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COMED NON-ENERGY IMPACTS RESEARCH PLAN – PART 1

Navigant's research plan to quantify non-energy impacts (NEI) is divided into Part 1 and Part 2 research activities based on the Stipulation and Future Energy Jobs Act (FEJA) legislation. In CY2018 and CY2019, Navigant will conduct Part 1 research quantifying NEIs for ComEd's residential income eligible (IE) programs and screen for evidence of NEIs in ComEd's non-IE programs. After reviewing the responses to the screening questions, Navigant will develop a Part 2 research plan which will describe the primary research and quantifying NEIs starting in CY2019 and continuing in CY2020 and CY2021. We will conduct additional primary research on programs where screening questions and secondary research show promise of enabling estimates of NEIs to be developed? Navigant will revise the annual research plan accordingly.

This Part 1 research plan details are the specific tasks, activities, deliverables, and schedule associated with the NEI research for ComEd's IE energy efficiency programs as well as screening for non-IE energy efficiency programs.

Introduction

This detailed evaluation plan describes the proposed methods the Navigant team will use to quantify and monetize NEIs from income eligible programs and screen for NEIs associated with residential, and business and public sector programs[1].

ComEd and the stakeholder advisory group (SAG) are interested in first researching NEIs for ComEd's income eligible (IE) programs, since substantial NEIs are typically associated with these programs. This decision is based on the Commonwealth Edison Company 2018 – 2021 Energy Efficiency and Demand Response Plan Settlement Stipulation[2]:

"ComEd agrees to work in good faith to consult and reach consensus with the Income-Qualified Advisory Committee on issues of importance to the Committee, including but not limited to the following: Development of program information and practices for Income-Qualified programs, including the identification and reflection of non-energy benefits ("NEBs") such as comfort, health and safety, reduced tenant turnover, reduced shut-offs, reduction in revenue collection costs, and lower energy burden in Income-Qualified measures and programs."

Future Energy Jobs Act (FEJA) legislation more broadly recognizes there may be NEIs associated with all energy efficiency programs, not only IE. FEJA states[3]:

"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…".

[1] Pilot programs do not typically have a long enough duration to screen for NEIs and conduct primary research. However, for IE pilot programs, Navigant will determine if NEIs can be quantified if not already quantified elsewhere.
[2] Page 7: http://ilsagfiles.org/SAG_files/Landing_Page/ComEd_EE_Plan_5_Stipulation_Final.pdf
[3] Page 33: http://www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf

Overall Research Goals

This NEI research (in Part 1 and Part 2) is relevant to ComEd's programs in varying amounts. This NEI research is distinct from annual program evaluation activities since NEIs are currently not quantified nor monetized as part of evaluation activities. The Illinois Technical Reference Manual (IL TRM) currently includes only NEIs related to the avoided use of water and a deemed operations and maintenance (O&M) cost adjustment calculation. ComEd's total resource cost test (TRC) considers avoided water consumption and carbon dioxide emissions.

The key objectives of this research are to:

- **Quantify NEIs as a proposed update to the IL TRM**
  - Calculate NEIs at the program level, first for IE programs and followed by other programs as determined by ComEd and Navigant
- **Monetize NEIs as a proposed update to the IL TRM**
  - Calculate dollar savings per NEI for inclusion in TRC calculations

Research Questions

This research will seek to answer the following key researchable questions:

- Which programs are likely to have quantifiable NEIs?
- What is the best way to quantify the NEI (i.e., at the measure, program, or portfolio level)?
- Is primary research required to quantify the NEI?

This research will provide value to ComEd and its customers by identifying, quantifying and monetizing NEIs. Currently, the TRC calculations exclude NEIs except for carbon dioxide and water.

Summary of Evaluation Research Activities

This section provides an overview of the planned methodology to estimate NEIs. Table 1 presents a summary of the evaluation plan.

This plan improves upon previous NEI research conducted by the IL SAG in 2015 to consider NEIs for the IL TRM by:

- Basing calculations on recent, reputable studies
- Ensuring reproducible research, quantification, and monetization processes
- Establishing logical connections between NEIs and energy efficiency measures
- Quantifying both negative and positive NEIs

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Table 1. Evaluation Plan Summary

Activity	Rationale	Timing

Agreement on Methods	Navigant proposes to have two rounds of the following to achieve satisfactory agreement on the proposed evaluation plan:
	• Comments from stakeholders
	• Navigant response, including:
	  ○ Updates to the evaluation plan
	  ○ Tracking document that outlines all collected feedback, Navigant's proposed resolution, and any additional context or response
	• Meeting to discuss updates
		July – August 2018

Data Collection	Navigant will submit a data request for CY2018 participants that includes required data and optional data fields (with descriptions) to complete the analysis.	August 2018
IE Surveys	Navigant will develop survey instruments and field surveys of single-family (SF) and multi-family (MF) program participants and pipe line participants as well as a MF building owner survey. Navigant will look for feedback from ComEd and other IE stakeholders on the survey instruments once in draft form. This recommended task is intended to: • Quantify NEIs Navigant will collect ComEd territory specific values to: • Monetize NEIs	September 2018, September 2019
Economic Modeling	Quantify energy efficiency-related job-creation at the portfolio level	Fall 2018 – Spring 2019
Utility NEI Modeling	Quantify utility NEIs from IE energy efficiency programs	Fall 2018 – Summer 2019
Secondary Research	Continue researching how other firms, utilities, entities are quantifying NEIs to inform ongoing research	Summer 2018 – Spring 2020
Screening Questions	Adding questions as appropriate to existing surveys to gauge possible existence of program-related NEIs	Summer 2018 – Spring 2019
Draft IL TRM Workpapers	Document NEI quantification methodology for inclusion in IL TRM	Fall 2019
Draft TRC Workpapers	Document NEI monetization methodology for inclusion in TRC	Fall 2019

