

Quantifying What Counts: Measuring Health and Social Benefits in Energy Efficiency

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ABSTRACT

DTE Energy is conducting a comprehensive study to evaluate the non-energy impacts (NEIs) of its income-qualified energy efficiency programs, an often-overlooked dimension of program value. While energy savings remain a key metric, this research highlights how these programs contribute to broader benefits, capturing measurable improvements in utility customer and societal health.

The study categorizes NEIs into three domains:

- **Societal Impacts:** Using public and proprietary modeling tools, the study quantifies benefits such as improved public health from reduced emissions and economic gains through job creation and increased industry output.
- **Participant Impacts:** Through pre-/post-intervention surveys, the research captures quantitative data on customer experiences, including improvements in health, safety, and quality of life, such as reduced asthma symptoms, enhanced food safety, and fall prevention.
- **Utility Impacts:** By analyzing pre- and post-intervention data, the study identifies reductions in administrative and compliance costs, supporting more efficient utility operations.

Overall, research to date shows that \$1.7 million in NEIs result for every million dollars invested in the DTE income-qualified energy efficiency programs. This and other findings underscore the strategic importance of integrating NEIs into program assessments to strengthen the case for sustained investment in low-income energy efficiency initiatives.

Introduction

While creating quantifiable energy savings is the primary goal of energy efficiency (EE) programs, EE and home repair can have broader impacts beyond energy savings, especially for communities with the highest need. These impacts, typically termed non-energy impacts (NEIs), are grouped into three categories, representing those most frequently cited in research:

- **Societal NEIs:** Impacts that accrue to all residents and their overall environment. These impacts are further segmented into two sub-categories of Public Health, or impacts resulting from improvements to health, safety and comfort of citizens due to reduced air pollution, and Economic, or job creation and other workforce impacts resulting from EE programming.

- Participant NEIs: Impacts that accrue to residents in homes that participated in EE programs including impacts like decreased medical symptoms and costs associated with asthma, arthritis, thermal stress and more.
- Utility NEIs: Impacts that accrue to the utility and result from reduced administrative and compliance costs including impacts like reduced carrying costs on arrearages, shutoffs and non-payments.

Across the utility sector, low-income and multifamily energy efficiency programs are increasingly recognized for delivering benefits beyond energy savings, including reduced energy burden, improved housing stability, and public health improvements. In response, DTE has expanded its income-qualified (IQ) and multifamily programs by strengthening health and safety components and enhancing delivery approaches. While these efforts reflect broader program objectives, evaluations have remained focused on energy savings. This research was undertaken to systematically measure and quantify the non-energy impacts of DTE's IQ and multifamily programs and better reflect their full value and support informed policy, planning and investment decisions. For IQ programs in particular, NEI research helps direct resources to households and communities where the benefits are greatest. DTE was interested in conducting research into all three NEI categories for their single-family IQ program, Energy Efficiency Assistance (EEA) program, and their IQ Multifamily (IQMF) program and to quantify the NEI returns per dollar invested. This paper will review the research methodology for all quantitative research and results from the 2025 portion of the study.¹

Methodology

All research tasks were focused on the 2024 DTE program year. The following describes the methodology for each of the four quantitative research tasks in the NEI study.

Public Health NEI Modeling

The evaluation team calculated and monetized the public health NEIs by applying the Environmental Protection Agency's (EPA) Co-Benefit Risk Assessment (COBRA) tool to emissions reductions projected for 2024 through 2048 based on EEA and IQMF program savings from program year 2024 (EPA 2026b). The evaluation team modeled the electric marginal emissions factors for PM_{2.5}, SO₂, NO_x, and Volatile Organic Compounds (VOCs) using Midcontinent Independent System Operator (MISO)-aligned hourly factors and end-use load shapes. This calculation involved analyzing all generators in MISO territory and determining marginal emissions factors based on dispatch patterns and generator composition. The team ran two model cases for the MISO region: one including the energy savings impact of DTE's EE programs and one without the savings impact. The team then subtracted the annual MISO-wide emissions of the EE case from the non-EE case emissions and divided the resulting displaced emissions by the EE annual energy savings to determine the emissions factor in lbs./MWh for each year. The evaluation team estimated the emissions reductions from 2024 IQ program activities for 2024 to 2048 by multiplying these marginal emissions factors by the verified lifetime net savings for the 2024 EEA and IQMF programs. Some of these emissions factors are

¹ Participant and Utility research is ongoing and will conclude summer 2026. Results in this paper are based on initial research and analysis conducted in 2025.

shown in Table 1. For gas marginal emissions factors, the evaluation team referenced the EPA AP-42 Compilation of Air Emissions Factors (EPA 2026a). EPA marginal emissions factors from reduced natural gas consumption are shown in Table 2.

