



ComEd CY2019-2021 Evaluation Plan

Presented to

Commonwealth Edison Company

February 19, 2019

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1. INTRODUCTION

This document provides a three-year overview of evaluation activities for the Calendar Year (CY) 2019-2021 cycle. This amends last year's four-year evaluation plan¹ with updates and additions. An overview of the evaluation's goals includes:

- **Evaluation, measurement, and verification (EM&V) of energy efficiency programs.** These evaluations will meet the requirements of the Future Energy Jobs Act (FEJA) and Section 8-103B(fg(6) of the Illinois Public Utilities Act (PUA), which states that the utility shall provide for an annual independent evaluation of the performance of the cost-effectiveness of the utility's portfolio of programs, as well as a full review of the four-year results of the broader net program impacts and for adjustment of the measures on a going forward basis as a result of the evaluations. Our general approach to this work for the 2019-2021 period will be to focus on programs that require deeper analysis. We will continue to conduct thorough, high-quality annual impact evaluations for ComEd's largest energy efficiency (EE) programs and those undergoing significant changes. However, we will not over-evaluate any EE program. For example, for programs whose recent net-to-gross (NTG) ratios have been consistent over time, we propose to conduct about two NTG evaluations over the four-year program cycle instead of doing NTG analysis every year, as we have usually done to date. Using this approach more funds will be available for program process improvement activities and cross-cutting research. Navigant plans to work with government and public interest parties, including the Illinois Stakeholder Advisory Group (SAG) and the Illinois Commerce Commission (ICC) Staff to ensure issues and topics relevant to EM&V are addressed in an efficient manner.
- **EM&V oversight and support that provides continuous improvement of ComEd's EE programs and processes.** As stated in ComEd's Plan 5 filing, evaluation efforts will support the program administrator's continuous improvement process by identifying the program's actual performance, showing how this performance differs from the planned performance, and identifying opportunities to improve the program processes over time. We propose to use a broader array of continuous improvement methodologies for our work for Plan 5 than the customer surveys and trade ally surveys that were used in the past for our EM&V work. The new techniques include benchmarking to identify the ComEd programs that are best-in-class in terms of normalized energy savings, costs of conserved energy, and customer satisfaction, as well as those that could be improved in one or more of the main parameters of interest to ComEd. The benchmarking analysis will focus on Midwest EE programs, Exelon operating company programs, and other programs of interest to ComEd.
- **Conduct significant research in 2019-2021 focusing on cross-cutting evaluation research and innovative evaluation techniques.** Previously, for most programs in most years, the Navigant team has performed detailed impact evaluations and often process evaluations. We have worked with ComEd and their implementation contractors to improve the ex ante estimate of savings and thus the evaluation realization rate. This efficiency improvement now allows Navigant, in coordination with ComEd and the SAG, to re-allocate some funds from standard verification work to other, newer, and more innovative cross-cutting evaluation research to support the programs. Examples include the use of Advanced Metering Infrastructure (AMI) into evaluation, research to update the Illinois Technical Reference Manual (IL TRM) and estimating the Effective Useful Life of measures. Other research will help ComEd define the technical side of new programs and new measures, such as advanced thermostats, advanced power strips, and behavioral program persistence. We will propose research at the sector level that will support

¹ ComEd 2018-2021 Four Year Plan:
http://ilsagfiles.org/SAG_files/Evaluation_Documents/Evaluation_Plans/Final_Plans_2018-2021/ComEd_CY2018-2021_Evaluation_Plan_2018-02-22.pdf

multiple programs, target specific market segments, and examine market characteristics to help improve portfolio and program design and implementation. Evaluation techniques throughout the country are in the midst of significant changes, some driven by “big data” approaches. Increased use of engineering metering studies is useful to refine parameters used to calculate energy and demand savings in the IL TRM. Some of this Other evaluation research will estimate energy savings expressed in cumulative persisting annual savings (CPAS), non-electric savings, non-energy impacts (NEIs), and other topics discussed below.

Several elements of FEJA drive the need for increased and changed evaluation research, as described below.

Focus on CPAS. Under the Future Energy Jobs Act, ComEd’s annual energy savings goals will be based on cumulative persisting annual savings (CPAS). As indicated in ComEd Plan 5, “the CPAS methodology is a new concept for energy efficiency in Illinois and emphasizes a shift to valuing the lifetime savings of the measure versus only the first-year savings, which was the focus of the prior energy efficiency framework.”² In the short term, one focus of evaluation research is to enable effective evaluation of CPAS. Key evaluation research initiatives include estimating measure effective useful life (EUL) and measure persistence, both of which are required to calculate CPAS. Concurrently, the team will be participating in continuous improvement efforts to update the IL TRM in conjunction with the IL SAG, such as researching and updating individual measure energy savings estimates to improve accuracy and reduce evaluation risk.

Non-electric savings. Up to 10 percent of ComEd’s annual energy savings goal can be derived from gas savings or savings from other fossil fuels. Priority for these savings must be given to low-income programs. For joint programs, gas conversion does not start until the gas company discontinues funding for the program. For non-joint programs, any gas (or other fuel savings, such as propane or fuel oil) can be counted. Each therm of natural gas savings at the customer’s premise is equivalent to 29.3 kWh of electric savings.

New customer segments. FEJA brought Income Eligible and Public Sector customers into ComEd’s portfolio for the first time. ComEd rolled all Public Sector customers into its existing Business Programs portfolio (except for the Public Housing Authority program and Small Public Facilities programs, which are standalone Business programs). Those programs are the only programs that have separate Public Sector evaluation plans. We also provide separate Income Eligible evaluation plans.

Third Party Programs. Under FEJA rules, ComEd issued an RFP in 2018 to request new program ideas from external parties for CY2019 – CY2021. Each of the programs implemented under this process will need a separate evaluation. As of January 14, 2019, the third party programs are not under contract yet.

Voltage Optimization. Voltage optimization (VO) is categorized as energy efficiency and must be evaluated as such. VO is estimated to contribute 12 percent to 15 percent of the savings each year, and has a measure life of 15 years, per the new legislation. Savings will be annualized based upon requirements of any ComEd stipulation agreements.

Total Resource Cost Test. Definition of the total resource cost test (TRC) is amended to include a societal discount rate.

Timeline. FEJA changed the program year to be based on the calendar year. It specified that ComEd will deliver final program year data by January 30th each year and the evaluation reports will be finalized by April 30th each year. To meet that deadline (and to improve other aspects of the evaluation), we are separating reporting on energy impacts, which will be completed by the April 30th deadline, from reporting on process evaluation research and NTG results. Where possible, NTG research will be completed by

² Commonwealth Edison Company’s 2019-2021 Energy Efficiency and Demand Response Plan dated June 30, 2017, page 6.

August 1 each year, so that reports can be reviewed and finalized in time for the September 1 initial evaluator NTG recommendations to SAG required by the Illinois NTG Policy Manual. In 2020, NTG research will be completed one month earlier, by July 1, to inform development of the next Energy Efficiency and Demand Response Plan. Process evaluation research results will be reported as the research is completed so that it is available as soon as possible.

Non-Energy Impacts. Navigant will investigate a range of non-energy impacts (NEIs) for ComEd. The initial focus for NEIs research will be on quantifying NEIs associated with income eligible programs, since previous research has shown NEIs to often be particularly significant for these programs.³⁴⁵⁶ In addition, we added screening questions to our participant surveys to explore NEIs in other programs. Based on the responses to the screening questions, as well as secondary research, we will conduct primary NEIs research to quantify NEIs associated with additional programs. Other key NEIs areas of interest include:

- Research, data collection, and reporting on non-energy impacts, with an emphasis first on NEIs in the income eligible market sector and secondly, as appropriate, in the Residential and Business sectors.

Navigant will determine:

- Beyond income eligible programs, which specific programs show evidence of NEIs based on participants' responses to screening questions
- Which NEIs are good candidates for primary research – all parties will be included in this selection process
- CY2019 will be the initial year for NEIs program-specific research
- Areas of high-priority focus include job creation (direct, indirect, and induced), reduced collection/arrears/shut-off costs, health improvements, and safety improvements

Summary Report

Navigant will produce a summary report providing a program-by-program and portfolio-level summary of the key results from the impact evaluations. The report will consist mostly of tables and figures to show the energy and demand impacts produced from the ComEd programs. The tables will include

- Ex post savings template tables agreed to by the SAG – those tables will be provided in the summary report as well as in an accompanying spreadsheet.
- Portfolio total and program-specific ex ante gross, verified gross, and verified net savings for energy, demand, and peak demand.
- Savings by sector (Residential, Business, Income Eligible, and Pilots)
- Savings spread over time based on measure-specific EULs and the calculation of CPAS.
- Calculation of the Weighted Average Measure Life (WAML).
- Gas savings converted to electricity in total and the amount that ComEd can claim.
- Savings by end use type (broad measure categories such as lighting, HVAC, refrigeration, etc.)
- A table of the high impact measures (those with the largest savings across the portfolio).
- Program costs (which will likely not be available for the first draft but will be distributed for comment when received).

Schedule: Navigant will deliver the first draft within days of the final first draft of the individual program impact evaluation reports. We will deliver the final report on April 30th after the last report is finalized.

³ Northeast Energy Efficiency Partnerships (2017). Non-Energy Impacts Approaches and Values: An Examination of the Northeast, Mid-Atlantic, and Beyond

⁴ NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation

⁵ Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program

⁶ Three³, Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study

ComEd 4 Year Plan Savings

Navigant will be evaluating the following 2018-2021 savings – this four year detail was filed and approved by the Illinois Commerce Commission in ComEd’s four year plan (2018-2021), dated June 30, 2017.

Savings/Budget	2018	2019	2020	2021
Statutory CPAS (MWh)	6,130,858	7,152,667	8,174,477	9,274,887
Legacy Savings (MWh)	4,558,843	4,087,238	3,537,033	3,144,030
Applicable Annual Incremental Goal (MWh)	943,209	1,021,810	1,021,810	1,100,410
Annual Budget	\$351.3	\$351.3	\$351.3	\$351.3

2. EVALUATING PROGRAMS

Four-year Residential, Business and Income Eligible specific-evaluation tasks are shown in each program-specific evaluation plan attached in the Appendix and also shown in Appendix A. "Program-Specific Four-Year Tasks." Navigant also develops evaluation plans for Pilot programs, commensurate with the Pilot program's implementations, most of which are still in a nascent stage of development. Navigant will approach each sector in a unique way given the needs of sector-specific needs. Below we discuss specific research needs for the Residential, Business and Income Eligible sectors, as well as our approach to Pilot programs.

Residential Sector

Our evaluation strategy for the residential-sector programs includes (1) robust impact analysis based on the IL TRM and regression analysis for behavior based programs (2) episodic NTG research corresponding with changes in program design, delivery, or market changes (3) process analysis (often conducted in conjunction with NTG research to reduce participant fatigue) to seek actionable recommendations for program enhancements, which will be reported separately from impact reporting and (5) screening questions in program participant surveys looking for evidence of non-energy impacts associated with the program. In consideration of current residential EE program issues, we will focus on ways that EISA 2007 continues to influence retailer decisions on what bulbs to stock and the implications for the residential lighting program. We will also research in-service rates of advanced power strips associated with different delivery channels and sectors.

We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available. The residential team will also leverage customer segmentation data from PRIZM to gain additional insights for better marketing and messaging tailored to specific groups that participate in ComEd's programs.

Income Eligible Sector

Given that the income eligible programs are a relatively new program area for ComEd, Navigant's evaluation will focus on (1) evaluating satisfaction and program processes (2) identifying gaps in participation or underserved regions, (3) identifying updates to be made to the IL TRM and (4) coordination with stakeholders, including the Income Qualified Energy Efficiency Advisory Committee.

We will conduct process research across the income eligible programs, with efforts concentrated on the Affordable Housing New Construction, Income Eligible Lighting Discounts, Single Family and Multi-Family programs. In 2019, this process research will include (1) program manager and implementer interviews focused on understanding the intent of the program (2) geographic (GIS) research to identify geographical gaps in participation, (3) customer, trade ally and stakeholder interviews and surveys to evaluate satisfaction, and (4) assessment of demographic data. The findings from these efforts will inform both recommendations to enhance income eligible programs as well as additional process research efforts going forward.

We will prioritize impact research that will result in updates to the IL TRM parameters for these programs. In addition to conducting an engineering review resulting in the prioritization of IL TRM measure updates, we plan to (1) conduct field work to confirm measure installation for the Single Family and Multifamily Retrofits in 2019 (2) conduct a billing analysis using a quasi-experimental design for the Single Family Retrofits program in 2020, and (3) conduct custom engineering analysis (site-specific billing analysis, metering, or modeling depending on program participation) for the Multi Family Retrofits program in 2020. Navigant will use the results of this higher rigor impact research to update the applicable IL TRM

measures and the results will inform both recommendations to enhance income eligible programs as well as additional impact related research efforts for the income eligible programs.

Finally, we plan to coordinate with Illinois stakeholders with an interest in income eligible programs and incorporate feedback from these groups into our evaluation plans and research as applicable. The Illinois stakeholders will provide input to a NTG research strategy, if needed, for the income eligible programs.

Business Sector

Our evaluation strategy for the business sector programs includes (1) impact analysis in each of the four years leveraging the IL TRM, when appropriate (e.g., Standard, Small Business and Instant Discounts) and custom evaluation for other business programs (e.g., Custom, Industrial, CHP, etc.), (2) NTG research at least twice during the four-year plan cycle corresponding with changes in program design, delivery, or market changes, (3) process analysis (conducted in conjunction with NTG research to reduce participant fatigue) to seek actionable recommendations for program enhancements no later than the end of September each year, (4) process and NTG reporting will be separate from impact reporting which will be completed every April 30th, (5) market effects research for programs that appear to be impacting market change (e.g., Instant Discounts), (6) screening questions in program participant surveys looking for evidence of non-energy impacts associated with these programs, (7) research of proper measure-level effective useful lives will be undertaken for various programs including RCx, Custom, Industrial, SEM, and (8) evaluation of Public Sector savings as part of the relevant business program and process research will be undertaken on each of the above. We will also continue to focus on ways EISA 2007 influences bulb decisions and the implications for the Instant Discounts program. EUL research will continue to be a priority based upon the CPAS requirements of FEJA.

Pilot Programs

ComEd's plan includes pilot programs to test feasibility for inclusion in ComEd's portfolio as well as adding new measures to the IL TRM. Although most of these pilot programs are currently in a nascent stage, Navigant evaluates the pilots in a similar manner to other programs in the portfolio including:

- Determining the data needed to conduct impact evaluations
- Tracking system review
- Engineering file review
- Assessing feasibility of measure added to a future IL TRM using primary and secondary research as needed
- Research on behavioral measure savings and custom measure savings and evaluation approaches
- Process evaluations (including program manager, implementation contractor and trade ally interviews)
- Other research (e.g., load shape) as needed

Navigant will produce separate evaluation plans and reports for pilot programs, as needed. For smaller pilots, evaluation memos may take the place of formal reports. As of the creation of this evaluation plan, Navigant has enough information on two pilots to create evaluation plans. Those pilots are HVAC Save and Save and Share. Those evaluation plans are in the appendix to this document. Other pilots for which we anticipate creating evaluation plans in the future are shown in the following table.

Table 1. Partial List of Pilot Programs

Name	Description	Evaluation Plan Written
Adsorbant Air Cleaner	Estimating savings from adsorbant air cleaner installation in a commercial building	
HVAC SAVE	Quality install program for HVAC	Yes
Ductless Heat Pump & Building Envelope Measures in Income Eligible, All-electric Multi-Family Buildings	Determining whether high performance, cold climate ductless heat pumps are a good fit for the ComEd Energy Efficiency Program both technically and economically.	
Commercial Ground Source Heat Pumps	Training classes for ground source heat pump installers combined with incentives for 25 – 30 pilot participants, depending on project size.	
Save and Share	Using a transaction-based digital platform, can ComEd empower residential and small business customers to reduce their electricity usage by offering performance-based incentives that can be kept or shared with family, friends, or community organizations?	Yes
Lucha Passive House	LUCHA building passive home with sensors. Baseline home and energy efficient home – direct comparison. Assess electric savings due to electric heat savings.	

Third Party Programs

ComEd received proposals in July 2018 for the third party program solicitation. ComEd submitted eleven programs for ICC approval, however as of January 14, 2019, their contracts are not finalized. Once ComEd has finalized the contracts for the new third party programs and shared third party program information with Navigant, Navigant will develop evaluation plans for review.

3. COST-EFFECTIVENESS RESEARCH

The primary objective of the cost-effectiveness research and calculations is to comply with the Illinois legislative requirement that all energy efficiency portfolios be shown to be cost-effective. The key tasks of the cost-effectiveness analysis are to: (1) develop a cost model reflecting ComEd's costs by program, (2) evaluate the assumptions provided by ComEd and included in Navigant's cost model, (3) after agreement on the cost model and inputs, develop the Total Resource Costs (TRC) for each program, and (4) provide a report with any recommended improvements and comments on the costs and the resulting TRCs. As part of Navigant's evaluation of ComEd energy efficiency and demand response programs, we will develop a cost model and resulting TRCs, as well as joint TRCs for programs that are jointly implemented by ComEd and one or both of Nicor and/or Peoples Gas / North Shore Gas Companies. The joint TRC calculations will be completed after each utility completes their relevant cost-effectiveness analysis – the joint analysis will focus on the joint programs between the companies.

We anticipate that the TRC assumptions review will support evaluation, measurement and verification and regulatory reporting objectives for ComEd and will also inform future ComEd planning efforts. The Navigant team will work with ComEd to ensure that the proper data is available for the modeling and evaluation. We will apply the most recent Illinois cost-effectiveness methodology and ICC rulings in reviewing the TRC test calculations. For programs that are jointly implemented by ComEd and one or more Illinois gas utilities (including Nicor Gas, Peoples Gas, and/or North Shore Gas), only the electric portion of the program savings and cost-benefit calculations are included here. The combined joint calculations for the joint programs will be included in a separate memo attached as an appendix to the report.

Navigant will comply with the Illinois Energy Efficiency Policy Manual v 1.1, Sections 8 or any other future relevant Policy Manual sections. The Illinois TRC test is defined by the Illinois General Assembly as follows:

'Total resource cost test' or 'TRC test' means a standard that is met if, for an investment in energy efficiency or demand-response measures, the benefit-cost ratio is greater than one. The benefit-cost ratio is the ratio of the net present value of the total benefits of the program to the net present value of the total costs as calculated over the lifetime of the measures. 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 (including both utility and participant contributions), plus costs to administer, deliver, and evaluate each demand-side program, to quantify the net savings obtained by substituting the demand-side program for supply resources. In calculating avoided costs of power and energy that an electric utility would otherwise have had to acquire, reasonable estimates shall be included of financial costs likely to be imposed by future regulations and legislation on emissions of greenhouse gases. In discounting future societal costs and benefits for the purpose of calculating net present values, a societal discount rate based on actual, long-term Treasury bond yields should be used. Notwithstanding any to the contrary, the TRC test shall not include or take into account a calculation of market price suppression effects or demand reduction induced price effects.⁷

The Illinois TRC test was modified by the Illinois General Assembly in December 2016 (for application starting in CY2019) to explicitly include a societal discount rate, avoided water and avoided operations and maintenance costs, and exclude market price suppression effects. The Illinois test makes it clear that the TRC requirement for plan approval is only at the portfolio level and excludes low income programs.

⁷ See <http://www.ilga.gov/legislation/publicacts/99/099-0906.htm>

Individual measures need not be cost effective. The Illinois TRC test differs from traditional TRC tests in its requirement to include a reasonable estimate of the financial costs associated with future regulations and legislation on the emissions of greenhouse gases (GHG). This difference adds an additional benefit to investments in efficiency programs that are typically included in the Societal Test in other jurisdictions.

Illinois TRC Equation used in the Assessment

The benefit-cost formulas will include avoided water costs, avoided O&M costs and other quantifiable societal benefits. Consistent with the principles laid out in the new *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources*, cost-effectiveness analyses other quantifiable benefits can include quantified participant NEIs and evaluation will make every attempt to quantify this in the cost effectiveness calculations.

The equation that will be used to calculate the Illinois TRC is presented below:

Equation 1 – Illinois TRC

$$BCR_{ILTRC} = B_{ILTRC} / C_{ILTRC}$$

Where,

- BCR_{ILTRC}** = Benefit-cost ratio of the Illinois total resource cost test
- B_{ILTRC}** = Present value of benefits of a Illinois program or portfolio
- C_{ILTRC}** = Present value of costs of a Illinois program or portfolio

The benefits of the Illinois TRC are calculated using the following equation:

Equation 2 – IL TRC Benefits

$$B_{ILTRC} = \sum_{t=1}^N \frac{UAEP_t + UATD_t + UAA_t + EB_t}{(1 + d)^{t-1}} + \sum_{t=1}^N \frac{UAC_{at} + PAC_{at}}{(1 + d)^{t-1}}$$

The costs of the Illinois TRC are calculated using the following equation:

Equation 3 - IL TRC Costs

$$C_{ILTRC} = \sum_{t=1}^N \frac{PNIC_t + IMCN_t + UIC_t}{(1 + d)^{t-1}} - RC$$

Where benefits are defined as:

- UAEP_t = Utility avoided electric production costs in year t
- UATD_t = Utility avoided transmission and distribution costs in year t
- UAA_t = Utility avoided ancillary costs in year t
- EB_t = Environmental Benefits in year t
- UAC_{at} = Utility avoided supply costs for the alternate fuel in year t
- PAC_{at} = Participant avoided costs in year t for alternate fuel devices

Navigant will include all relevant costs outlined in Section 8.4 of the Illinois Energy Efficiency Policy Manual v 1.1 or any future relevant section, example costs are defined as:

- RC = NPV of replacement costs of incandescent equivalents
- PNIC_t = Program Non-Incentive costs in year t

- IMCNt = Net Incremental costs in year t
- UICt = Utility increased supply costs in year t
- d = discounting future societal costs and benefits for the purpose of calculating net present values

The Illinois TRC test allows for utilities to account for the avoided baseline replacement measure costs that would accrue to program participants because of the significantly longer lifetimes of efficient CFLs and LED light bulbs. In general, the avoided cost per bulb is determined by comparing the estimated useful life of efficient and baseline bulbs to determine the number of baseline bulb purchases that are avoided. Based on the average purchase price of baseline bulbs, an NPV is determined by discounting the value of these avoided purchases over the course of the lifetime of the efficient bulb. The IL TRM provides deemed NPV values per bulb based on efficient bulb-type, socket type (commercial or residential), and lumen range.

UCT Equation used in the Assessment

The results of the Utility Cost Test are also presented in Section 2 of this report. The UCT (a subset of the Program Administrator Cost Test) approaches cost effectiveness from the perspective of the utility. It determines whether the energy supply and capacity costs avoided by the utility exceed the overhead and cost outlays that the utility incurred to implement energy efficiency programs. The structure of the calculation is similar to the IL TRC, with a few key changes. Since the UCT is primarily focused on utility outlays, incentives paid by the utility to either participants or third party implementers are included in the calculation in place of incremental or participant costs. Additionally, since non-energy impacts accrue to society rather than to the utility implementing energy efficiency programs, these benefits are not included in the UCT formula.

Using the equation terms previously defined for the IL TRC equation, the UCT equation that will be used is defined as:

Equation 4 – UCT

$$BCR_{UCT} = B_{UCT} / C_{UCT}$$

Where,

- BCR_{UCT}** = Benefit-cost ratio of the Utility Cost Test
- B_{UCT}** = Present value of benefits to a utility of a program or portfolio
- C_{UCT}** = Present value of costs to a utility of a program or portfolio

The benefits of the UCT are calculated using the following equation:

Equation 5 – UCT Benefits

$$B_{UCT} = \sum_{t=1}^N \frac{UAEP_t + UATD_t + UAA_t}{(1 + d)^{t-1}} + \sum_{t=1}^N \frac{UAC_{at}}{(1 + d)^{t-1}}$$

The costs of the UCT are calculated using the following equation:

Equation 6 - UCT Costs

$$C_{UCT} = \sum_{t=1}^N \frac{PRC_t + PIC_t + PEAM_t + PIN_t + UIC_t}{(1 + d)^{t-1}}$$

$$C_{ILTRC} = \sum_{t=1}^N \frac{PNIC_t + UIC_t + PIN_t}{(1 + d)^{t-1}}$$

Where the new term, *PIN_t*, is defined as the program incentives provided by the utility in year *t*.

Cost-Effectiveness Data Requirements

The data points needed to conduct the Illinois TRC test are provided in Table 1, below, and are divided into generic and program specific categories. The program specific data points are further subdivided into those that are provided by ComEd versus those that are a result of the Navigant’s evaluation activities.

Table 1. Data Points Needed to Conduct EEPS TRC

Category	Data Point	Source
Generic	• Avoided Energy Costs (\$/kWh)	ComEd and Relevant Joint Program Gas Company Costs
	• Avoided Capacity Costs (\$/kW-year)	
	• Discount Rate	
	• Escalation Rates	
	• Line Losses	
	• Avoided GHG Emission Costs	
Program Specific	• Participants / Measure Count	Navigant and Relevant Joint Program Gas Company Costs
	• Verified Ex-Post Energy Savings (kWh)	
	• Verified Ex-Post Capacity Savings (kW)	
	• Realization Rate	
	• Net to Gross Ratio	ComEd and Relevant Joint Program Gas Company Costs
	• Measure life	
	• Non-Incentive Costs	
	• Utility Incentive Costs	
	• Incremental Costs (Gross)	
• Incremental Costs (Net)		

Source: Navigant analysis

Our cost model will build-up from the measure and project level, cost detail by program which will roll-up into a portfolio level cost analysis. That cost analysis will be used to run the TRCs for each program so to arrive at final program TRCs and finalize a portfolio-level TRC.

Evaluation Schedule

Table 2 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as assessment and evaluation activities progress or changes in program delivery may be required. The SAG TRC template tables will be used for reporting purposes.

Plan start and delivery dates will be the same in most cases for CY2019 and subsequent years, except for potential changes in the timelines and specific calendar dates in CY2019 and following years. Navigant will strive to provide timely delivery of the results outlined above, but all are contingent upon ComEd delivering timely cost detail and proper back-up assumption detail to Navigant.

Table 2. Schedule – Key Deadlines in CY2019 – TRC Analysis for CY2018 Costs

Activity/Deliverables	Responsible Party	Date Delivered
Cost Assumptions and Detail	ComEd	July 15, 2019 (annually) *
Navigant Develops Initial Cost Model	Navigant	September 1, 2019 (annually)
Iterative Cost and Assumptions Discussions w/ComEd	ComEd / Navigant	July-October 2019
Finalize Cost Model	Navigant	November 15, 2019 (annually)
Navigant Develops Initial TRCs	Navigant	November 20, 2019 (annually)
Discussion of Initial TRCs	ComEd / Navigant	July-November 20, 2019 (annually)
Draft TRCs to ComEd	Navigant	November 23, 2019 (annually)
Draft Joint TRCs	Navigant	January 2020 (annually)
Navigant Draft TRC Report – Delivered (15 Bus Day R'vw)	Navigant	December 2020 (annually)
Comments on Draft TRC Report due from Parties	ComEd / Navigant	January 15, 2020 (annually)
Navigant Redraft of TRC Report Based on Comments	Navigant	January 22, 2020 (annually)
Navigant Draft of Joint TRC Report	Navigant	February 2020 (annually)
Final TRC Report to ComEd and SAG	Navigant	February 2020 (annually)
Comments on Navigant Draft of Joint TRC Report	ComEd / Navigant	February 2020 (annually)
Final Joint TRC Report	Navigant	March 2020 (annually)

*Note: Receipt of the initial assumption and cost data from ComEd is the initial step and without timely receipt of data and detail, the entire schedule shifts by an equal amount of time – each date will be delayed. Dates above for Joint TRC analysis are also contingent on timely receipt of joint program cost detail from ComEd, Peoples Gas, North Shore Gas and Nicor Gas.

4. CROSS-CUTTING RESEARCH

Cross-cutting evaluation includes initiatives that contribute toward the calculating CPAS, such as EUL and measure persistence research, Net-to-Gross research, and working with the IL SAG and the IL TRM administrator to update the IL TRM. Evaluation research is coordinated statewide with the evaluators for Ameren Illinois, Nicor Gas, Peoples Gas and North Shore Gas. A list of current activities is included in the tables below with specific evaluation research plans following in Appendix F.

