

Climate Solutions Serving Vulnerable Communities in Northern Illinois: Monetizing the Non-Energy Impacts of ComEd's Energy Efficiency Programs for Cost-Effectiveness Tests

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ABSTRACT

In Chicago and other urban areas, vulnerable communities already burdened with energy bills are facing an accelerating climate crisis, including extended heat waves. More extreme weather events are compounded by the economic and public health impacts of the COVID-19 pandemic. In September 2021, Illinois enacted the Climate and Equitable Jobs Act (CEJA), which includes provisions for the equitable deployment of energy efficiency resources, and continues the activities started under the Illinois Future Energy Jobs Act (FEJA). Additionally, Illinois utilities increased their comprehensive¹ energy upgrade programs for income eligible households. At ComEd's request, Guidehouse conducted research to quantify and monetize public health, economic, and participant non-energy impacts (NEIs²) associated with ComEd's energy efficiency programs. Including monetized societal health and participant NEIs in total resource cost (TRC) test values better represents the holistic impacts of ComEd's energy efficiency portfolio as well as the cost-effectiveness of comprehensive residential energy efficiency programs. Beginning in 2020, ComEd and Ameren Illinois reported TRC test values with and without public health NEIs³; several ComEd programs' TRC values rose above threshold values by including societal public health impacts. Also, beginning in 2018, Guidehouse analyzed and reported the economic and employment NEIs associated with ComEd's 2018-2021 energy efficiency portfolios in accordance with CEJA and FEJA. This paper describes our methodologies and results for estimating the NEIs associated with energy efficiency programs. We hope these methodologies will allow for increased scope of utility energy efficiency programs across the US, especially for vulnerable populations.

Introduction

Discussions on including non-energy impacts (NEIs) in cost effectiveness tests in Illinois began in 2015 through the Illinois Energy Efficiency Stakeholder Advisory Group (IL SAG). While those discussions did not achieve consensus, the stakeholders agreed on the criteria for NEIs in IL:

- NEIs should be calculated on a “measure-specific basis, rather than being a straight adder applied to all or to a particular market.”

¹ Comprehensive residential energy upgrades include heating, ventilation, and air conditioning (HVAC) improvements or replacements, and air sealing and insulation.

² Non-energy impacts are sometimes synonymous with non-energy benefits—both are captured here as NEIs.

³ Participant NEIs will be included in ComEd's cost-effectiveness tests following the conclusion of the research, estimated in 2024.

- NEI values need to be based on “IL-specific evaluation efforts.” (VEIC 2016)

Following the passage of FEJA⁴ (FEJA 2016) and to better serve all customers, including historically underserved income eligible⁵ customers, ComEd requested that Guidehouse, its independent third-party evaluator, conduct NEIs research to quantify and monetize NEIs to include in total resource cost (TRC) values. In September 2021, the Illinois legislature passed the CEJA (CEJA 2021) with language directing Illinois utilities to continue to include NEIs in TRC tests and to continue to report economic NEIs.⁶ The findings in this paper are a continuation of those presented at the American Council for an Energy-Efficient Economy (ACEEE) 2020 Summer Study on Energy Efficiency in Buildings (Plympton et al. 2020) which also describes the requirements in FEJA concerning NEIs.

Guidehouse categorizes NEIs into three groups: societal (public health and economic), participant, and utility. Societal public health NEIs accrue to society and include improvements to the environment, and the health, safety, and comfort of citizens, and include reduced morbidity and mortality associated with reduced air pollution. Societal economic NEIs accrue to the citizens and industries affected by the economic activities of the energy efficiency portfolio and include job creation and other economic benefits. Participant NEIs accrue to participants living in homes that received energy efficiency upgrades⁷ and to building owners and property managers (for multifamily buildings) and include decreased symptoms and medical costs associated with asthma, arthritis, and thermal stress. IL income eligible weatherization programs continue to grow resulting from CEJA’s direction to utilities to significantly increase their budgets for these programs (CEJA 2021). Utility NEIs mainly accrue to the utility and result from reduced administrative and compliance costs and include reduced carrying costs on arrearages. Guidehouse research on utility NEIs did not produce conclusive results and utility NEIs are omitted from this paper (Plympton 2020 and Plympton, Minor-Baetens, and Halbach 2021).