Source: Navigant

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Methodology

This detailed plan outlines activities for this research into 11 discrete tasks, as summarized in Table 2. We completed Tasks 1-3 in PY9 and Q1 CY2018.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needed	Deliverables	Timeline
Task 1: Kick Off Meeting(s)	Kick-off call(s)	None	Presentation deck	Duration: 4 weeks – Completed 12/17
Task 2: IE Secondary Research	Literature review	None	None	Duration: 8 months - Completed 2/17
Task 3: IE NEIs Report	Draft findings and recommendations based on Task 2	None	Draft and final report	Duration: 2 months- Completed 3/17
Task 4: Detailed Research Plan	Incorporate feedback from Task 3 and flesh out 4-year plan	None	• Draft and final research plan • Face to face meeting	Duration: 4 weeks
Task 5: Quantify and Monetize IE Participant / Societal NEIs	• Draft telephone and online survey instruments • Quantify NEIs • Monetize NEIs	• Customer contact information • Specific healthcare values from ComEd's territory	• Draft and final survey instruments • Memo summarizing findings • IL TRM workpaper(s)	Duration: 1 year
Task 6: Quantify and Monetize IE Utility NEIs	Regression Analysis	• Payment transaction dates • Actual billed amounts by billing period • Source and amount of external assistance by billing period • Arrearage amount • Reconnections by billing period	• Memo summarizing findings • IL TRM workpaper	Duration: 4 months
Task 7: Quantify and Monetize Economic NEIs	Modeling	• Number of jobs and average compensation for PMs • Budget for each program	• Memo summarizing findings • IL TRM workpaper	Duration: 4 months
Task 8: Secondary Research	Ongoing literature review	None	None	Duration: 1 year

Tasks	Activities	Data Needed	Deliverables	Timeline
Task 9: Add-on Survey Questions	**Add screening questions to certain surveys**	**None**	**Memo summarizing findings**	**Duration: 1 year**
Task 10: IL TRM Workpapers	**Draft workpapers based on Tasks 5, 6, 7**	**None**	**Workpaper**	**Duration: 2 years**
Task 11: TRC Workpapers	**Draft workpapers based on Tasks 5, 6, 7**	**Secondary data collection to monetize NEIs**	**Workpaper**	**Duration: 2 years**
Time to Complete Part 1 – IE NEI Research and screening in non-IE EE program				**2 years**

Task 1: Kick Off Meetings

Navigant held two meetings with ComEd staff to discuss the NEI research. The first face to face meeting was on November 10, 2017 and the second meeting was on December 7, 2017. The first meeting:

- Introduced and defined NEIs
- Discussed the current state of NEIs in Illinois
- Reviewed the history of NEIs in Illinois
- Addressed the FEJA/Stipulation language on NEIs
- Presented early findings from Navigant's literature review

The second meeting:

- Described the rationale to quantify NEIs for IE programs
- Reviewed the previous Illinois discussions regarding quantifying NEIs
- Defined quantifiable NEIs for ComEd research
- Recommended and proposed NEIs for research

Task 2: IE Secondary Research

Navigant conducted a secondary literature review of NEIs attributed to IE programs. We reviewed 32 documents including research reports, white papers, webinars, webpages, presentations, and discussion forums that discussed utility, participant, and societal NEIs. Navigant sought to answer the following research questions:

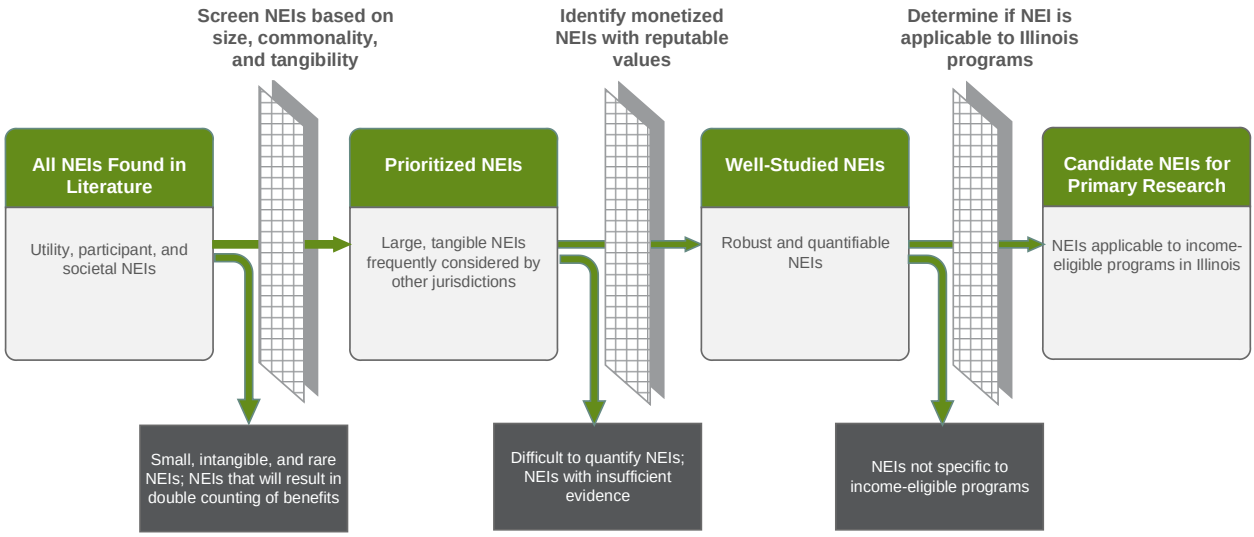
1. What are the most commonly researched and quantified income-eligible energy efficiency program NEIs?
2. What is the relative difficulty of quantifying each of the NEIs typically attributed to income-eligible energy efficiency programs?
3. What is the range of researched values reported for the most common income-eligible energy efficiency program NEIs?