Illinois TRM Measure Updates

The goal of IL TRM evaluation research is to improve IL TRM input parameter assumptions and formulas. All evaluators in Illinois, including Navigant, are part of the Illinois SAG Technical Advisory Committee (TAC) and are charged with providing materials to continually update and improve the IL TRM to provide the most accurate input parameter assumptions and impact evaluation methodology. Navigant will continue to produce IL TRM measure workpapers including primary and secondary research. Each year, Navigant reviews current IL TRM measures and priority recommendations from the TAC to develop evaluation research based on energy savings, historical realization rate, variability and uncertainty in measure impacts, feasibility to update, relative contributions of measures and planned future use, among others. Each year, we will develop research for high priority measures identified by the IL TRM subcommittee and measures with high portfolio impact or outdated references. The team plans to revisit this list on an ongoing basis as, for example, the IL SAG releases new updates on IL TRM research priorities and the ComEd portfolio measure mix shifts over time. This ongoing review will ensure Navigant's research will focus on the most important topics for ComEd and IL SAG stakeholders. Over the course of the next four years, we expect to continue updating IL TRM measures using the criteria above.

As new measures are proposed to the IL TRM, Navigant will conduct secondary research in coordination with the IL TRM administrator to determine whether the measure has been evaluated in other locations, such as IL TRMs from other states. Working with stakeholders, we will analyze a range of savings values for a particular measure, if such values are known.

Cross-Cutting Process Evaluation

Key items within cross-cutting process evaluation research include supporting program evaluations with innovative survey approaches, reviewing how surveys are deployed to avoid duplication with ComEd market research efforts and integrate data collection when feasible while maintaining independence as the third-party evaluation contractor. Separate research tasks will include coordinating with ComEd's baseline study and evaluating market effects and market impacts through market transformation programs.

Net-to-Gross Evaluation Research

Evaluation research to the IL TRM net-to-gross (NTG) methodologies include research to estimate free ridership and spillover in CY2019.

This will involve focusing on several aspects of the methodologies:

- Exploring key concerns (about the current IL TRM methodologies) that were articulated in 2018 Illinois SAG NTG Working Group meetings
- Conducting sensitivity analyses of Navigant's recent free ridership research results to identify problematic questions

- Analyzing the dynamics of recent research results where quantitative responses conflict with open ended responses
- Analyzing other problematic results of recent free ridership research
- Researching ways other jurisdictions use the IL TRM NTG methodologies, including documenting any modifications to the methodologies and supporting rationale
- Conducting a literature review on state-of-the-art methods for free ridership methods.

In CY2019, Navigant will continue its role leading the IL SAG NTG Working Group on improving the methodology. We will present the results of our research and facilitate working meetings to deliberate on translating our research results into specific improvements to the methodology. As in CY2018, in CY2019 we will also solicit other proposals for improvements from the Working Group and will facilitate discussions of these and will manage the proposed updates to the TRM.

Research Tasks

Table 1 through Table 3 summarize evaluation research tasks currently underway and being planned. The research team plans to revisit this list on an ongoing basis as, for example, the IL SAG releases new updates on IL TRM research priorities and the ComEd portfolio measure mix shifts over time. This ongoing review will ensure Navigant’s research will focus on the most important topics for ComEd’s evaluation and IL SAG stakeholders. Updates to required and planned research will occur on an ongoing basis and the detail below will be updated on an ongoing basis.

Note, the check marks (✓) in Table 1 through Table 3 indicate the year in which the research is planned and will occur.

Table 1. Evaluation Research Tasks: IL TRM Measure Research

Research Task	Description	2017	2018	2019	2020	2021
IL TRM 5.2.2: Advanced Power Strip Tier 1 - ISR/Persistence	Research study to determine the in-service rate and persistence of savings from Tier 1 Advanced Power Strips	✓	✓	✓		
IL TRM 5.3.16 Advanced Thermostats - Cooling Savings Factor	Billing analysis to estimate cooling savings factors for advanced thermostats	✓	✓	✓		
IL TRM 5.6.1-5.6.4: Shell Measures - Savings Verification	Engineering and billing analysis to update de-rating factors for air sealing and insulation	✓	✓			
IL TRM 6.1.1: Weather Normalization for Behavior Measures	Billing analysis to determine whether weather normalization is required for evaluating behavior measure savings	✓				
IL TRM 6.1.1: Adjustments to Behavior Savings to Account for Persistence	Billing analysis to estimate decay rates for behavior measure savings	✓				

Research Task	Description	2017	2018	2019	2020	2021
LED Street Lighting O&M Cost Savings Research (separate municipal and ComEd)	Secondary research to determine avoided operations and maintenance costs from upgrading to LED street lighting	✓	✓			
IL TRM 4.4.17: Variable Speed Drives for HVAC Pumps and Cooling Tower Fans - Measure Cost	Secondary research to update incremental cost estimates for VSDs	✓	✓			
IL TRM 4.4.19: Demand Controlled Ventilation - Savings Factors	Secondary research to update savings factors for demand-controlled ventilation	✓	✓			
IL TRM 4.5.4, 5.5.6, and 5.5.8: LED Bulbs and Fixtures - Incremental Costs	Secondary research to determine need for an update to LED product incremental costs	✓	✓			
Retro-commissioning Measure Persistence Study	Study to determine the persistence of savings from Retro-commissioning measures	✓	✓			
IL TRM 4.4.17: Variable Speed Drives for HVAC Pumps and Cooling Tower Fans – Measure Impacts	Metering study to update TRM savings estimates and input parameters for VSDs		✓	✓		
LED Streetlighting Impacts	Secondary research and metering study to update savings estimates for LED Streetlighting measures		✓	✓		
IL TRM 4.4.1 Air Conditioner Tune-Up: Deemed Savings Percentages	Metering and AMI study to update deemed savings percentages for AC Tune-up measures		✓	✓		
IL TRM 4.4.18: Small Commercial Programmable Thermostat - Savings Verification	Billing analysis to update deemed savings estimates		✓	✓		
Load Shape and Coincidence Peak Research	Secondary research to update TRM load shapes and determine need for additional primary research		✓	✓		
IL TRM 5.1.8: Refrigerator and Freezer Recycling – Secondary Review	Secondary research to update incremental cost estimates for VSDs			✓		
IL TRM Measures	Additional measures added each year, to be determined			✓	✓	✓

Table 2. Cross-Cutting Evaluation Research

Research Task	Description	2017	2018	2019	2020	2021
Income Eligible Program NEIs	Research to estimate non-energy impacts from income-eligible program measures	✓	✓			
Business Program NEIs	Conduct primary research on selected programs based on results from screening questions			✓	✓	✓
Residential Program NEIs	Conduct primary research on selected programs based on results from screening questions			✓	✓	✓
EUL Research: Technical Measure Life	Research to refine estimates of effective useful life for high priority measures	✓	✓	✓		
EUL Research: Persistence	Staged study to investigate persistence for high priority measures		✓	✓	✓	✓
Evaluating AMI for Individual Programs	Conduct secondary research and document in memorandum summarizing possible applications for using AMI data in evaluation	✓	✓	✓		
Pilot M&V 2.0 approaches for select programs	Conduct pilot evaluations using innovative M&V 2.0 approaches		✓	✓	✓	✓
PJM Bid Support	Provide savings values for ComEd's PJM M&V Plan in March, and their PJM M&V Report in May.	✓	✓	✓	✓	✓

Table 3. Cross-Cutting Process Evaluation Research

Research Task	Description	2017	2018	2019	2020	2021
Benchmarking	Conduct benchmarking research to identify innovative program design ideas				✓	
GIS Mapping Opportunities	Identify geographic areas for increased trade ally involvement		✓	✓		
Program channeling	Understand where channeling has occurred and how to increase channeling		✓	✓		
Market Transformation Evaluation Design	Determine evaluation approaches for ComEd's market transformation programs		✓	✓		
Cross-Cutting Survey Methods	Implement updates to survey methods and coordination		✓	✓	✓	✓
Evaluation Coordination with Baseline Study	Coordinate evaluation with baseline study		✓	✓		

APPENDIX A. PROGRAM-SPECIFIC FOUR-YEAR TASKS

Table 1. Income Eligible Programs Four-Year Plan

Program	Task	2018	2019	2020	2021
Affordable Housing New Construction	Tracking System Review	X	X	X	X
Affordable Housing New Construction	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Affordable Housing New Construction	Data Collection – Stakeholder Interviews	X	X	X	
Affordable Housing New Construction	Impact – Engineering Review	X	X	X	X
Affordable Housing New Construction	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Affordable Housing New Construction	Impact – Verification & Realization Rate	X	X	X	X
Affordable Housing New Construction	Impact Research – Calibrated Simulation Modeling		X		
Affordable Housing New Construction	Process Analysis	X		X	X
Food Bank LED Distribution	Tracking System Review	X			
Food Bank LED Distribution	Data Collection – Participant Surveys	X			
Food Bank LED Distribution	Data Collection – Program Manager and Implementer Interviews	X			
Food Bank LED Distribution	Impact – Engineering Review	X			
Food Bank LED Distribution	Impact – Measure-Level Deemed Savings Review	X			
Food Bank LED Distribution	Impact – Verification & Realization Rate	X			
Food Bank LED Distribution	Process Analysis	X			
Lighting Discounts – Income Eligible	Tracking System Review	X	X	X	X
Lighting Discounts – Income Eligible	Data Collection – Participant Surveys	X	X	X	X
Lighting Discounts – Income Eligible	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Lighting Discounts – Income Eligible	Impact – Engineering Review	X	X	X	X
Lighting Discounts – Income Eligible	Impact – Modeling	X	X	X	X
Lighting Discounts – Income Eligible	Impact – Verification & Realization Rate	X	X	X	X
Lighting Discounts – Income Eligible	Process Analysis	X	X	X	X
Multi-Family Retrofits	Tracking System Review	X	X	X	X
Multi-Family Retrofits	Data Collection – Participant Surveys	X		X	
Multi-Family Retrofits	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Multi-Family Retrofits	Data Collection – Property Manager Interviews	X		X	
Multi-Family Retrofits	Impact – Billing Analysis		X		
Multi-Family Retrofits	Impact – Engineering Review	X	X	X	X

Program	Task	2018	2019	2020	2021
Multi-Family Retrofits	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Multi-Family Retrofits	Impact – Verification & Realization Rate	X	X	X	X
Multi-Family Retrofits	Net-to-Gross – Customer Self-Report Surveys		X		
Multi-Family Retrofits	Process Analysis	X	X	X	X
Single-Family Retrofits	Tracking System Review	X	X	X	X
Single-Family Retrofits	Data Collection – Participant Surveys	X		X	
Single-Family Retrofits	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Single-Family Retrofits	Data Collection – Trade Ally Interviews	X		X	
Single-Family Retrofits	Impact – Billing Analysis		X		
Single-Family Retrofits	Impact – Engineering Review	X	X	X	X
Single-Family Retrofits	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Single-Family Retrofits	Impact – Verification & Realization Rate	X	X	X	X
Single-Family Retrofits	Impact – Field Work	X		X	
Single-Family Retrofits	Process Analysis	X	X	X	X
Low Income Kits	Tracking System Review	X			
Low Income Kits	Data Collection – Program Manager and Implementer Interviews	X			
Low Income Kits	Impact – Engineering Review	X			
Low Income Kits	Impact – Measure-Level Deemed Savings Review	X			
Low Income Kits	Impact – Verification & Realization Rate	X			
Low Income Kits	Process Analysis	X			

Table 2. Business Programs Four-Year Plan

Program	Task	2018	2019	2020	2021
AirCare Plus (AC Tune-Up)	Tracking System Review	X	X	X	X
AirCare Plus (AC Tune-Up)	Data Collection – Participant Surveys	X	X	X	X
AirCare Plus (AC Tune-Up)	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
AirCare Plus (AC Tune-Up)	Data Collection – Trade Ally Interviews	X		X	
AirCare Plus (AC Tune-Up)	Impact – Engineering Review	X	X	X	X
AirCare Plus (AC Tune-Up)	Impact – Measure-Level Deemed Savings Review	X	X	X	X
AirCare Plus (AC Tune-Up)	Impact – Verification & Realization Rate	X	X	X	X
AirCare Plus (AC Tune-Up)	Impact – Field Work (On-Site Metering)	X			
AirCare Plus (AC Tune-Up)	Net-to-Gross – Customer Self-Report Surveys		X		X
AirCare Plus (AC Tune-Up)	Net-to-Gross – Trade Ally Interviews		X		X
AirCare Plus (AC Tune-Up)	Process Analysis	X	X	X	X
Business Energy Analyzer (BEA)	Tracking System Review	X	X	X	X
Business Energy Analyzer (BEA)	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
CHP	Tracking System Review	X	X	X	X

Program	Task	2018	2019	2020	2021
CHP	Data Collection – Participant Surveys	X	X	X	X
CHP	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
CHP	Impact – Engineering Review	X	X	X	X
CHP	Impact – Modeling	X	X	X	X
CHP	Impact – Verification & Realization Rate	X	X	X	X
CHP	Net-to-Gross – Customer Self-Report Surveys		X		X
CHP	Net-to-Gross – Trade Ally Interviews		X		X
CHP	Process Analysis	X	X	X	X
Custom	Tracking System Review	X	X	X	X
Custom	Data Collection – Participant Surveys	X	X	X	X
Custom	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Custom	Impact – Engineering Review	X	X	X	X
Custom	Impact – Modeling	X	X	X	X
Custom	Impact – Verification & Realization Rate	X	X	X	X
Custom	Net-to-Gross – Customer Self-Report Surveys		X		X
Custom	Net-to-Gross – Trade Ally Interviews		X		X
Custom	Process Analysis	X	X	X	X
Industrial Systems Optimization	Tracking System Review	X	X	X	X
Industrial Systems Optimization	Data Collection – Participant Surveys	X	X	X	X
Industrial Systems Optimization	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Industrial Systems Optimization	Impact – Engineering Review	X	X	X	X
Industrial Systems Optimization	Impact – Modeling	X	X	X	X
Industrial Systems Optimization	Impact – Verification & Realization Rate	X	X	X	X
Industrial Systems Optimization	Net-to-Gross – Customer Self-Report Surveys		X		X
Industrial Systems Optimization	Net-to-Gross – Trade Ally Interviews		X		X
Industrial Systems Optimization	Process Analysis	X	X	X	X
Instant Discounts	Tracking System Review	X	X	X	X
Instant Discounts	Data Collection – Participant Surveys	X	X	X	X
Instant Discounts	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Instant Discounts	Data Collection – Trade Ally Interviews/Roundtables	X	X	X	X
Instant Discounts	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Instant Discounts	Impact – Verification & Realization Rate	X	X	X	X
Instant Discounts	Net-to-Gross – Participant Self-Report Surveys	X		X	
Instant Discounts	Net-to-Gross – Trade Ally Interviews	X		X	

Program	Task	2018	2019	2020	2021
Instant Discounts	Process Analysis	X	X	X	X
Street Lighting	Tracking System Review	X	X	X	X
Street Lighting	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Street Lighting	Data Collection – Stakeholder Interviews	X	X	X	X
Street Lighting	Impact – Engineering Review	X	X	X	X
Street Lighting	Impact – Verification & Realization Rate	X	X	X	X
Street Lighting	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Street Lighting	Process Analysis	X		X	
Business New Construction	Tracking System Review	X	X	X	X
Business New Construction	Data Collection – Participant Surveys	X	X	X	X
Business New Construction	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Business New Construction	Impact – Engineering Review	X	X	X	X
Business New Construction	Impact – Modeling	X	X	X	X
Business New Construction	Impact – Verification & Realization Rate	X	X	X	X
Business New Construction	Net-to-Gross – Customer Self-Report Surveys	X	X	X	X
Business New Construction	Net-to-Gross – Trade Ally Interviews		X		X
Business New Construction	Process Analysis	X	X	X	X
Appendix	Tracking System Review	X	X	X	X
Operational Efficiency/Facility Assessments	Data Collection – Participant Surveys		X		X
Operational Efficiency/Facility Assessments	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Operational Efficiency/Facility Assessments	Data Collection – Stakeholder Interviews	X	X	X	X
Operational Efficiency/Facility Assessments	Impact – Billing Analysis	X	X	X	X
Operational Efficiency/Facility Assessments	Impact – Engineering Review	X	X	X	X
Operational Efficiency/Facility Assessments	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Operational Efficiency/Facility Assessments	Impact – Modeling	X	X	X	X
Operational Efficiency/Facility Assessments	Impact – Verification & Realization Rate	X	X	X	X
Operational Efficiency/Facility Assessments	Researched NTG Analysis		X		X

Program	Task	2018	2019	2020	2021
Operational Efficiency/Facility Assessments	Participant Interviews	X	X	X	X
Operational Efficiency/Facility Assessments	Effective Useful Life Determination	X	X	X	X
Operational Efficiency/Facility Assessments	Process Analysis	X	X	X	X
Power TakeOff	Tracking System Review	X	X	X	X
Power TakeOff	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Power TakeOff	Net-to-Gross – Customer Self-Report Surveys	X			
Power TakeOff	Impact – Modeling	X	X	X	X
Public Housing Authorities	Tracking System Review	X	X	X	X
Public Housing Authorities	Data Collection – Participant Surveys	X	X	X	X
Public Housing Authorities	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Public Housing Authorities	Impact – Engineering Review	X	X	X	X
Public Housing Authorities	Impact – Modeling	X	X	X	X
Public Housing Authorities	Impact – Verification & Realization Rate	X	X	X	X
Public Housing Authorities	Net-to-Gross – Customer Self-Report Surveys		X		X
Public Housing Authorities	Net-to-Gross – Trade Ally Interviews		X		X
Public Housing Authorities	Process Analysis	X	X	X	X
Retrocommissioning	Tracking System Review	X	X	X	X
Retrocommissioning	Data Collection – Participant Surveys		X		X
Retrocommissioning	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Retrocommissioning	Data Collection – Trade Ally Interviews		X		X
Retrocommissioning	Impact – Project-specific Billing Analysis	X	X	X	X
Retrocommissioning	Impact – Engineering Review	X	X	X	X
Retrocommissioning	Impact – Verification & Realization Rate	X	X	X	X
Retrocommissioning	Net-to-Gross – Customer Self-Report Surveys		X		X
Retrocommissioning	Net-to-Gross – Trade Ally Interviews		X		X
Retrocommissioning	Process Analysis	X	X	X	X
Strategic Energy Management	Tracking System Review	X	X	X	X
Strategic Energy Management	Data Collection – Participant Surveys		X		X
Strategic Energy Management	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Strategic Energy Management	Data Collection – Stakeholder Interviews	X	X	X	X
Strategic Energy Management	Impact – Billing Analysis	X	X	X	X

Program	Task	2018	2019	2020	2021
Strategic Energy Management	Impact – Engineering Review	X	X	X	X
Strategic Energy Management	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Strategic Energy Management	Impact – Modeling	X	X	X	X
Strategic Energy Management	Impact – Verification & Realization Rate	X	X	X	X
Strategic Energy Management	Process Analysis	X	X	X	X
Small Business (private sector)	Tracking System Review	X	X	X	X
Small Business (private sector)	Data Collection – General Population Surveys	X	X		
Small Business (private sector)	Data Collection – Participant Surveys	X	X	X	X
Small Business (private sector)	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Small Business (private sector)	Data Collection – Stakeholder Interviews	X	X	X	X
Small Business (private sector)	Data Collection – Trade Ally Interviews	X	X	X	
Small Business (private sector)	Impact – Billing Analysis	X	X	X	X
Small Business (private sector)	Impact – Engineering Review	X	X	X	X
Small Business (private sector)	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Small Business (private sector)	Impact – Modeling	X		X	
Small Business (private sector)	Impact – Verification & Realization Rate	X	X	X	X
Small Business (private sector)	Net-to-Gross – Customer Self-Report Surveys	X		X	
Small Business (private sector)	Net-to-Gross – Trade Ally Interviews	X		X	
Small Business (private sector)	Process Analysis	X	X	X	X
Small Public Facilities (public sector)	Tracking System Review	X	X	X	X
Small Public Facilities (public sector)	Data Collection – General Population Surveys	X		X	
Small Public Facilities (public sector)	Data Collection – Participant Surveys	X	X		X
Small Public Facilities (public sector)	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Small Public Facilities (public sector)	Data Collection – Stakeholder Interviews	X	X	X	X
Small Public Facilities (public sector)	Data Collection – Trade Ally Interviews	X	X		X
Small Public Facilities (public sector)	Impact – Billing Analysis (as needed)	X	X	X	X

Program	Task	2018	2019	2020	2021
Small Public Facilities (public sector)	Impact – Engineering Review	X	X	X	X
Small Public Facilities (public sector)	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Small Public Facilities (public sector)	Impact – Modeling (as needed)	X	X	X	X
Small Public Facilities (public sector)	Impact – Verification & Realization Rate	X	X	X	X
Small Public Facilities (public sector)	Net-to-Gross – Customer Self-Report Surveys		X		X
Small Public Facilities (public sector)	Net-to-Gross – Trade Ally Interviews		X		X
Small Public Facilities (public sector)	Process Analysis	X	X	X	X
Standard	Tracking System Review	X	X	X	X
Standard	Data Collection – General Population Surveys			X	
Standard	Data Collection – Participant Surveys	X	X	X	
Standard	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Standard	Data Collection – Stakeholder Interviews	X		X	
Standard	Data Collection – Trade Ally Interviews	X	X		X
Standard	Impact – Billing Analysis	X		X	
Standard	Impact – Engineering Review	X	X	X	X
Standard	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Standard	Impact – Verification & Realization Rate	X			
Standard	Net-to-Gross – Customer Self-Report Surveys		X	X	
Standard	Net-to-Gross – Trade Ally Spillover Research		X		
Standard	Process Analysis	X	X	X	X

Table 3. Residential Programs Four-Year Plan

Program	Task	2018	2019	2020	2021
Appliance Rebates	Tracking System Review	X	X	X	X
Appliance Rebates	Data Collection – Participant Surveys	X		X	
Appliance Rebates	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Appliance Rebates	Data Collection – Retailer Interviews	X		X	
Appliance Rebates	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Appliance Rebates	Impact – Verification & Realization Rate	X	X	X	X
Appliance Rebates	Net-to-Gross – Customer Self-Report Surveys	X		X	
Appliance Rebates	Process Analysis	X	X	X	X
Elementary Education Kits	Tracking System Review	X	X	X	X
Elementary Education Kits	Data Collection – Parent, Teacher, and Student Surveys	X	X	X	X
Elementary Education Kits	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Elementary Education Kits	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Elementary Education Kits	Impact – Verification & Realization Rate	X	X	X	X
Elementary Education Kits	Net-to-Gross – Participant Take-Home Surveys to Estimate FR		TBD	TBD	TBD
Elementary Education Kits	Net-to-Gross – Survey to Estimate Spillover		TBD	TBD	TBD
Elementary Education Kits	Process Analysis	X	X	X	X
Fridge/Freezer Recycling	Tracking System Review	X	X	X	X
Fridge/Freezer Recycling	Data Collection – Participant Surveys	X	X	X	X
Fridge/Freezer Recycling	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Fridge/Freezer Recycling	Data Collection – Retailer Interviews		X	X	X
Fridge/Freezer Recycling	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Fridge/Freezer Recycling	Impact – Verification & Gross Realization Rate	X	X	X	X
Fridge/Freezer Recycling	Net-to-Gross – Customer Self-Report Surveys	X	X	X	X
Fridge/Freezer Recycling	Net-to-Gross Analysis		X	X	TBD
Fridge/Freezer Recycling	Process Evaluation		X	TBD	X
HEA - Single Family	Tracking System Review	X	X	X	X
HEA - Single Family	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
HEA - Single Family	Data Collection – Participant Survey		X		
HEA - Single Family	Impact – Measure-Level Deemed Savings Review	X	X	X	X
HEA - Single Family	Impact – Verification & Realization Rate	X	X	X	X
HEA - Single Family	Net-to-Gross – Customer Self-Report Surveys			X	
HEA - Single Family	Process Analysis	X	X	X	X
HVAC Rebates	Tracking System Review	X	X	X	X

Program	Task	2018	2019	2020	2021
HVAC Rebates	Data Collection – Participant Surveys	X	X	X	X
HVAC Rebates	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
HVAC Rebates	Data Collection – EESP Interviews	X	X		X
HVAC Rebates	Impact – Measure-Level Deemed Savings Review	X	X	X	X
HVAC Rebates	Impact – Verification & Realization Rate	X	X	X	X
HVAC Rebates	Net-to-Gross – Customer Self-Report Surveys	X	X		X
HVAC Rebates	Net-to-Gross – EESP Interviews	X	X		X
HVAC Rebates	Process Analysis	X	X	X	X
Lighting Discounts	Tracking System Review	X	X	X	X
Lighting Discounts	Data Collection – In-store Intercept Participant Surveys	X		X	
Lighting Discounts	Data Collection – In-store Shelf Surveys			X	
Lighting Discounts	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Lighting Discounts	Data Collection – Trade Ally Interviews	X		X	
Lighting Discounts	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Lighting Discounts	Impact – Verification & Realization Rate	X	X	X	X
Lighting Discounts	Net-to-Gross – Customer Self-Report Surveys	X		X	
Lighting Discounts	Process Analysis	X		X	
Multi-Family Market Rate	Tracking System Review	X	X	X	X
Multi-Family Market Rate	Data Collection – Building Owner and Property Manager Surveys	X		X	
Multi-Family Market Rate	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Multi-Family Market Rate	Data Collection – EESP Interviews	X	X		
Multi-Family Market Rate	Impact – Engineering Review	X	X	X	X
Multi-Family Market Rate	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Multi-Family Market Rate	Impact – Verification & Realization Rate	X	X	X	X
Multi-Family Market Rate	Net-to-Gross – Customer Self-Report Surveys	X		X	
Multi-Family Market Rate	Process Analysis	X	X	X	X
Home Energy Reports	Tracking System Review	X	X	X	X
Home Energy Reports	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Home Energy Reports	Impact – Modeling	X	X	X	X
Residential New Construction	Tracking System Review	X	X	X	X
Residential New Construction	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Residential New Construction	Data Collection – Builder and Rater Interviews		X	X	

Program	Task	2018	2019	2020	2021
Residential New Construction	Impact – Calibrated Simulation Modeling			X	
Residential New Construction	Impact – Verification & Realization Rate	X	X	X	X
Residential New Construction	Net-to-Gross – Builder Interviews			X	
Residential New Construction	Process Analysis	X	X	X	X
Weatherization – Market Rate	Tracking System Review	X	X	X	X
Weatherization – Market Rate	Data Collection – Participant Surveys	X	X		
Weatherization – Market Rate	Data Collection – Program Manager and Implementer Interviews	X	X	X	X
Weatherization – Market Rate	Data Collection – EESP Interviews	X	X		
Weatherization – Market Rate	Impact – Measure-Level Deemed Savings Review	X	X	X	X
Weatherization – Market Rate	Impact – Verification & Realization Rate	X	X	X	X
Weatherization – Market Rate	Net-to-Gross – Customer Self-Report Surveys	X	X		
Weatherization – Market Rate	Literature Review – NTG Values for Wall Insulation		X		
Weatherization – Market Rate	Process Analysis	X	X	X	X

APPENDIX B. BUSINESS PROGRAMS EVALUATION PLANS

Coordinated Business New Construction Program CY2019 to CY2021 Evaluation Plan

Introduction

This plan covers CY2019 to CY2021 for the Business New Construction Program. CY2019 (January 1, 2019 to December 31, 2019) is the 11th program year of ComEd's energy efficiency savings portfolio and the eighth program year for energy efficiency gas savings. The Business New Construction Program is coordinated between ComEd, Nicor Gas, Peoples Gas and North Shore Gas Companies. Seventhwave implements the program for ComEd, Nicor Gas, Peoples Gas, and North Shore Gas.

The CY2019 program will not change significantly from CY2018. The program has continued to develop and offer different program tracks to cater to different types of participants. These include the Comprehensive Track, the Expedited Assistance Track, the Design Replication Track, and the Accelerate Performance Track. The tracks vary in the incentives and technical assistance offered by the program based on the type of project and the point at which the project enters the program. In addition to these tracks, the program also serves public sector projects. Project must be 5,000 square feet or larger to participate in the offering.

This evaluation plan reflects evaluation approaches designed for the unique characteristics of this program. The evaluation approaches have been developed through discussions between the implementation and evaluation teams as well as ComEd over the course of the past several years. The primary objectives of this evaluation are as follows:

- Provide adjusted gross impacts for all completed projects using a researched realization rate.
- Provide verified net savings for all electric and gas projects completed in CY2019.
- Use a rolling approach for the eventual derivation of NTG, interviewing project representatives as they enter the reservation stage.

The evaluation activities and timing for each utility evaluation are the same, as this is one evaluation for all utilities. Desk reviews and participant interviews are done without respect to the associated gas utility. Net-to-gross (NTG) ratios are deemed prospectively with separate NTG values for electric and for gas. Beyond these points, the ComEd evaluation team will coordinate with the gas utilities on any relevant evaluation issues as needed.

Joint Evaluation Approach

In this plan, Navigant outlines the evaluation objectives and activities for the program and how results pertain to each utility. The evaluation team determined the approach for the three-year period based on the program's needs and history. To recognize the singular nature of the program, the evaluation team will synthesize process findings from each fuel type into a single set of findings. The impact evaluation work will be slightly more fuel-specific: the electric impact evaluation will focus on a sample of projects with electric savings (Population of 84 projects expected in CY2019), while the gas impact evaluation will focus on a sample of projects claiming gas savings (Population of 39 projects expected in CY2019).

