used by states or natural gas utilities to evaluate NEIs. This gas-focused research leveraged and builds upon the extensive research conducted by Guidehouse for ComEd.³⁴

² IL SAG. Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 8.0. Illinois Commerce Commission. Springfield: IL. s3.amazonaws.com/ilsag/2020_IL-TRM_Version_8.0_dated_October-17-2019_Final_Volumes_1-4_Compiled.pdf.

³ Guidehouse report "Quantifying Non-Energy Benefits from ComEd's Income Eligible Programs: Findings and Recommendations from Secondary Research," March 6, 2018. https://s3.amazonaws.com/ilsag/ComEd_Income_Eligible_Programs_NEBs_Secondary_Research_Report_2018-03-06.pdf

⁴ Guidehouse memo "Review of States' Methodologies to include Monetized Non-Energy Impacts in Cost-Effectiveness Tests," April 30, 2020. : https://s3.amazonaws.com/ilsag/ComEd-Memo-Methods-to-include-NEIs-in-C-E-Tests_Draft_2020-04-30.docx

For societal NEI estimates, Guidehouse conducted an analysis on programs expected to be implemented by North Shore Gas in CY2022 through CY2025 using the methodology developed for ComEd and adjusted for gas utilities. Under this approach, the analysis team used the lifetime stream of net savings achieved in the CY2019 portfolio as a representation of the lifetime stream of savings achieved under programs that may be implemented in CY2022-2025, as this represents the most recent set of savings vetted by the evaluation team.

For participant NEI estimates, Guidehouse recommends proxy values for monetized NEIs associated with North Shore Gas' implemented programs. Guidehouse determined these proxy values using NEI research conducted for Massachusetts to quantify and monetize participant NEIs. Massachusetts used monetized participant NEI values in their cost-effectiveness tests.

The following describes Guidehouse's approach to evaluating societal NEIs, as well as Massachusetts's methodologies and proxy values used for participant NEIs.

Societal NEIs

North Shore Gas' energy efficiency (EE) programs lead to substantial savings of natural gas across both the residential and non-residential sectors, with these savings projected to persist for as long as 25 years into the future, depending on the measures implemented. In turn, over the same period, substantial reductions in the emissions of PM_{2.5}, NO_x, SO₂, NH₃, and volatile organic compounds (VOCs) are expected.

Human health is significantly impacted by exposure to pollutants such as PM_{2.5}, SO₂, and NO_x. Premature infant and adult mortality has been linked to increased exposure to ambient air pollution.⁵ Further, increased exposure to pollutants such as PM_{2.5} can lead to the development or exacerbation of respiratory and cardiovascular conditions. Each of the health outcomes from ambient pollution exposure, particularly exposure to PM_{2.5},⁶ come at a substantial economic cost.⁷ The reduction in emissions of these pollutants attributed to North Shore Gas' EE programs and their lifetime savings also realized benefits associated with avoided adverse health outcomes.

The EPA developed a tool that estimates the health benefits of reduced emissions from power generation: CO-Benefits Risk Assessment (COBRA). Updated in June 2020, COBRA is a peer reviewed screening tool that establishes the human health benefits and associated economic impacts of emission reduction scenarios.⁸ The COBRA model uses county-level emission reductions to estimate changes in health outcomes.

Guidehouse generated four sets of Societal NEI estimates to be included in North Shore's TRC tests of CY2022-2025 programs, based on CY2019 data. To generate these estimates, Guidehouse repeated an annual six-step modeling approach four times. Guidehouse first worked to ensure that all lifetime energy savings were accounted for, as North Shore's programs cover a variety of measures with measure lives ranging from one to 25 years. In the case of 2022 Societal NEIs, Guidehouse took program savings for CY2019 programs, which spanned 2019 through 2042, then assumed these savings will occur from 2022 through 2046. Guidehouse then estimated the emissions reductions and health benefits associated with these savings for each year from 2022 through 2046, discounting

⁵ On an annual basis, the World Health Organization (WHO) estimates around 4.2 million premature deaths globally are linked to ambient air pollution, with the most harmful culprits being PM_{2.5}, SO₂, NO₂, and Ozone
<https://www.who.int/airpollution/ambient/health-impacts/en/> Accessed: August 17, 2020.

⁶ <https://www.epa.gov/clean-air-act-overview/air-pollution-current-and-future-challenges> Accessed: August 17, 2020.