While the societal public health and economic NEIs pertain to large populations within and outside of ComEd’s service territory, one of ComEd’s goals of this research is to convey the benefits of living in a home that has received an energy efficiency upgrade by participating in an income eligible energy efficiency program. Approximately one million of ComEd’s three million residential customers are households with incomes below 80% of area median income (AMI) and qualify for income-eligible energy efficiency programs (ComEd 2020). An income eligible

⁴ “A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and the 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 societal benefits, to the sum of all incremental costs of end-use measures that are implemented due to the program...” (FEJA 2016).

⁵ Eligibility to participate in ComEd’s income-eligible energy efficiency programs includes having a household income at or below 80% of the Area Median Income.

⁶ From CEJA: “The plan shall be determined to be cost-beneficial ...[including] the societal value of reduced carbon emissions and surface-level pollutants, particularly in environmental justice communities.” “The independent evaluator shall determine...an estimate of job impacts and other macroeconomic impacts of the efficiency programs for that [plan] year.”

⁷ Energy efficiency upgrades that can produce participant NEIs include HVAC and building envelope measures. Participant NEIs include improvements in health, safety, and comfort and reduced operations and maintenance (O&M) costs.

household's electricity burden is almost double that of the average Illinois household (Gazze, McCreery, and Seybolt 2019).

The majority of ComEd's residential customers live in the urban environment of Chicago which is subject to environmental conditions that are disproportionately more harmful to certain groups of people. For example, temperatures are warmer in Chicago and Cook County (where Chicago is located) than surrounding areas during the summer due to the urban heat island effect, causing increased heat stress in residents. Climatologists suggest Chicago will be 5 to 9 degrees Fahrenheit warmer by 2100. A warmer climate combined with more 95-plus-degree days results in more devastating heat waves, including the 1995 heat wave that killed 739 people, mostly in old, industrialized neighborhoods with homes and business that had little ventilation. In recent years, cooling centers and buses were available on the hottest days; however, studies show that many income eligible household members are reluctant to leave their homes.⁸ (Cusick 2020). Chicago has more than 10 "Code Orange" and "Code Red"⁹ air quality days every year, primarily from increased ground level ozone. This poor air quality is especially harmful to children, older adults, and those with asthma or lung diseases. Air pollution from cars, power plants, boilers, and refineries is exacerbated by warmer temperatures due to climate change (American Lung Association 2022). Researchers have found that living in a large city can make asthma symptoms worse for children in income-eligible households (Keet et al. 2017). In addition, precipitation is expected to increase in intensity, leading to increased flood damage. Flooding in combination with warmer temperatures is expected to increase the risk of exposure to diseases carried by insects and rodents, and increased mold and mildew (Angel 2018).

Studies show that energy efficiency measures like weatherization and HVAC upgrades can lessen the adverse health effects of heat waves and air pollution in cities (Fisk, Singer, and Chan 2020). The results of Guidehouse's participant research will more accurately reflect the benefits of ComEd's income eligible programs in cost-effectiveness tests by including monetized NEIs. In addition, ComEd intends to use this research to describe the health and financial benefits of participating in an income eligible energy efficiency program in outreach and educational information.

Our research approach includes the following:

- Quantifying and monetizing societal NEIs from the energy efficiency portfolio by using U.S. Environmental Protection Agency's (EPA's) AVOIDed Emissions and geneRation Tool (AVERT) and CO-Benefits Risk Assessment (COBRA) models (2022a; 2022b).¹⁰
- Estimating job creation and other economic impacts for the energy efficiency portfolio by using IMPLAN (IMPLAN 2018).¹¹

⁸ From Cusick 2020, members of income-eligible households are afraid of their homes getting burglarized and concerned about COVID-19 exposure.

⁹ The EPA's Air Quality Index reports daily air quality of common ambient air pollutants using colors to depict the health concern. "Code Orange" days are considered "unhealthy for sensitive groups," including people with heart or lung disease, older adults, and children. "Code Red" days are unhealthy for everyone.

¹⁰ AVERT is a free tool designed to meet the needs of state air quality planners and other interested stakeholders. AVERT is designed to use public data that is accessible and auditable. COBRA is a peer reviewed screening tool that establishes the air quality, human health, and associated economic impacts of various state- and county-level emissions reduction scenarios

¹¹ The IMPLAN software is a widely used economic input-output modeling tool for estimating job creation and economic impacts.

- Quantifying health and other participant NEIs associated with income eligible energy efficiency programs that include weatherization and HVAC upgrades using participant surveys, and monetizing NEIs using information from a northern Illinois health network and other sources (Plympton et al 2020).¹²

In a presentation to the IL SAG in June 2020, ComEd described its criteria on including societal public health and participant NEIs in TRC tests¹³ as (Fay 2020):

- Benefits must exceed costs on a lifetime basis for the energy efficiency portfolio (TRC > 1.0).
- Total benefits include avoided energy cost and quantifiable NEIs.
- NEIs can improve TRC cost-effectiveness, but:
 - A measure must compete for program resources on the basis of the cost of energy saved (\$/kWh).
 - The measure must improve the ability of the portfolio to meet its goals.
 - NEIs alone are not enough to justify program measures.