The CY2019 gross impact evaluation will not vary qualitatively from the previous years and will be based on engineering desk reviews. As in past years, the CY2019 evaluation will include customer free ridership research. The findings from the study will inform recommended NTG values for the Illinois Stakeholder Advisory Group (SAG) approval and future program application. The CY2019 free ridership research will include in-depth interviews with participating customers to learn about their perspectives and satisfaction with the program, the technical assistance services and incentive offerings, and how to improve the program in the future.

The evaluation team will use the same general evaluation approach for all tracks of the program, including the public sector projects, but will account for the variations in the tracks (e.g., Expedited Assistance) and program offerings as needed. To the extent there are a sufficient number of projects to be meaningful, we will present results for each track as well as overall results for the program. The evaluation of this program over the coming three years (CY2019-CY2021) will include a variety of data collection and analysis activities, including those indicated Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Materials Review	X	X	X
Data Collection – Participant Interviews	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Engineering Review	X	X	X
Impact – Building Energy Simulation Modeling	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Free Ridership Self-Report Surveys	X		X
Net-to-Gross – Spillover Research		X	
Process Analysis	X	X	X

Given that the program includes very large custom projects and that the program plans to roll out several new initiatives to better serve specific customer groups, we plan to conduct most research activities, including impact, process, and free-ridership analyses, annually. This approach will ensure that any year-to-year variations due to individual projects will not affect future years, as well as provide the program with timely information to continue to improve the program’s design.

Evaluation Research Topics

The objectives of the CY2019 evaluation are as follows:

1. Provide adjusted gross impacts for all completed projects using a researched realization rate.
2. Provide verified net savings for all projects completed in CY2019.
3. Update the verification, due diligence, and tracking system review from CY2019, if needed.
4. Continue the existing approach for NTG derivation. This includes:
 - a. Review of program documentation for projects that have recently reached the reservation stage, including project narratives and Measure Incentive Reservation forms. If needed

the evaluation team will coordinate with the implementation team to discuss their understanding of the project's participation prior to the evaluation team interviewing the project contacts.

- b. Collection of NTG data from an interview as soon as possible after the reservation date to minimize possible measurement issues associated with respondent recollection.

In the CY2019 evaluation, the Navigant evaluation team will seek to answer the following key researchable questions:

Impact Evaluation

- What are the researched gross energy and demand impacts?
- What are the verified net impacts from the program using SAG-approved NTG ratios?
- Did the program meet its energy and demand savings goals? If not, why not?
- What are the free ridership values to be used prospectively in future program years?

Process Evaluation

The program has several tracks for participants and serves a variety of customer types (e.g., public sector and small facilities). The process evaluation will explore participants' characteristics, satisfaction, and experiences with respect to these different paths, as well as other program implementation changes—such as changes to the program's marketing and outreach strategy, and program challenges. We will collect this information through program manager interviews, program participant interviews, and a review of program materials. Potential evaluation research questions may include:

- What design or implementation changes occurred in CY2019, and how have these, if at all, changed the way the program is offered?
- What is the level of participation for the different program tracks and among different customer types (e.g., public sector)?
- How do participants' experience with the program differ for the different program tracks?
- What challenges did the program face over the course of the program year and how did the program respond to them?

Navigant will perform additional process research, upon the request of the program manager, to support the program manager and implementer as they consider future program changes. Possible topics may include, but will not be limited to, research on impact of public sector projects introduced into the program, and investigation of the effects of codes and standards on the baseline of new construction in the ComEd service territory, and collaboration on new or streamlined evaluation approaches to support program redesign. The evaluation team could also support the program's planned redesign by developing a program theory/logic model to help the program map out the planned activities, outputs, and outcomes and related performance indicators.

Evaluation Approach

Table 2 summarizes the surveys, interviews, and other primary data sources that will be used to answer these research questions in CY2019. We anticipate employing similar sources and data collection activities in the evaluation of future program years, though quantities of projects reviewed will differ.

Table 2. Core Data Collection Activities, Sample and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Internal Tracking System	Entire System	Completed by January 30 th each year
In-Depth Interviews	Program Management and Implementers	2	Augment with monthly calls
Process and Impact Research on CY2019 Operations	Literature review, secondary research	n/a	Process, Impact
Gross Impact Evaluation	Early Feedback File Review	5	Early Feedback for Large Projects, As Needed
Gross Impact Evaluation	Engineering Desk Review	30†	Two Waves*†
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	n/a	
Researched NTG and Process	Telephone Interview with Participating Customers	~30	FR, Process, Targeting Projects Currently in Reservation Phase

Note: FR = Free Ridership

* The total number of projects receiving engineering desk reviews for each year may change based on the final list of projects and their savings. Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Navigant will coordinate with the utilities to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In line with program changes and an accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in 2019. The first wave of M&V sampling is expected to cover about two-thirds of the projects.

Proposed gross impact sampling timelines are shown below.

CY2019 Gross Impact Sampling Waves

- a) First wave sample drawn in July 2019 and completed September 2019
- b) Final (second) wave by January 30, 2020 or upon the completion of all CY2019 projects)

In-Depth Interviews and Research

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and marketing tactics.

Telephone Interviews

To fully implement the rolling NTG approach, we will attempt to conduct interviews with decision makers for all projects currently in the reservation stage, regardless of program year, to best capture the program's early influence. Once a sampled project reaches the reservation stage, the implementation contractor will provide the evaluation team with contact information for project contacts, and the team will conduct a post-reservation interview as soon as is practical. The evaluation team will seek to speak with key decision makers for the project. In most cases, the primary project contact will be the key decision maker, but we will verify this as part of the interview and ask to be referred to the appropriate contact if necessary. We will also incorporate customized questions for each project linked to the points of influence identified in the documentation review.

Because we will attempt to interview a census of projects, no sampling of projects or differentiation between electric and gas savings is needed. . We expect to complete about 30 interviews, which will represent approximately two-thirds of all projects in the reservation stage. In CY2019, the evaluation team does not expect there to be enough participating public sector projects to develop a separate NTG estimate, but will estimate a public sector-specific NTG analysis when enough projects participate in the program to support it.

In addition to NTG research, interviewers will also ask participants about their experience with elements of the program tracks, as applicable, to provide the program with actionable information about the different tracks. Because of the nature of the questions and the fact that we will be asking these process-related questions to a census of participants in the reservation phase as part of the net-to-gross interviews, a randomized controlled trial or quasi-experimental design is not applicable for this research.

Gross Impact Evaluation

The evaluation team will conduct gross savings research using building energy simulation models on a sample of approximately 30 projects to determine CY2019 savings and calculate realization rates. This research will include an engineering desk review of each project in our sample. The evaluation team will also develop a summary sheet for each project reviewed that outlines the evaluation activities completed, any resulting changes to the building energy simulation model because of ex post review, and the net effect on the electric and therm savings relative to ex ante claimed savings.

Per the program design, the baseline for all projects typically will be based on the applicable Illinois Energy Conservation Code for Commercial Buildings. Determination of the applicable code version will be subject to requirements, if any, of the ICC approved version of the *Illinois Energy Efficiency Policy Manual* in place at the time of a project's application to the program. At the time of drafting this plan, the policy will likely be for evaluation to estimate savings using the code in effect at the time of the issuance of the construction permit.

All projects accepted under the guidance of *Illinois Energy Efficiency Policy Manual Version 1.1* (or earlier versions), will continue the practice of using a project's application date to determine which version of the Illinois Energy Conservation Code is the most appropriate to use as baseline. The Illinois Energy Conservation Code for Commercial Buildings references the *International Energy Conservation Code* (IECC), which also allows for use of *ASHRAE Standard 90.1* as an alternate compliance method.

The evaluation team will also calculate interactive effects associated with projects for each utility to be used within the cost-effectiveness analysis by each fuel type. We include all interactive effects for projects within participating gas companies' service territories (e.g., the project receives natural gas service from Nicor Gas and electric service from ComEd but may or may not have received a gas incentive). We will also present researched savings without interactive effects for comparison to utility goals.

Some new construction projects have high uncertainty surrounding the baseline selection (e.g., major renovations with HVAC reconfiguration), resulting in higher risk for downward evaluation savings adjustment if the evaluation determines that the appropriate baseline is more efficient than what was assumed in the ex ante savings calculations. To anticipate and reduce the incidence of such cases, a review of the baseline by the evaluation team prior to incentive commitment may be appropriate. As a part of monthly evaluation update calls, there will be an opportunity for the program staff to identify projects where they perceive higher uncertainty. After discussion, the program staff and evaluation team may agree to have the evaluation team follow up with a brief but deeper review of project details and provide feedback on baseline selection within 10 days. The evaluation follow-up review will be optional, advisory and non-binding from the standpoint of updating ex ante savings claims but may serve to reduce downward savings adjustments in the ex post evaluation.

Sampling Approach

The evaluation team plans to create two sample frames, one focused on electric projects and the other focused on gas projects. The electric sample frame will be composed only of projects with electric savings. These projects may or may not have gas savings and may or may not be in any of the participating gas utilities’ service territories. The gas sample frame will consist of all gas projects with positive therm savings before interactive effects from electric measures, regardless of whether the project received a gas incentive.⁸ Within each of the sample frames, we plan to use a stratified random sample design. Each sample will be designed to reach 90% confidence and 10% precision two tailed for MWh and therms, respectively. The overall sample will include 30 projects, approximately 12 of which will have received gas incentives.⁹

Table 3. Estimated Number of Projects in Sample

Fuel-Type	Estimate of Projects in Sample (Approximate)
Electric	18
Gas	12
Total	30

Navigant will perform tracking system review and M&V project sampling in two waves in CY2019. The first wave of M&V sampling is expected to cover about one-third of projects completed in CY2018.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

⁸ Similarly, when estimating verified savings, the evaluation will include all therm savings in the gas utilities’ service territories with the interactive effects removed, whether the project received a gas incentive.

⁹ The number of projects in the sample may change based on the final list of projects and their savings.

Table 4. Deemed NTG Values for CY2018

Utility	CY2019 Deemed NTG Value
ComEd (MW and MWh)	0.68
Gas Utilities (therms)	0.70

Source:

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final.xlsx

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final.pdf

NTG Impact Evaluation and Research

The team will implement a rolling approach for deriving the NTG estimates, where net savings data will be captured as projects progress through the stages of participation. This methodology will include the following for each sampled project:

- 1) **Project Documentation Review.** This includes:
 - a. Measure Incentive Reservation. The evaluation team will begin by reviewing the measure incentive reservation for each sampled project. This document will inform the evaluation team’s characterization of the decision-making processes for specific components of each project. The measure incentive reservation documents contain:
 - i. Project description
 - ii. Estimated savings by energy efficiency measures (baseline compared to proposed equipment)
 - iii. Estimated incentive, by energy efficiency measures
 - b. Project Narrative. The evaluation team will also review project narrative files developed by the implementation contractor. These narratives will allow the team to determine potential points of influence of the program. Each project narrative file includes:
 - i. Project contacts
 - ii. Project history. The implementation contractor will list key dates for the project, including formal project milestones (e.g., date of application reception), informal milestones (e.g., documenting receipt of updated drawings), and communication between the participant and implementation contractor, for each entry, the implementation contractor will list the date and a summary description of the event/milestone.
 - iii. Project narrative. The implementation contract will provide a summary of the project

- 2) **Post-Reservation Interview.** Once a sampled project reaches the reservation stage, the implementation contractor will provide the evaluation team with contact information for project contacts, and the team will conduct a post-reservation interview as soon as is practicable. The evaluation team will seek to speak with key decision makers for the project. In most cases, the primary project contact will be the key decision maker, but we will verify this as part of the interview and ask to be referred to the appropriate contact if necessary. If needed, the evaluation team will work with the implementer to identify alternate contacts. We will also incorporate customized questions for each project linked to the points of influence identified in the documentation review.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA) for electric energy efficiency, Navigant will report ex post gross and ex post net savings for the program. The cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. In CY2019, we will use the EUL values for electric and gas measures developed in CY2018. In future years, we will review these values for representativeness and update them if needed. The evaluation team will also add the savings converted from gas savings to the equivalent electric savings for all gas savings not otherwise claimed. Gas savings will first be counted by the gas companies and any remaining gas savings can be counted by ComEd (as described in FEJA) and converted to kWh electric savings.

Use of Randomized Control Trial and Quasi-Experimental Design

The evaluation team will not use the Randomized Control Trials (RCT) or Quasi-Experimental Design for process evaluation because:

- There are not enough participants in this program to achieve statistically significant savings estimates using this method.
- It would not be possible to create a valid matched control group for the customers in this program.
- This method would estimate average savings across all program participants which is not the desired savings estimate for this program

Evaluation Schedule

Table 5 below provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress.

Table 5. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
CY2019 program tracking data for participant interviews	ComEd	April 1, 2019
Post-reservation phase participant interviews	Evaluation	April 1, 2019 through November 29, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 3, 2019
Wave 1 engineering desk reviews	Evaluation	September 30, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	January 30, 2020
Wave 2 engineering desk reviews	Evaluation	February 28, 2020
NTG Analysis Findings	Evaluation	March 2, 2020
Internal Report Draft by Navigant	Evaluation	March 6, 2020
Draft Report to ComEd, Gas Utilities, and SAG	Evaluation	March 13, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 3, 2020
Revised Draft by Navigant	Evaluation	April 10, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 17, 2020
Final Report to ComEd, Gas Utilities, and SAG	Evaluation	April 27, 2020

ComEd CHP Program CY2019 to CY2021 Evaluation Plan

Introduction

The ComEd Combined Heat and Power (CHP) Program provides a custom incentive to business customers, based on eligibility requirements outlined in TRM v.7, for CHP installations incentivized under the CHP Program. CHP incentives are available based on the project's kWh savings, provided the project meets all program eligibility requirements. Projects involving CHP equipment where the customer conducted their feasibility study prior to applying for participation in the ComEd CHP program are out of scope for CHP program evaluation and will be evaluated as Custom projects.

Notable program considerations in CY2019 include:

- The Program will report annual savings and lifetime savings.
- CHP Program savings will be reported separate from other ComEd Business projects.

The objective of the evaluation is to quantify net savings impacts from the CHP Program for each Calendar Year in the three-year plan (CY2019 - CY2021). Key evaluation activities for CY2019 will take place from January 2019 through March 2020. For the CY2019 evaluation, per request by ComEd, the evaluation team will work towards parallel, real-time verification and analysis, and parallel impact evaluation. The main purpose of this is that it allows earlier engineering review and measurement and verification (M&V), ensuring that critical impact issues are resolved in early stages. Navigant expects most, or all CHP projects will utilize a parallel impact evaluation approach, allowing Navigant, the implementers, and the ComEd team to provide information regarding appropriate savings approaches early in the process. Since we are likely to select a sample of large projects for evaluation,¹⁰ the team will review them in early stages of the project and provide feedback to ComEd as needed. This is to ensure that the calculation methodology and M&V plans align with best practices for impact evaluation according to the International Performance Measurement and Verification Protocol (IPMVP) and other guiding documents such as the Uniform Methods Project (UMP).

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

¹⁰ Navigant will evaluate a census sample of projects unless there are too many projects to evaluate within the available budget or available time.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Engineering Review	X	X	X
Impact – Modeling (as needed)	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys*	X	X	X
Net-to-Gross – Trade Ally Interviews		X	
Process Analysis (as needed)	X	X	X

*NTG research will be conducted on each CHP project mostly focusing on free-ridership with research into a deemed NTG value occurring in CY2020.

Process evaluation will be performed as needed and it will be triggered based on the changes to the program scope, goals or to the implementation team.

High-capital-investment projects are generally not performed solely due to an energy efficiency program, therefore to help minimize evaluation risk, the evaluation team will determine free ridership for each project as part of the application process prior to ComEd accepting a project into the CHP program.

Coordination

Navigant will coordinate with the evaluation teams for other Illinois utilities on any issues relevant to this program. Specifically, Ameren Illinois currently incentivizes CHP projects under their custom program. Ameren hopes to have a small number of CHP projects near the end of the three-year plan.

The ComEd evaluation team will coordinate with the Ameren evaluators to ensure that the two CHP evaluations use similar approaches, following the guidance in the TRM where applicable, and to identify and report on any substantive differences. The ComEd evaluation team will coordinate with the Ameren team on data collection and survey instrument design to ensure consistency and appropriate questions in the customer surveys.

Evaluation Research Topics

Navigant will provide real-time, parallel evaluation input starting as early as the pre-application phase while M&V plans and baseline are being established. Feedback from the evaluation team will be provided before each application is finalized and paid by the program.

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual and total lifetime verified gross savings?

2. What is the research estimate of gross electric and gas savings (energy, peak demand, and total demand) for the program?
3. What are the program's annual and lifetime verified net savings?
4. Secondary questions include:
 - Are the ex ante per-unit gross impact savings correctly implemented by the tracking system and reasonable for this program?
 - What updates are recommended for the Illinois Technical Reference Manual (TRM)?
 - What are the results of field data collection?
 - Are the measure life assumptions valid and up-to-date?
5. Where are there opportunities for improvement to the program impact calculations and estimates?
6. Has the program has met its energy savings goals? If not, why not?

Provide real-time, parallel evaluation to provide evaluation input, starting as early as the pre-application phase while M&V plans and baseline are being established. Feedback from the evaluation team will be provided before each application is finalized and paid by the program.

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. What are participant and vendor perspectives and overall satisfaction with the program?
2. What are effective marketing strategies to inform customers of the CHP program?
3. How can the program be improved?

Evaluation Approach

Table 2 summarizes the proposed data collection activities for CY2019 including the sample sizes of each activity.

At the time of this plan, one known CHP project is in the pipeline and will be evaluated as a Custom project.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes 2019	Notes
Tracking System Review*	Tracking system	Census	Quarterly, or as needed
In-Depth Interviews	Program Management and Implementers	2	Augment with monthly calls
Gross Impact Evaluation	Early Feedback File Review	Census	Early Feedback for Pipeline Projects
Gross Impact Evaluation	Engineering File Review	Census	Quarterly
Gross Impact Evaluation	On-site M&V	Census	
Verified Net Impact Evaluation	Calculation using project-specific NTG ratio	NA	
Survey: NTG and Process	Telephone Survey with Participating Customers	Census	Free Rider & Spillover, Process, as needed
Survey: NTG and Process †	Telephone Interviews with Influential Trade Allies	TBD	Free Rider & Spillover, Process, as needed
Literature review, secondary research	Process and Impact Research on CY2019 Operations	Census	Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts.

† Trade ally surveys are triggered by high importance ratings by participating customers to the trade ally or vendor. Therefore, the number of trade ally or vendor surveys is dependent on the results of the participating customer survey.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Gross Impact Evaluation

The evaluation will analyze program-level savings data for all CHP projects (census sample). If more than 35 CHP projects are completed in a single evaluation year, the sampling approach will change to a random sampling approach targeting 90 percent confidence and 10 percent relative precision (90/10).

Final annual program gross and net impact results will be based upon evaluation results for each entire program year (e.g., CY2019). A census sample approach will comply with the PJM verification requirements outlined in Manual 18B.

CHP program savings are expected to be high-impact, high-uncertainty savings. Per the Illinois TRM, CHP project savings for complex projects that cannot be addressed using the prescriptive algorithms in the TRM will be calculated on a custom basis. Navigant will check minimum eligibility requirements per IL TRM v 7.0 which states *“an eligible system must demonstrate a minimum total system efficiency of 60% (HHV) with at least 20% of the system’s total useful energy output in the form of useful thermal energy on an annual basis.”*

Accuracy of estimated CHP system savings depends on how well the engineering analysis can predict the future annual usage of the facility or campus served by the CHP system incentivized under the program. Variables affecting CHP project savings include:

- Annual run hours of the system
- Capacity factor (loading) of the system during annual CHP run hours which depends on demand of the end use equipment served by the system, including
 - HVAC equipment
 - Proprietary industrial processes
 - Manufacturing production cycles
 - Equipment control sequence of operation
 - Temperature setpoints
 - Outdoor air temperature

The Navigant M&V plan and savings analysis will focus on these variables and will be in accordance with the best practices outlined in the IPMVP. The M&V procedures also will draw from Chapter 23: Combined Heat and Power Evaluation Protocol of the Uniform Methods Project (UMP), using either the “full” or “modified” approach, and include consideration of the special cases covered in Section 6, such as early retirement and CHP plant performance degradation.

Data Collection Approach

Regarding core data collection methodologies, ComEd will have an opportunity to review and comment on the M&V plans as they are drafted, prior to conducting a site visit. Navigant expects all CHP projects to utilize a parallel evaluation approach, so that Navigant, the implementer, and ComEd have an opportunity to discuss the recommended verification approach in advance of the CHP system being purchased or installed. Any comments provided by ComEd will be reviewed and addressed accordingly before finalizing the M&V plan. However, because of the tight timeline, the evaluation team expects to receive the comments on these M&V plans within five business days after the draft plans are completed.

Pre-metering and post-installation interval metering data will be collected from the program implementers for all projects. The evaluators will also request all available production data and other pertinent records and files from the implementers for all projects.

Due to the size of the savings for CHP projects, on-site M&V audits will be performed for all projects in the sample. Out of these projects, the evaluation team will select projects for metering in cases where there is not sufficient data from existing utility meters and CHP system metering to calculate gross impact savings

in accordance with the IPVMP. These projects will be selected based on the verified conditions and available ex ante project documentation so that evaluation metering efforts can contribute significantly to developing ex post analysis.

Additionally, on-site audits will also include collecting information from dedicated facility meters for the system power usage or load profile (e.g., air-flow profile), when available. Production data and spot measurements will be collected to support ex post savings calculations. The evaluation will verify both net generation and total system efficiency. Specific types of data that will be considered in the evaluation of CHP projects, and are expected to be available from the CHP unit interface, targeted datalogging, or equipment nameplate, include: annual hours of operation of the CHP system, annualized useful thermal energy output, useful annualized electricity output, total annualized fuel consumed by the CHP system, CHP nameplate capacity, parasitic electric load required to run the CHP system, on-site boiler efficiency for energy that is displaced by the CHP system, and other proxy variables as needed to annualize and verify savings, including relevant temperature setpoints and schedules. The expected level of granularity for data is hourly or sub-hourly.

In addition to the data collection methods highlighted above, when invited by ComEd Navigant staff responsible for CHP program evaluation will attend standing monthly Custom program calls with ComEd to discuss CHP project status, evaluation updates, and project-specific issues. This will allow for early discussion and feedback on project findings, as well as provide a setting for early feedback and real-time, parallel evaluation discussions. A reasonably detailed site-specific M&V plan will be discussed prior to the onsite evaluation. ComEd also will have an opportunity to review and comment on the M&V plans as they are drafted, prior to Navigant conducting a site visit.

Ex Post Analysis Approach

Navigant will utilize the guidance in the TRM v.7 CHP measure to assess the appropriate evaluation methodology, whether deemed or custom, for both gas and electric savings. Navigant will coordinate evaluation across the Illinois evaluation teams. Based on the TRM, a deemed or prescriptive evaluation method will be used depending on the deemed eligibility requirements in TRM v. 7. Where not eligible for deemed savings, the evaluation will follow a custom methodology.

Per the TRM, custom calculations may be used subject to agreement between the participant, the program administrator, and the independent evaluator (Navigant), however this does not eliminate ex post evaluation risk (retro-active adjustments).

Engineering desk reviews will be performed for all projects to complete ex post analysis. Desk reviews involve review of project documentation provided by the program, an engineering review of the algorithms and auditing ex ante calculation models used by the program to estimate energy savings. The engineering audit of program calculations determines if the inputs that feed the program calculations are reasonable and acceptable or need revision based on evaluation findings. Additionally, telephone interviews with the site contact(s) will be conducted in support of these desk reviews and information obtained from the interviews will be used to verify savings. Also, site contact(s) will be requested to provide production data electronically. The savings will be adjusted based on all the available information.

A site-specific engineering analysis will be performed for all projects. The engineering analysis methods will vary from project-to-project, depending on the complexity of the measures installed, the size of the associated electric and gas savings and the availability and reliability of existing data. Gross impact calculation methodologies are generally based on IPMVP protocols, options A through D. We will communicate the evaluation M&V approach to the customer before conducting the site visit.

The gross realization rate will be calculated for each site as ex post savings divided by ex ante electric and/or gas savings, based on Navigant's determination of the appropriate variables and project boundaries according to the TRM, such as whether the CHP system is a topping or bottoming system, and whether the CHP system participated in both gas and electric efficiency program. Given the long lead times for development of CHP projects, the evaluation will address projects that start during the plan period but do not complete one year of production within the evaluation year by annualizing the savings based on IPMVP best practices and attributing a full year of savings to the current evaluation year where sufficient documentation exists to support the savings. Where insufficient information is available to extrapolate the savings beyond the available metering period (production period) for the current evaluation year, Navigant will develop a realization rate relative to a pro-rated ex ante value, covering only the period where production data is reasonably available for the current evaluation year.¹¹

Gas savings will be addressed based on the avoided gas that would have been purchased to provide some or all the useful thermal energy output of the CHP system.¹² Note that "Net" as used in this evaluation plan generally refers to the Net to Gross factor (NTG) related to spillover and free ridership. The NTG factor is applied to the total claimable gross savings. The claimable gross savings is total energy savings that is net of energy adjustments as outlined in the TRM.

For each site, a site-specific report detailing evaluation findings will be prepared. ComEd will have an opportunity to review and comment on the site-specific reports prior to each being finalized.

Verified Net Impact Evaluation

Net-to-gross (NTG) evaluations have not been performed for this program, to date, since this is a new program. The evaluation will analyze NTG for each project starting in CY2019. Note that the NTG approach will be fully compliant with the Illinois NTG framework for CHP programs that has been adopted by the SAG and is part of the Illinois statewide TRM. The evaluation team will provide project-specific NTG values early for each project. Real-time free-ridership analysis will be conducted through a survey of participants. This approach to NTG research will likely be done every year for every project in the sample. NTG for CHP projects is expected to remain highly project-specific and not reduceable to a single deemed value, however Navigant in 2020 will consider based on projects to date whether any specific types of CHP projects may have a robust NTG that could be deemed based on further study.

Data Collection Methods

1. Telephone surveys with participant decision makers
2. Trade ally interviews – with participating equipment vendors (suppliers and/or installers).

Sample

We expect there will be a small number of CHP projects, and will therefore include all of them in the survey sample and use enhanced rigor to evaluate the NTG ratio. Participating customers will be interviewed in all cases. NTG research will also include interviews with program representatives and participating equipment vendors or influential opportunity assessment or facility assessment representatives. The vendor interviews will be conducted before the customer interviews. NTG research may also include secondary research on standard industry practices.

¹¹ This means that Navigant will advise ComEd ahead of final tracking data reporting, as part of the parallel evaluation agreement, which part of the year savings will be verifiable. ComEd will have sufficient time to adjust the ex ante reported savings for the highest possible realization rate for the current calendar year. Once sufficient data becomes available in the following year to verify the full annual savings, ComEd could report the remaining savings the following year that could not be verified the prior year.

¹² TRM v. 7, pp. 308-312.

All telephone sample points selected will be submitted to ComEd to obtain Project Overview documents which provide information on the primary decision maker (name/phone/email address), program staff's role in project implementation and any additional data related to program influence. The evaluation team will review the Project Overview documents before conducting NTG interviews.

Analysis

The evaluation team will calculate a net-to-gross ratio in CY2019 using CY2019 participant surveys and apply it retrospectively for CY2019. If enough data is available by the time of the SAG NTG deliberations in the fall of 2019, Navigant will present data for potentially deeming CY2020 NTG values through the SAG process. The telephone surveys will provide all inputs needed for the calculation of the program's net-to-gross ratio. Free ridership will be assessed using an algorithm approach which relies on survey self-report measure level data. Where there are multiple data sources, a result will be determined using triangulation between participant surveys, service provider surveys, implementation staff, and program staff interviews. Enhanced cases will include input from any relevant secondary research.

The existence of spillover will be examined using participant surveys self-report data. We will quantify spillover where (1) significant program influence is indicated and (2) significant spillover is revealed by the customer.

Survey: NTG and Process

Navigant will conduct NTG research through phone surveys with participating customers. The phone surveys will determine free ridership and spillover to inform NTG recommendations.

A battery of process questions will be added to the phone surveys with participating customers. Process questions will address: (1) participant satisfaction with the program overall, and key program elements; and, (2) the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, and participation procedures.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), the measure-specific and total ex ante and verified ex post gross savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated for each measure along with the total CPAS for all measures. Additionally, the weighted average measure life will be estimated.