⁷ <https://www.epa.gov/environmental-economics/mortality-risk-valuation> Accessed: August 17, 2020.

⁸ <https://www.epa.gov/statelocalenergy/how-cobra-works>. Accessed: July 15, 2020.

each year's health benefits estimates back to 2022, then summed the stream of discounted health benefits. This process was repeated for 2023, 2024, and 2025 Societal NEI estimation. The annual, six-step approach and an example of how to apply these values is detailed further in Appendix A.

To facilitate the measurement of reductions in emissions of pollutants due to North Shore Gas' CY2019 programs, the U.S. Environmental Protection Agency (EPA) provided Guidehouse with natural gas emissions factors. **Error! Reference source not found.** below shows the emissions factors provided, grouped by sector and pollutant type.^{9,10,11}

Table 1. Emission Factors

Pollutant	Non-Residential Factors (lb/MMCF)	Residential Factors (lb/MMCF)
PM _{2.5}	0.43	0.43
NO _x	100	94
SO ₂	0.6	0.6
NH ₃	0.49	20
VOC	5.5	5.5

Source: U.S. EPA reports AP-42, EIIP, and NEI.

Using emissions factors illustrated above, Guidehouse calculated the emissions reductions associated with verified savings across the residential and non-residential sectors. As North Shore Gas' CY2019 measures can accrue savings for up to 25 years, emissions reductions were calculated for each year the portfolio claimed savings via multiplication of each year's natural gas savings with emissions factors. Table 2 below provides the total calculated emissions reductions associated with North Shore Gas' CY2019 sectors.

Table 2. Emission Changes

Pollutant	Non-Residential Sector (tons)	Residential Sector (tons)
PM _{2.5}	0.12	0.23
NO _x	28.89	50.12
SO ₂	0.17	0.32
NH ₃	0.14	10.66
VOC	1.59	2.93

Source: North Shore Gas CY2019 Data; Guidehouse Analysis.

⁹ U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, (AP-42), Volume I: Stationary Point and Area Sources. Research Triangle Park, NC. <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed>

¹⁰ U.S. Environmental Protection Agency. 2004. Emission Inventory Improvement Program (EIIP). Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

¹¹ U.S. Environmental Protection Agency. 2020. 2017 National Emissions Inventory Complete Release: Technical Support Document. Research Triangle Park, NC. (NEI) https://www.epa.gov/sites/production/files/2020-04/documents/nei2017_tsd_full_30apr2020.pdf

The COBRA model has three baseline emission data frames pre-loaded into the software – 2016, 2023 and 2028, and the EPA has estimated population changes and resulting health responses to emission changes in each of these baseline years. Guidehouse conducted the COBRA analysis on an annual basis by inputting the estimated savings from what we expect will be North Shore Gas's CY2022-2025 program measures for each year ranging from 2022 to 2049. COBRA also accounts for the changes in baseline population and health responses to emissions over time. During this process, Guidehouse carefully aligned the nearest COBRA baseline year to each portfolio year, as shown in **Error! Reference source not found.**

Table 3. COBRA Baseline and Portfolio Years

COBRA Baseline Used	Portfolio Years
2016	2022
2023	2023-2027
2028	2028-2049

Source: Guidehouse.

The COBRA model also allows the user to choose the location of emissions and energy mix. Guidehouse selected the North Shore Gas territory's counties for the emissions location and selected residential and non-residential natural gas emissions tiers. As natural gas emissions are created on a local scale relative to electricity, the distinction between residential and non-residential emissions is essential. Guidehouse evaluated the benefits resulting from these portfolio sectors separately and applied the discounted benefits per therm values annually to each program encompassed in the sectors in CY2019.

Furthermore, COBRA has an option to input a preferred discount rate. The EPA provided Guidehouse a custom valuation file using a 2.40 percent discount rate, a discount rate deemed by the Illinois Technical Reference Manual (IL TRM) beginning in v9.0.¹² Guidehouse applied this discount rate to evaluate the economic benefits resulting from emissions reductions attributed to North Shore Gas' CY2019 programs.

Table 4**Error! Reference source not found.** shows the estimated benefits per therm for the residential and non-residential sectors for modeled CY2022-2025 portfolios. Guidehouse discounted these values back to the program year's dollar value. So, in this case, CY2025 societal NEI estimates are presented in 2025 dollars. The values encompass all monetized health benefit categories within COBRA and cover all years between 2019 and 2042.¹³ Appendix A provides program-level and annual benefits per therm estimates for the four program years evaluated from the CY2019 portfolio.