Beginning in 2020, ComEd included societal public health NEIs in their cost effectiveness tests (Deo, Nwosu, and Maoz 2021). In addition, ComEd included societal public health NEIs in its final 2022-2025 Portfolio Plan's TRCs (ComEd 2022). Also, Guidehouse reported economic NEIs for ComEd's 2018-2021 portfolios (Eakin and Ross 2020, Plympton, Winston, and Bergland 2021, Plympton, Montes, and Bergland 2021, and Plympton, Montes, Winston 2022). Guidehouse anticipates including participant NEIs in TRC values beginning in 2024.

Societal Public Health NEIs

Energy efficiency programs produce societal NEIs by reducing electricity generated from fossil fuels, which reduces emissions including particulate matter 2.5 (PM_{2.5}), sulfur dioxide (SO₂), nitrogen oxides (NO_x), and carbon dioxide (CO₂).¹⁴ This reduction in emissions causes reduced adverse health impacts, which are monetizable. At a high level, societal NEIs associated with a ComEd energy efficiency program are represented by the total monetary value of illnesses and deaths avoided due to program-induced reduced emissions over 20 years, discounted to the year of implementation using the COBRA tool (EPA 2022b).

Beginning in 2020, Guidehouse calculated ComEd's TRC values with and without societal health NEIs, as reported in the *Evaluation of ComEd's CY2020 Total Resource Cost Test* (Deo, Nwosu, and Maoz 2021). In addition, societal NEI estimates were generated for ComEd's

¹² Because of COVID-19, ComEd suspended the implementation of energy efficiency programs that directly installed measures in customers' homes from March – September 2020, which delayed our participant surveys. We started surveying participants in March 2021.

¹³ The Illinois Technical Reference Manual version 9 (IL-TRM) includes several deemed savings values to quantify participant, societal, and utility NEIs (IL TRM 2021). The NEI values are linked to state or federal sources and were added to the IL-TRM via a stakeholder vetting process.

¹⁴ Particulate matter with a diameter of 2.5 micrometers and smaller, sodium dioxide, nitrogen oxides, and carbon dioxide.

2022-2025 programs' TRC tests (Plympton, Young, and Johnson 2021). The following sections summarize the methodology developed and used by Guidehouse to estimate societal NEI values.

Quantifying Public Health Impacts Associated with Reduced Emissions

Guidehouse conducted the societal NEI public health analysis using two models developed and maintained by the U.S. EPA: AVERT and COBRA (2022a; 2022b). The AVERT tool estimates the emissions benefits of energy efficiency and renewable energy policies and programs. The COBRA tool estimates the health and economic benefits associated with energy efficiency and renewable energy policies and programs. Guidehouse chose these tools for their established and continued use in state-level energy efficiency and renewable energy analyses to estimate societal NEIs and monetize results at a county-level.

The AVERT tool calculates avoided PM_{2.5}, SO₂, NO_x, and CO₂ emissions associated with energy efficiency and renewable energy programs. The emissions are based on generation across the EPA-defined Great Lakes/Mid-Atlantic eGrid¹⁵ (EPA 2022c) region for ComEd, which stretches from northern Illinois to the Mid-Atlantic coast. The COBRA tool estimates human health and the associated economic impacts of various emissions reduction scenarios at the county level. The COBRA tool calculates the societal health impacts of chronic and acute bronchitis, non-fatal heart attacks, respiratory or cardiovascular hospital admissions, work loss days, and other impacts associated with improved outdoor ambient particulate matter.

Guidehouse used the AVERT tool to develop estimates of emissions reductions using *ComEd Summary Impact Evaluation Report* (Ampong and Kunkel 2019). Estimates of reduced emissions reflect annual energy savings and cumulative persisting annual savings (CPAS) for each installed energy efficient measure. For ComEd, the program-level CPAS values vary in duration and magnitude depending on the measures implemented; programs with longer persisting savings will realize emissions reductions and related health benefits over a longer time.