Evaluation Schedule

Table 3 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available by the 4th Quarter.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	February 1, 2019
CY2019 program tracking data for QA/QC	ComEd	Quarterly: March 29, 2019 June 28, 2019 September 30, 2019 January 30, 2020 (final program tracking data)
Parallel impact evaluation: project documentation, engineering reviews, schedule, conduct on-site M&V, feedback for pipeline projects (all projects)	Evaluation	TBD
Tracking System Ex Ante Review Findings and Recommendations for paid projects (all projects)	Evaluation	July 30, 2019
Participating customer NTG survey fielding	Evaluation	TBD
Project documentation, engineering reviews, schedule, conduct on-site M&V, including baseline research as needed, feedback	Evaluation	February 18, 2019 – February 28, 2020
Illinois TRM Update Research Findings	Evaluation	March 2, 2020
NTG Analysis Findings	Evaluation	TBD
Internal Report Draft by Navigant	Evaluation	March 2, 2020
Draft Report to ComEd and SAG	Evaluation	March 9, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 30, 2020
Revised Draft by Navigant	Evaluation	April 6, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 13, 2020
Final Report to ComEd and SAG	Evaluation	April 22, 2020

ComEd Custom Program CY2019 to CY2021 Evaluation Plan

Introduction

The ComEd Custom Incentive Program provides a custom incentive to commercial, industrial and public sector customers, based on a formula, for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects. Custom incentives are available based on the project’s kWh savings, provided the project meets all program eligibility requirements. For eligible projects, ComEd pays an incentive between \$0.07 and \$0.21 per first-year kWh saved, depending on the technology, and caps the incentives at 100% of the incremental project cost. Starting in CY2019, the majority of the Data Center Program will become part of the Custom Program and there are various open questions that are likely to impact this evaluation plan. Given this point, Navigant will gather the appropriate evaluation detail to update this plan prior to the final draft in February 2019.

The objective of the CY2019 evaluation is to quantify net savings impacts from the Custom Program. Evaluation activities for CY2019 will be like CY2018. The CY2019 gross impact evaluation will not vary from previous years, but adjustments will be made to reflect specific measure and project characterizations. For the CY2019 evaluation, the evaluation team will continue working towards real-time verification and analysis. The main purpose of this is that it allows earlier engineering review and M&V work, ensuring that critical impact issues are resolved in early stages. Since large projects are likely to be selected in the sample, the evaluation team will review them in early stages of the project and provide feedback to ComEd as needed. This is to ensure that the calculation methodology and M&V plans align with the expectations of the evaluation team.

The evaluation will include a participating customer free ridership and spillover study. The findings from the study will inform recommended net-to-gross (NTG) values for Illinois Stakeholder Advisory Group (SAG) approval and future program application. The CY2019 NTG study will include in-depth interviews with participating customers to learn about their perspectives and satisfaction with the program, the energy assessment services and incentive offerings, and how to improve the program in the future.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Engineering Review	X	X	X
Impact – Modeling (as needed)	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – EE Service Provider Interviews	X		X
Process Analysis (as needed)	X	X	X

The evaluation team determined the evaluation approach for the 2019-2021 period based upon the needs of the program and the program's prior history. In prior program years, the evaluation was limited to analyzing the electrical energy savings claimed resulting from the program's influence. Like CY2018, the evaluation will continue to evaluate any potential gas savings that may occur because of the program. The team will evaluate both first-year savings and savings over the lifetime of the equipment. Real-time (parallel) evaluation will also be conducted for the largest projects where requested, and early feedback provided for complex projects. Open communication between the evaluation team and the ComEd Custom team will continue to be key in successfully meeting evaluation requirements. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Monthly review of completed and pipeline projects
- Multiple waves of sample pull throughout the year, based on completion rates of projects
 - Site-specific M&V (SSMVP) plans provided to the ComEd team for all sampled points receiving an on-site survey
 - Final Site Reports (FSRs) and detailed calculations for every sampled site
 - Real-time evaluation for the largest sampled points or early feedback provided, upon request
 - NTG analysis and reporting every alternate year (CY2019 and CY2021)
 - Cumulative Persisting Annual Savings (CPAS) will be calculated based upon the requirements of the Future Energy Jobs Act (FEJA)
 - Process surveys will be performed as needed, triggered by changes to the program scope, goals or to the implementation team

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What is the program's annual total lifetime verified gross savings?
2. What is the research estimate of gross savings (energy, peak demand, and total demand) for the program?
3. What is the program's lifetime verified net savings? What is ComEd's program influence versus other factors in installing energy efficient equipment?
4. What are the gas savings from the program?
5. What is the estimated free-ridership and spillover for participating customers? What is the research estimate for participant spillover for this program?
6. What are the opportunities for improvement for program impact calculations?
7. Has the program met its energy savings goals? If not, what barriers did the program face in meeting these goals?
8. Are the effective useful life (EUL) assumptions of typical measures to report lifetime savings in the CY2019 program valid and up-to-date?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. What are participants' perspectives and overall satisfaction with the program?
2. What are effective marketing strategies to inform customers of the Comprehensive Energy Savings Offers?
3. What is the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, participation procedures, program implementation and outreach?
 - a. What is the customer satisfaction level with the program and various program elements?
4. What is the effectiveness of program design and processes?
5. What is the level of customer and program partner experience and satisfaction with the program?
6. What is the level of program awareness and potential market effects?
7. How can the program be improved?

Evaluation Approach

Table 2 below summarizes the proposed data collection activities for CY2019 including the sample sizes and timing of each activity.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Three waves
In-Depth Interviews	Program Management and Implementers	2	Augment with monthly calls
Gross Impact Evaluation	Early Feedback File Review	TBD	Early Feedback for Large Projects
Gross Impact Evaluation	Engineering File Review	TBD	Three Waves*
Gross Impact Evaluation	On-site M&V	TBD	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	
Surveys: NTG and Process	Telephone Survey with Participating Customers	TBD	Free Ridership & Spillover, Process. Two Waves
Interviews: NTG and Process	Telephone Interviews with Influential Trade Allies Triggered by Customer Responses	TBD	Free Ridership & Spillover, Process. Two Waves
Literature Review, Secondary Research	Process and Impact Research on CY2019 Operations	TBD	Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Trade ally surveys are triggered by high importance ratings by participating customers to the trade ally or vendor. Therefore, the number of trade ally or vendor surveys is dependent on the results of the participating customer surveys.

In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in 2019. The first wave of M&V sampling is expected to cover about one-third of the projects.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

Program Manager and Implementer Interviews

We will conduct in-depth interviews with the program manager and implementation contractor. Interviews will focus on progress towards goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Gross Impact Evaluation

The evaluation will analyze program-level savings data by project size to inform the sample design for this population of measures. Separate samples will be calculated for data center measures and the remaining custom measures. Using the tracking data extract provided by ComEd, we will classify the population as either “data center” or “custom”, and then sort the two sets of projects from largest to smallest ex ante kWh claimed and place them into one of three strata, such that each stratum contains about one-third of the program total kWh claim.

The sample size will be calculated using the following equation:

$$n = \frac{ER^2}{\left(\frac{RP^2}{1.282^2} + \frac{ER^2}{N}\right)}$$

Where:

- n = Sample Size
- ER = Error Ratio (based on CY2018 results)
- RP = Relative Precision (10%)
- N = Estimated CY2019 Project Population
- 1.282 = One-tailed Z-Value for 90% Confidence

The error ratio for each sample will be calculated from a combination of prior program year results. The evaluation team expects a sample size of approximately 20 custom projects and 8 data center projects but will increase the cap of sample size up to a total of 33 projects, if necessary. The final number will be determined when the final count of the CY2019 population is known. Other than splitting the population into two categories, this approach is consistent with PY9 and CY2018 program evaluations. If the population variability in CY2019 remains close to that in CY2018, this cap will allow us to achieve the overall portfolio-level 90/10 requirements. We will conduct onsite M&V audits to confirm custom project savings and verify project details. We will perform onsite visits if there is uncertainty associated with the savings or if enough documentation was not provided for the desk review sites. These will be performed prior to January 2020.

We will perform sampling for both custom and data center categories in three phases during the CY2019 evaluation period. We will draw the sample for the first wave around May 2019 based on the number of paid projects completed. We will draw the sample for the second wave around October 2019 after most of the projects have been finalized. The final sample will be drawn after the program participation closes at the end of January 2020 and projects have had a chance to be finalized and paid. Final program gross and net impact results will be based upon the three waves combined.

Proposed gross impact sampling timelines are shown below.

- First wave sample drawn in April or May 2019 and completed July 2019
- Second wave sample drawn in October 2019 and completed November 2019
- Final wave starts February 2020 (or projects completion date)

Regarding core data collection methodologies, ComEd will have an opportunity to review and comment on the M&V plans as they are drafted, prior to conducting a site visit. Any comments provided by ComEd will be reviewed and addressed accordingly before finalizing the M&V plan. However, because of the tight timeline, the evaluation team expects to receive the comments on these M&V plans within five business days after the draft plans are completed.

Pre-metering and post-installation interval metering data will be collected from the program implementer for all the sampled projects. The evaluators will also request all available production data and other pertinent records and files from the implementers for all projects selected in the sample.

On-site M&V audits will be performed for approximately fifteen custom projects and five data center projects.¹³ Out of these projects, the evaluation team will select projects for metering from stratum one and stratum two sample points. These projects will be selected based on the verified conditions and available ex ante project documentation so that evaluation metering efforts can contribute significantly to developing ex post analysis.

Additionally, on-site audits will also include collecting information from dedicated facility meters for the system power usage or load profile (e.g., air-flow profile), when available. Production data and spot measurements will be collected to support ex post savings calculations.

Engineering desk reviews will be performed for approximately five custom projects and three data center projects to complete ex post analysis. Desk reviews do not incorporate on-site audits. Desk reviews involve review of project documentation provided by the program, an engineering review of the algorithms and auditing ex ante calculation models used by the program to estimate energy savings. The engineering audit of program calculations determines if the inputs that feed the program calculations are reasonable and acceptable or need revision based on evaluation findings. Additionally, telephone interviews with the site contact(s) will be conducted in support of these desk reviews and information obtained from the interviews will be used to verify savings. Also, site contact(s) will be requested to provide production data electronically for measure(s) installation detail. The savings will be adjusted based on all the available information.

In addition to the data collection methods highlighted above, monthly calls will be held between the evaluation team and ComEd to discuss program status, evaluation updates, and project-specific issues. This will allow for early discussion and feedback on project findings, as well as provide a setting for early feedback and real-time evaluation discussions. ComEd will also have an opportunity to review and comment on the M&V plans as they are drafted, prior to conducting a site visit. Any comments provided

¹³ The evaluation team may choose to perform additional onsite visits if there is uncertainty associated with the savings or if enough documentation was not provided for the desk review sites.

by ComEd will be reviewed and addressed accordingly within a 5-day review period before finalizing the M&V plans for a project.

A site-specific engineering analysis will be performed for the sampled CY2019 projects. The engineering analysis methods will vary from project to project, depending on the complexity of the measures installed, the size of the associated savings and the availability and reliability of existing data. Gross impact calculation methodologies are generally based on IPMVP protocols, options A through D. We will communicate the evaluation M&V approach to the implementation team before conducting the site visit. The measure-level engineering review will verify documentation and installed measure inventory and characteristics, hours of operation, modes of operation, and characteristics of replaced equipment. Any measured values obtained during on-site M&V audits will also be used to revise algorithm assumptions as appropriate.

The gross realization rate will be calculated for each site, and for the sample. For each site in the sample, a site-specific report detailing evaluation findings will be prepared. ComEd will have an opportunity to review and comment on the site-specific reports prior to each being finalized. Site-level gross impact realization rates from the sample will then be extrapolated based on kWh savings to the program population using a ratio estimation approach to calculate CY2019 program level gross impact estimates

The measure type will dictate the savings verification approach. We will also make a research estimate of gross savings based entirely on site-collected data and evaluation engineering analysis of savings. The two methods are described below:

1. Savings Verification

- Measures with fully custom or partially-deemed¹⁴ ex ante savings will be subject to retrospective evaluation adjustments to gross savings on custom variables. For fully custom measures, Navigant will subject the algorithm and parameter values to evaluation adjustment, where necessary. For partially-deemed measures, TRM algorithms and deemed parameter values will be used where specified by the TRM, and evaluation research will be used to verify custom variables.

2. Evaluation Research Savings Estimate

- The evaluation will also include an analysis of on-site collected verification data for a subset of projects. The engineering analysis methods and degree of monitoring will vary from project to project, depending on whether the measure has deemed savings or not, the complexity of the measures, the size of the associated savings, the potential to revise input assumptions, and the availability and reliability of existing data. The evaluators will contact the implementers prior to conducting site visits to ensure that the evaluation team has all correct and relevant information.

The measure-level realization rates will be extrapolated to the program population based on the ex-ante kWh using a ratio estimation method to yield ex post evaluation-adjusted gross energy savings. Any therm savings identified will be converted to kWh savings. Gross realization rates will be developed for energy and demand savings. The sample design will provide 90/10 statistical validity for the overall program. The sample of approximately 15 on-site audits and five desk reviews for the custom sample, and five on-site audits and three desk reviews for the data center sample is expected to achieve a 90/10 confidence/relative precision level (one-tailed test) to comply with the PJM verification requirements outlined in Manual 18B.

¹⁴ Fully custom savings refer to savings which take an entirely custom approach specific for that project, to calculating savings. These should be based on site-specific metering or billing data. Partially-deemed savings are those which rely on TRM calculations or input variables which are not specific to the site, but are deemed based on research.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the CY2019 net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed kWh NTG Value	CY2019 Deemed kW NTG Value
Custom kWh	0.56	0.58
Data Centers (New Construction) – Co-Location	0.20	0.20
Data Centers (Retrofit) – Co-Location	0.72	0.72
Data Centers (New Construction) – Non-Co-Location	0.71	0.71

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.pdf

Participant Surveys - Process Questions

A battery of process questions will be added to the surveys. Survey questions may address the effectiveness of program implementation and outreach, effectiveness of program design and processes, customer and program partner experience and satisfaction with the program, opportunities for program improvement, program awareness and potential market effects. These questions will be refined prior to deploying the survey and will answer the evaluation research questions in the section above on *Process Evaluation and Other Research Topics*.

Research NTG Impact Evaluation

Previous NTG evaluations have performed an NTG analysis for each program year. Due to the relatively stable results year to year, the evaluation team elected to conduct a combined NTG analysis for PY8 and PY9. The disadvantage of this approach is that findings are delayed considerably, which is an issue if the NTG ratios have fluctuated significantly from year to year, as was the case in PY8 and PY9. For now, the evaluation team will plan on collecting and analyzing NTG data every other program year and report NTG ratios in CY2019 and CY2021.¹⁵ The research plan net-to-gross ratios are based on primary data collected as described below. Note that the method described is fully compliant with the framework for Custom programs that has been adopted by the SAG and is part of the most recent Illinois statewide TRM.

Data Collection Methods

1. Telephone surveys with participant decision makers.
2. Trade ally interviews – with participating equipment vendors (suppliers and/or installers).

Content

Net-to-gross ratio: The telephone surveys will provide all inputs needed for the calculation of the program’s net-to-gross ratio. We will use the self-report method which assigns sampled projects to one of three levels of rigor, based on the size and complexity of the project:

¹⁵ The need to analyze and report the NTG ratios every year will be reconsidered in CY2020 based on previous findings and the state of the program.

- Basic – small or medium sized projects
- Standard – larger projects and smaller projects representing those measure categories that comprise the highest percentage of program savings impacts
- Enhanced – approximately 10-20% of the largest projects - this generally includes those with rebates of \$100,000 or greater

Navigant will field two waves of Free Ridership and Spillover surveys with participating customers. NTG survey questions will address both free ridership and participant spillover. Free-ridership questions will determine the value of energy savings coming from customers who would have installed the measures offered by the program in the absence of the program offering. Spillover questions will determine energy savings from measures installed outside of the program as a direct result of the program's influence. Together, the free-ridership and spillover survey answers will be used to calculate NTG ratios for the program.

Participating customers will be interviewed in all cases. Standard and enhanced cases will also include interviews with program representatives and participating equipment vendors or influential facility assessment representatives. The vendor interviews will be conducted before the customer interviews. Enhanced cases may also include secondary research on standard industry practices.

For enhanced cases, NTG summaries detailing all the findings from the interview performed by senior consultant will be provided.

Sample

The sampling approach for participant surveys will attempt to survey a sample of CY2019 customers to achieve one-tailed 90/10 confidence/precision level at the program level and will ensure that the sample points are representative of the program population.

All telephone sample points selected will be submitted to ComEd to obtain project overview documents which provide information on the primary decision maker (name/phone/email address), program staff's role in project implementation and any additional data related to program influence. The evaluation team will review the project overview documents before conducting NTG interviews

net-to-gross ratio will be calculated in CY2019 based on participant surveys for use in future evaluations. Free ridership will be assessed using an algorithm approach which relies on survey self-report measure level data. Where there are multiple data sources, a result will be determined using triangulation between participant surveys, service provider surveys, implementation staff, and program staff interviews. Enhanced cases will include input from any relevant secondary research.

The existence of spillover will be examined using participant surveys self-report data. We will quantify spillover where (1) significant program influence is indicated and (2) significant spillover is revealed by the customer.

Measure level information will be collected for the three largest measures to keep the interview to a reasonable length. However, this is only possible if there are sufficient findings differentiated by measure. The self-reported data is based on the level of program influence as reported by the customer and service provider. This could be at either the whole project level or at the individual measure level, if sufficient sample is available and depending on the project.

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Note that coordination with other utilities has not typically been needed for this program, but if issues arise, the evaluation team will coordinate needed discussion and evaluation.

Calculation of CPAS and Annual Savings

As required by FEJA, the measure-specific and total ex post gross and ex post net savings for the program and the CPAS in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Controlled Trial and Quasi-Experimental Design

The evaluation team will not use the Randomized Control Trial (RCT) or Quasi-Experimental Design for the evaluation because:

- There are not enough participants in this program to achieve statistically significant savings estimates using this method
- It is not possible to create a valid matched control group for the customers in this program
- This method estimates average savings across all program participants which is not the desired savings estimate for this program

Evaluation Schedule

Table 4 below provides the schedule for key deliverables and data transfer activities. (See Table 2 for other schedule details.) Adjustments will be made, as needed, as evaluation activities progress. Process analysis will be completed subsequent to the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered By
Program Operations Manual and Workpapers	ComEd	February 1, 2019
CY2019 program tracking data for QA/QC	ComEd	May 1, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 3, 2019
CY2019 participating customer survey design	Evaluation	June 28, 2019
Wave 1 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	July 26, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	August 30, 2019
Wave 1 participating customer NTG and process survey fielding	Evaluation	September 30, 2019
Wave 2 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	November 22, 2019
CY2019 Program EOY Tracking Data	ComEd	January 31, 2020
Wave 2 participating customer NTG and process survey fielding	Evaluation	February 28, 2020
Wave 3 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	February 28, 2020
NTG Analysis Early Findings	Evaluation	March 4, 2020
Internal Report Draft by Navigant	Evaluation	March 5, 2020
Draft Report to ComEd and SAG	Evaluation	March 12, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 2, 2020
Revised Draft by Navigant	Evaluation	April 9, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 16, 2020
Final Report to ComEd and SAG	Evaluation	April 23, 2020

ComEd Remote Commissioning Program CY2019 Evaluation Plan

Introduction

The ComEd Remote Commissioning Program is an energy efficiency program with the Retrocommissioning Program¹⁶ designed and operated for ComEd by Power TakeOff (PTO) that provides qualified ComEd business customers¹⁷ with energy management and information system services to better manage their energy usage, identify energy savings opportunities, and achieve energy savings through low- or no-cost energy-saving measures. The Remote Commissioning Program follows a step-by-step process to identify customers with significant potential for low- or no-cost energy savings, work with them to understand their energy usage and identify savings opportunities, enroll them in the Remote Commissioning Program, and monitor their progress throughout the program. Energy savings actions taken by each participant are documented as part of the program and the resulting energy savings claimed for each action are estimated by PTO using a regression analysis of the participant’s pre- and post-enrollment energy usage data.

Unlike behavioral energy efficiency (EE) programs that provide participating customers with generic energy savings recommendations, where little or nothing is known about the specific actions taken by individual participants, the Remote Commissioning Program collects specific information about each participant, including a detailed log of each contact PTO had with the customer, the operational actions each participant agreed to take, and the date each action was undertaken.¹⁸ Additionally, the program collects at least one year of pre-enrollment and three to six months of post-enrollment interval usage data from each meter.

Navigant will employ regression analysis to model the responses of individual participants’ energy usage to measure the program’s savings in CY2019. This is a one-year program and, as such, no evaluation activities are planned for CY2020 and CY2021 at this time.

Table 1. Evaluation Approaches for CY2019

Tasks	CY2019
Tracking System Review	X
Data Collection – Program Manager and Implementer Interviews	X
Data Collection – Participant Surveys	X
Impact – Regression Analysis (Customer-Specific)	X
Net-to-Gross – Customer Self-Report Surveys	X

Coordination

At present there are no equivalent programs at other Illinois utilities. We will continue to monitor that situation.

¹⁶ Although Remote Commissioning falls within the Retrocommissioning Program it will be evaluated separately due to differences in implementation and the evaluation methodology.

¹⁷ To qualify, a participant must be a ComEd business customer with at least one year of 30-minute interval smart-meter data available.

¹⁸ Recommended actions are focused on operational adjustments to automated systems and may include, but are not limited to, adjusting HVAC schedules to match occupancy, installing smart timers to turn off unneeded equipment during off hours, managing equipment start-up and shut-down schedules, and delamping.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual total verified gross savings?
2. What are the program’s verified net savings?
3. What is the appropriate net-to-gross ratio (NTGR) for this program?

Process Evaluation and Other Research Topics

1. What are the participants’ satisfaction with and perceptions of the program?
2. What aspects of the program would participants like to see changed?
3. Does the program implementer seek to channel participants to other ComEd EE programs, and did participants join other ComEd EE programs because of their experience with this program?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Evaluation Plan Summary for Remote Commissioning

Activity	CY2019
Gross Impacts Evaluation	Regression Analysis
Review of Apparent Uplift in Other EE Programs	Yes*
Sampling Frequency	Annual
Program Manager and Implementer Interviews	Yes
Materials Review	Yes
Participant NTG	Yes
Participant Survey	Yes

Gross Impact Evaluation

Navigant will measure the Remote Commissioning Program’s CY2019 annualized energy savings by developing baseline daily energy usage models for each CY2019 program participant, calibrated to their year of pre-enrollment daily usage data using regression analysis, of the form shown in Equation 1, and use the model to estimate each participant’s gross energy savings attributable to the program. Net CY2019 program savings will be the sum of the individual participants’ gross annualized savings.

Equation 1. Remote Commissioning Load Model

$$kWh_t = \beta_0 + \beta_1 Weekday_t + \sum_{i=1}^{12} \beta_{2i} Month_{ti} + \beta_3 CDD_t + \beta_4 HDD_t + \sum_{j=1}^J \beta_{5j} Change_{tj} + \varepsilon_t$$

where:

kWh_t	is customer energy usage during day t
$Weekday_t$	equals 1 when t is a weekday and 0 otherwise ¹⁹
$Month_{ti}$	equals 1 when t falls within month i and 0 otherwise
CDD_t	is the cooling degree-hours during day t ²⁰
HDD_t	is the heating degree-hours during day t ⁴
$Change_{tj}$	is a binary indicator that equals 1 when day t falls after agreed-upon behavior change j and 0, otherwise
The β_k	are unknown model parameters to be estimated
ε_t	is a white-noise disturbance with zero mean and constant variance

In cases where the above model is used to assess the energy savings from changes pertaining to exterior lighting measures, the model may be adjusted to include an hours-of-daylight variable based on the customer’s longitude and latitude. When this variable and the set of month dummies are both included, the CDD and HDD variables may be dropped from the model if there is evidence of multicollinearity.²¹

Participant-specific parameter values will be obtained by fitting the above model to each participant’s actual daily usage data and weather data using all available (pre- and post-enrollment) data. The parameter values will then be used, together with normal (TMY3) weather data²², to forecast individual annualized usage profiles for the post-install period for all participating customers. Annualized savings will be calculated by forecasting each participant’s predicted usage twice: once with the change variable(s) set to zero (to simulate their baseline usage) and once with the change variable(s) set to one (to simulate their usage with the changes in place) and subtracting the post-change profile from the baseline profile.

Navigant will consider using modified models for certain types of changes, such as the exterior lighting example described above. All alternative models will be discussed and agreed to by Navigant and the program implementer. Due to the lack of a control group we will be unable to adjust the savings for any uplift it causes in participation in other EE programs. However, we will review participation in other ComEd programs before and after participation in the Energy Analyzer Program. This will be an area of focus by evaluation.

Verified Net Impact Evaluation

The Illinois Stakeholders Advisory Group (SAG) consensus process agreed to a net-to-gross (NTG) value of 1.0 for this program for CY2019 (Table 2). Navigant will apply that NTG ratio to the adjusted gross savings to estimate the verified net savings for the program in CY2019.

¹⁹ The day-type granularity can be changed to daily increments (i.e., a Monday dummy, a Tuesday dummy, etc., rather than just a weekday/weekend dummy) if warranted by the customer-specific demand pattern or type of behavioral actions the customer agrees to undertake.

²⁰ Navigant will use a grid search to solve for individual premise degree-day balance points.

²¹ Past experience suggests that inclusion of the hours-of-daylight and month dummy variables in models for exterior lighting changes tends to annihilate the coefficients on the degree-day variables. Continuing to include them would not cause statistical bias to the coefficients of any included variables, but it might cause the regression standard errors to be larger than would be the case if the degree-day variables were dropped.

²² See http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ for more information.

The regression analysis described in the previous section produces gross savings with respect to free ridership.²³ Therefore, Navigant will pursue net-to-gross research in CY2019 to measure free-ridership. This research will involve participant interviews using the study-based protocol as defined by the Illinois Technical Reference Manual (IL TRM).²⁴ We will use the results of this analysis to support a revised NTG proposal for CY2020.

Table 2. Deemed NTG Value for CY2019

Program Path/Measure	CY2019 Deemed NTG Value
Remote Commissioning	1.00

Source: http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report measure-specific ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Navigant will not have the gas usage data and so will not calculate gas savings for this program.

Program Manager and Implementer Interviews

Navigant will conduct interviews with the ComEd program manager and implementation contractor to understand the program design and goals. These interviews will focus on how Power Takeoff recruits and interacts with customers, whether and how Power Takeoff informs customers about or promotes other ComEd program offerings, and any areas for program improvement. These interviews will be used to inform the survey instrument that will be used for the participant surveys.

Materials Review

Navigant will request and review program materials to ensure a thorough understanding of the program design and any materials that the program provides to the customer. This review may include documents such as marketing materials; materials provided to participants to explain the program, help them implement the recommended changes, or promote other ComEd program offerings; public and participant-only internet sites; or explanations of program design.

Participant Net-to-Gross and Process Survey

The participant surveys will be combined with the NTG research described above and will consist of 20- to 30-minute surveys. We will survey as many participants as can be reached²⁵ to provide a 90/10 confidence/precision level of NTG ratios for program-level savings. The survey will follow the appropriate free ridership and spillover protocols as defined in the TRM, with an additional focus on the process

²³ The evaluation does capture participant spillover, and the program is unlikely to generate significant non-participant spillover, but the evaluation does not remove free-ridership bias. Thus, research to identify free-ridership is warranted.

²⁴ See IL TRM version 7.0, volume 4, section 3.

²⁵ If participation is similar to PY9, when there were 75 participants in the program, Navigant will aim to reach a census of program participants, focusing on those with the highest energy savings.

research questions listed above (i.e., customer satisfaction and perceptions of the program, desired programmatic changes, and channeling).

Use of Randomized Control Trial and Quasi-Experimental Design

The evaluation team uses a regression-based evaluation method for this program, but it is not a randomized controlled trail (RCT) or quasi-experimental design (QED). An RCT is not being utilized as the program was not designed with a random control group. A QED is not being used as we expect the program savings to be very different for each customer since they’re getting a unique program experience; the method we are utilizing allows us to estimate customer-specific impacts, whereas QED would estimate average program impacts.

Data Requirements

Table 3 shows the data Navigant will need for the CY2019 evaluation.