¹² Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, final available at: <http://www.ilsag.info/technical-reference-manual.html>

¹³ All estimated health benefits for the years 2019 through 2042 were discounted to 2022-2025 dollars according to program year.

Table 4. CY2022-2025 Societal NEI Estimates - By Portfolio (Real Dollars)

Sector	CY2019 Verified Net Lifetime Savings (Therms)	Program Year	\$ Total Health Benefits	\$ Total Health Benefits per Net Therm (Average)
Residential	11,057,852	CY2022	\$1,554,233	\$0.1441
		CY2023	\$1,566,014	\$0.1452
		CY2024	\$1,576,288	\$0.1461
		CY2025	\$1,586,606	\$0.1471
Non-Residential	5,991,530	CY2022	\$874,608	\$0.1484
		CY2023	\$887,518	\$0.1506
		CY2024	\$894,431	\$0.1517
		CY2025	\$901,374	\$0.1529

Source: Guidehouse CY2019 North Shore Gas Program Savings data and COBRA model. Values shown for CY2019 lifetime net therms may have minor rounding differences for some measures compared with end of year summary reports, related to partial year measure lives.

Please note that the dollar per therm benefits shown in Table 4 should only be applied to the lifetime therms saved from a given implementation year. For example, if a measure was installed in CY2022 and has not reached its end of useful life by 2025, the therms saved from that measure in 2025 should not be incorporated in the CY2025 cost-effectiveness tests. This recommended application of dollars per therm benefits would avoid double-counting benefits year after year.

Sources of Values for Participant NEIs

Guidehouse used studies from Massachusetts to produce recommended values for North Shore Gas' participant NEIs. The table below lists the NEI types and the sources we used to produce recommendations for North Shore Gas' NEI values.

Table 5. NEI Types and Sources

NEI Type	State	Research Study	Authors
Participant	Massachusetts	Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study (2016)	Three ³ Inc. and NMG Group, Inc.
Participant	Massachusetts	Low-Income Multifamily Health- and Safety-Related NEIs Study (TXC 50) Preliminary Findings Report (2018)	Three ³ Inc. and NMG Group, Inc.

Source: Guidehouse

Participant NEIs

Participant NEIs quantify health and safety impacts of energy efficiency programs to participants and their household. These impacts include reduced medical costs associated with reduced asthma symptoms and thermal stress, as well as reduced missed days of work.

In 2014, the U.S. Department of Energy's (DOE) conducted a national assessment of the participant NEIs associated with its Weatherization Assistance Program (WAP). The DOE WAP assessment included a comprehensive participant survey which participants completed before participation and one year following participation.¹⁴

Massachusetts used the same methodology to conduct participant NEI studies which quantified and monetized values used in cost-effectiveness tests. Error! Bookmark not defined., Error! Bookmark not defined. The state performed studies in varying years and the reported values do not represent the current value of the dollar.

Guidehouse compiled the participant NEI values from these studies to determine estimates in 2022 to 2025 dollars, shown in Table 6. Multifamily and single-family building types are shown separately in the below tables to reflect the differing measure mixes and resulting impacts on the participants in those households. Appendix C provides the unadjusted values from the state's studies.

Table 6. Multifamily Monetized Participant NEI Proxys – Per Household Annually

Participant NEI type	Guidehouse Adjusted Values (\$2022)	Guidehouse Adjusted Values (\$2023)	Guidehouse Adjusted Values (\$2024)	Guidehouse Adjusted Values (\$2025)
Thermal Comfort	29.20	29.80	30.39	30.96
Health & Safety (including Asthma Reduction)	38.17	38.96	39.74	40.49
Reduced missed days of work	67.79	69.18	70.57	71.89
Total	128.15	135.16	137.93	140.70

¹⁴ Oak Ridge National Laboratory 2014., "Weatherization Works- Summary of Findings from the Retrospective Evaluation of the Department of Energy's Weatherization Assistance Program, Managed by UT-Battelle for the US Department of Energy." (DOE WAP Study 2014) September. <https://www.energy.gov/eere/wap/downloads/weatherization-assistance-program-national-evaluation>. Accessed: April 24, 2020.