To generate societal NEI estimates for ComEd's Plan 6 portfolio, Guidehouse repeated an annual, seven-step modeling approach four times, as described in our 2020 ACEEE Summer Study 2020 paper (Plympton et al 2020). Table 1 highlights the societal health benefit estimates for ComEd's Plan 6 portfolio, generated via the annual modeling approach. The continued benefits from ComEd's Plan 6 portfolio forecasted through 2046 totaled more than \$2B (USD) (Plympton, Young, and Johnson 2021).

Table 1. Societal NEI estimates through 2046 for ComEd Plan 6 Portfolio 2022-2025

Program year	2019 verified net lifetime savings (kWh)	\$ Total health benefits through 2046	\$ Total health benefits per kWh (average)
2022	15,561,383,503	\$644,899,186	\$0.0414
2023		\$608,718,877	\$0.0391
2024		\$577,977,148	\$0.0371
2025		\$550,927,877	\$0.0354

Source: Guidehouse analysis using ComEd CY2019 programs' savings.

¹⁵ eGrid regions refer to regions referenced in the U.S. EPA-developed emissions and generation resource-integrated database, which is a source of data on the environmental characteristics of almost all electric power generated in the US.

Including Monetized Societal Public Health Impacts into TRC Test Values

As ComEd’s third-party evaluator, Guidehouse determines program-level cost-effectiveness using the utility cost test (UCT) and the Illinois TRC test for ComEd’s energy efficiency portfolio. To demonstrate the impact of societal NEIs on cost-effectiveness, we determined the 2020 TRCs with and without societal NEIs for all 42 energy efficiency programs (Deo, Nwosu, and Maoz 2021), and a selection of program TRCs is shown in Table 2. Several programs’ TRCs rose above the 1.0 threshold by including societal public health impacts, (e.g., Fridge & Freezer Recycling, Multi-Family Assessments, Facility Assessments, Nonprofit Retrofits, and Affordable Housing New Construction). In a similar manner, Ameren Illinois’ (AIC) third-party evaluator, Opinion Dynamics also determined the 2020 TRCs with and without societal NEIs (Ross 2021).

Table 2. Selection of ComEd programs’ 2020 TRC values with and without societal NEIs

Program	Illinois TRC test (with societal NEIs)	Illinois TRC test (without societal NEIs)
Fridge & Freezer Recycling	1.43	0.84
Residential Behavior	7.78	4.57
Lighting Discount	6.00	3.62
Multi-Family Assessments	1.44	0.98
Business Instant Discounts	5.02	3.18
Facility Assessments	1.12	0.56
Public Buildings in Distressed Communities	5.07	3.52
RetroCommissioning and Virtual Commissioning	5.12	2.86
Strategic Energy Management	3.92	1.93
Affordable Housing New Construction	1.06	0.67
Food Bank-LED Distribution	3.39	2.16
Income Eligible Product Discounts – Lighting Discounts and Appliance Rebates	10.61	6.49
Multi-Family Retrofits - IEMS and IHWAP	0.84	0.73
Public Housing Retrofits	0.58	0.33
Single-Family Retrofits - CBA and IHWAP	0.82	0.69
University of Illinois at Chicago Energy Resources Center (UIC-ERC) Income Eligible Kits	9.08	6.74
Savings for Income Eligible Seniors Pilot	2.27	1.93
Portfolio Total	3.36	2.30

Source: Guidehouse analysis 2021.

In addition, Guidehouse produced societal health NEI values (Plympton, Young, and Johnson 2021) for ComEd to include in its final Plan 6 cost-effectiveness test results (ComEd 2022). Table 3 shows the Plan 6 portfolio-level TRCs—with and without NEIs. At least one income eligible program’s (New Construction – IE) Plan 6 TRC value rose above the 1.0 threshold with the NEIs included to 1.07 (ComEd 2022).

Table 3. ComEd Plan 6 2022-2025 cost-effectiveness (CE) test results

Total Portfolio	CE Results Excluding NEIs	CE Results Including NEIs
TRC	1.83	2.89
TRC – Excluding income eligible programs	2.02	3.24

Source: ComEd 2022.

Economic Impacts

Economic (including employment) impacts occur when participants and non-participants experience positive impacts (e.g., bill savings) and negative impacts (e.g., bill surcharges). These economic impacts affect industries associated with the energy efficiency programs and households participating in the energy efficiency program that span varying levels of income.¹⁶

To assess the economic impacts, Guidehouse conducted economic analyses using cost and benefit data associated with ComEd energy efficiency portfolio for years 2018-2021 (Eakin and Ross 2020, Plympton, Winston, and Bergland 2021, Plympton, Montes, and Bergland 2021, and Plympton, Montes, and Winston 2022). The following is a summary of the methodology used to estimate economic impacts associated with ComEd's energy efficiency portfolio.¹⁷

Using information from the ComEd's energy efficiency programs (e.g., funding, expenditures, participant spending) and the regional economic analysis software application IMPLAN (IMPLAN 2018), Guidehouse built a model to estimate the economic impacts of energy efficiency programs based on underlying economic relationships among various market participants such as industry sectors, households, and institutions. IMPLAN is widely used for economic input-output modeling to estimate impacts on the economy.