Table 3. Data Requirements for CY2019 Remote Commissioning Evaluation

Required Data	Relevant Information Requested
	For all Remote Commissioning participants:
Tracking Data	• Account ID
	• Date participant was enrolled in Remote Commissioning
	• Date participant began each agreed-upon Remote Commissioning energy-saving action
	• Opt-out/move-out date (if relevant)
	• Type of Business or Segment
	• Customer contact information
	• Tracking data for other ComEd C&I EE programs (for evaluation of post-participation changes in program participation)
	For all Remote Commissioning participants:
Customer Usage Data	• Account ID
	• Daily energy usage values* for CY2019 (Jan 1, 2019 – Dec 31, 2019) and at least 1 year prior to enrollment
	• Corresponding 30-minute interval usage data for equivalent period

* Daily values rolled up from 30-minute interval AMI/AMR meter data obtained from PTO.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Process reporting will occur after the April 30th impact deadline.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Manager and Implementer Interviews	Navigant	December 3-21, 2019
Final evaluation data request sent to ComEd / PTO	Navigant	December 31, 2019
Final evaluation data delivered to Navigant	ComEd	January 30, 2020
Material Review and Participant Surveys	Navigant/Blackstone	January-February 2020
Draft Report to ComEd and SAG	Navigant	March 6, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 27, 2020
Revised Draft by Navigant	Navigant	April 3, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 10, 2020
Final Report to ComEd and SAG	Navigant	April 19, 2020
NTG Draft Memo to ComEd	Navigant	June 15, 2020
Comments on NTG Draft Memo (15 Business Days)	ComEd and SAG	July 6, 2020
Revised NTG Draft by Navigant	Navigant	July 13, 2020
Comments on NTG redraft (5 Business Days)	ComEd and SAG	July 20, 2020
Final NTG Memo to ComEd and SAG	Navigant	July 27, 2020

ComEd Industrial Systems Program CY2019 to CY2021 Evaluation Plan

Introduction

The Industrial Systems Program offers a combination of technical assistance and financial incentives:

- **Technical assistance** offered includes an industrial systems study which assesses the performance of the facility's industrial compressed air system, process cooling system, refrigeration system, or waste water treatment plant to ensure efficient, economical operation. This service examines the system's operating characteristics to help identify energy saving measures, using a combination of capital investments and low or no cost measures.
- ComEd offers a one-time **incentive** payment of \$0.12 per annual kWh saved after proper implementation of recommendations identified through the Industrial Systems Program. The exception to this are waste water treatment projects where the customer receives \$0.21 per annual kWh saved. Recommendations from the study that are implemented and incentivized by the program are not eligible for any other ComEd incentive. Eligible annual kWh and kW savings are determined through measurement and verification activities. The total incentive cannot exceed 100% of the total implementation costs or 100% of the total incremental costs for improvements recommended in the study.

The objective of the evaluation is to quantify CY2019 net savings impacts for the Industrial Systems Program. Key evaluation activities for CY2019 will take place from January 2019 through March 2020. Evaluation activities for CY2019 will be like CY2018. For the CY2019 evaluation, the evaluation team will work towards earlier engineering review and M&V work, to help ensure that critical impact issues are resolved early. Since large projects are likely to be selected in the sample, the evaluation team will review them in early stages of the project and provide feedback to ComEd as needed. This is to ensure that the calculation methodology and M&V plans align with the expectations of the evaluation team.

The CY2019 gross impact evaluation will not vary from previous years, but adjustments will be made to reflect specific measure and project characterizations. The evaluation will include a participating customer free ridership and spillover study. The findings from the study will inform recommended net-to-gross (NTG) values for Illinois Stakeholder Advisory Group (SAG) approval and future program application. The CY2019 NTG study will include in-depth interviews with participating customers to learn about their perspectives and satisfaction with the program, the energy assessment services and incentive offerings, and how to improve the program in the future.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Modeling (as needed)	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – EE Service Provider	X		X
Net-to-Gross – Technical Service Provider Interviews	X	X	X
Process Analysis (as needed)	X	X	X

The evaluation team determined the evaluation approach for the 2019-2021 period based upon the needs of the program and program’s prior history. Prior to CY2018, the evaluation was limited to analyzing the electrical energy savings claimed resulting from the program’s influence. Like CY2018, the evaluation will continue to evaluate any potential gas savings that may occur because of the program. The team will evaluate both first-year savings and savings over the lifetime of the equipment. Real-time evaluation will also be conducted for the largest projects when requested by ComEd, and early feedback provided for complex projects. Open communication between the evaluation team and the ComEd Industrial Systems team will continue to be key in successfully meeting evaluation requirements. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Monthly review of completed and pipeline projects
- Multiple waves of participant sample availability throughout the year, based on completion rates of projects
- Site-specific M&V (SSMVP) plans provided to the ComEd team for all sampled points receiving an on-site survey
- Final Site Reports (FSRs) and detailed calculations for every sampled site
- Real-time evaluation for the largest sampled points or early feedback provided, upon request
- Optimized timing on when to conduct NTG research
- NTG analysis and reporting every other year when programs are stable and NTG results are consistent over time
- NTG analysis each year when markets or program designs are changing
- Cumulative Persisting Annual Savings (CPAS) will be calculated based upon the requirements of Future Energy Jobs Act (FEJA)
- Process surveys will be performed as needed as it will be triggered based on changes to the program scope, goals or implementation team.

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Note that coordination with other utilities has not typically been needed for this program; if issues arise, the evaluation team will coordinate needed discussion and evaluation.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What is the program's annual total lifetime verified gross savings?
2. What is the research estimate of gross savings (energy, peak demand, and total demand) for the program?
3. What is the program's lifetime verified net savings? What is ComEd's program influence versus other factors in installing energy efficient equipment?
4. What are the gas savings from the program?
5. What is the estimated free-ridership and spillover for CY2019 participating customers? What is the research estimate for participant spillover for this program?
6. What are the opportunities for improvement for program impact calculations?
7. Has the program met its energy savings goals? If not, what barriers did the program face in meeting these goals?
8. Are the ex ante per-unit gross impact savings correctly implemented by the tracking system and reasonable for this program?
9. Are the effective useful life (EUL) assumptions of typical measures to report lifetime savings in the CY2019 program valid and up-to-date?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will assess the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, participation procedures, and determine customer satisfaction with the program and various program elements. The process research will address the following questions:

1. What are participants' perspectives and overall satisfaction with the program?
2. What are effective marketing strategies to inform customers of the comprehensive energy savings offers?
3. What is the effectiveness of program implementation and outreach?
4. What is the effectiveness of program design and processes?
5. What is the level of customer and program Energy Efficiency Service Provider (EESP) experience and satisfaction with the program?
6. What is the level of program awareness and potential market effects?

7. How can the program be improved?
8. How is the transition into CY2019 along with the public-sector programs impacting the program?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Timeline	Notes
Tracking System Review	Tracking system	Census	Three waves	Three Waves and Early Feedback for Large Projects
In-Depth Interviews	Program Management and Implementers	TBD	April 2019	Augment with monthly calls
Gross Impact Evaluation	Early Feedback File Review	TBD	June 2019 – Feb 2020	Early Feedback for Large Projects. Engineering File Review and On-site M&V
Gross Impact Evaluation	Engineering File Review	TBD	April 2019 – Feb 2020	Three Waves*
Gross Impact Evaluation	On-site M&V	TBD	April 2019 – Feb 2020	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	March 2020	Deemed Value
Surveys: NTG and Process	Telephone Survey with Participating Customers	TBD	June 2019 – March 2020	Free Rider & Spillover, Process. Two Waves
Interviews: NTG and Process †	Telephone Interviews with Influential EESPs Triggered by Customer Responses	TBD	June 2019 – March 2020	Free Rider & Spillover, Process. Two Waves
Literature Review, Secondary Research	Process and Impact Research on CY2019 Operations	TBD	April 2019 – March 2020	Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Trade ally surveys are triggered by high importance ratings by participating customers to the trade ally or vendor. Therefore, the number of trade ally or vendor surveys is dependent on the results of the participating customer surveys.

Tracking System Review

In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in 2019. Navigant will perform tracking system review and M&V project sampling in three waves in CY2019. The first wave of M&V sampling is expected to cover about one-third of projects completed in CY2019. Proposed gross impact sampling timelines are shown below.

- a) First wave sample drawn in April 2019 and completed in July 2019
- b) Second wave sample drawn in August 2019 and completed November 2019
- c) Year-end data provided by ComEd to Navigant by January 30 2020

- d) Final wave starts February 2020 (or projects completion date)

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Gross Impact Evaluation

The gross impact evaluation is a combination of desk reviews and on-site audits:

- **On-site audits** On-site metering (full M&V) activity is expected to be performed for a third of the selected sample (approximately seven sites). Note that the evaluation team will not perform metering if facility owned meters are already installed for data collection.
- **Desk reviews** will be performed for the rest of the sample (estimated to be three sites). The ex ante data, including metering data, will be the primary data source for ex post analysis. This desk review approach is like the RCx program’s desk review approach-auditing ex ante calculations and adjusting, if needed, based on any additional customer provided data, such as production data.

These evaluation approaches will provide the evaluation team sufficient detail and information to verify program achievements and provide recommendations to improve program performance. Also, these activities will allow the evaluation team to adjust the CY2019 evaluation approach (by reducing or increasing on-site activity) based on CY2018 findings. Since the program involves industrial facilities, where conditions may vary more than commercial facilities, the evaluation team believes the proposed approach will help verify the conditions and allow for informed adjustments to savings estimates for such sites. This will also help the evaluation team provide actionable recommendations to improve program M&V guidelines.

The evaluation will analyze program-level savings data by project size for this population of heterogeneous measures. Using the tracking data extract provided by ComEd, we will sort the projects from largest to smallest ex ante kWh claim and place them into one of three strata such that each stratum contains about one-third of the program total kWh claim.

The sample size will be calculated using the following equation:

$$n = \frac{ER^2}{\left(\frac{RP^2}{1.282^2} + \frac{ER^2}{N}\right)}$$

Where:

- n = Sample Size
- ER = Error Ratio (based on CY2018 results)

RP	= Relative Precision (10%)
N	= Estimated PY9 Project Population
1.282	= One-tailed Z-Value for 90% Confidence

The error ratio will be calculated from a combination of prior program results. Given the projected CY2019 project population, the sample size will be determined to achieve 90/10 confidence and precision levels. The sample size for CY2019 is estimated to be approximately 10 projects, like the CY2018 program evaluation.

Core data collection activities will include the following:

- We will collect pre-metering and post-installation interval data from the program implementers for all sampled projects. The evaluators will also request all available production data and other pertinent records and files from the implementers for all projects selected in the sample.
- We will perform on-site M&V audits for approximately seven projects.²⁶ Evaluators will select these projects for metering from stratum one and stratum two sample points based on the verified conditions and available ex ante project documentation so that evaluation metering efforts can contribute significantly to developing ex post analysis. On-site audits will also include collecting information from dedicated facility meters for the system power usage or load profile (e.g., air-flow profile), when available. Production data and spot measurements will be collected to support ex post savings calculations.
- Engineering desk reviews will be performed for approximately three projects to complete ex post analysis. Desk reviews do not incorporate on-site audits. Desk reviews involve review of project documentation provided by the program, an engineering review of the algorithms and auditing ex ante calculation models used by the program to estimate energy savings. The engineering audit of program calculations determines if the inputs that feed the program calculations are reasonable and acceptable or need revision based on evaluation findings. Additionally, telephone interviews with the site contact(s) will be conducted in support of these desk reviews and information obtained from the interviews will be used to verify savings. Also, site contact(s) will be requested to provide production data electronically for measure(s) installation detail. The savings will be adjusted as needed based on all the available information.

In addition to the data collection methods highlighted above, monthly calls will be held between the evaluation team and ComEd to discuss program status, evaluation updates, and project-specific issues. This will allow for early discussion and feedback on project findings, as well as provide a setting for early feedback and concurrent evaluation discussions. ComEd will also have five business days to review and comment on the M&V plans as they are drafted, prior to conducting a site visit. Any comments provided by ComEd will be reviewed and addressed accordingly before finalizing the M&V plans for a project.

The gross savings impact approach will review the ex ante measure type to determine whether it is covered by the Illinois TRM or whether it is a non-deemed measure that is subject to retrospective per unit savings adjustment of custom variables. The measure type, deemed or non-deemed, will dictate the savings verification approach. We will also make a research estimate of gross savings based entirely on site-collected data and evaluation engineering analysis of savings. The two methods are described below:

- A site-specific engineering analysis will be performed for the sampled CY2019 projects. The engineering analysis methods will vary from project to project, depending on the complexity of the measures installed, the size of the associated savings and the availability and reliability of existing data.

²⁶ The evaluation team may choose to perform additional onsite visits if there is uncertainty associated with the savings or if enough documentation was not provided for the desk review sites.

- Engineering calculations will be performed to derive gross kWh and kW savings. These calculations will start with an engineering audit of the algorithms used by the program to calculate energy savings and the inputs used for the algorithms. The engineering review will also include preliminary judgment to identify the assumptions with higher uncertainty or potential to influence the program savings estimate. The focus of the data collection will be to verify or update the assumptions that are used in the engineering algorithms for measure level savings. Data obtained for the sampled sites will serve to verify measure installation, determine installed measure characteristics, assess operating hours and relevant modes of operation, identify the characteristics of the replaced equipment and support the selection of baseline conditions and to perform ex post savings calculations. If needed, the evaluation team will use the data obtained from the sampled sites to model calculations using AIRMaster+²⁷ for compressed air projects, when the evaluators determine that the facility conditions have changed significantly, and the ex ante data or calculation model is no longer representative for estimating savings. The evaluation team will notify the implementation team when AIRMaster+ is being used for ex post analysis and the evaluation team will communicate any issues identified in the ex ante calculation models to the implementation team. The peak kW savings calculation methodology will be consistent with PJM requirements for each project.

A gross realization rate will be calculated for each site. Site-level gross impact realization rates from the sample will then be extrapolated to the program population using a ratio estimation approach. ComEd will have an opportunity to review and comment on the site-specific reports prior to each being finalized.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Industrial Systems kWh	0.77
Industrial Systems kW	0.78

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Rcommendations_2018-10-01.pdf

Participant Surveys

Participant survey questions will address both free ridership and participant spillover; see the next section for a discussion of the free ridership and spillover approach. We will add a battery of process questions to the participant surveys. These questions may include an assessment of the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, and participation procedures to determine customer satisfaction with the program and various program elements. These questions will be refined prior to deploying any process survey. Other data sources include program forms and marketing collateral, and findings from program manager interviews

²⁷ AIRMaster+ is a Windows-based software tool used to analyze industrial compressed air systems. It is intended to enable users to model existing and future improved system operation and evaluate savings from energy efficiency measures with relatively short payback periods.

We will attempt to survey a sample of CY2019 customers to achieve one-tailed 90/10 confidence and precision level at the program level and will ensure that the sample points are representative of the program population.

All telephone sample points selected will be submitted to ComEd to obtain project overview documents which provide information on the primary decision maker (name, phone, email address), program staff's role in project implementation and any additional data related to program influence. The evaluation team will review the project overview documents before conducting the surveys.

Research NTG Impact Evaluation

Previous NTG evaluations have performed an NTG analysis for each program year. Due to the relatively stable results year to year, the evaluation team elected to conduct a combined NTG analysis for PY8 and PY9. Although findings are delayed considerably, which is an issue if the NTGRs have fluctuated significantly from year to year, the evaluation team has found that Industrial Program results have been relatively stable year after year. For this reason, the evaluation team will continue collecting and analyzing NTG data for each program year, but only rolling up results and reporting NTG findings every other year. The research plan net-to-gross ratios are based on primary data collected as described below. Note that the method described is fully compliant with the framework for Custom programs that has been adopted by the SAG and is part of the most recent Illinois statewide TRM.

Data Collection Methods

1. Telephone surveys with participant decision makers
2. Service provider interviews with participating compressed air, process cooling and refrigeration service providers who completed projects in CY2019.

Content

Our NTG approach is consistent with the TRM and will address both free ridership and participant spillover. The telephone surveys will provide all inputs needed for the calculation of the program's net-to-gross ratio. We will use the self-report method which assigns sampled projects to one of three levels of rigor, based on the size and complexity of the project:

- Basic – small or medium sized projects.
- Standard – larger projects and smaller projects representing those measure categories that comprise the highest percentage of program savings impacts.
- Enhanced – approximately 10-20% of the largest projects - this generally includes those with rebates of \$100,000 or greater.

We will survey participating customers regardless of rigor. Standard and enhanced cases will also include interviews with program representatives and participating equipment vendors or influential opportunity assessment or facility assessment representatives. Further, for those projects that received a program-sponsored study, an interview with the service provider will be completed. Enhanced cases may also include secondary research on standard industry practices. For enhanced cases, NTG summaries detailing all the findings from the interview will be provided.

Analysis

The telephone surveys will provide the inputs needed for the calculation of the program's NTG ratio. Free ridership will be assessed using an algorithm approach which relies on survey self-report measure level data. Where there are multiple data sources, a result will be determined using triangulation between participant surveys, service provider surveys, implementation staff, and program staff interviews. Enhanced cases will include input from any relevant secondary research.

The existence of spillover will be examined using participant survey self-report data. We will quantify spillover where (1) significant program influence is indicated²⁸ and (2) significant spillover is revealed by the customer.

Our goal is to analyze and report NTG findings at the measure level. The measure level information will be collected for the three largest measures to keep the participant survey to a reasonable length. However, this is only possible if there are sufficient findings differentiated by measure type. The self-reported data is based on the level of program influence as reported by the customer and service provider. This could be at either the whole project level or at the individual measure level, if sufficient sample is available and depending on the project.

An abbreviated process evaluation is planned. The process evaluation will assess the:

- Effectiveness of program implementation and outreach
- Effectiveness of program design and processes
- Customer and program partner experience and satisfaction with the program
- Opportunities for program improvement
- Program awareness and potential market effects

A battery of process questions will be added to the planned surveys with participating customers. The findings and recommendations will be based on data collected from the surveys. The analysis is likely to include an assessment of the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, and participation procedures. Determine customer satisfaction with the program and various program elements. These questions will be refined prior to deploying any process survey. Other data sources include program forms and marketing collateral, and findings from program manager interviews.

Randomized Control Trial or Quasi-Experimental Design

The evaluation team will not use the Randomized Control Trial (RCT) or Quasi-Experimental Design for process evaluation because:

- There are not enough participants in this program to achieve statistically significant savings estimates using this method
- It is not possible to create a valid matched control group for the customers in this program

²⁸ Corresponding to a score of 8, 9 or 10 for the importance of the program on their decision to do the spillover.

- This method estimates average savings across all program participants which is not the desired savings estimate for this program

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), the measure-specific and total ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Process analysis will be completed subsequent to the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	February 1, 2019
CY2019 program tracking data for QA/QC	ComEd	May 1, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 3, 2019
CY2019 participating customer survey design	Evaluation	June 27, 2019
Wave 1 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	July 26, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	August 30, 2019
Wave 1 participating customer NTG and process survey fielding	Evaluation	September 30, 2019
Wave 2 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	November 22, 2019
CY2019 Program EOY Tracking Data	ComEd	January 30, 2020
Wave 2 participating customer NTG and process survey fielding	Evaluation	February 28, 2020
Wave 3 project documentation, engineering reviews, schedule, conduct on-site M&V, project tracking feedback	Evaluation	February 28, 2020
Illinois TRM Update Research Findings	Evaluation	March 1, 2020
NTG Analysis Findings	Evaluation	March 1, 2020
Internal Report Draft by Navigant	Evaluation	March 6, 2020
Draft Report to ComEd and SAG	Evaluation	March 13, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 3, 2020
Revised Draft by Navigant	Evaluation	April 10, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 17, 2020
Final Report to ComEd and SAG	Evaluation	April 24, 2020

ComEd Instant Discount Program CY2019 to CY2021 Evaluation Plan

Introduction

The non-residential Instant Discounts Program (formerly Business Instant Lighting Discounts, or BILD) is designed to provide an expedited, simple solution to business customers interested in purchasing high efficiency products by providing instant discounts at the point of sale. The Instant Discounts Program provides incentives for energy efficient LED lamps (screw based, pin based, and tubular), trim kits, and exit signs, and wall packs, as well as reduced wattage Linear Fluorescent (LF) lamps. Three-phase, high-frequency battery chargers are also offered through the Instant Discounts Program. Instant Discounts Program administrators are considering the addition of more non-lighting measures such as HVAC and motor measures, but these will not be included in CY2019.

The primary objectives of the evaluation of the Instant Discounts Program are to: (1) quantify gross and net program impacts and (2) identify ways in which the program can be improved. The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

The CY2019 program will not change significantly from CY2018, in terms of measure mix and end-use. Notable program changes made from CY2018 to CY2019 include:

- Addition of wall packs and requirement for installation address (end customer) for this specific incentive.
- Splitting of trim kit incentive categories to track and incentivize higher kW downlight fixtures.

The CY2019 gross impact evaluation will not vary from the previous years, but adjustments will be made to reflect specific measure and project characterizations. Additional free ridership and spillover research will occur in CY2020.

Given that new product classes are being added to the Instant Discounts Program and the overall rate of change in the lighting market (e.g. rapidly decreasing costs, increasing uptake of TLEDs, etc.), we currently recommend that most of evaluation activities occur annually. General population surveys and impact modeling are noted as potential one-time activities. General population surveys have not been used in the Instant Discounts Program before but could be a good compliment to participant surveys and identify reasons for non-participation. This approach is under consideration for CY2019. An impact modeling component is also marked as tentative in CY2019 to examine potential savings from lamps with dimming. A true examination of these savings would require an extensive lighting logger study. Lacking that, a combination of secondary research, modeling, and primary data collection through surveys would provide an initial assessment to inform future research.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Trade Ally Interviews / Roundtables	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Participant Surveys		X	
Net-to-Gross – Trade Ally Interviews		X	
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the 2019-2021 period, based upon the needs of the program and the program’s prior history. The three-year evaluation approach for this program is based on the following:

- A gross and net verification analysis will be performed in each year based on NTG deemed values as agreed to by the IL SAG NTG deeming process.
- The evaluators, program implementers, and ComEd will have regular (at least quarterly) check-in calls to keep the evaluation team informed of any changes to program design or product availability. These calls will also include discussions of data needs, errors, omissions, etc., as well as updates on evaluation activities.
- Participant and trade ally surveys and interviews are the primary data source for NTG, installation rate, and residential and non-residential split parameter estimate updates.
- While some of the split parameters have remained relatively stable over time, the lighting market is changing quickly, and it may be necessary to complete targeted research for certain lamp types each year. For instance, TLEDs are rapidly increasing in popularity and there is very little data supporting program drivers. Similarly, prices for LEDs in general have continued to drop dramatically which has NTG implications. The decision on how often to conduct parameter research will be evaluated in each year’s planning period and informed by comparisons to past evaluation research, market trends, distributor roundtable learnings, and overall evaluation priorities.
- Process analysis will be conducted each year, based upon ongoing feedback from program implementers, trade allies, and ComEd. The participant and trade ally surveys will inform process findings and recommendations.
- Cumulative Persisting Annual Savings (CPAS), calculated based upon the requirements of Future Energy Jobs Act (FEJA).

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. The Instant Discounts team is in close coordination with Ameren, which has an “Instant Incentives” program that also provides discounts at the point of sale through commercial lighting distributors. In CY2019 the ComEd and Ameren lighting program evaluations will continue to be closely aligned with respect to data collection activities and analysis methods.

Evaluation Research Topics

There are three primary areas of evaluation activity for CY2019: 1) a savings verification analysis that utilizes program tracking data, deemed parameters from the Illinois Technical Reference Manual (TRM), and recommended net-to-gross (NTG) values from the Illinois Energy Efficiency Stakeholder Advisory Group (SAG); 2) evaluation research, which consists of telephone interviews with program energy efficiency service providers and program participants to gather data on key evaluation parameters such as installation rate, residential and non-residential split, and net-to-gross; and 3) process research.

Evaluation research serves two functions. First, it allows a comparison of the verified program savings estimates (using deemed values) to evaluation research program savings estimates. Second, it provides key parameter values for deeming in future updates to the IL TRM as well as SAG recommended NTG.

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What is the level of gross annual energy (kWh) and gross peak demand (kW) savings induced by the program?
2. What are the net impacts from the program? What is the level of free ridership and spillover associated with this program? What is the researched value for net-to-gross (NTG) ratio?
3. Did the program meet its energy and demand savings goals? If not, why not?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. How burdensome is the rebate application and submission process for distributors? What elements of the program could be improved from the distributor perspective?
2. How aware are customers of the ComEd-sourced bulb discounts? How effective are the promotional materials (radio, web, e-mail, etc.) supplied by ComEd and associated marketing campaigns?
3. What is the distributor experience with selling LEDs and TLEDs in the program in terms of incentive levels and the quality and diversity of approved products?
4. How is the overlap between the Small Business Program and Instant Discounts Program affecting those programs, and are any changes recommended?

Evaluation Approach

As described in further detail below, the evaluation team has begun testing and implementing data collection strategies that will assist in ComEd's goal of receiving more real-time feedback on an ongoing basis. The evaluation will continue using a primarily web-based survey approach that can be fielded at regular intervals throughout the program year. The web-based approach has proven successful in recent program years for both distributors and participants. Also, the evaluation team will verify the application of TRM parameters in the tracking data on a regular basis throughout the program year. Through close coordination with the ComEd Instant Discounts program manager and program implementer, the

evaluation team strives to provide more timely and accurate feedback that can help to increase the effectiveness of the Instant Discounts Program.

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Three Waves and Early Feedback for Large Projects.
In-Depth Interviews	Program Management and Implementers	TBD	Augment with monthly calls
Gross Impact Evaluation	Early Feedback File Review	TBD	Early Feedback for Large Projects. Engineering File Review and On-site M&V
Gross Impact Evaluation	Engineering File Review	TBD	Waves*
Gross Impact Evaluation	On-site M&V	TBD	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	Deemed Value
Surveys: Free Rider and Process Evaluation	Email Survey with Participating Customers	250	Three Waves
Surveys: Process Evaluation	Email Surveys with Distributors	Census	
Interviews	Telephone Interviews with Distributors	As needed	

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review

In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in CY2019. The first wave of M&V sampling is expected to cover about one-third of the projects.

The Program Tracking Data collected for the CY2019 gross impact analysis will allow us to verify rebated measure sales and understand the characteristics of the installed measures that drive savings (such as bulb type and wattage).

Program Manager and Program Implementer Interviews

Program manager and program implementer interviews will be conducted with the ComEd Instant Discounts program manager as well as ICF/DNV GL staff, who manage the implementation of the Instant Discounts Program. These interviews will focus on program design, data collection, program participation, challenges and changes to the program.

Evaluation conference Calls and face-to-face meetings will be conducted with the ComEd program manager and program implementation team. These calls will be focused on the status of the Instant Discounts Program, recent updates to the program, and changes likely to occur to the program in CY2019 and beyond.

As in the previous evaluation cycles, the evaluation team will be conducting monthly calls with the ComEd program leads to improve communication and to better tailor evaluation activities to suit ComEd's objectives. The general discussion items for these 30-minute calls will include:

- Planned evaluation tasks
- Data requirements
- Planned project or data reviews
- Setting expectations for the next month

Impact Evaluation

The CY2019 gross impact evaluation will not vary from the previous years, but adjustments will be made to reflect specific measure and project characterizations. The evaluation will utilize the results of the CY2018 net-to-gross (NTG) research and recommendations from the Illinois Stakeholder Advisory Group (SAG) for assessing net program impacts. Additional free ridership and spillover research will occur in CY2020.

At regular intervals throughout the program cycle (every three to four months), the program tracking data will be reviewed for application of IL TRM v7 parameters. The evaluation team will provide a memorandum of findings to ComEd at each interval. Proposed gross impact sampling timelines are shown below.

CY2019 Gross Impact Sampling Waves

- a) First wave sample drawn in April 2019 and completed June 2019
- b) Second wave sample drawn in August 2019 and completed October 2019
- c) Final wave drawn in January 2020

After the conclusion of the program year, a thorough review of savings calculations will be performed. Gross kWh, kW and Peak kW savings will be calculated across all program bulbs using the following equations:

$$\begin{aligned} \text{Annual kWh Savings} &= \text{Program bulbs} * \text{Delta Watts}/1000 * \text{Annual HOU} * \text{Installation Rate} * \\ &\quad (1-\text{Leakage Rate}) * \text{Interactive Effects} \\ \text{Annual kW Savings} &= \text{Program bulbs} * \text{Delta Watts}/1,000 * \text{Installation Rate} * (1-\text{Leakage Rate}) \\ &\quad * \text{Interactive Effects} \\ \text{Annual Coincident Peak} &= \text{Annual kW Savings} * \text{Peak Load Coincidence Factor}^{29} \\ \text{kW Savings} & \end{aligned}$$

For the verification analysis in CY2019, the evaluation team will calculate gross savings using the following parameter estimates:

- **Program Bulb Sales** data will be obtained from the CY2019 Instant Discounts tracking database.
- **Program Bulb Installation Rates** (both current program year and delayed program year installations) will come from the IL TRM v7.0.

²⁹ Summer Peak is calculated as the percentage of lighting turned on in each room during peak hours of the summer months (hour ending 15:00 – 18:00 EPT, June 1 through August 32). <http://www.pjm.com/~media/documents/manuals/m18.ashx> (pg. 67).

- **Delta Watts** will be calculated using the lumen-equivalence mapping in the IL TRM v7.0.
- **Non-Residential HOU and Summer Peak CF** estimates will come from the IL TRM v7.0.
- **Residential/Non-Residential Bulb Installation** estimates will come from the IL TRM v7.0.³⁰
- **Energy and Demand Interactive Effects** will be estimated using the algorithms presented in the IL TRM v7.0.