4. Which NEIs could be adapted or borrowed directly from existing secondary research, versus which require primary research to quantify savings?
5. Which NEIs does Navigant recommend for primary research?

To identify candidate NEIs, we used the following screening process in Figure 1. NEIs Screening Process

to prioritize NEIs based on relative size, relevancy, and rigor of evidence.

Figure 1. NEIs Screening Process



Source: Navigant

Among the 32 documents reviewed, two emerged as key studies of income eligible NEIs:

- *Health and Household-Related Benefits Attributable to the Weatherization Assistance Program* conducted by Oak Ridge National Laboratory in 2014[4]: This study used survey responses to monetize 12 health, safety, and comfort NEIs for society and participants who weatherized income-eligible homes (single family, mobile home, and small multifamily units – does not include large multifamily buildings). We refer to this report as the National WAP study.
- *Low-Income Single-Family Health- and Safety- Related Non-Energy Impacts (NEIs) Study* conducted by NMR and Three[3] in 2016[5]: This study applied data gathered in the National WAP study to quantify NEIs for income-eligible programs in the state of Massachusetts. We refer to this report as the MA 2016 study.

Values in Table 3 are program-level, first year benefits (per participant per year), which captures benefits that immediately accrue upon completion of weatherization. The 12 NEIs are listed by Tier. Tier 1 NEIs are the most defensible, have the most measurable outcomes, the most reliable data, and clearest link to EE. Tier 2 and Tier 3 NEIs lack direct observation of improved health or need more assumptions to monetize.

[4] Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program
[5] Three[3], Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study

Table 3. Range of Values for Health, Safety and Comfort NEIs

Tier	NEI	Participant/ Societal	Range of values (per participant per year)	Source of Savings
1	Reduced asthma symptoms	Both	$202.00 - $332.00	Lower medical costs
1	Reduced cold-related thermal stress	Both	$393.26 - 496.94	Lower medical costs and avoided death
1	Reduced heat-related thermal stress	Both	$87.45 - $173.93	Lower medical costs and avoided death
1	Reduced missed days at work	Both	$20.25 – $186.81	Increased wealth due to fewer sick days
1	Reduced need for food assistance	Societal	$84.00	Retained wealth due to reduced energy bills
2	Reduced use of short-term, high-interest loans	Participant	$4.72 - $7.12	Retained wealth due to reduced energy bills
2*	Reduced CO poisoning	Both	$31.43 - $38.85	Lower medical costs and avoided death
2	Increased ability to afford prescriptions	Societal	$193.98	Retained wealth due to reduced energy bills
3	Increased home productivity due to improvements in sleep	Participant	$37.75 - $133.67	Higher productivity for housekeeping
3	Increased worker productivity due to improvements in sleep	Societal	$182.33	Higher worker productivity
3*	Reduced home fires	Both	$84 - $111.71	Lower medical costs, avoided death, and avoided property damage
3	Reduced need to choose between heating or eating	Societal	$19.92	Lower medical costs for infants

* Navigant will not attempt to quantify via survey

Source: National WAP and MA 2016 Study

The MA 2016 study identified key limitations of the National WAP study. One broad limitation was that these results are only applicable to low-income SF homes which include housing units in small MF buildings consisting of two-four units in total. Large MF homes were not considered. Navigant's primary research will include both SF and MF homes. Navigant also recognizes that these 12 NEIs are not the only health, safety, and comfort NEIs; however, these are the ones that are most readily quantified. In addition to these 12 NEIs, Navigant will quantify the following NEIs based on feedback from stakeholders:

- Improvements in housing stability
- Reduced missed days of school

- Reduced need for heating assistance
- Increased school productivity

Navigant will survey MF building owners to quantify:

- Reduced vacancy
- Reduced equipment maintenance
- Marketability
- Reduced tenant turnover
- Home improvements
- Durability of property
- Tenant complaints

Navigant will not attempt to quantify CO poisoning, home fires, lead exposure, cardiovascular disease, or cancer through participant surveys. Navigant will work with the SAG to identify quantification methodologies as appropriate.

Task 3: IE NEIs Report

Navigant drafted a 28-page report summarizing NEIs recommended for primary research and NEIs not recommended for research. We submitted this report, *Quantifying Non-Energy Benefits from ComEd's Income Eligible Programs: Findings and Recommendations from Secondary Research* to ComEd and stakeholders on March 6, 2018. We received comments from Citizens Utility Board (CUB), Elevate Energy, Green and Healthy Home Initiative (GHHI), and Natural Resource Defense Council (NRDC) on March 16, 2018 and additional comments from ICC Staff on March 23, 2018. We reviewed and incorporated comments in this detailed research plan.

Task 4: Detailed Research Plan

Navigant will draft a detailed research plan annually, updating the plan with new NEI research activities. The research plan will detail the methodologies for each research activity.

Task 5: Quantify and Monetize IE Participant/Societal NEIs

Navigant will conduct online and telephone surveys for MF and SF IE customers as well as MF IE building owners. We will:

- Use a third-party contractor to implement the telephone surveys and will use Qualtrics for the online surveys
- Take precautions to not survey the same customers surveyed for the ThreeCubed / Seventhwave research effort (see Appendix B for more information)
- Sample from a separate pool from the standard process evaluation activities
- Survey three sample groups in 2018 and conduct follow up surveys with the same sample in 2019

Navigant's process to develop and deploy surveys begins with the sampling design, developing the survey instrument, and developing key questions. It continues through a sequence of design, instrument

development, surveyor training, telephone and online surveying, and delivery of findings. The survey schedule is outlined in Table 4.