The analysis is based on the 2021 energy efficiency programs and their effect over the life of the measures (e.g., until 2045) covering 25 years (Plympton, Montes, and Winston 2022).

Economic Impact Assessment Methodology

The economic impact assessment for ComEd's energy efficiency programs follows a three-step process.

1. Collect data on changes in spending and savings associated with each energy efficiency program.
2. Evaluate changes in spending using IMPLAN to understand the effect these energy efficiency programs are having on the Illinois economy.
3. Summarize economic impact results to convey how the Illinois economy will respond to these energy efficiency programs using economic measures such as business sales, labor income, and jobs.

The relationship between participants and the estimated, localized impacts of energy efficiency programs using IMPLAN are based on data from the Bureau of Economic Analysis Regional Economic Accounts, the Bureau of Labor Statistics Census of Employment and Wages, the U.S. Census, and County Business Patterns. This data is specific to the regional economy

¹⁶ CEJA (CEJA 2021) and the Policy Document for the Illinois Statewide Technical Reference Manual for Energy Efficiency v2.1 (IL SAG 2021) require that Illinois' utilities report the economic impacts of their energy efficiency programs on an annual basis. CEJA specifies that an independent evaluator must determine the annual savings for a given plan year and "...an estimate of job impacts and other macroeconomic impacts of the efficiency programs for that year." (CEJA 2021)

defined as the utility service territory combined with the remaining portion of Illinois.¹⁸ Table 4 shows the economic impact results from the 2021 energy efficiency portfolios for ComEd.

Table 4. Summary of ComEd 2021 energy efficiency portfolio economic impacts (2021-2045)

Impact category	Statewide total
Jobs created	20,1880 job years
Labor income	\$1.20 billion
Economic output	\$4.04 billion

Source: Guidehouse 2022.

Figure 3 presents the employment impacts of ComEd’s portfolio investments, separated into direct, indirect, and induced impacts.¹⁹ Because the portfolio produces long-term economic effects due to continued energy savings, employment impacts are not confined to a particular year but occur over the 2021-2045 period.

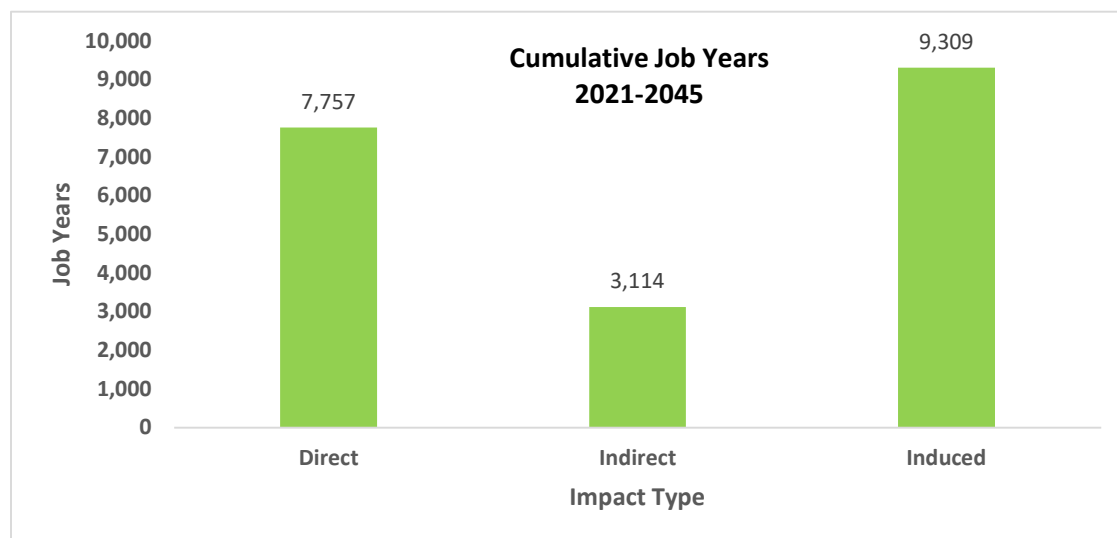


Figure 1. ComEd energy efficiency portfolio employment impacts (e.g. cumulative job years 2021-2045). Source: Guidehouse analysis of ComEd 2021 tracking data.