Sources: Skumatz, 2014; Three³ and NMR Group 2018; Guidehouse analysis.

Table 7. Single-family Monetized Participant NEI Proxys – Per Household Annually

Participant NEI type	Guidehouse Adjusted Values (\$2022)	Guidehouse Adjusted Values (\$2023)	Guidehouse Adjusted Values (\$2024)	Guidehouse Adjusted Values (\$2025)
Thermal Comfort	82.64	84.26	85.88	87.43
Health & Safety (including Asthma Reduction)	11.20	11.42	11.64	11.85
Reduced missed days of work	209.52	213.63	217.74	221.66
Total	303.36	309.31	315.26	320.94

Sources: Skumatz, 2014; Three³ and NMR Group 2016; Guidehouse analysis.

RECOMMENDATIONS

Based on our review of the current practices that other states use to include monetized NEIs in cost-effectiveness tests, and the current state of relevant data to North Shore Gas, we submit the following recommendations for North Shore Gas consideration:

Recommendation #1: Include monetized nationwide Societal NEI benefits in the North Shore Gas portfolio programs' TRC tests. Please note that the dollar per therm benefits should only be applied to the therms saved from a given implementation year and should not include therms saved from measures installed in previous program years.

Application Process #1: Multiply the averaged sector-level discounted dollar per therm estimates by the lifetime therms savings of the program in the respective sector.

Application Process #2: Given that program measures and mix change with each implementation year, Guidehouse provided non-discounted and non-inflated annual sector-level dollar per therm benefits for CY2022-25 in Appendix A. Multiply these values by program-level annual therm savings of the respective sector from each year of implementation. The resulting savings must be discounted back to the year of implementation using a nominal discount rate of 2.4 percent.

Recommendation #2: Include monetized proxy Participant NEI values associated with the North Shore Gas Income Eligible programs in these programs' TRC tests. When available and if statistically significant, use the primary monetized values from ComEd Participant NEI research focused on the joint utility Income Eligible Multifamily, Single-Family and Public Housing programs in these programs' TRC tests.

Application Process: Apportion annual NEI benefits between electric and gas utilities according to utility investment in the program. After apportioning, calculate the lifetime net present value of benefits per household using the program's weighted average measure life and a nominal discount rate of 2.4 percent, as deemed by the IL TRM v9.0.

APPENDIX A. SOCIETAL NEIs - COBRA ESTIMATED HEALTH BENEFITS

Societal NEI Methodology

The annual, six-step approach described below is an illustration in Table 8 **Error! Reference source not found.** below. The example used in the table below focuses on estimation of Societal NEIs for 2032 assuming CY2019 program savings begin in 2022. Additional detail providing context for each step in the analysis is provided in the following paragraphs.

Table 8. Stepwise Summary of Annual Estimation of CY2022 Health Benefits: Year 2032

Step	Description
1. Year 2032 Portfolio-Level CPAS	Assuming CY2019 programs are implemented in CY2022, gather and aggregate all sector-level therm savings to construct a portfolio-level annual timeline of residential and non-residential savings spanning 2022 through 2046, then extract sector-level therm savings for 2032.
2. Evaluate Emission Reductions	Use the emission factors provided by the EPA (shown in Error! Reference source not found.) to estimate the tons of emissions reduced by sector for 2032.
3. Execute COBRA Model	Use COBRA to estimate 2032 health benefits from emissions reductions.
4. Discount Benefits to CY2022	Discount 2032 COBRA-estimated sector-level health benefit to CY2022 for TRC tests.
5. Divide Discounted Benefits by Year 2032 CPAS	Divide discounted 2032 COBRA-estimated sector-level health benefit by sector-level savings to generate a discounted health benefit per therm.
6. Multiply by Program-Level Year 2032 CPAS	Multiply discounted 2032 health benefit per therm by program-level savings to calculate 2032 program-level health benefit.

Step 1: Year 2032 Portfolio-Level CPAS

For this summary we focus on estimation of societal health benefits for the Non-Residential Small Business program in 2032 assuming CY2019 programs and the stream of associated savings begin in CY2022. In this first step, gather and aggregate the North Shore Gas CY2019 programs' savings data and measure lives to construct an annual savings table. Assuming CY2019 savings begin in 2022, extract the total Non-Residential savings for year 2032 equal to 79,777 Therms for use in Step 2.