Navigant is planning to survey three groups pre- and post-weatherization[6].

- **Comparison with Treatment (CwT)** – buildings weatherized between 2012 through September 2017
- **Treatment (T)** – buildings weatherized between September 2018 and February 2019
- **Control (C)** – buildings will not be weatherized until after November 2019

Collecting CwT data before and after weatherization will provide insights about persistence and possible gains in health and budget impacts over time. Additionally, we may have to move to a cross-sectional analysis between the CwT and C groups if we are unable to survey a sufficiently large T group.

Table 4. Summary of Planned Surveys

Survey	Field Dates	Method
Single Family Income Eligible Customer Survey	September 10 - 28, 2018 September 9 – 27, 2019	Online and Telephone
Multifamily Income Eligible Customer Survey	September 10 - 28, 2018 September 9 – 27, 2019	Online and Telephone
Multifamily Income Eligible Building Owner Survey	September 10 - 28, 2018 September 9 – 27, 2019	Online and Telephone

This effort provides context for quantifying:

- **Occupant physical health impacts:** These questions will aim to understand impacts on occupant physical health because of ComEd's energy efficiency programs. Example questions for this objective include:
    - In the past 12 months, has anyone in the household needed medical attention because your home was too hot or cold?
    - Other than a routine visit, has anyone in your household had to see a doctor, visit an emergency room, or be admitted to a hospital in the past 12 months for symptoms related to asthma?
- **Occupant financial health impacts:** These questions will aim to understand impacts on occupant financial health because of ComEd's energy efficiency programs. Example questions for this objective include:
    - In the past year, have you used any loans to assist with paying your energy bill?
    - Over the past 12 months, how often has your household not purchased food in order to pay an energy bill?

[6] Terminology adopted from ThreeCubed / Seventhwave JPB Foundation research effort (See Appendix B)

- **Occupant safety impacts:** These questions will aim to understand impacts on occupant safety because of ComEd's energy efficiency programs. Example questions for this objective include:
    - How safe do you feel while on your building's property?
    - How bright or dark are hallways and stairwells inside your building?
- **Occupant comfort impacts:** These questions will aim to understand impacts on occupant comfort because of ComEd's energy efficiency programs. Example questions for this objective include:
    - Which of the following statements best describes the indoor temperature of your apartment during the winter or summer?
    - How much outdoor noise do you hear indoors when the windows are closed?
- **Building and home owner impacts:** These questions will aim to understand impacts on building and home owners because of ComEd's energy efficiency programs. Example questions for this objective include:
    - During the last 12 months, approximately how much was spent on preventative maintenance or maintenance cost due to equipment failure on this property?
    - During the last 12 months, approximately how much was spent on marketing[7]?

Navigant will develop the survey instrument questions primarily focusing on the objectives listed above. NEI equations are mapped to research questions in Appendix A. Additional data points required to monetize NEIs are also outlined in Appendix A.

Task 6: Quantify and Monetize IE Utility NEIs

Navigant will use a quasi-experimental method to quantify utility NEIs from ComEd's IE programs. This method analyzes one year of pre- and post-program payment data and administrative cost data for a treatment group and comparison group. The treatment group will be customers who participated in IE weatherization programs. The comparison group will be a select group of customers who did not participate but are eligible for the same IE programs. Navigant will work with ComEd to identify these customers.

Navigant will analyze both customer payment and utility cost metrics using a difference-in-difference (DID) technique. We are using a simple DID approach because we expect there will not be a large enough sample size to use a regression analysis. If the sample is larger than expected, we could use a regression analysis. The DID technique looks at the change in any given metric for participants between the post- and pre-periods and subtract from that the same difference for the comparison customers. Dollar values will determine avoided utility costs. The metrics are:

- **Customer payment metrics –** Portion of households receiving payment arrangements, total arrangements in dollars, and the percentage of bill paid by arrangements
- **Billing and payment metrics –** Average annual billed amount, on-time payments, and late payments
- **Utility metrics –** Amount of disconnections and reconnections, collection action, average carried arrearage

Navigant will request ComEd data that includes:

- Payment transaction dates

[7] Question for multifamily building owners only

- Actual billed amounts by billing period
- Source and amount of external payment assistance by billing period
- Arrearage amount
- Reconnections by billing period

Task 7: Quantify and Monetize Economic NEIs (Jobs created and customers' savings on bills)

FEJA identifies target spending levels associated with energy efficiency programs and related equipment investments. Navigant can quantify cumulative Full Time Equivalent (FTE)s and average FTEs/spend year assuming either that the investments in energy efficiency assets occurs at the end of the assets' economic life or that investments in energy efficiency assets occur at a set percentage before the end of the assets' economic life.

Navigant recommends using a software tool called Impact Analysis for Planning (IMPLAN) to analyze jobs impact related to energy efficiency goals. IMPLAN is widely used to conduct economic impact assessments and is a commonly used economic input-output (I-O) model. If ComEd needs a precise estimate of the timing of economic impacts, we would use a dynamic general equilibrium model (REMI). REMI would require a substantially greater level of effort. REMI is more appropriate for state-level policy decisions and is not a recommended approach for ComEd.