Table 1. Electric marginal emissions factors by year (lbs./MWh)

Pollutant emissions factor	2025	2030	2035	2040	2045
PM _{2.5} emissions factor	0.12	0.11	0.09	0.09	0.08
SO ₂ emissions factor	0.96	0.59	0.59	0.58	0.55
NO _x emissions factor	0.96	0.66	0.67	0.63	0.53
VOC emissions factor	0.05	0.04	0.04	0.03	0.03

Source: Guidehouse analysis of MISO electric generators

Table 2. Gas marginal emissions factors (lbs./MMcf) used as inputs

	PM _{2.5}	SO ₂	NO _x	VOC
Marginal emissions reduction factor	0.43	0.60	94	5.50

Source: AP-42: Compilation of Air Emissions Factors from Stationary Sources.

The emissions reductions were input into the COBRA tool to estimate the health benefits of these program-related emissions reductions.

Economic NEI Modeling

The evaluation team estimated the economic impacts supported by DTE IQ program spending in 2024. First the team calculated the annual program expenditures incurred by DTE and other spending related to the programs in 2024. The team utilized the Impact Analysis for Planning (IMPLAN) modeling tool for analysis (IMPLAN Group 2026). This input-output modeling tool simulates how a change in spending or economic activity affects industries, households and governments across a defined geography, estimating the direct, indirect and induced effects impact economic metrics. The evaluation team input program spending into the model. Program spending was assumed to be the sum of energy efficiency incentive spend, health and safety spend, DTE labor spend and implementation contractor spend as provided by DTE. Additional inputs included:

- measure lifetime bill savings (energy savings² multiplied by the variable cost of energy for program participants in 2025)
- residential bill surcharges (estimated based on ratios from the 2023 Energy Waste Reduction application)
- reduced spending on fuel (energy savings multiplied by the average fuel cost recovery factor in 2024) were also used as model inputs.

The model outputs include the estimated jobs, labor income and Gross Domestic Product (GDP) supported by the 2024 IQ programs.

² The estimation of measure lifetime energy savings assumes that all measures create the same level of energy savings in their final useful year as they did in their first year. Measure lifetime energy savings therefore may overestimate actual energy savings.

Participant NEI Surveys

The evaluation team estimated and monetized the participant impacts of the 2024 EEA program, focused on health and safety. This research utilizes two surveys to determine the impact of EEA program intervention on customers. The initial survey was fielded to Q4 2024 and February 2025 EEA program participants to capture baseline health, safety and economic conditions for participants prior to program participation and relevant to the measures they received through the EEA program. For example, respondents were only asked about any food spoilage/food poisoning due to a broken refrigerator if they had received a new refrigerator through the program. Tables 1 and 2 show each of the conditions surveyed (rows) and the measures installed in the 2024 EEA program (columns) that could influence that condition. Table 3 shows the energy efficiency measure influences while Table 4 shows the health and safety measure influences.

Table 3. NEI map for conditions influence by each 2024 EEA energy efficiency measure

	HVAC equipment	Water equipment	Weatherization	Thermostat	Appliance	Tune-up	Lighting	Other
Aging in place	X	X	X	X	X	X	X	X
Alternative heating	X							
Arthritis	X		X	X				
Asthma			X					
Chronic stress	X	X	X	X	X	X	X	X
Common cold			X					
Chronic obstructive pulmonary disease (COPD)			X					
Environmental allergies			X					
Financial burden	X	X	X	X	X	X	X	X
Food poisoning					X			
Scalding		X						
Thermal stress	X		X	X				
Trips and falls							X	

Source: Guidehouse analysis

Table 4. NEI map for conditions influence by each 2024 EEA health and safety measure

	Wiring	Asbestos	Roof repair	Mold removal	Structural repair	Water infiltration	Pest control	Health and safety other
Aging in place	X	X	X	X	X	X	X	X
Alternative heating								
Arthritis			X					
Asthma		X	X	X		X	X	
Chronic stress	X	X	X	X	X	X	X	X
Common cold			X	X			X	
Chronic obstructive pulmonary disease (COPD)		X	X	X			X	
Environmental allergies			X	X			X	
Financial burden	X	X	X	X	X	X	X	X
Food poisoning								
Scalding								
Thermal stress			X		X			
Trips and falls					X			