Step 2: Evaluate Emission Reductions

To facilitate the measurement of reductions in emissions of pollutants due to North Shore Gas' CY2019 programs, the U.S. Environmental Protection Agency (EPA) provided Guidehouse with natural gas emissions factors. **Error! Reference source not found. Error! Reference source not**

found. Table 9 below shows the emissions factors provided, grouped by sector and pollutant type.^{15,16,17}

Table 9. Emission Factors

Pollutant	Non-Residential Factors (lb/MMCF)	Residential Factors (lb/MMCF)
PM _{2.5}	0.43	0.43
NO _x	100	94
SO ₂	0.6	0.6
NH ₃	0.49	20
VOC	5.5	5.5

Source: U.S. EPA reports AP-42, EIIP, and NEI.

Using emissions factors illustrated above, calculate the emissions reductions associated with verified savings across the non-residential sector in 2032.

Step 3: Execute COBRA model

Following estimation of saved emissions estimates, COBRA estimation was conducted using adjusted county-level emissions reductions estimates. COBRA uses emissions reductions to estimate county-level changes in air quality, then estimates the resulting county-level health outcomes and economic costs. The COBRA model has three sets of baseline years included in its current build – 2016, 2023 and 2028. Guidehouse conducted the COBRA analysis on an annual basis by inputting the estimated savings from what we expect will be North Shore Gas's CY2022-2025 program measures for each year ranging from 2022 to 2049. During this process, Guidehouse carefully aligned the nearest COBRA baseline year to each portfolio year, as shown in Table 10 below **Error! Reference source not found..**

Table 10. COBRA Baseline and Portfolio Years

COBRA Baseline Used	Portfolio Years
2016	2022
2023	2023-2027
2028	2028-2049

Source: Guidehouse.

The COBRA model also allows the user to choose the location of emissions and energy mix. Guidehouse selected the North Shore Gas territory's county for the emissions location and selected residential and non-residential natural gas emissions tiers. As natural gas emissions are created on a local scale relative to electricity, the distinction between residential and non-residential emissions is essential. Guidehouse evaluated the benefits resulting from these portfolio sectors separately and

¹⁵ U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, 5th Edition, (AP-42), Volume I: Stationary Point and Area Sources. Research Triangle Park, NC. <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#5thed>

¹⁶ U.S. Environmental Protection Agency. 2004. Emission Inventory Improvement Program (EIIP). Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report. Prepared by E.H. Pechan and Associates, Inc. Research Triangle Park, NC. https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf

¹⁷ U.S. Environmental Protection Agency. 2020. 2017 National Emissions Inventory Complete Release: Technical Support Document. Research Triangle Park, NC. (NEI) https://www.epa.gov/sites/production/files/2020-04/documents/nei2017_tsd_full_30apr2020.pdf

applied the discounted benefits per therm values annually to each program encompassed in the sectors in CY2019.

The EPA provided Guidehouse a custom valuation file using a 2.40 percent discount rate, as will be deemed by the Illinois Technical Reference Manual (IL TRM) beginning in v9.0¹⁸. COBRA currently estimates the low- and high-sensitivity health impacts of reduced pollution exposure over a 20 year period, as reduced exposure to emissions in one year reduces acute morbidity in the year of analysis and reduces the incidence of premature mortality for up to 20 years.¹⁹ COBRA then discounts this stream of health benefits back to the year in which savings are realized, which in this example is 2032.²⁰ Guidehouse applied the custom valuation file with a 2.40 percent discount rate to evaluate the low- and high-sensitivity economic benefits resulting from emissions reductions attributed to 2032 savings. The mean of national low- and high-sensitivity estimates was used as the health benefit estimate for 2032.

Step 4: Discount results to CY2022

Under the annual analysis methodology employed in steps two and three, health benefits estimates are expressed in terms of dollars in the analysis year of interest. In the case of 2022 implementation of CY2019 programs, Societal NEIs are being used to inform TRC tests of the 2022 implementation of programs, which use cost and benefit inputs expressed in terms of 2022 dollars. To remain consistent with other inputs to TRC tests, Guidehouse discounted each year's county-level COBRA results back to 2022 using a 0.42 percent discount rate.