The IMPLAN model is:

- Constructed based on the concept that all industries within an economy are linked together; the output of one industry becomes the input of another industry until all final goods and services are produced
- Used to both analyze the structure of the relevant area's economy and the economic impact of the construction and operational phase of projects

IMPLAN models the economic activity within a specified area through the spending and consumption among different economic sectors, such as businesses, households, government entities, and external economies. Economic sectors or industries conduct typical business operations, including hiring employees, using capital to maximize performance, and selling goods or services to final users. Navigant's energy efficiency IMPLAN analysis will:

- Input target spending data to IMPLAN economic sectors (i.e., industries) for use in the economic benefits model
- Rely upon IMPLAN's regional attribution percentages to quantify the spending that is expected in the area
- Quantify the direct, indirect, and induced economic benefits of the incremental energy efficiency spending

Navigant would need the following information from ComEd:

- Number of jobs and average compensation for program management roles at ComEd
- Budget for each program with detail about budget categories (incentives, marketing, implementation contractors, etc.) and the locations (zip codes)

These programs should also include the economic impacts of energy savings – bill reductions for customers – this will have a substantial economic impact across the service territory. With zip code level

details of energy efficiency measure implementation and CVR feeder locations, Navigant can estimate the economic impacts of bill savings.

Task 8: Secondary Research for NEIs associated with non-IE EE Programs

Navigant will coordinate with ComEd to identify which non-IE EE programs are likely to generate NEIs and are appropriate for secondary research. When a program is identified as possibly having NEIs, Navigant will conduct a brief secondary literature review and propose possible NEIs to review in Task 9.

Task 9: Add-on Survey Questions for NEIs associated with non-IE EE Programs

If a program is identified in Task 8 as possibly having NEIs, Navigant will add survey questions about NEIs to existing survey efforts fielded by Navigant to identify the likelihood of perceived NEIs from a program. If the responses from the survey questions show the likelihood of NEIs, we will propose primary research to quantify and monetize the NEIs.

Task 10: IL TRM Workpapers

Navigant recommends adding the NEIs to cross cutting volume 4 of the TRM, like the NTG methodology, with the NEIs presented at the program level. Navigant will present early findings to the Technical Advisory Committee to confirm how the results should be incorporated into the TRM.

Task 11: TRC Workpapers

Navigant would recommend how ComEd incorporate the monetized NEI values in the cost effectiveness test. Currently ComEd has an adder for CO_2 reduction but does not monetize any NEIs.

Schedule

The timeline shown in Figure 2 lays out expected time and dates to complete each task of the project. Based on the list of proposed tasks, Navigant anticipates completing all research tasks by March 2020. This timeline is approximate, and adjustments to the stated deadlines are possible.

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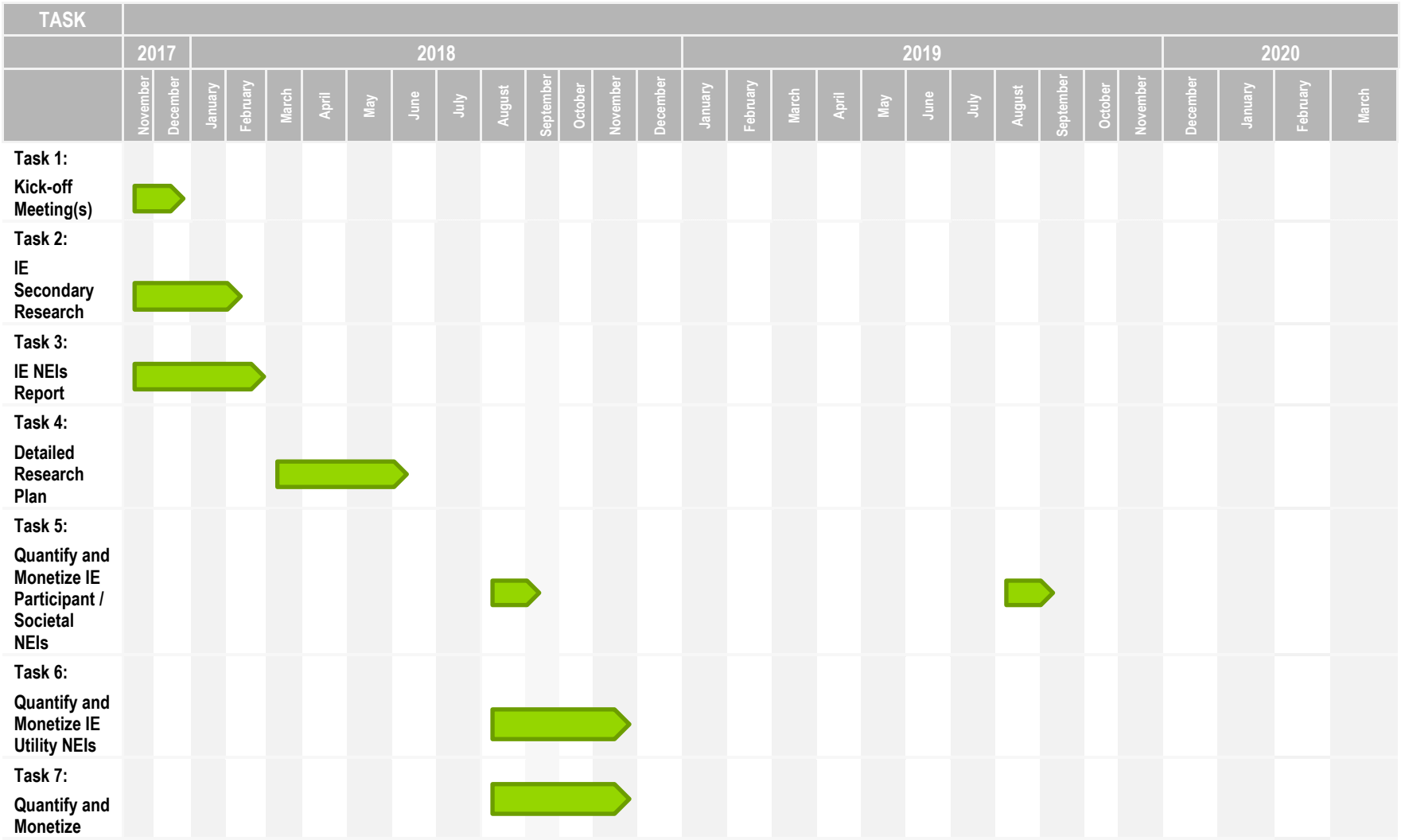
Figure 2. Project Schedule by Task