Source: Guidehouse analysis

Approximately one year after program intervention, the same participants will be surveyed again to assess health and safety improvements. Using Michigan-specific health care claims data, the evaluation team can estimate the monetary impact of customers' improved conditions. The evaluation team identified the average out-of-pocket cost for Michigan customers across insurance providers for medical interventions and medications of most NEIs surveyed. Average total patient payments includes copay, coinsurance and deductible amounts as applicable across all insurance types which may include Commercial, Medicare, Medicaid and/or VA/DOD/Federal. At the time of writing, the second survey fielding and analysis is ongoing. In the interim, as described below, the estimated monetary impact ranges are based on initial survey results and secondary research, including academic NEI studies, program evaluation reports, and literature reviews on NEIs.

Based on survey responses, the evaluation team determined the number of respondent households with a history of each surveyed condition and the medical interventions they had needed for those conditions in the year prior to program intervention. The team estimated the expected improvements each condition once the post-survey data is collected using secondary research conducted for these conditions. If past research did not identify a percent reduction range, a normal distribution was used (16-84%). Then the team calculated the corresponding monetary impact of these improvements based on average patient out-of-pocket costs from health care claims data. Conditions without clear associated health care claims (aging in place, chronic stress, food poisoning etc) were not included in the monetization calculations.

Utility NEI Analysis

Using a quasi-experimental design, the evaluation team assessed changes in payment behavior metrics of 2024 EEA program participants relative to a matched group of eligible non-participants. The team reviewed and compiled all available data (billing data, payment plan data, arrears data, customer call data, etc.) and utilized a Euclidean distance matching approach to identify comparable non-participants based on pre-intervention monthly consumption, arrears and payment plan participation. Program impacts were estimated using difference-in-difference (DID) calculations and t-tests comparing participant payment metrics to the matched comparison group across six metrics: customer calls, disconnections/reconnections, arrearage carrying costs, participation in payment assistance programs, participation in payment plans and late payments.

Only the customer calls, disconnections/reconnections and arrearage carry costs were monetized. Monetized customer call NEIs were calculated by multiplying the change in call volume by the marginal cost per call. Monetized disconnections/ reconnections NEIs were estimated by multiplying the reduction in non-payment shutoffs by the cost per shutoff to the utility. Monetized arrearage carrying costs were determined by multiplying the reduction in arrearage by the percentage of participants with pre-arrears and the utility annual interest rate on short-term debt.

Because the analysis requires a full year of pre- and post-participation data, and the 2025 calendar year was incomplete at the time of analysis, sufficient post-participation data was only available for customers who participated in the first quarter of 2024. Accordingly, the results presented in this report are based solely on 2024 Q1 participants.

Results

Public Health NEI Modeling

Annual emissions reductions were calculated for electric and gas savings by multiplying the pollutant-specific marginal emissions factors by the verified net savings for each year. Annual emissions reductions were then aggregated across all measures and years to estimate IQ portfolio-level emissions reductions as shown in Table 5. Over the lifetime of the installed measures, the IQ EE programs are estimated to reduce emission by 13.6 tons of PM_{2.5}, 103.0 tons of SO₂, 188.8 tons of NO_x and 10.4 tons of VOCs.

Table 5. Lifetime IQ EE marginal emissions reductions by pollutant (tons)

Program	PM _{2.5} emissions reduction	SO ₂ emissions reduction	NO _x emissions reduction	VOC emissions reduction
EEA electric	3.6	27.8	25.1	1.3
EEA gas	0.2	0.3	46.2	2.7
IQMF electric	9.6	74.6	67.4	3.5
IQMF gas	0.2	0.3	50.1	2.9
Total	13.6	103.0	188.8	10.4

Source: Guidehouse analysis

These emissions reductions were input into the COBRA tool to estimate the health impacts from reduced pollution exposure over the life of the program measures. Based on the COBRA modeling output, these emissions reductions will lead to \$21.5 million (2024 dollars) in total health benefits. Program-level health benefits are shown in Table 6 as well as the estimated health benefits per million dollars of program spend. Based on these findings, if an additional \$1 million were invested in the IQ EE portfolio, DTE could expect about \$339,000 in NEIs from public health impacts.