Step 5: Divide by analysis year sector-wide savings

After discounting each year's sector-level health benefits to 2022, discounted health benefits were divided by the sector-level's yearly savings. In the case of 2032 estimation of health benefits, the discounted health benefits of approximately \$12,148 dollars from Step 3 were divided by 2032's 79,777 therms of non-residential sector-level savings, generating an estimate of 0.15 cents in discounted health benefits per therm (BPT) of energy saved in 2032.

Step 6: Multiply by program-level savings

The final step in generating a program-level Societal NEI estimate for a specific year is multiplying the sector-level BPT value resulting from Step 4 by the program-level savings. The result is a total estimated benefit of approximately \$190,384 dollars for the Small Business program.

¹⁸ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, draft available at: <http://www.ilsag.info/technical-reference-manual.html>

¹⁹ COBRA assumes that the incidences of premature mortality attributed to pollution exposure occurs over a 20 year period following exposure. COBRA currently assumes that 30 percent of premature deaths occur in the first year, 50 percent of deaths occur in years two through five, and the remaining 20 percent of deaths occur in years six through twenty. For more information, see page F-8 of the COBRA user manual: https://www.epa.gov/sites/production/files/2020-06/documents/cobra_user_manual_june_2020.pdf

²⁰ In the case of analysis of emissions reductions in the year 2032, COBRA models the associated reductions in morbidity and mortality that can be expected to occur over a 20 year period between 2032 and 2051. This 20 year stream of health benefits is then discounted back to the analysis year, which in this case is 2032.

Annual Sector-Level Benefits per Therm Estimates

Table 11 through Table 14 show the sector level dollar per therm estimates by program year, based on the CY2019 portfolio. The values provided have not been adjusted for inflation or discounted following the COBRA model runs. Thus, these values are presented in nominal dollars.

Please note the dollar per therm values should only be applied to annual therms saved from measures installed in the respective year's implementation. This method avoids double counting benefits.

Table 11. Sector Level Dollars per Therms Savings – CY2022 (Nominal Dollars)

Year	Residential Sector			Non-Residential Sector		
	Therms Savings (Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)	Therms Savings (Non-Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)
2022	1,215,418	\$164,125	\$0.1350	835,191	\$117,073	\$0.1402
2023	1,215,418	\$171,660	\$0.1412	835,191	\$123,113	\$0.1474
2024	1,197,539	\$169,397	\$0.1415	835,191	\$123,113	\$0.1474
2025	1,197,055	\$169,313	\$0.1414	780,127	\$115,113	\$0.1476
2026	1,197,055	\$169,313	\$0.1414	780,127	\$115,113	\$0.1476
2027	498,782	\$70,267	\$0.1409	778,255	\$114,864	\$0.1476
2028	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2029	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2030	482,208	\$72,379	\$0.1501	156,175	\$24,385	\$0.1561
2031	482,208	\$72,379	\$0.1501	100,274	\$15,660	\$0.1562
2032	426,080	\$63,988	\$0.1502	79,777	\$12,668	\$0.1588
2033	250,964	\$37,495	\$0.1494	79,777	\$12,668	\$0.1588
2034	250,964	\$37,495	\$0.1494	75,203	\$12,023	\$0.1599
2035	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2036	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2037	223,088	\$33,634	\$0.1508	36,457	\$5,850	\$0.1605
2038	223,088	\$33,634	\$0.1508	32,365	\$5,264	\$0.1626
2039	222,908	\$33,605	\$0.1508	31,948	\$5,205	\$0.1629
2040	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2041	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2042	8,532	\$1,157	\$0.1356	10,522	\$1,496	\$0.1421
2043	8,532	\$1,157	\$0.1356			
2044	6,062	\$801	\$0.1322			
2045	6,062	\$801	\$0.1322			
2046	6,062	\$801	\$0.1322			
Lifetime	10,788,826	1,554,233	\$0.1441	5,894,470	874,608	\$0.1484

Source: Guidehouse CY2019 North Shore Gas Program Savings Analysis data and COBRA model.