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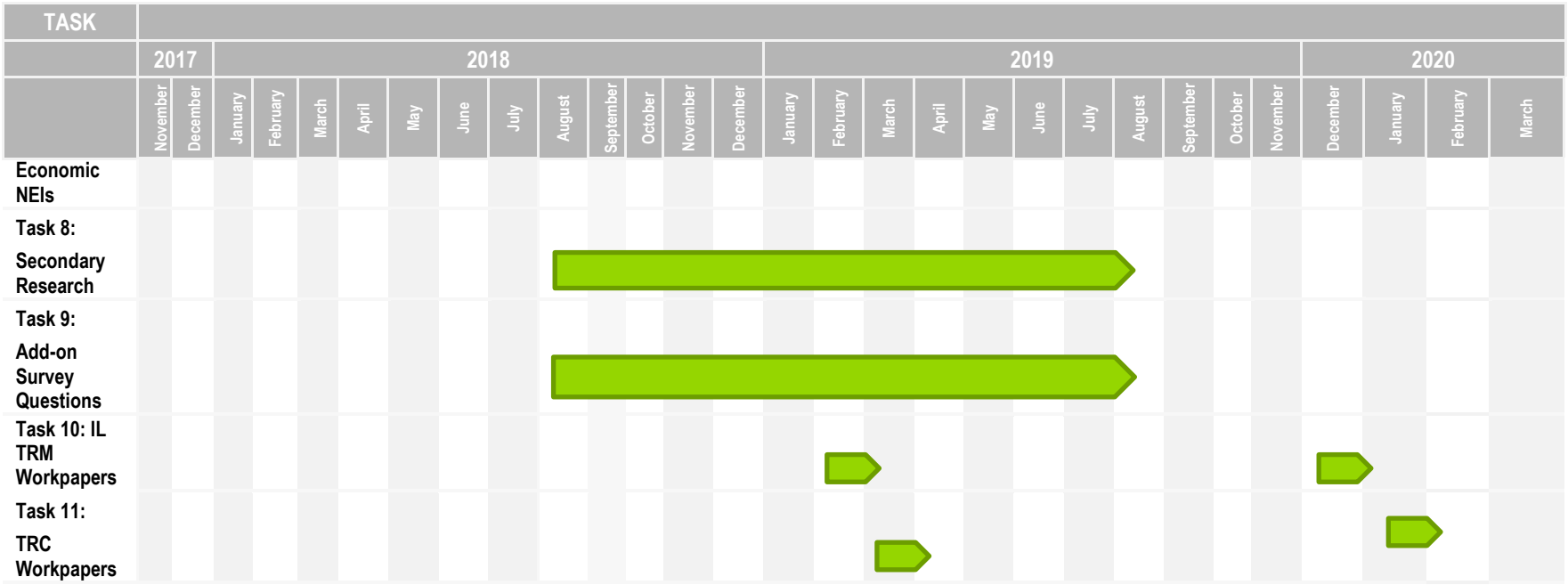
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Economic NEIs
Task 8: Secondary Research
Task 9: Add-on Survey Questions
Task 10: IL TRM Workpapers
Task 11: TRC Workpapers

1. APPENDIX A – NEI IE EQUATIONS

The following section outlines equations Navigant will use to quantify NEIs related to IE Wx programs.

Compare Sample Groups

This equation will average the impact of treatment to compare a Wx group before and after treatment and a comparison group that had received treatment one year prior:

Reduction in instance = [(Pre-treatment – Post-treatment) + (Pre-treatment – Comparison group)] / 2

Reduced Thermal Stress on Occupants QD1-QD10

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Percentage of hospitalizations, ED visits, and physician office visits for cold- and heat-related stress (state-specific where available)
- Average cost for each type of medical treatment including hospitalizations, ED visits, and physician office visits (state-specific where available and adjusted for inflation)
- Percentage of income-eligible with Medicare, Medicaid, Private/Other Insurance, or Uninsured (state-specific where available)

This equation quantifies the number of occurrences of (a) hospitalization, (b) ED visit, and (c) physician office visit avoided:

N (a, b, c) = [*(number of jobs completed in CY) * (decreased rate of seeking medical care) * (% of type of medical treatment sought for cold and heat-related thermal stress (for a, b, and c)*]

And the percent of annual medical costs for (a, b, and c) for those with (p1) Medicare, (p2) Medicaid, (p3) private/other, and (p4) uninsured or out-of-pocked payers:

% of annual medical costs— (for p1, p2, p3, p4)—for population (for a, b, and c) =
*[[(% of population by medical coverage type) * (% of medical costs—by payer—for Population (for a, b, and c)] / (% of population by medical coverage type)]]*

And finally, the benefit associated:

Total Program (without avoided deaths) =
*[(N (a, b, c) * % medical costs (for p1, p2, p3, p4)) **
Average cost for treatment (for a, b, and c)]

Monetizing Avoided Death Benefit

To incorporate the benefit of avoided deaths, Navigant will need to find these additional inputs from reputable secondary sources:

- Number of deaths following hospitalization (state-specific where available)

- Percentage of hospitalizations resulting in deaths (state-specific where available)
- Current Value of Statistical Life

These equations monetize the number of avoided deaths:

*# of avoided deaths= [(% of hospitalizations resulting in deaths (U.S. population) * (# of hospitalizations prevented by program in CY)]*

*Total benefit of avoided deaths = [# of avoided deaths * VSL]*

Reduced Asthma Symptoms

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average cost for hospitalizations per adult and child and ED visit for all individuals (state-specific where available and adjusted for inflation)
- Percentage of income-eligible with Medicare, Medicaid, Private/Other Insurance, or Uninsured (state-specific where available)
- Frequency of re-admittance to hospital for adults and children and ED visits for all individuals
- Other direct medical costs and indirect costs associated with high-cost asthma patients adjusted for inflation

These equations quantify the benefit associated for ED and hospitalizations:

*Benefit = (number of persons served by program in CY) * (asthma prevalence for adults and children) * (reduction in ED visits or hospitalizations) * (frequency of re-admittance (adults and children)) * (average hospital costs (adults and children))*

and other direct and indirect medical savings for high-cost patients:

*Benefit = (number of persons served by program in CY) * (asthma prevalence for adults and children) * (reduction in high-cost patients) * (difference in high and low-cost patients after extracting the ED visit and hospitalization costs already claimed))*

Reduced COPD, Emphysema, and Chronic Bronchitis

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average cost for hospitalizations per adult and child and ED visit for all individuals (state-specific where available and adjusted for inflation)
- Percentage of income-eligible with Medicare, Medicaid, Private/Other Insurance, or Uninsured (state-specific where available)
- Frequency of re-admittance to hospital for adults and children and ED visits for all individuals

This equation quantifies the benefit associated for ED and hospitalizations:

*Total Program Benefit = (number of persons served by program in CY) * (COPD/Emphysema/Bronchitis prevalence for adults and children) * (reduction in ED visits or hospitalizations) * (frequency of re-admittance (adults and children)) * (average hospital costs (adults and children))*

Reduced Need for Short-Term Loans

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average loan amount
- Average interest payment

This equation quantifies the benefit:

*Total Benefit = (number of jobs completed in program year) * (percent reduction in households using short-term, high-interest loans) * (reduction in interest payments)*

Reduced Need for Heating Assistance

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average monthly per person heating assistance subsidy (state-specific where available and adjusted for inflation)

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent of reduction in households requiring heating assistance) * (average annual per person heating assistance subsidy) * (average program household size)*

Improved Home, Work, and School Productivity

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Cost in lost productivity per year for employees with sleep problems
- Cost in lost productivity per year for K-12 students with sleep problems
- Average hourly wage rate for general housekeeping
- Average hours per week on housework

This equation quantifies the benefit in worker productivity:

*Total Program Benefit = (number of jobs completed in CY) * (percent increase in respondents reporting no rest or sleep problems) * (cost per year per employee in productivity losses due to sleep problems) * (percent of respondents employed full-time)*

This equation quantifies the benefit in home productivity:

*Total Program Benefit = (number of jobs completed in CY) * (percent increase in respondents reporting no rest or sleep problems) * (cost per year per employee in productivity losses due to sleep problems/average national hourly wage rate) * (wage rate for general housekeepers) * (average hours per week of housework/40 hours per work week)*

This equation quantifies the benefit in school productivity:

*Total Program Benefit = (number of jobs completed in CY) * (percent increase in respondents reporting no rest or sleep problems) * (cost per year per student in productivity losses due to sleep problems) * (percent of respondents' children in K-12 school)*

Reduced Missed Days at Work

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average hourly wage (state-specific where available and adjusted for inflation)
- Percent of income-eligible worker without sick leave

This equation quantifies the benefit for missed days at work:

*Total Program Benefit = (number of jobs completed in CY) * (% of program households with an employed primary wage earner) * (reduction in missed days at work) * (average hourly wage) * (8 hours/day)*

Reduced Missed Days at School

Three potential methods to quantify missed days at school:

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average hourly wage (state-specific where available and adjusted for inflation)
- Percent of income-eligible worker without sick leave

To monetize the benefit of reduced missed days at school, Navigant will assume that the parent who is the primary wage earner will have to miss work to care for the sick child. This equation quantifies the benefit for missed days at school:

*Total Program Benefit = (number of jobs completed in CY) * (% of program households with an employed primary wage earner) * (reduction in missed days at school) * (average hourly wage for parent) * (8 hours/day)*

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average hourly cost of childcare (state-specific where available and adjusted for inflation)

To monetize the benefit of reduced missed days at school, Navigant will assume that the parent will have to pay for childcare for that day. This equation quantifies the benefit for missed days at school:

*Total Program Benefit = (number of jobs completed in CY) * (reduction in missed days at school) * (average hourly cost for childcare) * (8 hours/day)*

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Value of K12 school day in lifetime labor market benefit

To monetize the benefit of reduced missed days at school, Navigant will assume reduced missed days at school result in added lifetime labor market benefits. This equation quantifies the benefit for missed days at school:

*Total Program Benefit = (number of jobs completed in CY) * (% reduction in missed days at school) * (lifetime labor market benefit per day per student)*

Reduced Need for Food Assistance

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average monthly per person food assistance subsidy (state-specific where available and adjusted for inflation)

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent of reduction in households requiring food assistance) * (average annual per person food assistance subsidy) * (average program household size)*

Improved Ability to Afford Prescriptions

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Annual cost to nation of patients not taking prescription medicines
- Number of people who should be taking prescription medications in the US
- Prescription use compliance rate