Table 6. First-year and lifetime health benefits from IQ EE 2024 program year activities (2024 \$)

Program	Program spend	First-year health benefits	Total health benefits	Lifetime health benefits per million dollar of program spend
EEA	\$38,809,000	\$2,440,000	\$8,097,000	\$209,000
IQMF	\$24,617,000	\$1,732,000	\$13,383,000	\$544,000
Total	\$63,426,000	\$4,172,000	\$21,480,000	\$339,000

Source: Guidehouse analysis and Co-Benefit Risk Assessment (COBRA) tool.

Economic NEI Modeling

All program-related spending must be calculated and used as inputs to estimate economic activity supported by program activities using the IMPLAN model. Table 7 displays the program-related spending for the IQ EE 2024 programs including estimated lifetime residential bill surcharges, bill savings and reduced spending on fuel.

Table 7. IQ EE program-related spending (2024 \$)

Program	Program spend in 2024	Lifetime residential bill surcharges	Lifetime bill savings	Lifetime reduced spending on fuel
EEA	\$38,809,000	\$10,529,000	\$20,650,000	\$4,227,000
IQMF	\$24,617,000	\$6,034,000	\$42,585,000	\$5,551,000

Source: DTE Energy

Based on the IMPLAN modeling output, program-related spending for the 2024 IQ EE programs will support 851 jobs and \$85 million in gross domestic product (GDP), \$53.7 million of which comes from labor income, over the lifetime of the measures installed through the programs. Figure 1 shows both the positive and negative impacts of program spending on the estimated GDP supported by the 2024 program activities. “Positive impacts” represent economic impacts that will occur as a result of program activity in 2024 program activities while “negative impacts” capture economic impacts that could have occurred if not for program activity (e.g., customers spending more money on energy). The blue bars represent the impacts accrued during the first year after program intervention while the stacked gray bars represent the impacts accrued over the remainder of the measure lifetime. A larger portion of the EEA program’s economic NEIs are accrued during the first year after program intervention compared to the IQMF program. However, over the lifetime of the measures installed through the programs, the IQMF program generates more economic NEIs than the EEA program. Based on these findings, if an additional \$1 million were invested in the IQ EE portfolio, DTE could expect about \$1.3 million in GDP from economic NEIs.

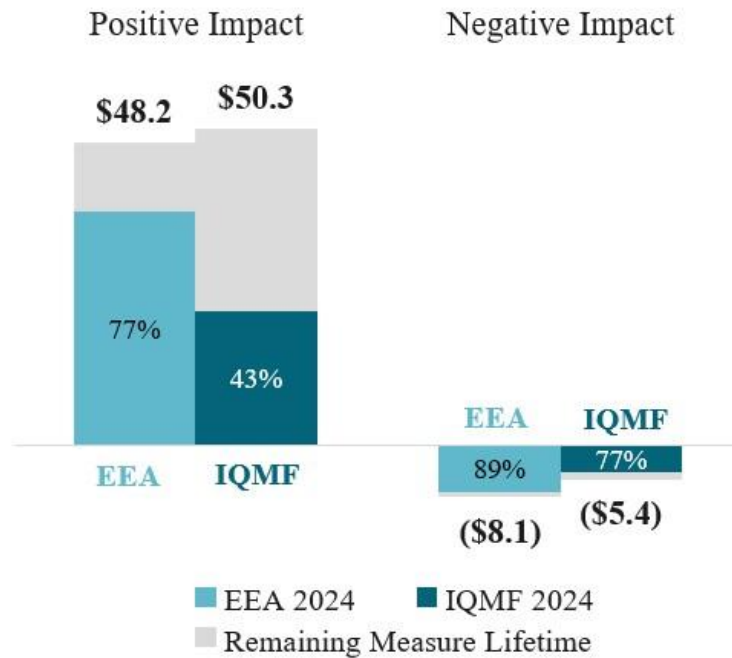


Figure 1. Estimated GDP supported by IQ EE 2024 programs (millions).
Source: IMPLAN.

Participant NEI Surveys

Through the EEA program, customers benefited from a range of energy efficiency as well as health and safety improvements, with these upgrades installed in over 2,000 homes within DTE's service area between October 2024 and February 2025. After distributing the pre-intervention survey to a census of participants from this timeframe, 339 of those households completed the first of two surveys. Figure 2 shows how many respondents received measures that could impact the specified condition and how many of those respondents reported experiencing that condition.