Table 12. Sector Level Dollars per Therms Savings – CY2023 (Nominal Dollars)

Year	Residential Sector			Non-Residential Sector		
	Therms Savings (Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)	Therms Savings (Non-Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)
2023	1,215,418	\$171,660	\$0.1412	835,191	\$123,112.74	\$0.1474
2024	1,215,418	\$171,660	\$0.1412	835,191	\$123,112.74	\$0.1474
2025	1,197,539	\$169,397	\$0.1415	835,191	\$123,112.74	\$0.1474
2026	1,197,055	\$169,313	\$0.1414	780,127	\$115,112.52	\$0.1476
2027	1,197,055	\$169,313	\$0.1414	780,127	\$115,112.52	\$0.1476
2028	498,782	\$74,604	\$0.1496	778,255	\$121,879.21	\$0.1566
2029	498,029	\$74,486	\$0.1496	175,495	\$27,683.08	\$0.1577
2030	498,029	\$74,486	\$0.1496	175,495	\$27,683.08	\$0.1577
2031	482,208	\$72,379	\$0.1501	156,175	\$24,385.42	\$0.1561
2032	482,208	\$72,379	\$0.1501	100,274	\$15,660.47	\$0.1562
2033	426,080	\$63,988	\$0.1502	79,777	\$12,667.68	\$0.1588
2034	250,964	\$37,495	\$0.1494	79,777	\$12,667.68	\$0.1588
2035	250,964	\$37,495	\$0.1494	75,203	\$12,022.61	\$0.1599
2036	248,976	\$37,228	\$0.1495	75,203	\$12,022.61	\$0.1599
2037	248,976	\$37,228	\$0.1495	75,203	\$12,022.61	\$0.1599
2038	223,088	\$33,634	\$0.1508	36,457	\$5,850.13	\$0.1605
2039	223,088	\$33,634	\$0.1508	32,365	\$5,263.67	\$0.1626
2040	222,908	\$33,605	\$0.1508	31,948	\$5,204.67	\$0.1629
2041	222,908	\$33,605	\$0.1508	21,777	\$3,197.93	\$0.1468
2042	222,908	\$33,605	\$0.1508	21,777	\$3,197.93	\$0.1468
2043	8,532	\$1,157	\$0.1356	10,522	\$1,495.66	\$0.1421
2044	8,532	\$1,157	\$0.1356			
2045	6,062	\$801	\$0.1322			
2046	6,062	\$801	\$0.1322			
2047	6,062	\$801	\$0.1322			
Lifetime	10,788,826	1,566,014	\$0.1452	5,894,470	887,518	\$0.1506

Source: Guidehouse CY2019 North Shore Gas Program Savings Analysis data and COBRA model.

Table 13. Sector Level Dollars per Therms Savings – CY2024 (Nominal Dollars)

Year	Residential Sector			Non-Residential Sector		
	Therms Savings (Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)	Therms Savings (Non-Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)
2024	1,215,418	\$171,660	\$0.1412	835,191	\$123,113	\$0.1474
2025	1,215,418	\$171,660	\$0.1412	835,191	\$123,113	\$0.1474
2026	1,197,539	\$169,397	\$0.1415	835,191	\$123,113	\$0.1474
2027	1,197,055	\$169,313	\$0.1414	780,127	\$115,113	\$0.1476
2028	1,197,055	\$179,761	\$0.1502	780,127	\$122,143	\$0.1566
2029	498,782	\$74,604	\$0.1496	778,255	\$121,879	\$0.1566
2030	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2031	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2032	482,208	\$72,379	\$0.1501	156,175	\$24,385	\$0.1561
2033	482,208	\$72,379	\$0.1501	100,274	\$15,660	\$0.1562
2034	426,080	\$63,988	\$0.1502	79,777	\$12,668	\$0.1588
2035	250,964	\$37,495	\$0.1494	79,777	\$12,668	\$0.1588
2036	250,964	\$37,495	\$0.1494	75,203	\$12,023	\$0.1599
2037	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2038	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2039	223,088	\$33,634	\$0.1508	36,457	\$5,850	\$0.1605
2040	223,088	\$33,634	\$0.1508	32,365	\$5,264	\$0.1626
2041	222,908	\$33,605	\$0.1508	31,948	\$5,205	\$0.1629
2042	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2043	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2044	8,532	\$1,157	\$0.1356	10,522	\$1,496	\$0.1421
2045	8,532	\$1,157	\$0.1356			
2046	6,062	\$801	\$0.1322			
2047	6,062	\$801	\$0.1322			
2048	6,062	\$801	\$0.1322			
Lifetime	10,788,826	1,576,288	\$0.1461	5,894,470	894,431	\$0.1517

Source: Guidehouse CY2019 North Shore Gas Program Savings Analysis data and COBRA model.