This equation quantifies the benefit:

*Total Program Benefit = ((number of jobs completed in CY) * (percent increase in program households being able to afford prescription medicines) * (annual cost to nation of patients not taking prescription medicines) / number of people who should be taking prescription medications in the US) * (1.0 - prescription use compliance rate)) *.5*

Reduced Need to Choose Between Heating or Eating

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Expected births per year per females aged 15-44
- Expected percent of births being low weight
- Percent low-birth weights avoided
- Hospitalization costs first year for low birth weight infants

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent decrease in households trading off heat for food, food for heat, or both) * (expected births per year per females aged 15-44) * (percent of births expected to be low birth weight) * (percent of LBW births avoided) * (avoided first year infant hospitalization costs)*

Reduced Property and Equipment Maintenance Cost

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average annual cost for property maintenance
- Average annual cost for equipment maintenance

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent decrease in property and equipment maintenance cost) * (average annual cost for property and equipment maintenance)*

Improved Housing Stability

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average increase in value of extended lifetime of dwelling due to whole-house weatherization

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent of respondents observing increase in housing stability) * (average increase* in value of extended lifetime of dwelling due *to whole-house weatherization)*

Reduced Marketing Cost

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average annual marketing cost for multifamily building owners

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent decrease in marketing cost) * (average annual marketing cost for multifamily building owners)*

Reduced Tenant Turnover and Unit Vacancy Cost

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average monthly rent (state specific and adjusted for inflation if needed)

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent reduction in vacant units in month-equivalent) * (average monthly rent)*

Improved Value of Home

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average increase in multifamily property value due to whole-house weatherization

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (percent of respondents observing increase in property value) * (average increase in multifamily property value due to whole-house weatherization)*

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Reduced Tenant Complaints

Monetizing the Benefit

Navigant will need to find these additional inputs from reputable secondary databases:

- Average hourly wage for multifamily building maintenance and staff (state-specific where available and adjusted for inflation)

This equation quantifies the benefit:

*Total Program Benefit = (number of jobs completed in CY) * (reduction in time spent responding to tenant complaints in hours) * (average hourly wage for multifamily building maintenance and staff)*

2. APPENDIX B – OVERVIEW OF SEVENTHWAVE/THREECUBED RESEARCH

Three[3], Inc. and Seventhwave have been awarded a grant from the JPB Foundation to estimate the health and resilience benefits of weatherizing affordable multifamily (MF) buildings.[8] Results generated from this research will be valuable to numerous stakeholders including:

- Organizations that advocate for increased funding to weatherize affordable MF buildings
- Local and state weatherization programs
- Healthy homes programs
- Public utility commissions and utilities
- Public health and health care organizations
- Building owners/managers
- Property insurers
- Residents

Inputs regarding the goals of this research and research design were provided by stakeholders who participated in three national workshops, held in New York City, Chicago, and Knoxville, Tennessee. Prior to the workshops, the team visited numerous affordable MF buildings to facilitate listening sessions with residents on topics related to health and resilience experiences connected to the home environment.

Based on these inputs, these research goals were established:

- Measure and validate health benefits (e.g., reductions in asthma-related emergency room visits)
- Measure and validate other household benefits (e.g., reductions in missed days of work)
- Measure and validate impacts on household budgets (e.g., reductions in households not buying food to pay utility bills)
- Monetize health and resilience benefits (e.g., health care system cost savings from reductions in asthma-related emergency department visits)
- Identify benefits accruing to property owners (e.g., lower O&M costs, reduced tenant turnover)

[8] Note: We are defining weatherization as a job that includes insulation, air sealing, and/or heating and cooling systems and not just electric baseload measures.

- Assess resilience vulnerabilities of the affordable multifamily building stock to pulse events (e.g., extreme temperatures and winds, floods, and power outages)
- Measure changes in indoor environmental quality (e.g., temperature and humidity)

These five data collection tasks have been identified:

- Implement a resident health and household non-energy impacts survey pre- and post-weatherization with comparison and control groups.
- Collect measures installed and utility bills.
- Interview building owners and managers to document their experiences with respect to the non-energy impacts of improving the energy efficiency of their buildings.
- Conduct field studies of buildings to, among several things, assess the building systems resilience impacts post-weatherization.
- Conduct a small indoor environmental quality monitoring study.

This research will include affordable MF buildings that fall into these three categories:

- Buildings already weatherized. This is the *Comparison with Treatment* (CwT) group. We would consider buildings weatherized between 2012 through March 2017 to be part of this group;
- Buildings in the queue to be weatherized. This is the *Treatment* (T) group. We would consider buildings to be weatherized between March 2018 and August 2018 for this group.
- Buildings that will not be weatherized till after May 2019 to compose a control group. We refer to this group of buildings as the *Control Waiting List* (CWL) group.

Data collection will begin in March 2018. Data will be collected from MF buildings that vary by building types (e.g., low-rise, high-rise), building ownership types (e.g., nonprofit versus privately owned), primary use (e.g., senior housing, supportive housing, mixed general housing), and occupancy (e.g., demographics). Data will be collected in the greater Midwest and Northeast regions. To bolster data collected in the Northeast, this project will collaborate with another, utility-based project that is collecting the same survey data in the Commonwealth of Massachusetts. In total, this project seeks to enroll over 300 affordable multifamily buildings and over 2000 units.

Navigant is working with Three[3], Inc. and Seventhwave to ensure the same customers are not contacted for the separate survey efforts. Additionally, after Three[3], Inc. and Seventhwave publish their results they will share the raw data from ComEd respondents to bolster Navigant's results.