The calculation of carryover savings will be broken out by measure and based on the following parameter estimates:

- **Delta Watts** – Verified savings estimate from the year of installation (source: IL TRM v7.0).
- **Residential and Non-Res Split** - Evaluation research from the year of purchase (PY9/CY2018 Report and IL TRM v5.0/v6.0).³¹
- **HOU and Peak CF** – Verified savings estimate from the year of installation (source: IL TRM v7.0).
- **Energy and Demand IE** – Verified savings estimate from the year of installation (source: IL TRM v7.0)
- **Installation Rate** - Verified savings estimate from the year of purchase (source: PY9/CY2018 report and IL TRM v5.0/v6.0).
- **NTGR** – Evaluation research from the year of purchase (source: PY9/CY2018 report and SAG recommended NTGR).

We will distribute surveys³² to participating customers to verify measure receipt and installation of program bulbs, collect data on the characteristics of the facility (such as business type and room location where program bulbs are being installed, which are related to hours-of-use [HOU] and Peak Coincidence Factor [CF] estimates), and gather other information that will help inform other key lighting parameter estimates (Delta Watts, Installation Rate) for the gross impact analysis. Additionally, as part of this research we will quantify the leakage of program bulbs outside of ComEd service territory and the proportion of program bulbs that is installed in residential locations.

Distributor Surveys and Interviews

Web-Based Distributor Surveys will also be used as a supplementary source of data in CY2019. Distributor surveys will also be used to explore process-related issues such as their experience with the rebate application and submission process, availability of approved products and incentive levels, and any recommendations for improving and streamlining the program. A web-based survey will be administered to all program distributors (via email) near the end of the program year. The evaluation team does not anticipate that all distributors will complete the survey, but with the assistance of ComEd program staff, will make every effort to ensure responses are representative of all types of program distributors.

Distributor Interviews will be undertaken. In-depth distributor interviews will be conducted on an as-needed basis to clarify responses received in the web-based distributor survey and to probe specific issues that are of high interest to ComEd. The content and focus of these interviews will be refined over

³⁰ Bulbs installed in residential locations will be assigned residential HOU and Peak CF estimates from the IL TRM v6.0.

³¹ Typically, carryover savings would use evaluation research findings from the prior two program years to estimate res/non-res split, installation rate, and NTGR.

³² Distributors collect email addresses at the time of purchase.

the course of the program year during the monthly evaluation calls with the Instant Discounts program manager and implementers.

The distributor surveys and a distributor roundtable will be used to explore additional process questions. The focus of this process research will be refined over the course of the program year with input from ComEd. Potential topics may include:

- Distributor experience with program incentive levels and co-pays for LEDs given widespread customer adoption and rapidly changing prices.
- Effect of import tariffs on pricing of efficient lighting and customer response
- Distributor experience identifying installation site/customer for wall pack transactions

Additionally, the evaluation will continue to participate in the distributor roundtable, where many process evaluation and market related topics may be discussed, giving more real-time feedback on the Instant Discounts Program from the distributors' perspective.

Net Impact Analysis

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table3. Deemed NTG Values for CY2019

Utility	CY2019 Deemed NTG Value
LED Lamp and Fixture	0.83
Linear Fluorescent	0.67
LED Exit Sign	0.80
Battery Charger	0.80
Linear LED	0.80

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final.xlsx

Process Evaluation – Distributor, Program Manager and Implementer Interviews

The process evaluation will include a brief synthesis of both qualitative and quantitative data collected during the program participant surveys and the distributor surveys. There are several process-related topics that can be explored using the data collected for NTG and other researched parameters including:

- Awareness of the discount provided by ComEd through various channels (web, radio, email, etc.)
- Importance of distributor recommendations for efficient lamps and influence on lamp choices
- Importance of ComEd supplied informational materials
- Importance of company or industry standard practice
- Business-type distribution
- Direction of initial customer communication with distributors

- Experience of end users related to national account aggregators

Finally, the Navigant teams evaluating the Small Business Program and the Instant Discounts Program will continue to carefully examine the overlap between these two programs and relevant savings impacts. The evaluation will also make recommendations on areas of improvement between the two programs, if applicable.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Control Trial and Quasi-Experimental Design

No portion of the process or impact analysis will use randomized control trial (RCT) or quasi-experimental design (QED). These techniques are not possible, given the program delivery method. We are not evaluating Instant Discounts via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental consumption data because this method would estimate average savings across all program participants which is not the desired savings estimate for this program

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Process analysis will be completed after the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	January 21, 2019
CY2019 program tracking data for QA/QC	ComEd	February 28, 2019
CY2019 Wave 1 program tracking data for verification and sampling	ComEd	April 30, 2019
CY2019 Wave 1 early impact verification memo	Evaluation	May 31, 2019
CY2019 Wave 1 participating customer survey	Evaluation	July 26, 2019
CY2019 Wave 2 program tracking data for verification and sampling	ComEd	August 30, 2019
CY2019 Wave 2 early impact verification memo	Evaluation	September 30, 2019
CY2019 Wave 2 participating customer survey	Evaluation	October 30, 2019
CY2019 Program tracking data for sampling Wave 3	ComEd	January 15, 2020
CY2019 Distributor survey	Evaluation	January 22, 2020
CY2019 Wave 3 participating customer survey	Evaluation	January 24, 2020
CY2019 Final program tracking data for verification	Evaluation	January 30, 2020
Draft Report to ComEd and SAG	Evaluation	March 6, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 27, 2020
Revised Draft by Navigant	Evaluation	April 3, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 10, 2020
Final Report to ComEd and SAG	Evaluation	April 20, 2020

ComEd LED Street Lighting Program CY2019 to CY2021 Evaluation Plan

Introduction

The LED Street Lighting Program seeks to secure energy savings by replacing mercury vapor (MV) and high-pressure sodium (HPS) fixtures with light-emitting diode (LED) fixtures. The Program targets municipalities with municipal and/or ComEd-owned high-intensity discharge (HID) street lights. There are approximately 600,000 municipality-owned and 150,000 ComEd-owned street light fixtures in the ComEd service territory. If 85% of these street lights are HID lighting fixtures, approximately 510,000 municipal and 127,500 ComEd-owned fixtures can be replaced for energy savings. The cost savings analysis for municipality-owned fixtures is the energy and maintenance savings. For ComEd-owned fixtures serving a municipality, the municipalities pay a monthly fee that recovers installed capital cost, maintenance cost and electricity cost based on a fixture-included street lighting tariff. Municipalities seeking to exchange a ComEd-owned fixture for a more efficient LED fixture prior to the existing fixture's failure would pay a fee (including compensation for ComEd's stranded asset) of approximately \$350 per fixture. Incentives offered under this proposed program would cover this fee, promoting early retirement of the existing HID fixtures for more efficient LED fixtures.

The evaluation of this Program will review ComEd's LED Street Lighting tracking data for consistency and accuracy of use of all values and proper application of Illinois Technical Resource Manual (TRM) LED savings values. The hours of use agreed to by ComEd and the Illinois Commerce Commission for LED Street Lights is outlined in the 2019 Illinois Statewide TRM version 7.0

Coordination

Navigant is also evaluating Ameren's streetlight program. We will ensure that the evaluation approaches are consistent across utilities, where appropriate, including fixture hours of use and baseline assumptions.

Evaluation Research Topics

The primary objectives of the evaluation of the LED Street Lighting Program are to: (1) quantify gross and net savings impacts from the program, and (2) as the program evolves, make recommendations to enhance the program.

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program's verified gross savings?
2. What are the program's verified net savings?
3. What updates are recommended for the Illinois Technical Reference Manual, including hours of operation?

Process Evaluation and Other Research Topics

The evaluation team will conduct a limited process evaluation by interviewing ComEd's program manager to explore opportunities to enhance the program. Additionally, the evaluation team will interview

municipalities in early 2019 to determine and deem the NTG value for municipality-owned fixtures based on CY2018 participants. The process research will address the following questions:

1. Does the municipality determine the type of fixture to be installed?
2. Are the installed fixtures eligible for incentives?
3. What are the marketing strategies for this program, and are they effective?
4. How can the program be improved?
5. Have program changes to the public-sector offering, and changes to the incentive level and program documentation, impacted program participation?

Evaluation Approach

The evaluation of this program over the CY2019 to CY2021 three-year period will include a variety of data collection and analysis activities, including those indicated in Table 1. The evaluation team determined the evaluation approach for the CY2019-2021 period, based upon the needs of the program and the program’s prior history.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Engineering Review	X	X	X
Impact – Verification and Gross Realization Rate	X	X	X
Process Analysis	X		X
NTG Review ³³ - Participant Self-Report	X	X	

The evaluation team determined the evaluation approach for the CY2019-2021 period outlined in the table above based upon the needs of the program and the program’s prior history. Navigant realizes that the program is relatively new and will likely change as it matures over the next three years. Navigant also notes that the current approach may change over the next three years as the program grows, but has based the current three-year evaluation approach on the following:

- Gross and net impact analyses will be conducted each year.
- NTG values are not likely to change over time unless major changes to the program occur. Reviewing NTG values in 2020 will allow Navigant to update NTG values as new customers participate in the program.
- Cumulative Persistence Annual Savings (CPAS) will be calculated annually based upon the requirements of the Future Energy Jobs Act (FEJA). The CPAS calculated in any given year will remain the same once reported and is unlikely to fluctuate yearly because of the limited number and consistency of measures available through the program.
- Process interviews will be conducted every other year (CY2019 and CY2020), based on the number of program participants. Once initial NTG values are calculated for municipality-owned fixtures, NTG values are not likely to fluctuate significantly unless many new participants engage

³³ Interview municipalities to deem net-to-gross value for municipality owned fixtures.

with the program. Navigant will assess the number of new participants every year to determine if NTG values need to be updated.

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Engineering File Review and Tracking Data Review
In-Depth Interviews	Program Management and Implementers	1	Augment with monthly calls
Gross Impact Evaluation	Engineering File Review	All	Three Waves*
Verified Net Impact Evaluation	Calculation using deemed NTG ratio		
Telephone Interviews - Researched NTG and Process	Participating Municipalities	~10-15	Various†

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† The evaluation team will seek ComEd’s guidance to reach out to municipalities for process interviews.

Tracking System Review

ComEd will upload program data on an on-going basis to the eTrack system for Navigant’s review. Additionally, ComEd will inform Navigant when all CY2019 data has been uploaded to the eTrack system. In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in CY2019.

Navigant will review project documentation and conduct an engineering review of the initial data provided by ComEd of both municipality-owned and ComEd-owned fixtures approximately half way through the calendar year. Navigant will provide a memo outlining the initial program findings. Navigant will draft impact findings to ComEd in a memo and work with ComEd and the Illinois Stakeholder Advisory Group (SAG) to edit the memo until it has been finalized.

In-Depth Interviews

Navigant will interview the program manager to understand changes in the program, and to make recommendations on program enhancements. Navigant will perform additional process research and interview municipalities to determine and deem the NTG value for municipality-owned fixtures and present ComEd with research findings in a memo. In CY2019, Navigant will interview the program manager to understand changes in the program, and to make recommendations on program enhancements. Navigant will perform additional process research and interview municipalities to determine and deem the NTG value for municipality-owned fixtures.

Gross Impact Evaluation

The program key gross impact evaluation activities for CY2019 will be based on (1) reviewing the tracking system to determine whether all fields are appropriately populated, (2) reviewing the hours of use information in the tracking system and provide recommendations based on research, if necessary, and (3) cross-checking measure totals and savings recorded in the tracking database.

Verified Net Impact Evaluation

Navigant will use a deemed NTG of 1.0 for ComEd-owned and municipality-owned fixtures for CY2019.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
ComEd-owned fixtures	1.0
Municipality-owned fixtures	1.0*

*Navigant will use a NTG value for the CY2019 evaluation but will conduct research into a more appropriate NTG value.

Source:

http://lsagfiles.org/SAG_files/NTG/2017_NTG_Meetings/Final/ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx

Telephone Interviews - Research NTG Impact Evaluation

Navigant will conduct a participating customer NTG study in early 2020 to provide NTG values for municipality-owned fixtures for potential deeming in future program years.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program as well as the CPAS generated by the program in CY2019. Additionally, Navigant will estimate average measure life for each of the unique LED fixtures in the program and generate a weighted (based on measure counts and energy savings) measure life at the program level.

Use of Randomized Control Trial and Quasi-Experimental Design

Given the small number of participants, Navigant does not plan to complete a randomized control trial (RCT) or quasi-experimental design (QED) approach to the process evaluation but rather, attempt to get a census of all participants.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Process analysis will be completed after the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Deadlines

Activity	Deliverable	Responsible Party	Date Delivered
Program Documents	Develop Program Operations Manual and Workpapers	ComEd	January 2, 2019
Data Upload	Upload CY2019 program tracking data to eTrack	ComEd	On going
Data Review	Review initial project documentation, engineering review and memo	Evaluation	August 15, 2019
Data Upload	ComEd to indicate when all CY2019 program tracking data has been uploaded to eTrack	ComEd	January 30, 2020
Data Review	Review entire program savings and complete engineering review	Evaluation	February 14, 2020
Program Report	Internal Report Draft by Navigant	Evaluation	February 21, 2020
Program Report	Draft Report to ComEd and SAG	Evaluation	March 4, 2020
Program Report	Comments on draft (15 Business Days)	ComEd and SAG	March 25, 2020
Program Report	Revised Draft by Navigant	Evaluation	April 1, 2020
Program Report	Comments on redraft (5 Business Days)	ComEd and SAG	April 8, 2020
Program Report	Final Report to ComEd and SAG	Evaluation	April 17, 2020
NTG Findings	Provide NTG findings (municipality-owned fixtures)	Evaluation	Q4 2020

ComEd Operational Efficiency Program CY2019 to CY2021 Evaluation Plan

Introduction

The Operational Efficiency Program (OEP) is made up of several, specific low-cost and operational measures that are identified while conducting ComEd engineering commercial and industrial facility assessments. OEP measures are not covered by the Custom or Standard Programs due to their no-cost or low-cost nature. The measures focus on applying maintenance or operational best practices to realize energy savings with little or no investment by the customer.

During a facility assessment, OEP measures are identified and entered into the OEP tracking system. Implementation may or may not occur at the time of the assessment. If it does not occur during the assessment, ComEd outreach professionals follow up with the customer to see if the measures were implemented. If implemented, outreach confirms the details of the conversation (who/when) and documents the action that was taken. If the action is different than what was identified in the facility assessment, the savings calculations are updated by the facility assessment engineer. When completed, the OEP measure becomes a “win” in the tracking system and is processed as a final application.

To calculate savings for measures included in this program, ComEd’s engineers have developed a calculator for each measure. The measures identified through the program include, for example, turning off lighting and equipment when not needed, addressing air compressor issues such as leaks and high-pressure adjustments, adjusting space temperatures with pre-existing controls, and simple HVAC maintenance.

In CY2018, Navigant focused on site savings through desk reviews of individual projects. Through this process, Navigant calculated a realization rate of program savings based on a sampled number of projects and identified inefficiencies in measure documentation. In CY2019, Navigant will continue to verify savings for new projects completed as well as look to provide insight into process improvements that could be implemented.

Evaluation of OEP will include the following activities over the CY2019 to CY2021 period:

Table1. CY2019-2021 Evaluation Plan Summary

Activity	CY2019	CY2020	CY2021
Gross Impact Approach	X	X	X
Gross Sampling Frequency	X	X	X
Verified Net Impact Approach	X	X	X
Researched NTG Approach	X		X
Program Manager and Implementer Interviews/ Review Materials	X	X	X
Participant Interview	X	X	X
Effective Useful Life Determination	X	X	X

Navigant anticipates the following evaluation activities will occur over the CY2019-2021 period:

- Gross savings will be calculated through a detailed desk review of the sampled projects.

- The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program – the program CY2019 NTG ratio is 0.94.
- Any resulting changes to savings will be rolled up to the sample and a program level realization rate will be calculated.
- We tentatively plan to conduct NTG research in 2019.
- Assist the ComEd OEP team as it revises and implements improved program calculators.

Due to the wide range of measures included in the program, it is difficult to calculate a program measure life. Instead, the program should consider calculating measure life for each of its individual measures and apply this measure life on a site-by-site basis. If requested, Navigant will provide input on individual measure life based upon secondary research in CY2019.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the actual achieved energy savings in this program?
2. How did the achieved savings compare to the ex ante estimates?

Process Evaluation and Other Research Topics

1. How is measure information collected during and after the initial assessment? In what ways could this process be improved?
2. How is the collected information used within the calculators created for the program? In what ways could this process be improved?
3. Is there a need to market this program or could this program be used in the marketing of the other programs (e.g., use of market facility assessments)?

Evaluation Approach

Overview

In CY2019, Navigant will focus on site-specific savings calculations and processes around the collection and processing of individual site data. Navigant will use telephone-supported desk reviews to review individual site savings. These reviews will involve:

- Reviewing each calculation method for each site
- Checking all assumptions and inputs against site information
- Identifying any potential discrepancies and following up with sites as needed

Navigant will complete a process survey with the program management team focused on data collection and recording for individual site projects. This interview will focus on how information is currently collected and how these practices could be improved.

Data Collection, Methods and Sample Sizes

For CY2019, Navigant will complete several site-specific calculation reviews. The sampling plan for this review will target overall 10 percent precision at 90 percent confidence using the stratified ratio estimation technique to optimize sample size and control evaluation costs. The strata will be defined by project size and offering type. Depending on the need of the program, Navigant may review a sample of projects in 2019, but the size of this sample will be determined later.

Table 2. Core Data Collection Activities and Sample

What	Target Completes 2018
Tracking System Review	
In-Depth Interviews	1
Engineering Calculation Desk Review	*

*The size of the sample will be determined later once full program data is available.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In-Depth Interviews

The process evaluation research will be informed by a Navigant staff site-by-site measure review, as well as an in-depth program manager interview. The CY2019 process evaluation research will include a synthesis of both qualitative and quantitative data collected during the program staff and implementer interviews, and during the participant surveys in CY2019. Work with ComEd to ensure cohorts and models are appropriate for the program going forward. We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Gross Impact Evaluation

The impact evaluation will be grounded in site-specific desk reviews. Navigant will collect individual site calculation data, review all calculation assumptions and follow up with sites as needed to update any inputs within the calculations.

Verified Net Savings Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program. For CY2018 that

ratio was 0.94.³⁴ Over the course of 2018 we examined the program theory and evaluation approach to inform discussions in the fall Illinois Stakeholder Advisory Group (SAG) net-to-gross (NTG) deliberations about the need for doing free ridership surveys with OEP participants in future years. We tentatively plan to do NTG research in CY2019 and CY2021.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated for each measure, along with the total CPAS for all measures. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Coordination

Navigant will coordinate with the evaluation teams from other utilities on any issues relevant to this program. OEP is unique to ComEd and is a catch-all savings program so coordination is likely to be minimal.

Use of Randomized Control Trails and Quasi-Experiment Design

The evaluation team will not evaluate this program via a randomized controlled trial (RCT) because the program was not designed with randomly assigned treatment and control groups.

The evaluation will not use quasi-experimental design (QED) because there are not enough participants for individual measures in this program to achieve statistically significant savings estimates.

Evaluation Schedule

Table 3 below provides the schedule for key deliverables and data transfer activities for 2019. Process analysis will be completed after the April 30th impact date and will be reported in a timely manner by the 4th quarter.

³⁴

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Table 3. Evaluation Schedule

Activity/Deliverables	Responsible Party	Date Delivered
CY2019 Site Calculations are available to Navigant	ComEd	Q2/Q3 2019
Sample of sites determined and approved	Evaluation	Q3/Q4 2019
Project review	Evaluation	Q3/Q4 2019
Program manager interview	Evaluation	Q2/Q3 2019
Internal Navigant Draft Report Review	Evaluation	March 5, 2020
Draft Report to ComEd and SAG	Evaluation	March 12, 2020
Comments on draft (15 Business Days)	ComEd	April 2, 2020
Redraft of Report	Evaluation	April 9, 2020
Comments on Redraft (5 Business Days)	ComEd	April 16, 2020
Final Report to ComEd and SAG	Evaluation	April 27, 2020

ComEd Public Housing Authorities Program CY2019 to CY2021 Evaluation Plan

Introduction

The Public Housing Energy Savings (PHA) Program provides standard and custom incentives for federally-assisted low-income and public housing, residential and common areas.

The purpose of this program is to: work with 21 Illinois Public Housing Authorities (PHAs) and their portfolios of 51,693 housing units and other buildings to achieve electric savings. This market segment is considered hard-to-reach and is comprised of the extremely low to very low-income groups, including seniors, disabled, and households on federal assistance. The residents are renters with incomes at or below 30% to 80% of the area median income poverty levels. The program provides outreach, education, and incentives to management of eligible buildings to upgrade old, inefficient energy equipment in residential units, common areas, maintenance and community buildings, and any other buildings they own and manage in ComEd’s territory.

Elevate Energy is the program implementation contractor for this program. Prior to PY2018, the program was operated under the Illinois Department of Commerce and Economic Opportunity (DCEO). CY2018 research focused on collecting foundational information on how Elevate Energy markets and implements the program, the experiences of the PHA managers participating in the program, and how data is being tracked, stored, and utilized to calculate savings impacts. In CY2019 and beyond, the research will reach beyond the foundational tasks by conducting research with building residents (the beneficiaries of the EE upgrades), defining the non-energy impacts of public housing programming, and conducting interviews with the growing number of Energy Efficiency Service Providers (EESP) delivering the program.

The primary objectives of the CY2019 evaluation of the Program are to: 1) quantify the gross savings impacts of the program, and 2) determine key process-related program strengths and weaknesses and identify ways in which the program can be improved.

The evaluation of this program over the next three years will include a variety of data collection and analysis activities, including those indicated in the following table.

Table 1. PHA Program Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Data Collection – Resident Interviews	X		X
Data Collection – Program Implementer Interviews	X	X	X
Data Collection – EESP and Stakeholder Interviews	X		X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Impact – NTG Analysis	X		X
Process Analysis	X	X	X

The three-year evaluation approach for this program is based on the following:

- Quantify the gross and net savings impacts of the program
- Determine key process-related program strengths and weaknesses and identify ways in which the program can be improved
- Data collection from the program manager and implementers will be conducted each year
- NTG analysis will occur in CY2019
- CPAS will be calculated based upon the requirements of FEJA
- Process surveys will be conducted each year to assess program performance with a focus on program operations

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Specifically, Navigant will coordinate impact and process research with the Ameren Illinois Public Housing Initiative evaluation team. Navigant will coordinate with the Ameren team on data collection and survey instrument design to ensure consistency and appropriate questions in the customer and Energy Efficiency Service Provider surveys. Navigant will also utilize the non-energy impacts (NEI) statewide working group as a venue to coordinate with Ameren and other stakeholders regarding methodology and objectives of NEI research for PHA programs.³⁵

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program's annual verified gross savings (energy, peak demand, and total demand)? What are the verified gross savings from lighting measures? What are the verified gross savings from non-lighting measures?
2. What is the monetary value of NEIs³⁶ resulting from the PHA Program, from the perspective of residents?

Process Evaluation

The process evaluation effort for CY2019 will focus on program growth and delivery, in addition to collecting information from the residents that are served by the program. The process research will address the following questions:

³⁵ NEI research is being coordinated with the broader ComEd NEI research underway and other statewide efforts.

³⁶ The NEIs in question will follow from portfolio-wide research efforts to quantify and monetize NEIs in low income programs and will utilize standardized questionnaires and approaches developed by the Navigant team and the Statewide NEI Working Group.

1. How and why do PHAs decide to invest in EE upgrades?
2. What are the shared decision-making responsibilities among PHA staff and building managers?
3. How satisfied are building residents with the program, if at all?
4. Are building residents receiving education on how to save energy?
5. Do the implementation contractors and EESPs receive sufficient support in delivering the program? Can the process be improved?
6. Are EESPs and others involved in the program satisfied with their participation in the program?
7. How will new participants be recruited as the program grows?

Navigant will work with ComEd and the implementer to determine priority research objectives in addition to those listed above, if any.

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
In-Depth Interviews	Program Management and Implementers	2	Augment with monthly calls
Interviews	PHA Residents	**	One wave of pre-treatment surveys to establish baseline conditions for eventual NEI measurement***
Telephone Interviews	Energy Efficiency Service Providers and Stakeholders	10	Small sample size reflects program size
Gross Impact Evaluation	Engineering File Review	25	Three Waves*
Verified Net Impact Evaluation	Calculation using deemed Net-To-Gross (NTG) ratio	NA	NTG deemed at 1.0

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

** Navigant will determine an appropriate sample size based on program size, portfolio-wide objectives, and prioritization of NEI measurements.

*** Navigant will conduct a post-treatment survey to measure NEIs one year after participation in the program.

Core data collection activities will include the following:

1. Engineering examination of ComEd tracking system calculations of claimed savings.
2. Engineering review of project documentation at the measure-level for a sample of projects to verify participation and tracking system entries, check documentation of invoiced quantities and installed measure characteristics, confirm compliance with eligibility, and deemed input values.

3. Interviews with a sample of public housing residents to measure NEIs of program participation, gauge satisfaction with the program, and determine if the program is providing sufficient educational value to residents.
4. Interviews with program management and key staff with the implementation contractor (IC). Regular monthly meetings by telephone with ComEd program staff and the IC staff.
5. The evaluation team will collect demand savings estimates and program and measure-specific cost detail to further ComEd's PJM auction and cost-effectiveness analysis.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, as well as education and marketing tactics.

Interviews with PHA Residents

We will conduct interviews with PHA residents either in person or via the telephone. Navigant may conduct the interviews in person based on previous recommendations on how best to reach this population. The primary objective of the interviews is to serve NEI research by establishing pre-treatment conditions related to health and safety, which may improve after program participation. Though the program does not directly address improvements for health and safety, EE measures may indirectly impact these areas. Given that the pre-treatment interviews will occur after program participation, they will ask about pre-period conditions retrospectively and will also cover topics such as program satisfaction, successes and challenges.³⁷ The interviews will be coordinated with PHA building managers and other relevant management.

Telephone Interviews with EESPs and Stakeholders

We will conduct in-depth interviews with ESPs and stakeholders. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and education and marketing tactics. These interviews will most likely be done in person.

Gross Impact Evaluation

Navigant will calculate program impacts in three waves³⁸ in CY2019. Proposed gross impact sampling timelines are as follows:

1. First wave sample drawn in June 2019 and completed in July 2019
2. Second wave sample drawn in October 2019 and completed November 2019
3. Third and final sample drawn in February 2020, or when all projects are completed and database is finalized.

³⁷ Pre-treatment interviews must occur after participation because the evaluation team will not know who participated in the program until the work has been completed.

³⁸ Conducting impact research in waves allows the evaluation team to confirm the consistent and reliable collection of all data needed to verify impacts. Additionally, conducting early impact work ensures timely completion of the evaluation cycle after the close of the program year.

The measure type, deemed or non-deemed, will dictate the savings verification approach. For measures with per unit savings values deemed by the TRM, Navigant will calculate verified gross savings estimated by multiplying deemed per unit savings (kWh and kW) by the database-verified quantity of eligible measures installed. Eligible deemed measures must meet all physical, operational, and baseline characteristics required to be assigned to the deemed value as defined in the TRM.³⁹ Measures with fully custom or partially-deemed ex ante savings will be subject to retrospective evaluation adjustments to gross savings on custom variables. For fully custom measures, Navigant will subject the algorithm and parameter values to evaluation adjustment, where necessary. For partially-deemed measures, TRM algorithms and deemed parameter values will be used where specified by the TRM, and evaluation research will be used to verify custom variables.

The measure-level realization rates will be extrapolated to the program population using a ratio estimation method to yield ex post evaluation-adjusted gross energy savings. Gross realization rates will be developed for energy and demand savings. The sample design will provide 90/10 statistical validity for lighting savings, non-lighting savings, and the program overall.

Verified Net Impact Evaluation

The evaluation team will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program. Therms savings will be subjected to the electric NTG adjustments. The SAG has deemed NTG at 1.0 for this program for CY2019.

Research NTG Impact Evaluation

The program has historically seen a deemed NTG ratio of 1.0 because the program targeted the income-eligible sector. However, because the income-eligible customers are not typically the decision makers for this program, Navigant believes the TRM NTG working group should consider whether it might be appropriate to do research on the NTG ratio for the Public Housing Energy Savings Program. If the TRM NTG working group deems it appropriate to conduct NTG research for this program, the evaluation team will build NTG research into future evaluation plans.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), the measure-specific and total ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Evaluation Schedule

Table 3 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress.