Table 5 presents the cumulative economic and employment impacts for ComEd’s energy efficiency programs offered in 2018 to 2021. As ComEd expands its portfolio in Plan 6, we anticipate a commensurate increase in job years.

¹⁸ IMPLAN makes several simplifying assumptions, such as constant returns to scale, fixed prices, no substitution effects, no supply constraints, and no changes in competitiveness or other demographic factors. This methodology is generally accepted to be an effective tool for evaluating impacts that do not shift economic equilibrium conditions and has been used in the utility industry for economic impact evaluations of energy efficiency programs.

¹⁹ Due to a lack of portfolio-level data reflecting costs and energy savings associated with voltage optimization, these were assigned to commercial, residential, and income-eligible customer portfolios in a 50%-25%-25% split, respectively, roughly approximating costs and energy savings associated with each portfolio.

Table 5. 2018 – 2045 Illinois economic impacts from ComEd’s 2018-2021 portfolio

Time Period	Job Years	Labor Income	Industry Output
2018 – 2042	14,707	\$876M	\$2.94B
2019 – 2043	16,747	\$1.01B	\$3.37B
2020 – 2044	20,246	\$1.21B	\$4.04B
2021 – 2045	20,180	\$1.21B	\$4.04B

Source: Guidehouse analyses 2019-2022.

Lessons Learned from Analyzing Data for Economic NEIs

- Understanding the process of how ComEd cost data is collected, processed, and organized reduces time spent validating the information and increases confidence in the economic impact results.
- Consistency in program names between reporting years facilitates replication of the methodology and enables direct comparison of results year over year.

Participant NEIs

Overall Approach for Quantifying Participant NEIs

CEJA requires Illinois utilities to grow their income eligible weatherization programs and health and safety improvements (CEJA 2021). The ability to monetize participant NEIs to include in TRC tests will increase these programs’ cost-effectiveness test values as utilities provide weatherization upgrades to significantly more income eligible households. Participant NEIs associated with income eligible energy efficiency program improvements (Figure 4) include reduced medical costs associated with four health conditions: asthma, arthritis, thermal stress from heat, and thermal stress from cold. In addition, we are also surveying for fewer missed days of work, less reliance on loans for household necessities, and reduced O&M costs for multifamily buildings. Guidehouse is quantifying participant NEIs associated with the income eligible comprehensive retrofit components of ComEd’s single-family and multifamily programs (ComEd 2017).²⁰ We are quantifying the NEIs using two methods: (1) surveying an adult member of the household that received the energy efficiency measures at the time of participation and 12 months after participation to determine changes in health and other outcomes; and (2) interviewing building owners and operators of buildings that received energy efficiency measures at the time of participation and 12 months after participation to determine changes in O&M costs. By including monetized participant NEIs associated with income eligible energy efficiency programs into these programs’ cost-effectiveness tests, ComEd has the ability to expand programs that represent significant health and financial benefits to ComEd customers.

²⁰ ComEd’s single-family and multifamily residential energy efficiency programs were reorganized on January 1, 2022. The Single Family Retrofits program implemented by Resource Innovations includes two components: Illinois Home Weatherization Assistance Program (IHWAP) and retrofits. The Multi-family Retrofits program implemented by Franklin Energy includes IHWAP, retrofits, and a public housing component. There are other market rate components not included in this research.

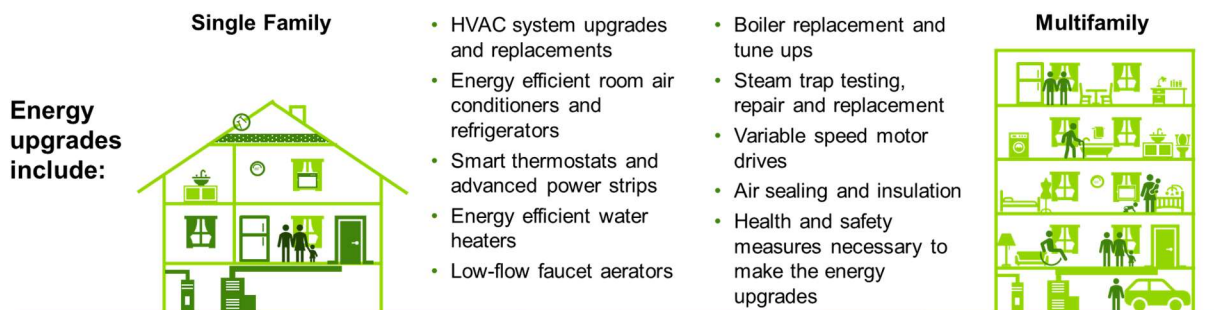


Figure 2. ComEd Income Eligible Single Family Retrofits and Multifamily Retrofits energy efficiency measures.
Source: Guidehouse 2022.