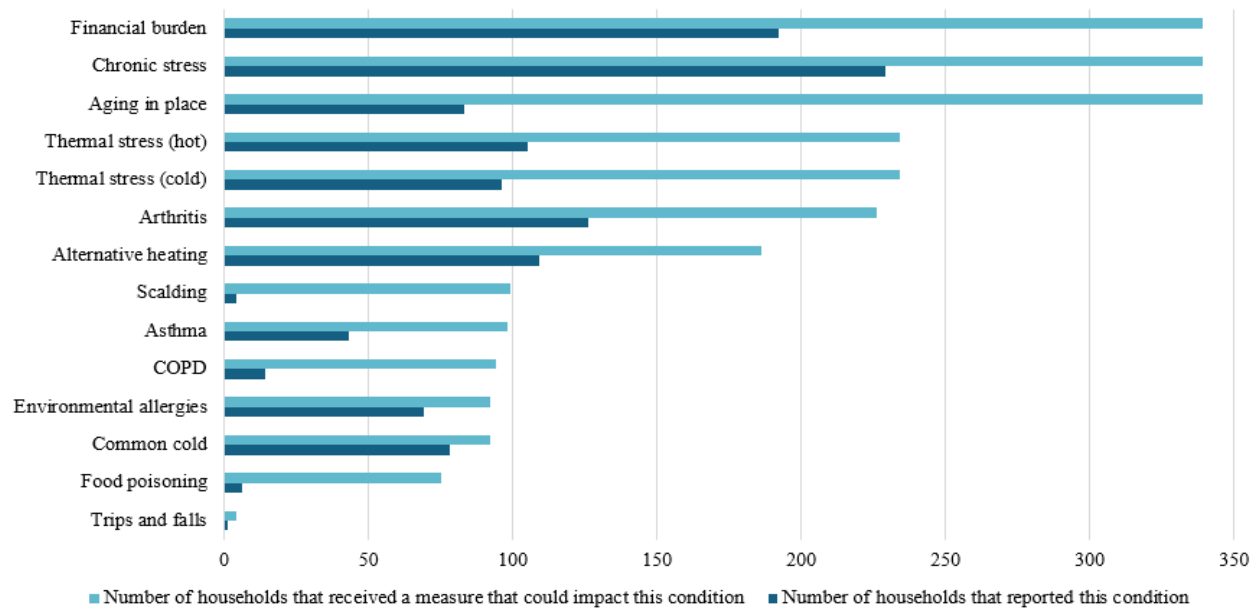


Figure 2. Reported conditions and potential for NEIs. *Source:* Guidehouse analysis.

Not all surveyed NEIs can be monetized with health care costs since not all of them are conditions addressed by medical professionals. Table 8 shows the conditions that could be monetized based on health care claims data and how many of respondents indicated they sought medical attention for that condition in the year prior to program intervention.

Table 8. Medical attention sought for each monetized condition

Monetized condition	Households that reported this condition	Households that sought medical attention for this condition
Arthritis	126	78 (62%)
Asthma	43	35 (81%)
Common cold	78	55 (71%)
COPD	14	8 (57%)
Environmental allergies	69	49 (71%)
Scalding	4	4 (100%)
Thermal stress (cold)	96	22 (27%)
Thermal stress (hot)	105	23 (26%)
Trips and falls	1	1 (100%)

Source: Guidehouse analysis.

Using the average paid claims for Michigan patients seeing Michigan providers, the evaluation team estimated the out-of-pocket cost to sampled customers in the year prior to program intervention to be about \$500,000. In the absence of the post-intervention survey results, the team estimated the range of reductions in medical interventions and associated costs will be based on existing literature. If past research did not identify a percent reduction range, a normal distribution was used (16-84%). These calculations assume respondents who sought medical attention for their condition did so only once, unless otherwise stated. As shown in

Table 9, the participant NEI savings for the sampled EEA population are estimated to be \$76,600-\$310,700. Based on this range and the EEA program spend for the sampled months, the estimated participant NEI savings per million dollars invested in the program are \$4,000-\$15,000.

Table 9. Participant NEI monetization based on health care claims and estimated reduction in medical interventions

Monetized condition	Total maximum monetized value of sample EEA population	Percent reduction range	Anticipated monetized value range of sample EEA population
Arthritis	\$156,000	16-84%	\$25,000 – \$131,000
Asthma	\$160,000	20-70%	\$32,000 – \$112,000
Common cold	\$61,000	12-21%	\$7,000 – \$13,000
COPD	\$39,000	16-84%	\$6,000 – \$33,000
Environmental allergies	\$52,000	5-12%	\$3,000 – \$6,000
Scalding	\$2,000	16-84%	\$300 – \$1,000
Thermal stress (cold)	\$16,000	16-84%	\$3,000 – \$14,000
Thermal stress (hot)	\$13,000	1.4%	~\$200
Trips and falls	\$1,000	24-85%	\$100 – \$500
Total	\$500,000		\$76,600 – \$310,700

Values are rounded to the nearest thousand. If less than one thousand, values are rounded to the nearest hundred.