³⁹ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 6.0, available at: <http://www.ilsag.info/technical-reference-manual.html>

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	January 15, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 1, 2019
Wave 1 project documentation, engineering review completed	Evaluation	July 30, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	October 1, 2019
Participant Interviews	Evaluation	October 1, 2019
Wave 2 project documentation, engineering reviews completed	Evaluation	November 30, 2019
CY2019 Program tracking data for sampling Wave 3	ComEd	January 30, 2020
Wave 3 project documentation, engineering review completed	Evaluation	February 28, 2020
Internal Report Draft by Navigant	Evaluation	March 1, 2020
Draft Report to ComEd and SAG	Evaluation	March 8, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 29, 2020
Revised Draft by Navigant	Evaluation	April 8, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 15, 2020
Final Report to ComEd and SAG	Evaluation	April 24, 2020

ComEd Public Small Facilities Program CY2019 Evaluation Plan

Introduction

The Public Small Facilities (PSF) Program is designed to assist qualified ComEd public sector non-residential customers⁴⁰ to achieve electric energy savings by educating them about energy efficiency opportunities through no-cost on-site energy assessments conducted by preapproved, specially-trained Energy Efficiency Service Providers (EESPs).⁴¹ EESPs are the primary means of promoting the Public Small Facilities Program and obtaining participants.

Willdan, Energy Solutions is the implementation contractor for the Public Small Facilities Program.

The PSF Program in CY2018 included only lighting projects. In CY2019, the program will add HVAC end-use measures. The primary objectives of the CY2019 evaluation of the PSF Program will be to: (1) quantify the gross and net savings impacts of the program; (2) investigate potential gas savings counted as kWh (therms conversion); and (3) determine key process-related program strengths and weaknesses to aid in program improvement.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – General Population Surveys		X	
Data Collection – Participant Surveys	X		X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – EESP Interviews	X		X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – EESP Interviews	X		X

The evaluation team determined the evaluation approach for the CY2019-2021 period, based upon the needs of the program and the program’s history. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Optimized timing on when to conduct net-to-gross (NTG) research

⁴⁰ To qualify, participants must be ComEd public sector non-residential customers with monthly peak demand levels up to 100 KW.

⁴¹ No-cost direct-install measures include low-flow showerheads and faucet aerators, pre-rinse spray valves, smart power strips, and controls for novelty coolers, beverage machines, and snack machines.

- Cumulative Persisting Annual Savings (CPAS) will be calculated based upon the requirements of the Future Energy Jobs Act (FEJA) ⁴²
- Process research will be conducted each year based upon client request and program performance details

Coordination

Ameren Illinois does not currently have a program analogous to ComEd's PSF Program, and instead will serve small public-sector customers through their existing Small Business Program. Navigant will coordinate with the Ameren Illinois Small Business Program evaluation team on data collection, analytical methods, and survey instrument design to ensure consistency in our evaluation approaches for small public-sector facilities.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

- What are the program's verified gross savings?
- What are the program's verified net savings?
- What are the program's demand savings?
- What updates are recommended for the Illinois Technical Reference Manual (TRM)?
- What are the effective useful lives (EUL) of measures within the program?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research may address the following topics:

- How does the decision-making and project approval process differ for this cohort of customers?
- How much interest do decision makers have in non-energy impacts compared to financial metrics?
- What is the interest in comprehensive and/or non-lighting end use measures and projects?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

⁴² Illinois Public Act 099-0906 (<http://www.ilga.gov/legislation/publicacts/99/099-0906.htm>).

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019 (approx.)	Notes
Tracking System Review	Tracking system	Census	
In Depth Interviews	Program Management and Implementers	4	Augment with monthly calls
Gross Impact	Early Feedback File Review	Census	Two Waves*
Gross Impact	Engineering File Review	10	Early Feedback for Sampled Projects (One Wave)
Verified Net Impact	Calculation using deemed NTG ratio	Census	
NTG Research	Participants and EESP Surveys		Free ridership and Spillover research
Process and Impact Research on CY2019 Operations	Literature review, primary and secondary research		Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Navigant will complete an appropriate number of surveys with participants and interviews with EESPs to achieve statistically significant NTG results.

Navigant will perform tracking system review and engineering file reviews on a sample of participant projects in three waves in CY2019. Navigant will hold interviews with program management and key staff with the implementation contractor (IC) in CY2019 pertaining to impact, process and NTG research related issues (three waves of data collection). Navigant will use the SAG approved net-to-gross ratios for CY2019 to calculate program net savings in CY2019.

Gross Impact Evaluation

Since most PSF Program savings are derived from deemed values contained in the TRM, gross savings will be evaluated primarily by (1) reviewing the tracking system data and savings workbook to ensure that all fields are appropriately populated and savings are consistent with the implementation contractor’s workpapers and savings calculators that feed into the tracking system; (2) reviewing new measures’ algorithms and values in the tracking system and savings workbook to assure that they are appropriately applied; and (3) cross-checking totals. This approach will be supplemented where possible with a review of project documentation on a random sample of projects to verify participation, installed measure quantities, and associated savings. Findings from the impact analysis will be reviewed to provide an opportunity for improving the tracking system and data collection.

Proposed CY2019 gross impact and sampling timelines are shown below.

Core data collection activities will include the following:

1. Engineering examination of ComEd workpapers, tracking system and measure workbook calculations of claimed savings.
2. Engineering review of project documentation at the measure-level for a sample of projects to verify participation and tracking system entries, check documentation of invoiced quantities and installed measure characteristics, confirm compliance with eligibility, and deemed input values.
3. Computer assisted telephone interviews (CATI) with a sample of PSF Program project to quantify participating customer free-ridership and spillover, and trade ally free ridership and spillover.

4. Hold regular monthly meetings by telephone with ComEd program staff and the IC staff to discuss specific impact issues that need to be addressed during program implementation.
5. The evaluation team will collect PJM demand savings estimates and program and measure-specific cost detail to further ComEd’s PJM auction and TRC analysis.
6. Investigate potential gas measures with kWh savings and review the parameters ComEd used to estimate potential kWh savings (therms conversion).

Verified Net Impact Evaluation

The verified net impact evaluation will apply the NTG ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program (Table 3).

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Small Public Facilities (all public-sector measures)	0.92

Source: http://ilsagfiles.org/SAG_files/NTG/2017_NTG_Meetings/Final/ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx

Research NTG Impact Evaluation

Navigant will conduct a participating customer NTG study in CY2019 to provide NTG values for potential deeming in future program years through surveys with CY2019 participating customers. We will complete computer assisted telephone interviews with a minimum of 60 contacts who participated in the CY2019 program to quantify participant free-ridership and spillover (Navigant may attempt a census for the free ridership survey depending on CY2019 participation. The spillover research will include participants from CY2018). We will interview up to 20 participating EESPs to quantify free ridership and spillover, and average the results with customer participants results, to estimate program level NTG. The sample will be designed to achieve a 90/10 confidence/precision level of NTG ratios for lighting and non-lighting, and a roll up at the program-level, through a weighted average of lighting and non-lighting energy savings in the program.

Process Evaluation

The CY2019 process evaluation research will include a synthesis of both qualitative and quantitative data collected during the program staff and implementer interviews and meetings, and additional appropriate primary and secondary research in response to programmatic need. Navigant will research differences in the decision-making and project approval process for the public sector participants, including their interest in non-energy impacts compared to financial metrics. Navigant will investigate program participants and potential participants’ interest in comprehensive or non-lighting end use measures and projects. Navigant will perform additional process research, upon the request of the program manager, to support the program manager and implementer in transitioning into the revised regulatory requirements starting in CY2019.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and the CPAS in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also calculate gas savings from the program.

Use of Randomized Control Trial and Quasi-Experimental Design

Navigant is not evaluating the PSF Program via a randomized controlled trial (RCT) because the program was not designed with randomly assigned treatment and control groups. Navigant is not using quasi-experimental consumption data (QED) for the following reasons.

- It would not be possible to create a valid matched control group for the customers in this program.
- This method would estimate average savings across all program participants which is not the desired savings estimate for this program.
- This program delivers a unique mix of program measures to each participating customer. At best, a quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for all analysis.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities (see Table 2 for other schedule details.) The April 30th deadline in is for the impact report. The process and NTG findings will be delivered in different documents and on a different schedule. Adjustments will be made, as needed, as evaluation activities progress.

Table 4. Schedule – Key Impact Deadlines

Activity/Deliverables	Responsible Party	Date Delivered*
Monthly Evaluation Calls	ComEd/Navigant & IC Staff	Monthly as needed
Program Operations Manual and Workpapers/Workbook Review	ComEd/Nexant	March – April 2019
CY2019 Wave 1 Tracking Data	ComEd	July 30, 2019
Early impacts findings memo	Evaluation Team	August 30, 2019
Sample Projects Documentation for Review	ComEd	September 30, 2019
Wave 2 and Final CY2019 Tracking Data to Navigant	ComEd	January 30, 2020
Internal Impact Report Draft by Navigant	Evaluation Team	March 5, 2020
Draft Impact Report to ComEd and SAG	Evaluation Team	March 12, 2020
Comments on draft (15 Bus. Days)	ComEd / SAG	April 2, 2020
Revised Impact Draft by Navigant	Evaluation Team	April 9, 2020
Comments on Impact Redraft (5 Bus. Days)	ComEd / SAG	April 16, 2020
Final Impact Report to ComEd and SAG	Evaluation Team	April 26, 2020
Draft NTG Memo to ComEd and SAG	Evaluation Team	June 14, 2020
Comments on NTG Memo draft (15 Bus. Days)	ComEd / SAG	July 5, 2020
Revised NTG Memo Draft by Navigant	Evaluation Team	July 22, 2020
Comments on NTG Memo Redraft (5 Bus. Days)	ComEd / SAG	July 29, 2020
Final NTG Memo to ComEd and SAG	Evaluation Team	August 12, 2020

Coordinated Utility Retro-Commissioning Program CY2019 to CY2021 Evaluation Plan

Introduction

The Coordinated Utility Retro-Commissioning (RCx) Program seeks to realize energy savings by restoring building HVAC systems and optimizing controls to meet the needs of the current building occupants. RCx is a study-based process that generates savings through improved understanding and operation of the existing equipment, rather than capital outlays to install new equipment.

The RCx Program is managed by ComEd. ComEd coordinates with Nicor Gas, Peoples Gas and North Shore Gas to account for gas savings generated through the program. The RCx Program continues to evolve to serve more diverse customer segments. To reach smaller customers and market segments, the utilities began expanding the program to support additional offerings in the fifth electric and second gas program years (PY5/GPY2) and in the seventh electric and fourth gas program years (PY7/GPY4). Beginning in CY2018 public sector customers could participate in any of the RCx offerings from the utilities.

There are four RCx Program options to optimize energy performance:

- Traditional RCx represents the original offering for large commercial buildings and completes a four-phase RCx process (Planning, Investigation, Implementation, and Verification). Projects are unique, and savings are determined using program standard and custom calculations developed by service providers and implementation contractors with input from the evaluators.
- Monitoring-Based Commissioning (MBCx) is a long-term engagement between the Energy Efficiency service provider (EESP) and customer to identify, implement, and monitor measures over time. MBCx features the integration of monitoring software into the building automation system to assist in the identification and documentation of deeper energy saving opportunities than those found in traditional RCx. It can also be used as a process to continue and augment prior projects that will help ensure measure persistence and improve building operations over time.
- Retro-Commissioning Express (RCxpress) is an offering targeted to mid-sized commercial buildings or buildings interested in a shorter project timeline. RCxpress is differentiated by a more streamlined approach to RCx with a targeted list of measures and uses program-standard calculators in addition to custom calculations for savings estimates.
- RCx Building Tune-Up (Tune-Up) is for public and private customers less than about 150,000 ft² but with more than 100 kW of peak demand. This offering offers an implementation incentive in addition to the RCx study incentive provided in the other offerings.

Navigant anticipates that the evaluation will pursue the following research areas for CY2019 to CY2021:

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X		X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Trade Ally Interviews		X	
Impact – Project-specific Billing Analysis	X	X	X
Impact – Engineering Review and Site Visits	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – Service Provider Interviews	X		X
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and program’s prior history. The three-year evaluation approach for this program is based on the following:

- RCx measures are custom to respective applications and often use custom calculation tools to estimate savings. As a result, we will continue to review and estimate gross and net impacts each year over CY2019-2021.
- Because of the longevity and stability of the program, we will conduct process research with participants and service providers every other year, in keeping with past patterns. To minimize outreach costs, we will ask NTG questions during the same interview session as our process evaluation.
- Cumulative Persistent Annual Savings (CPAS) will be calculated based upon the requirements of the Future Energy Jobs Act (FEJA).
- Following the pattern from past evaluations, Navigant will conduct Net-to-Gross (NTG) research in alternate years. NTG research with participants and EESPs will conform to statewide NTG methodologies described in the Illinois Technical Reference Manual.

The primary objectives of the CY2019 RCx evaluation is: (1) to quantify net savings impacts in therms, kWh, and kW from the program during CY2019 and identify any systemic problems with calculators; (2) to update net-to-gross for program offerings for both gas and electric savings in 2019 and 2021 for electric and only 2019 for the gas companies; and (3) to determine key process-related program strengths and weaknesses and identify ways in which the program offering(s) can be improved. The process evaluation will include input from program management and the experiences of active EESPs and participants.

Coordination

Navigant will coordinate with the evaluation teams for other Illinois utilities on any issues relevant to this program. A collaborative agreement between ComEd and the gas utilities promotes estimating complementary gas savings at ComEd customer sites for all RCx offerings. The RCx Program evaluation plan parallels the planned work for the Ameren Illinois (AIC) RCx Program. Both the ComEd and AIC programs will conduct annual impact evaluations. Depending on the number of completed projects the

AIC impact analysis may include a sample or census of participants. Approximately 30% of sampled projects will also receive on-site verification.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable topics:

Impact Evaluation

1. What are the program's first year verified gross savings?
2. What are the program's first year verified net savings?
3. What is the CPAS for the program⁴³?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will include participants in the ComEd offerings. Process research may focus on persistence, channeling, and program delivery, and may address the following questions:

1. Why do Tune-Up customers drop out of the program?
2. How can channeling be increased across the portfolio?
3. How can reports be more valuable to the customers and offer next steps that are easy to follow?
4. How can program materials better encourage action from customers?
5. How does facility staff turn-over impact persistence of savings?
6. How do controls contractors impact project timelines?

Some insight into these questions may be learned from recent CY2018 process evaluation research. Other topics for investigation may be raised by any of the coordinating utilities. New information will inform the TRM. Navigant will perform additional process research which may include research on impact of public sector projects introduced into the program, and effective useful life.

Evaluation Approach

Due to the custom analysis for each RCx project, we anticipate continuing to conduct impact research each program year. Navigant will use impact methodologies from the International Performance Measurement and Verification Protocols (IPMVP), as appropriate for the market segment we are researching. In some cases, Navigant may opt to use regression methods with meter data (IPMVP – Option C) for Tune-Ups or select measures in other offerings which would be apparent on meter data seasonally or during select hours of the day.

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

⁴³ CPAS estimates will use the 7.5 EUL determined from recent research by SeventhWave, 2018.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Three waves
In-Depth Interviews	Program Management and Implementers	4	Augment with monthly calls
Service Provider Interviews [†]	Active retro-commissioning service providers (EESP)	10	Census sample frame
Participant Interviews	Program Participants	40	Census sample frame
Gross Impact Evaluation	Early Feedback File Review	10	Early Feedback for Large Projects
Gross Impact Evaluation	Engineering File Review	50	Three Waves*
Gross Impact Evaluation	On-site M&V	24	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	Census	

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Trade ally surveys are triggered by high importance ratings by participating customers to the trade ally or vendor. Therefore, the number of trade ally or vendor surveys is dependent on the results of the participating customer surveys.

Tracking System Review

In line with changes to the RCx offerings and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review and M&V project sampling in waves in 2019. Initial feedback on sampled project files will occur within 45 days of their posting. Navigant will report monthly preliminary evaluated impact findings. The three waves of M&V sampling are expected to cover about one fourth, one fourth and one half of the projects, respectively.

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, as well as marketing tactics and EESP education.

Service Provider Interviews

The evaluation team will conduct interviews with RSPs to inform NTG recommendations for each program offering. Interviews will address free-ridership and participant spillover using protocols developed by the Illinois EM&V NTG Working Group and incorporated into the TRM.

We will sample a census of service providers participating in each offering.

Participant Interviews

We will interview 40 participants to inform NTG recommendations for each program offering, gauge participant satisfaction and answer other key participant research questions. Interviews will address free-ridership and participant spillover using protocols developed by the Illinois EM&V NTG Working Group and incorporated into the TRM.

We will target a 90/10 sample by program offering. For natural gas NTG research, we will attempt a census of all gas projects. Each gas participant data point will also constitute an electric participant data point.

Gross Impact Evaluation

The CY2019 gross impact evaluation will not vary significantly from the previous years, but the sampling plan may be adjusted to reflect ComEd's research goals.

Sampling Strategy

Our overarching goal is to research savings impacts sufficiently to report program-level savings at $\pm 10\%$ precision and 90% confidence for each utility. We will also accommodate secondary research objectives, such as analysis by offering and/or sector level (public vs. private) as requested by ComEd, but with relaxed precision and confidence, to fit research within budget constraints and as permitted by ComEd.

The primary differentiator among participants is whether they are private or public-sector customers. Our sampling and analysis plans will seek to report on these groups with confidence and precision. The private sector offerings use an overlapping pool of service providers. As such, these projects will be sampled by size-based strata and analyzed together. The RCxpress or Building Tune-Up offering participants may form their own stratum(a) in the sampling protocol to ensure adequate representation in the sampling. The sampling plan for private sector participants will target at least overall 15% precision at 85% confidence using the stratified ratio estimation technique to optimize sample size and control evaluation costs. The strata will be defined by project size and/or offering type.

Public sector participants are significantly different from the private sector and these projects will be sampled separately, but in a similar manner, while also targeting overall 15% precision at 85% confidence⁴⁴.

The impact research sample will be drawn in July 2019 based on actual status and *informed expectation to complete* prior to year's end. Since most RCx projects take several months between application and completion, the July status should identify most projects anticipated to complete in CY2019. After program ex ante results are final, the July sample will be compared to the year-end program participation and savings, and Navigant will adjust the July sample to comply with sampling goals by adding additional projects to the sample (if participation exceeds July expectations), or not replacing projects that did not complete (if program participation falls short of July expectations).

Natural gas impacts will be sampled and evaluated in a similar fashion to ensure 90/10 confidence and precision for each gas utility at the program-level. Projects with gas savings will be organized in utility-specific sampling frames and stratified for sampling by savings magnitude. To reduce over-sampling of

⁴⁴ Sampling in this manner for 85/15 confidence/precision is the approach used by Exelon-PECO for sub-program level research. When the subprograms are considered the overall research achieves 90/10 results for the program.

electric savings participants, Navigant will sample gas projects first and then sample the appropriate number of electric-only projects to complete the electric sample.

CY2019 Gross Impact Research Waves

Navigant will perform tracking system review and M&V project review in three waves in CY2019 following an initial sample plan in July 2019. The first wave of M&V review is expected to cover about one-quarter of the projects.

All sampled projects will be subject to engineering file review and about 50% of sampled projects will receive on-site inspection and verification of installed measures. Navigant will employ IPMVP – option A or B for projects enrolled in RCx, MBCx and RCxpress. Gross impact estimates will mimic ex ante methods to the extent they are reasonable and accurate per data collected during verification steps. The evaluation team will modify calculations if methods are not reasonable or if verified operation differs from what was reported.

The Tune-Up impacts will be verified by engineering file review and may be determined with regression analysis of trend or utility billing data and weather or other independent variables that affect energy use (for example, days of operation), as appropriate. This approach parallels IPMVP Option B or C, depending on which data are used. On-site verification of Tune-up projects will attempt to confirm that measures implemented for the program persist until evaluation verification. If implemented measures are not amenable to regression analysis, the engineering review will form the basis of evaluated savings using IPMVP Option A. This review process may point to special needs of this market segment. As noted above, Navigant will sample Tune-Up projects to report an offering-specific realization rate at 85/15 confidence and precision.

Proposed gross impact timeline:

- a) Projects completed and sampled at the time of the sample draw, will be researched by the end of October 2019.
- b) Second wave of completed projects will be posted in September 2019 and verified by December 2019.
- c) Final wave of completes will be posted January 15, 2020.

Table 3 below summarizes data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions for each program offering. For planning purposes, Navigant assumes CY2019 participation will be similar to CY2018 participation⁴⁵: RCx (14), MBCx (17), RCxpress (19), and Tune-Up (65). Participation by gas utility customers is unknown at the time of this Plan, but we anticipate approximately 40% of participants will be gas customers, based on recent history. The number of gas participants spread across three utilities may necessitate a near-census sampling of gas participants.

⁴⁵ Counts based on analysis of the October 1, 2018 operations report and past performance completing pipeline projects.

Table 3. CY2019 Core Data Collection Activities and Sample*

What	Who	Private Sector Target Completes (approx.)	Public Sector Target Completes (approx.)
Engineering Review	Participating Customers	235	18
Onsite M&V Audit†	Participating Customers (nested among engineering review sample)	117	19
In Depth Interviews	Program Management‡	4	2

* Final sample sizes may change based on actual participation and stratification

† Onsite M&V Audits are a subset of Engineering Reviews, not a unique sample

‡ Includes interviews with implementation contractor management as well as utility program management. Interviews across offerings may be combined if management teams are shared. Due to the length of the program year, Navigant plans to interview some managers twice.

The gross savings impact approach will review the ex ante measure type to determine whether it is covered by the Illinois TRM or whether it is a non-deemed measure that is subject to retrospective per unit savings adjustment of custom variables. The measure type, deemed or non-deemed, will dictate the savings verification approach. We will also make a research estimate of gross savings based entirely on site-collected data and evaluation engineering analysis of savings. The two methods are described below:

Savings Verification

- Any measures with per unit savings values deemed by the TRM, or otherwise directed by the TRM, would have verified gross savings estimated by multiplying deemed per unit savings (therm, kWh and kW) by the verified quantity of eligible measures installed. Eligible deemed measures must meet all physical, operational, and baseline characteristics required to be assigned to the deemed value as defined in the TRM.⁴⁶
- Measures with fully custom or partially-deemed ex ante savings will be subject to retrospective evaluation adjustments to gross savings on custom variables. For fully custom measures, Navigant will subject the algorithm and parameter values to evaluation adjustment, where necessary. For partially-deemed measures, TRM algorithms and deemed parameter values will be used where specified by the TRM, and evaluation research will be used to verify custom variables.

Evaluation Research Savings Estimate

- The evaluation will also include an analysis of on-site collected verification data for a subset of projects. The engineering analysis methods and degree of monitoring will vary from project to project, depending on the complexity of the measures, the size of the associated savings, the potential to revise input assumptions, and the availability and reliability of existing data. The evaluators will contact the implementers prior to conducting site visits to ensure that the evaluation team has all correct and relevant information.

The measure-level realization rates will be extrapolated to the program population using a ratio estimation method to yield ex post evaluation-adjusted gross energy savings. Gross realization rates will be developed for energy and demand savings. The sample design will provide 90/10 statistical validity for program savings overall. The sample of on-site visits drawn is also expected to achieve an approximate 90/10 confidence/relative precision level (one-tailed test) to comply with the PJM verification requirements outlined in Manual 18B.

⁴⁶ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: <http://www.ilsag.info/technical-reference-manual.html>

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 4. Deemed NTG Values for CY2019

Coordinated Energy Efficiency Program Offering	CY2019 Deemed NTG Value
RCx	0.94
MBCx	0.94
RCxTune-Up	0.94
RCxpress	0.94
All-Natural Gas	0.94

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Navigant will apply overall values to all RCx Program offerings.

Research NTG Impact Evaluation

The evaluation team will conduct NTG research to inform NTG recommendations for the future for each program offering. Evaluators will collect NTG data for all program offerings in CY2019 and CY2021 for electric and in 2019 for gas. Public and private sector NTG will be determined separately. All NTG research will address free-ridership and participant spillover using survey protocols developed by the Illinois EM&V NTG Working Group and incorporated into the TRM.

Our NTG research sampling will attempt a census of service providers participating in each offering. The participant surveys will target a 90/10 sample by program offering. For natural gas NTG research, we will attempt a census of all gas projects. Each gas participant data point will also constitute an electric participant data point.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA) for electric energy efficiency, the measure-specific and total ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) for the electric measures installed in CY2019 will be calculated along with the total CPAS across all electric measures. Additionally, the weighted average measure life will be estimated. When gas savings is not attributed to a gas utility, the evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Control Trial and Quasi-Experimental Design

We are not evaluating the RCx Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental consumption data because there are not enough participants in this program to achieve statistically significant savings estimates using this method and it would not be possible to create a valid matched control group for the customers in this program.

Evaluation Schedule

Table 5 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available by the 4th Quarter.

Table 5. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	January 20, 2019
CY2019 program tracking data for QA/QC	ComEd	April 5, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	April 30, 2019
Wave 1 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	July 26, 2019
Tracking System Ex Ante Review Findings and Recommendations	Evaluation	July 26, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	August 30, 2019
Wave 2 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	November 30, 2019
CY2019 Program tracking data for sampling Wave 3	ComEd	January 17, 2020
Wave 3 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	February 24, 2020
Final Tracking Data from ComEd	ComEd	January 30, 2020
Illinois TRM Update Research Findings	Evaluation	March 2, 2020
Internal Report Draft by Navigant	Evaluation	March 2, 2020
Draft Report to ComEd, Gas Utilities, and SAG	Evaluation	March 9, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 30, 2020
Revised Draft by Navigant	Evaluation	April 7, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 14, 2020
Final Report to ComEd, Gas Utilities, and SAG	Evaluation	April 24, 2020

ComEd Small Business Program CY2019 to CY2021 Evaluation Plan

Introduction

The Small Business program is designed to assist qualified ComEd private-sector, non-residential customers⁴⁷ to achieve electric energy savings by educating them about energy efficiency opportunities through no-cost on-site energy assessments conducted by preapproved, specially-trained energy efficiency service providers (EESPs) and installation of no-cost direct-install (DI) measures.⁴⁸ Further savings are available to participating customers through incentives of 30-75 percent offered for select contractor-installed measures.⁴⁹ EESPs are the primary means of promoting the Small Business program and recruiting participants.

The program's offerings did not change from calendar year 2018 (CY2018) to CY2019. The program's affiliated EESPs are required to obtain Illinois Commerce Commission (ICC) certification to qualify for participation in the Small Business program.

ComEd's CY2019 net planning target for the Small Business program is 330,686 MWh for both first year and cumulative persisting annual energy savings.^{50,51} Nexant, Inc. (Nexant) is the implementation contractor for the Small Business program throughout ComEd's service territory.

The primary objectives of the CY2019 evaluation of the Small Business program will be to: (1) quantify the gross and net savings impacts of the program, and (2) determine key process-related program strengths and weaknesses to aid in program improvement.

The evaluation of this program over the remaining three years of the 2018-2021 cycle will include a variety of data collection and analysis activities, including those indicated in Table 1.

⁴⁷ To qualify, participants must be ComEd private-sector commercial or industrial customers with monthly peak demand levels up to 100 KW.

⁴⁸ No-cost direct-install measures include low-flow showerheads and faucet aerators, pre-rinse spray valves, power strips, and controls for novelty coolers, beverage machines, and snack machines.

⁴⁹ Incented measures may include upgrades to T8/T5 lighting, LED retrofits and fixtures, high bay fluorescents, lighting controls, HVAC system components, electric water heaters, refrigeration system components, commercial kitchen equipment, compressed air system measures, smart thermostats, and building envelope measures.

⁵⁰ Per Section 8-103B of the Public Utility Act (as amended), beginning in CY2018 energy savings goals will be based on, and verified energy savings measured as, Cumulative Persisting Annual Savings (CPAS).

⁵¹ There are no project or customer engagement goals listed in the 2018-2021 ComEd Plan beyond gross and net savings goals and numbers of measures installed.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – EESP Interviews	X	X	X
Impact – Billing Analysis (as needed)	X	X	X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Modeling (as needed)		X	
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys		X	
Net-to-Gross – EESP Interviews		X	
Process Research	X	X	X

* Timing of NTG research depends on when project data are received.

The evaluation team determined the evaluation approach for the 2018-2021 period based upon the needs of the program and program’s history. The 4-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Optimized timing on when to conduct NTG research
- NTG analysis every other year when programs are stable and NTG results are consistent over time
- NTG analysis each year when markets or program designs are changing
- Cumulative Persisting Annual Savings (CPAS) will be calculated based upon the requirements of the Future Energy Jobs Act (FEJA)
- Process research will be conducted each year based upon client request and program performance details.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What is the program’s annual total verified gross savings?
2. What is the program’s annual verified net savings?
3. What is the program’s demand savings?
4. What updates are recommended for the Illinois Technical Reference Manual (TRM)?
5. What are the effective useful lives (EULs) of program measures that currently lack them?

The evaluation team will coordinate with the evaluation leads to calculate the annual incremental goal and the cumulative persistent annual savings.