Guidehouse developed a participant survey with stakeholder feedback and modeled on the U.S. Department of Energy’s Weatherization Assistance Program’s (WAP) National Evaluation (Tonn et al. 2014). Table 6 shows sample questions for categories of participant NEIs.²¹ Our goal is to obtain survey responses from 80 households with a household member with at least one of the four health conditions listed above.

Guidehouse began surveying single-family program participants in Q1 2021. The research is not finished at the time of writing this paper, but we expect data collection to be completed by Q3 2022. Beginning in Q1 2022, after 12 months have elapsed since energy efficiency measure installation, Guidehouse is inviting participants to complete the survey again. Following the second round of single-family participant surveys, Guidehouse will quantify the participants’ NEIs by analyzing the survey responses for differences in incidences.

Guidehouse began surveying multifamily program participants in Q2 2021. We met challenges with distributing the survey link to multifamily units, and the research was put on hold in Q3 2021 to explore different methods of distributing the survey link. The research restarted in Q1 2022 and is not finished at the time of writing this report. We expect baseline data collection to be completed by Q2 2023 and final data collection to be completed by Q2 2024. Following the second round of multifamily participant surveys, Guidehouse will quantify the participants’ NEIs by analyzing the survey responses for differences in incidences.

Table 6. Sample participant survey questions to quantify NEIs

Type of NEI	Sample questions asking about last 12 months
Health	How many times did any of these adults [showing asthma symptoms] seek the following types of medical care because of their asthma symptoms? Please do <i>not</i> include Covid-19 related medical care. - Use an emergency inhaler - Go to an urgent care clinic or doctor’s office - Go to the emergency room, but not stay overnight - Go to the hospital and stay overnight
Fewer missed days of work	How many days of work did <u>you</u> miss because you or someone else in the household were sick with Covid-19 or colds, the flu, sinus infections, or some other respiratory infection like bronchitis or pneumonia? Please do not include days missed due to asthma.
Reduced reliance on payday loans and assistance programs	How did your household pay for the basic things you needed, like food, energy bills, housing, or other expenses?

²¹ Survey questions reflect the COVID-19 pandemic’s impacts on the households in ComEd’s territory, and ask questions related to outcomes associated with the energy improvements.

Type of NEI	Sample questions asking about last 12 months
Reduced O&M costs	Approximately how much was spent on maintenance costs due to equipment failure?

Guidehouse modified questions from the national WAP survey to develop a survey for ComEd income eligible program participants. *Source:* Guidehouse participant survey and building owner interview guide 2021.

In Q3 2021, Guidehouse interviewed multifamily building owners and managers about O&M costs. In Q3 2022, we will re-interview the building owners and managers to determine if they experienced a decrease in O&M costs following participation in ComEd’s programs.

Monetizing Participant NEIs

Guidehouse will monetize residents’ health impacts (i.e., decreased need for medical visits associated with arthritis and asthma symptoms and thermal stress) by multiplying the change in healthcare utilization by its associated costs. ComEd customers’ change in healthcare utilization will be measured via the participant survey, while healthcare costs are the average emergency department and hospital inpatient admission costs obtained from a representative northern Illinois health system.²²

Guidehouse will quantify residents’ financial NEIs using survey questions responses and estimates of various financial activities. Guidehouse will quantify fewer missed days of work and participants’ reduced need for payday loans, credit card usage, and participation in assistance programs using survey responses. Using Illinois-specific secondary sources that reflect the impacts of the pandemic on ComEd’s customers, Guidehouse will identify appropriate sources of information for the values used to monetize the financial NEIs accrued to participants.

Guidehouse will quantify building owners’ and managers’ reduced O&M costs by interviewing multifamily building owners and managers. Using ComEd territory-specific sources, we will determine the average annual cost for property maintenance, equipment maintenance, and water usage to monetize these NEIs. Guidehouse conducted a baseline interview with 22 participating multifamily building owners and managers in 2021. The number of units for these buildings ranged from 2 to more than 350 units. We collected quantitative and qualitative responses from building managers related to their O&M costs. Table 7 shows the average annual cost in 2021 for property maintenance, equipment maintenance, and water usage in multifamily buildings at the time of their HVAC and building envelope upgrades. Our baseline analysis suggests equipment failure caused by extreme weather events affected 633 building units with an estimated cost of \$326,500. Currently, this research is ongoing, and we expect data collection completion by Q3 2022 when Guidehouse will re-interview the same building owners and managers. Guidehouse will quantify the change in O&M costs and NEIs 12 months after energy efficiency upgrades were installed.