Table 14. Sector Level Dollars per Therms Savings – CY2025 (Nominal Dollars)

Year	Residential Sector			Non-Residential Sector		
	Therms Savings (Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)	Therms Savings (Non-Residential)	\$ Total Health Benefits (average)	\$Total Health Benefits per Therm (average)
2025	1,215,418	\$171,660	\$0.1412	835,191	\$123,113	\$0.1474
2026	1,215,418	\$171,660	\$0.1412	835,191	\$123,113	\$0.1474
2027	1,197,539	\$169,397	\$0.1415	835,191	\$123,113	\$0.1474
2028	1,197,055	\$179,761	\$0.1502	780,127	\$122,143	\$0.1566
2029	1,197,055	\$179,761	\$0.1502	780,127	\$122,143	\$0.1566
2030	498,782	\$74,604	\$0.1496	778,255	\$121,879	\$0.1566
2031	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2032	498,029	\$74,486	\$0.1496	175,495	\$27,683	\$0.1577
2033	482,208	\$72,379	\$0.1501	156,175	\$24,385	\$0.1561
2034	482,208	\$72,379	\$0.1501	100,274	\$15,660	\$0.1562
2035	426,080	\$63,988	\$0.1502	79,777	\$12,668	\$0.1588
2036	250,964	\$37,495	\$0.1494	79,777	\$12,668	\$0.1588
2037	250,964	\$37,495	\$0.1494	75,203	\$12,023	\$0.1599
2038	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2039	248,976	\$37,228	\$0.1495	75,203	\$12,023	\$0.1599
2040	223,088	\$33,634	\$0.1508	36,457	\$5,850	\$0.1605
2041	223,088	\$33,634	\$0.1508	32,365	\$5,264	\$0.1626
2042	222,908	\$33,605	\$0.1508	31,948	\$5,205	\$0.1629
2043	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2044	222,908	\$33,605	\$0.1508	21,777	\$3,198	\$0.1468
2045	8,532	\$1,157	\$0.1356	10,522	\$1,496	\$0.1421
2046	8,532	\$1,157	\$0.1356			
2047	6,062	\$801	\$0.1322			
2048	6,062	\$801	\$0.1322			
2049	6,062	\$801	\$0.1322			
Lifetime	10,788,826	1,586,606	\$0.1471	5,894,470	901,374	\$0.1529

Source: Guidehouse CY2019 North Shore Gas Program Savings Analysis data and COBRA model.

APPENDIX B. PARTICIPANT NEIs – SOURCE VALUES

Three³ and NMR Group conducted a primary research study for Massachusetts to determine the participant NEIs associated with income eligible programs including reduced effects of asthma, cold- and heat-related thermal stress, missed days of work, deaths, and fire damage. **Error! Bookmark not defined.** These monetized values are provided in the statewide TRM. Massachusetts utilities include these monetized values in their programs' TRC tests.²¹

The 2018 Massachusetts study is specific to Low-Income Multi-family (LIMF) Health and Safety-Related NEIs **Error! Bookmark not defined.** Three³ and NMR Group conducted a similar study in

²¹ Database of State Efficiency Screening Practices (DSESP), 2020. "National Energy Efficiency Screening Project, <https://nationalefficiencyscreening.org/> Accessed: July 5, 2020.

2016 for Low-Income Single Family (LISF) NEIs.²² The 2018 report complements the past values and recommendations provided in the 2016 study. Variabilities in the values from the two studies are due to differences in installed measures and household types.

Guidehouse adjusted Massachusetts NEI recommended values from 2016 and 2018 to 2022 through 2025-dollars using a conservative inflation forecast of approximately 2 percent annually following 2020. Table 15 provides the original recommended values, prior to inflation.

Table 15. Massachusetts Participant NEI Recommendations – Per Household Annually

Participant NEI type	Massachusetts LISF Program Values (\$2016)	Massachusetts LIMF Program Value (\$2018)
Total Thermal Comfort	12.95	5.95
Health & Safety (Asthma Reduction)	9.99	35.55
Reduced missed days of work	149.45	48.61

Sources: Three³ and NMR Group, 2016; Three³ and NMR Group, 2018; Guidehouse.

²² Three³ and NMR Group, 2016. "Low-Income Single-Family Health- and Safety-Related NEIs Study." Massachusetts Program Administrators August 5.