Source: Guidehouse analysis, literature review, Michigan-specific health care claims data from Commercial, Medicare, Medicaid and/or VA/DOD/Federal insurance providers.

Utility NEI Analysis

After completing DID analyses and t-tests for all six metrics for the EEA 2024 Q1 participants, the evaluation team found statistically significant program impacts only for customer calls. Customer calls, disconnections/reconnections and arrearage carrying costs are the three metrics that can be monetized for this study. Because no program-related changes were observed for disconnection/reconnection and the arrearage carry costs analysis is still in progress, only customer calls were monetized at this stage, as shown in Table 10. Based on these findings, an additional million dollar investment in the EEA program is estimated to generate about \$8,000 in utility NEIs.

Table 10. Utility lifetime NEIs and monetization

Utility NEI metric	Lifetime impact	Lifetime monetized impact
Customer calls	~27,000 fewer calls	\$320,000
Disconnections/reconnections	No change	\$0
Arrearage carrying costs	TBD	TBD
Participation in payment assistance programs	No change	N/A
Participation in payment plans	No change	N/A
Late payments	No change	N/A

Source: Guidehouse analysis.

Monetization of Quantitative Results

Based on the analysis conducted for this study to date, the evaluation team monetized the results and determined the NEIs that are accrued for every million dollars invested in the DTE IQ EE programs. The team found that these programs yield approximately \$1.7 million in lifetime NEIs for every million dollars invested. Table 11 displays the NEIs estimated per million dollars invested for each quantitative research activity. The monetization of Public Health NEIs, Economic NEIs, and Utility NEIs are based on NEIs accrued over the lifetime of the measures. Participant NEIs are estimated medical cost reductions for one year based on medical interventions reported in the initial participant survey the multiplied by the EEA program's weighted average measure life (8.25 years). To avoid potential double counting between Public Health NEIs and Participant NEIs, monetized impacts from asthma and respiratory illnesses were removed from the Public Health calculations. IQMF was not included in the participant survey or Utility NEI research activities. As a result, participant and utility NEIs for IQ EE Programs Overall only represent NEIs associated with the EEA program.

Table 11. Marginal NEIs for every million dollars invested in DTE IQ EE programs

	For every \$1 million invested, non-energy impacts equate to...		
	IQ EE Programs Overall	EEA	IQMF
Public health NEIs	\$339,000	\$209,000	\$544,000
Economic NEIs (Michigan GDP)	\$1.3 million	\$1.0 million	\$1.8 million
Participant NEIs	\$33,000-\$124,000	\$33,000 - \$124,000	N/A
Utility NEIs	\$8,000	\$8,000	N/A
Total (approximate)	\$1.70 million	\$1.30 million	\$2.15 million

Values are rounded. Program-specific numbers are ratios (\$NEI yield/\$ spend). The denominators are not equal and therefore not additive. Source: Guidehouse analysis.

Conclusions

The early findings from this study indicate that DTE's IQ EE programs delivers substantial NEIs and that the programs provide considerable value relative to cost based on the NEI yield-to-spend ratios. Even though the IQMF program was not included in the participant

NEI or utility NEI research, the program still provides a larger NEI yield than the EEA program from the two societal NEI activities. This is likely due to the IQMF program having a higher weighted average measure life in 2024 (10.41 years) compared to the EEA program (8.25 years), meaning the program's measures have more time operating in customers' homes to generate NEIs. Based on the initial survey results, the largest portion of participant NEIs is likely to come from improvements to arthritis and asthma, the two most prevalent conditions reported in the survey with the highest maximum value of the monetized conditions. Utility NEIs research show a decrease in customer calls, including those related to billing or collections based on Q1 of the 2024 program year.

As of the time of writing, the next steps for this study will be to field the post-intervention survey for the participant NEI research activity and reassess the monetized benefits accrued based on survey analysis. Additionally, the utility NEI research activity will be reevaluated for all 2024 EEA participants once all 2025 data, or a full year of post-intervention data, is available. The monetized benefits will be reassessed based on this updated analysis as well. All report findings to date support the continued investment in and expansion of IQ EE programs as an effective strategy for achieving both economic and environmental benefits for participating households and the broader community.

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