²² To determine healthcare costs associated with changes in participant healthcare utilization, Guidehouse accounted for the differences in patient conditions by obtaining average costs for emergency department visits and hospital admissions related to asthma and thermal stress from a representative health system in northern Illinois. Guidehouse’s detailed methodology and sources to monetize participant health NEIs is described in our 2020 ACEEE paper. (Plympton et al. 2020).

Table 7. Monetized values of multifamily building O&M costs

O&M condition	Baseline average per-unit cost
Property maintenance	\$2,070
Equipment maintenance	\$490
Annual water bills	\$1,800

Source: Guidehouse 2022.

Lessons Learned from Collecting Primary Source Data for Participant NEIs

At the time of writing this paper, Guidehouse has collected over 12 months of single-family participant baseline survey responses and restarted the multifamily baseline data collection effort. Our experience socializing this survey and collecting primary source data has led to some key findings.

- **Physically distributing survey invitations to single-family and multifamily residents requires collaboration and buy-in from all stakeholders.** Guidehouse did not have access to customer name and mailing address information at the time of energy efficiency upgrades to mail survey invitations directly to program participants. Instead, Guidehouse coordinated distribution of a leave-behind card with a survey link through the program managers, implementation contractors, community action agencies (CAAs), energy efficiency service providers (EESPs), and building owners and managers. Successfully distributing survey invitations required close oversight and strong collaboration from all parties. We found that a break in the survey invitation distribution process jeopardized primary data collection and our ability to meet survey response quotas.
- **Most building owners and managers do not have time to support survey invitation distribution.** The implementation contractors worked as liaisons between Guidehouse and the building owners and managers. Guidehouse mailed leave-behind cards with survey links and an instruction page to building owners and managers, who were instructed to give the leave-behind cards to their tenants. Building owners and managers struggled to comply with this request and some expressed their discontent at being involved in this process. We found that requesting leave-behind card distribution was too cumbersome for building owners and managers and too unreliable for our data collection needs. In 2022, we are mailing cards with the survey QR link to residents whose multifamily buildings recently received energy upgrades to simplify the survey distribution process.
- **Gift cards are effective incentives for long surveys (more than 15 minutes).** Our participant NEI survey has the potential to be long, depending on how many people in a household have the qualifying health conditions (asthma, arthritis, thermal stress). We offered a \$25 Tango gift card for completing the survey to all single-family and multifamily participants, which is valued at \$1-2 per minute spent on the survey. A larger incentive might be more effective at collecting survey responses for a survey of this length with personal health and financial questions.

Conclusion

Income eligible communities and communities of color disproportionately have to live with and die from heat (Cusick 2020). As residents in ComEd's service territory experience more frequent Code Orange and Red summer days, warmer average yearly temperatures, and more heavy rain events, the income eligible population will be increasingly vulnerable to the effects of climate change. One role utilities play in providing assistance to vulnerable communities is to help prepare them for these extreme weather events by making energy efficiency resources available to them. Although utilities in several states have used one or more categories of monetized NEIs in their cost-effectiveness tests (ACEEE 2018), Illinois is the first state with IOUs that included monetized societal health NEIs in their cost-effectiveness tests (Deo, Nwosu, and Maoz 2021 and Ross 2021). In addition, ComEd included these NEIs in their 2022-2025 portfolio cost-effectiveness tests for all programs including income eligible programs (ComEd 2022). Guidehouse is using AVERT and COBRA to monetize societal NEIs, IMPLAN to monetize economic NEIs, and primary research to monetize participant NEIs. When Guidehouse completes the participant NEI research, ComEd will be able to more accurately represent the health and financial benefits that result from its income eligible whole-house energy efficiency programs. With more primary research by other jurisdictions, utilities throughout the U.S. will be able to use participant NEI values derived from primary research in their justification to include participant NEIs in their cost-effectiveness tests. By including NEIs in energy efficiency program cost-effectiveness tests, ComEd customers will have greater opportunities to participate in programs that provide health and financial benefits in addition to energy savings, especially in historically underserved limited wealth communities facing challenges regarding environmental and social justice issues.

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