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following topics:

1. What are effective methods to reach small business owners amidst varying demands and calls for their attention?
2. What is the program’s cumulative penetration by region and business segment?
3. What prevents former participants from re-enrolling, from two perspectives: the TAs business model on customer relationship management, and the former participants’ interest, ability and barriers?
4. What is the EESPs’ experience, reach, and operation, focusing on comprehensive measures, impact of cumulative savings, and prior research on regional and business segment penetration?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019 (approx.)	Notes
Tracking System Review	Tracking system	Census	Impacts. Three data waves
Gross Impact	Early Feedback File Review	Census	Wave 1 data*
Gross Impact	Engineering File Review	30	Early Feedback for sampled projects (One Wave)
Verified Net Impact	Calculation using deemed NTG ratio	Census	
In Depth Interviews	Program Management and Implementers	6	Augment with monthly calls
Process Research	Telephone Survey with Participating Customers	Up to 120†	Process. Three waves
Process Research	Telephone Interviews with EESPs	Up to 30†	Three waves
Process and Impact Research on CY2019 Operations	Literature review, secondary research		Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† Navigant will complete an appropriate number of surveys with participants and interviews with EESPs achieve to conduct process research.

Navigant will perform tracking system review and engineering file reviews on a sample of participant projects in two waves in CY2019. Navigant will have interviews with program management and key staff with the implementation contractor (IC) in CY2019 for impact or process and NTG research related issues

(three waves of data collection). Navigant will use the SAG approved net-to-gross ratios for CY2019 to calculate program net savings in CY2019.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program's data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

Gross Impact Evaluation

Since most Small Business program savings are derived from deemed values contained in the TRM, gross savings will continue to be evaluated primarily by (1) reviewing the tracking system data and savings workbook to ensure that all fields are appropriately populated and savings are consistent with the implementation contractor workpapers and savings calculators that feed into the tracking system; (2) reviewing new measures' algorithms and values in the tracking system and savings workbook to assure that they are appropriately applied; and (3) cross-checking totals. This approach will be supplemented where possible with a review of project documentation on a random sample of projects to verify participation, installed measure quantities, and associated savings. Findings from the impact files will be reviewed to provide an opportunity for improving the tracking system and data collection.

Proposed CY2019 gross impact and sampling timelines are shown below.

1. Mid-year early impact review of Wave 1 data in June 2019 and completed in July 2019. This will include developing a memorandum of findings from early impact review.
2. Wave 2 sample of project files and documentation drawn in September 2019 and completed November 2019.
3. Final and third wave of tracking data by January 30, 2020 and completed by March 6, 2020.

Core data collection activities will include the following:

1. Engineering examination of ComEd workpapers, tracking system and measure workbook calculations of claimed savings.
2. Engineering review of project documentation at the measure-level for a sample of projects to verify participation and tracking system entries, check documentation of invoiced quantities and installed measure characteristics, confirm compliance with eligibility, and deemed input values.
3. Computer assisted telephone interviews (CATI) with a sample of Small Business program project contacts completed to quantify participating customer free-ridership and spillover, and EESP free ridership and spillover.
4. Hold regular monthly meetings by telephone with ComEd program staff and the IC staff to discuss specific impact issues that need to be addressed during program implementation.
5. The evaluation team will collect PJM demand savings estimates and program and measure-specific cost detail to further ComEd's PJM auction and TRC analysis.
6. Investigate potential gas measures with kWh savings and review the parameters ComEd used to estimate potential kWh savings (therms conversion).

Use of RCT and QED

Navigant is not evaluating the Small Business Program via a randomized controlled trial (RCT) because the program was not designed with randomly-assigned treatment and control groups. Nor will we base the CY2019 impact analysis on a quasi-experimental design (QED), because the program targets a heterogeneous group of businesses and has many unique measures with significant cross-participation. While the evaluation will continue to be based primarily on deemed TRM values, Navigant will consider using a QED approach to prospectively update the TRM for certain measures or measure-business type combinations.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Small Business (all measures)	0.92

Source: http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.pdf

Research NTG Impact Evaluation

Navigant conducted NTG research with the CY2018 participant population. No such research will be pursued in CY2019. Navigant will resume NTG research on a participating customer in CY2020.

In-Depth Interviews and Surveys

Navigant will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics. Navigant will research effective methods to reach small business owners amidst varying demands and calls for their attention. This research may include a review of customer-facing marketing, promotion and operational materials; investigation into why eligible businesses refuse to engage or drop out; and research into trusted sources of energy efficiency information within the community. Navigant will also measure program penetration geographically, by business segment, measure type and EESP saturation to aid in developing a strategy to expand the program and recruit EESPs by underserved measure type. We plan to investigate why the re-enrollment rate is low among participants, including research on EESP business models, customer relationship management (CRM) efforts, and former participants' experience, interest and barriers to participating again in the program. Research into EESPs' experience and operations, focusing on the impact of delivering cumulative savings, offering comprehensive measures will be conducted.

Coordination

Ameren Illinois's Small Business Incentives program is like ComEd's Small Business program.⁵² The ComEd evaluation team will coordinate with the independent evaluator of the Ameren program to ensure that the two evaluations use similar approaches, and to identify and report on any substantive differences.⁵³

Navigant will coordinate any NTG or process research with the Ameren Illinois Small Business Incentives program evaluation team on data collection and survey instrument design to ensure consistency and appropriate questions in the customer surveys.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer. Adjustments will be made, as needed, as evaluation activities progress. Process analysis will be completed after the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Impact Deadlines

Activity/Deliverables	Responsible Party	Date Delivered*
Monthly Impact/Process Meetings	ComEd/Navigant & IC Staff	Every month as needed
Program Operations Manual and Workpapers/Workbook Review	ComEd/Nexant	March 15 – April 15, 2019
CY2019 Wave 1 Tracking Data	ComEd	June 28, 2019
Early impacts findings memo	Evaluation Team	July 31, 2019
Sample Projects Documentation for Review	ComEd	September 30, 2019
CY2019 Wave 2 Tracking Data	ComEd	September 30, 2019
Wave 3 and Final CY2019 Tracking Data to Navigant	ComEd	January 30, 2020
Internal Impact Report Draft by Navigant	Evaluation Team	March 6, 2020
Draft Impact Report to ComEd and SAG	Evaluation Team	March 13, 2020
Comments on draft (15 Bus. Days)	ComEd / SAG	April 3, 2020
Revised Draft Impact Report by Navigant	Evaluation Team	April 10, 2020
Comments on redraft (5 Bus. Days)	ComEd / SAG	April 17, 2020
Final Impact Report to ComEd and SAG	Evaluation Team	April 30, 2020

⁵² See <https://amerenillinoisavings.com/for-my-business/explore-incentives/small-business-incentives> for more information.

⁵³ Opinion Dynamics is the lead evaluator for Ameren Illinois energy efficiency programs.

ComEd Standard Program CY2019 to CY2021 Evaluation Plan

Introduction

As part of the Business Incentives Program⁵⁴ the ComEd Standard Incentives Program (Standard) offers prescriptive financial incentives and a streamlined application to facilitate the implementation of cost-effective energy efficiency improvements for non-residential (commercial and industrial) customers and market segments, with a program network of Energy Efficiency Service Providers (EESP). Eligible measures include energy-efficient indoor and outdoor lighting, HVAC equipment, refrigeration, energy management systems (EMS), commercial kitchen equipment, variable speed drives, compressed air equipment and other qualifying products. The program also targets new system installation opportunities (e.g., lighting systems) by offering incentives that “bundle” equipment and controls technologies. ICF International Inc. is the program implementation contractor for the Standard Program. ICF collaborates with DNV-GL for the program day-to-day operations of both private sector and public-sector customers.

The primary objectives of the CY2019 evaluation of the Standard Program are to: (1) quantify the gross and net savings impacts of the program; (2) conduct research to support the program’s mandate under the Future Energy Jobs Act (FEJA)⁵⁵; (3) investigate potential gas savings (therms conversion) counted as kWh, and (4) determine key process-related program strengths and weaknesses and identify ways in which the program can be improved.

Notable program changes made from CY2018 to CY2019 include:

- The addition of five new measures (rooftop units, geothermal heat pumps, adsorbent air cleaning, energy recovery wheels, q-sync motors for refrigeration).
- Increased private Standard program incentive levels for certain measures, including LED Fixtures, VSD (HVAC fan or pump), Air Compressor (with VSD), Injection Molding (hybrid injection molding), Integrated Lighting (formerly known as Advanced Lighting).
- Removal of T8/T5 and Induction Fixtures from the Standard program to Custom program as custom lighting measure.
- Public sector (PS) facilities over 100kW are integrated into the Standard Program.⁵⁶ Increased incentive cost cap for private sector projects from 50 to 75% (public already at 75%)
- Changes in the requirement for the comprehensive package (bonus) - flexibility on eligible projects
- Introducing a new project tracking system (eTRACK), with capabilities of online-entry for customers and contractors from project start and allow measure savings calculations in the system (based on TRM and program workpapers).

Continuing from CY2018, ComEd’s marketing strategy presents the overall portfolio to customers. The CY2019 program will continue with the Office Space and Made in Illinois promotions introduced during the PY9 bridge period. Streamlined incentive application and verification and quality control processes are expected to facilitate customer participation ease and minimize the time required for incentive payment.

⁵⁴ The Business Incentive Program is comprised of the non-residential Standard and Custom programs. Incentive structure is based either on a “standard,” per-unit basis, as with most lighting measures, or “custom,” with the incentive based on the calculated annual energy savings for the customer.

⁵⁵ Illinois Public Act 099-0906 (<http://www.ilga.gov/legislation/publicacts/99/099-0906.htm>), passed in 2016.

⁵⁶ PS facilities under 100kW would be allowed in the Standard program, if they did not participate in the Small Business program, for that specific measure.

Also continuing from CY2018, prior to issuing certain standard energy efficiency incentives in CY2019, ComEd will verify that the contractor responsible is certified through the Illinois Commerce Commission (ICC) to install energy efficiency measures.⁵⁷

ComEd’s CY2019 net planning target for the Business Incentives Program⁵⁸ is 320,001 MWh for first year savings and 633,334 net MWh. Cumulative Persisting Annual Savings (CPAS).⁵⁹ ComEd expects to achieve these targets by installing 78 percent of measures in qualifying private sector commercial and industrial facilities, and 22 percent of measures in qualifying public sector premises.⁶⁰

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – General Population Surveys		X	
Data Collection – Participant Surveys	X		X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Stakeholder Interviews		X	
Data Collection – EESP Interviews	X		X
Data Collection – Literature Review	X		
Impact – Billing Analysis	X	X	X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – EESP Spillover Research	X		X
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the CY2019-2021 period, based upon the needs of the program and the program’s history. The three-year evaluation approach for this program is based on the following:

⁵⁷ Energy Efficiency Measure Installer certification is only required to seek certification pursuant to Code Part 462 if the entity performs, while installing energy efficiency measures, electrical connections other than connections of class 2 circuits as defined in the National Electric Code effective August 24, 2016 and the incentive for the measure is \$300 or more. These rules do not apply if the customer self-installs the measure.

⁵⁸ The ComEd 2018-2021 EE/DR Plan does not split the savings target of the Business Incentive Program for the Standard and Custom portions of the program. The Business Incentive Program 1st year and CPAS targets include CHP and Data Center Programs. See “Commonwealth Edison Company’s 2018 – 2021 Energy Efficiency and Demand Response Plan,” June 30, 2017, pp. 6-7, 51-52.

⁵⁹ Per Section 8-103B of the Public Utility Act (as amended), beginning in CY2018 energy savings goals will be based on, and verified energy savings measured as, cumulative persisting annual savings (CPAS). See “Commonwealth Edison Company’s 2018 – 2021 Energy Efficiency and Demand Response Plan,” June 30, 2017, pp. 134.

⁶⁰ There are no project or customer engagement goals listed in the 2018-2021 ComEd Plan, just gross and net savings goals and numbers of measures installed.

- Gross and net impact analysis will be conducted each year
- Optimized timing on when to conduct NTG research
- NTG analysis every other year when programs are stable and NTG results are consistent over time
- NTG analysis each year when markets or program designs are changing
- CPAS will be calculated based upon the requirements of FEJA
- Process surveys will be conducted each year based upon client request and program performance details.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual total lifetime verified gross savings? What are the verified gross savings from private and public lighting projects? What are the verified gross savings from private and public non-lighting projects?
2. What is the research estimate of gross savings (energy, peak demand, and total demand) for the program?
3. What are the program’s verified annual total lifetime net savings?
4. What is the estimated free-ridership and spillover for CY2019 participating customers? What is the research estimate for participant and EESP spillover for this program?
5. Secondary questions include:
 - Are the ex ante per-unit gross impact savings correctly implemented by the tracking system and reasonable for this program?
 - What updates are recommended for the Illinois Technical Reference Manual (TRM)? What are the results of field data collection?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address geographical penetration and dispersion, methods and approaches to reduce free ridership for lighting and non-lighting measures, and other topics as requested by ComEd.

Navigant will perform additional process research, upon the request of the program manager, to support the program manager and implementer in CY2019. Possible topics may include, but will not be limited to, research on impact of public sector projects introduced into the program, impact of the new offerings and measures, EESP perspectives and impact of the changed incentives.

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions. Each activity in the table is summarized below the table.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Three waves
Net-to-Gross and Process Interview	Telephone Interviews with EESPs	~25	Spillover & Process. Two Waves
Free Ridership and Process Customer Survey	Telephone Survey with Participating Customers	125	NTG & Process. Two Waves
In-Depth Interviews	Program Management and Implementers	4	Augment with monthly calls
Gross Impact Evaluation	Engineering File Review	85	Three Waves* plus Early Feedback for Large Projects
Gross Impact Evaluation	On-site M&V	40	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	
Literature review, secondary research	Process and Impact Research on CY2019 Operations	Census	Process, Impact

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review

In line with program changes and accelerated evaluation schedule for delivering tracking data to the valuation team, Navigant will perform tracking system review and M&V project sampling in waves in CY2019. The first wave of M&V sampling is expected to cover about one-third of the projects.

NTG and Process Interview

Navigant will survey CY2019 participating customers to provide NTG values for potential deeming in future program years through surveys. We will complete computer assisted telephone interviews (CATI) with a minimum of 125 contacts who participated in the CY2019 program to quantify participant free-ridership and spillover. Program influence on participating customers through interviews with EESPs and account managers will be conducted in CY2019 if triggered by customer NTG responses for the largest projects, or with contacts identified for multiple smaller projects. The sample design developed for gross impact research will be applied to the NTG interviews. This will provide a 90/10 confidence/precision level of NTG ratios for lighting and non-lighting, and program-level savings. The CY2019 research will include EESP spillover and process interviews.

Free Ridership, Spillover and Process Surveys

Surveys will also be used to assess potential free ridership and spillover in the program. Customer surveys will be conducted to understand program satisfaction, issues encountered with the program from

a participant standpoint and other related issues These will be done between February 2019 and March 2020.

Program Management and Implementer In-Depth Interviews

Program management and implementer interviews shall be conducted to understand how the program is operating and identify issues with the program. These will be conducted between April and December of 2019.

Gross Impact Evaluation

Navigant will perform tracking system review and M&V project sampling in three waves in CY2019. The first wave of M&V sampling is expected to cover about one-third of projects completed in CY2019. Proposed gross impact sampling timelines are shown below.

The CY2019 gross impact evaluation will not vary significantly from CY2018, but adjustments will be made to reflect specific measure and project characterizations. Navigant will measure program penetration geographically, by business segment, measure type, and Energy Efficiency Service Providers (EESP) saturation to aid ComEd in developing a strategy to expand the program and recruit EESPs from underserved sectors. We will continue to study the impact of and methods to reduce free ridership. The CY2019 NTG study will include in-depth interviews with participating customers to learn about their perspectives and satisfaction with the program, the energy assessment services and incentive offerings, and how to improve the program in the future. The findings from the study will inform recommended net-to-gross (NTG) values for the Illinois Stakeholder Advisory Group (SAG) approval and future program application.

CY2019 Gross Impact Sampling Waves

- a) First wave sample drawn in June 2019 and completed in September 2019
- b) Second wave sample drawn in October 2019 and completed in December 2019
- c) Final wave starts February 2020 (or projects completion date)

Core data collection activities will include the following:

1. Engineering examination of ComEd workpapers and tracking system calculations of claimed savings.
2. Engineering review of project documentation at the measure-level for a sample of projects to verify participation and tracking system entries, check documentation of invoiced quantities and installed measure characteristics, confirm compliance with eligibility, and deemed input values.
3. On-site M&V of measure-level savings on a subset of project sites selected from the engineering review sample to estimate site-specific savings. On-site measurement and verification includes participant interviews, baseline assessment, installed equipment verification, and performance measurement. Measurement may include spot measurements, run-time hour data logging, review of participant energy management system trend data, and post-installation interval metering. Our approach to selecting M&V strategies follows the International Performance Measurement and Verification Protocol (IPMVP); Option A or Option B are typically selected.
4. Computer assisted telephone interviews (CATI) with a sample of Standard Program projects and in-depth interviews with EESPs and account managers to research methods and approaches to reduce free ridership.

5. Interviews with program management and key staff with the implementation contractor (IC). Hold regular monthly meetings by telephone with ComEd program staff and the IC staff.
6. The evaluation team will collect PJM demand savings estimates and program and measure-specific cost detail to further ComEd's PJM auction and TRC analysis.
7. Identify and exclude customers who exceeded 10MW demand eligibility threshold to participate in the program since calendar year 2017.

The gross savings impact approach will review the ex ante measure type to determine whether it is covered by the Illinois TRM or whether it is a non-deemed measure that is subject to retrospective per unit savings adjustment of custom variables. The measure type, deemed or non-deemed, will dictate the savings verification approach. We will also make a research estimate of gross savings based entirely on site-collected data and evaluation engineering analysis of savings. The two methods are described below:

Savings Verification

- Measures with per unit savings values deemed by the TRM, would have verified gross savings estimated by multiplying deemed per unit savings (kWh and kW) by the verified quantity of eligible measures installed. Eligible deemed measures must meet all physical, operational, and baseline characteristics required to be assigned to the deemed value as defined in the TRM.⁶¹
- Measures with custom or partially-deemed ex ante savings input will be subject to retrospective evaluation adjustments to gross savings on custom variables. TRM algorithms and deemed parameter values will be used where specified by the TRM, and evaluation research will be used to verify or adjust custom variables.

Evaluation Research Savings Estimate

- The evaluation will also include an analysis of on-site collected verification data for a subset of projects. The engineering analysis methods and degree of monitoring will vary from project to project, depending on whether the measure has deemed savings or not, the complexity of the measures, the size of the associated savings, the potential to revise input assumptions, and the availability and reliability of existing data. The evaluators will contact the implementers prior to conducting site visits to ensure that the evaluation team has all correct and relevant information.

The measure-level realization rates will be extrapolated to the program population using a ratio estimation method to yield ex post evaluation-adjusted gross energy savings. Gross realization rates will be developed for energy and demand savings. The sample design will provide 90/10 statistical validity for lighting savings, non-lighting savings, and the program overall. The sample of 40 on-sites drawn is also expected to achieve a 90/10 confidence/relative precision level (one-tailed test) to comply with the PJM verification requirements outlined in Manual 18B.

The 40 on-site projects will be randomly selected based on the magnitude of the project savings in the stratified sample. The on-site sample design will consider both lighting and non-lighting technologies, including measures with high savings variations and certain new technologies with potential savings impact (e.g., advanced lighting controls, EMS, etc.). Where the TRM allows retrospective adjustment of savings using site collected data (e.g., lighting quantities, VSD hours and controls), the savings are recalculated based on site-specific data but still using the approach set forth in the TRM. Parameters defined in the TRM are not adjusted even if the site findings suggest alternate values are more appropriate. For these projects the collected information will be used to develop a "research estimate" savings level in addition to the TRM verified savings level. This can be tracked over time to identify

⁶¹ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0, available at: <http://www.ilsag.info/technical-reference-manual.html>

measures where the TRM may not accurately represent the projects being completed. The information collected will be useful and will be aggregated over time for TRM updates. For measures not covered in the TRM (such as EMS), the on-site data collection will be used to develop an independent assessment of project savings. For these projects, all available information is used to recalculate savings.

Verified Net Impact Evaluation

The evaluation team will apply the net-to-gross (NTG) ratios accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program (Table 3). Therms savings will be subjected to the electric NTG adjustments.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Lighting	0.83
Non-Lighting	0.78

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Literature Review and Additional Research Subjects

Navigant is currently researching topics related to the ComEd Standard Program. One research effort involves the VSD HVAC pumps and cooling tower fans measure savings algorithm and input parameter assumptions to enhance the IL TRM. Additionally, future proposed research topics include new measure ideas for refrigerated warehouses and compressed air end uses. An EMS Working Group set up in CY2018 to deliberate on ways to improve the savings realization rate of EMS measures, will continue their work in CY2019. The group involves the evaluation team, ComEd staff and implementation contractor staff. The group will consider the development of EMS workpaper and recommendation for potential inclusion in future TRM versions.

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Specifically, Navigant will coordinate planned NTG or process research with the Ameren Illinois Standard program evaluation team. Navigant will coordinate with the Ameren team on data collection and survey instrument design to ensure consistency and appropriate questions in the customer and EESP surveys.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and the CPAS in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated (CPAS will be provided year by year for the longest measure EUL for each program year). Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report. Use of Randomized Controlled Trial and Quasi-Experimental Design
 Navigant is not evaluating the Standard Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. Navigant is not using quasi-experimental consumption data for the following reasons:

- It would not be possible to create a valid matched control group for the customers in this program.
- This method would estimate average savings across all program participants which is not the desired savings estimate for this program.
- This program contains many unique measures with significant cross-participation. In this case, quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for all analysis.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Process analysis will be completed after the April 30th impact date and will be reported in a timely manner by the 4th quarter.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	January 25, 2019
CY2019 program tracking data for QA/QC	ComEd	April 8, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 3, 2019
CY2019 participating customer survey design	Evaluation	July 1, 2019
Wave 1 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	July 31, 2019
Tracking System Ex Ante Review Findings and Recommendations	Evaluation	July 31, 2019
CY2019 program tracking data for sampling Wave 2	ComEd	September 19, 2019
Wave 1 participating customer Free Ridership and process survey fielding	Evaluation	September 26, 2019
Wave 1 participating EE Service Provider spillover interview	Evaluation	September 30, 2019
Wave 2 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	December 13, 2019
CY2019 Program tracking data for sampling Wave 3	ComEd	January 30, 2020
Wave 2 participating customer Free Ridership and process survey fielding	Evaluation	February 14, 2020
Wave 2 participating EE Service Provider spillover interview	Evaluation	February 18, 2020
Wave 3 project documentation, engineering reviews, schedule, conduct on-site M&V, feedback	Evaluation	February 28, 2020
Illinois TRM Update Research Findings	Evaluation	March 2, 2020
Internal Impact Report Draft by Navigant	Evaluation	March 4, 2020
Draft Impact Report to ComEd and SAG	Evaluation	March 11, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 1, 2020
Revised Impact Report Draft by Navigant	Evaluation	April 8, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 15, 2020
Final Impact Report to ComEd and SAG	Evaluation	April 28, 2020
NTG Recommendations to ComEd and SAG	Evaluation	August 14, 2020

ComEd Strategic Energy Management Program CY2019 to CY2021 Evaluation Plan

Introduction

The Strategic Energy Management (SEM) Program provides training and guidance to participating commercial and industrial customers, gathered in cohorts. Each cohort is a group of SEM participants that receive training together and work with each other to provide practical insight on how to implement energy efficiency measures at their sites. In addition, each site received one on one training to identify opportunities that were unique to each site. The program is jointly managed by ComEd and gas utilities. The program implementer manages the training and day to day operation of the SEM Program.

The goal of the SEM Program is to implement a process of continuous energy management improvements which result in energy savings and reductions in energy intensity. Energy savings can be achieved through operational and maintenance (O&M) improvements, incremental increases in capital energy efficiency projects, additional capital projects that would not otherwise have been considered (e.g., process changes, consideration of energy efficiency in all capital efforts), and improved persistence for O&M and capital projects. The program seeks to educate participants in the identification of low cost or no cost measures, improve process efficiency, and reduce energy use through behavioral changes.

Currently the program has two types of participants: (1) new cohort made up of new participants and, (2) the practitioners cohort for customers that continue to participate after their first year. Navigant's focus in CY2019 will be on Cohort 3 (CLEARResult) and Cohort 1 (Graphet) as that detail becomes available for evaluation.

Notable program changes made from CY2018 to CY2019 include:

- Evaluation of new participants in the program as opposed to the practitioner group that was reviewed in CY2018.
- As sites transition into the practitioner cohort, the evaluation activities will change to meet the needs of the client and implementer without overburdening the site. Navigant will not complete onsite surveys with sites that have already been surveyed in the past or complete simpler surveys to not overburden participants. Impact evaluation may be reduced as well for sites that have already received impact evaluations in the past.

The CY2019 gross impact evaluation will not vary from the previous years. Over the course of 2018 we examined the program theory and evaluation approach to inform discussions in the fall Illinois Stakeholder Advisory Group (SAG) net-to-gross (NTG) deliberations about the need for doing free ridership surveys with SEM participants in future years. We tentatively plan to do NTG research in CY2019 and CY2021 pending the outcome of those deliberations.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in the following table. As noted above, limited process evaluation will be completed with the practitioner cohorts with a focus on persistence, but not normal detailed process evaluation.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Interviews	X		X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Billing Analysis	X	X	X
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Modeling	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and program’s prior history. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Site specific process surveys will occur every other year. If the program participation changes greatly from one year to the next and/or the utility has interest in specific site surveys that work can be completed after discussion with ComEd.
- Cumulative Persisting Annual Savings (CPAS) will be calculated based upon the requirements of Future Energy Job Act (FEJA).
- The impact evaluation of the SEM Program will characterize and quantify:
 - Energy savings achieved through SEM improvements and behavior change beyond capital projects (prescriptive and custom)
 - The influence of the SEM Program on increasing the number of Standard and Custom projects and their associated savings
- Limited process evaluation will be completed with the practitioner cohorts to focus on persistence. The CY2019 process study will include site participant interviews, and program manager and implementer interviews. Site interviews will be limited to the sampled sites in Cohort 3 (CLEAResult) and Cohort 1 (Graphet).

Coordination

The SEM Program is independently and jointly managed with Nicor Gas. ComEd will coordinate with Nicor Gas on issues relevant to the program. The SEM evaluation report is developed as a combined ComEd and Nicor Gas evaluation report. Navigant leads the evaluation and will work with Nicor to finalize the report. There are special data collection issues with the SEM Program and Navigant will manage those data issues with ComEd and Nicor Gas.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the actual achieved energy behavior savings in this program?
2. What were the realization rates of the projects? [Defined as evaluation-verified (ex post) savings divided by program-reported (ex ante) savings].
3. Are there any major changes occurring during or after program implementation (production, size, hours etc.) which may have affected the results?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program satisfaction and SEM process. The process research will address the following questions:

1. What is the satisfaction of the participants?
2. How can the program structure be improved?
3. What were the major results of the SEM training? What actions did participants take? What recommended actions did they not take, and why?
4. What were the motivating factors for a facility to choose to participate?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions. Final activities will be determined as program circumstances are better understood.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Participating Customers	Census	Engineering Review- Cohort 3 Second Engineering Review – Practitioner Cohort
Gross Impact Evaluation	Engineering File Review	Census	This is a multi-regression model based upon whole-building data, production data and other key variables.
Verified Net Impact Evaluation	Calculation Using Deemed NTG Ratio	* Deemed Value Electric (1.00) Gas (1.00)	
Interviews	Program Management and Implementers	~2	Augment with monthly calls
Interviews	Cohort 3 Participants	*	Timing is based on data availability
Effective Useful Life Determination			5 years

*Sample size will be determined to achieve 90/10

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program’s data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

Gross Impact Evaluation

The impact evaluation will be grounded in site-specific data using engineering models and analysis.

1. A site-specific analysis approach will be implemented. Because this program contains primarily behavioral-based changes, International Performance Measurement and Verification Protocol (IPMVP) option C – – billing/metered data regression, will be the main method of impact evaluation.
2. The data collection will focus on verifying or updating the assumptions that feed into the implementer’s energy model for each site. This data may include: program tracking data and supporting documentation (project specifications, invoices, etc.), utility billing and interval data, Navigant-calibrated building automation system (BAS) trend logs, production data and telephone conversations with onsite staff.

Energy models have been provided for all the sites within the SEM Program. This data will be used with other collected information from the site to identify operating characteristics of the site both pre-and post these activities. If major changes have occurred at the site during or after the SEM activities, it is expected the model will need to be adjusted to account for these changes. The changes that could affect the model savings include but are not limited to:

- Changes in hours of operation
- Changes in employees
- Changes in production
- Various factors that affect the model savings
- Other measures installed at the site that were implemented through other Utility EE/DR programs or outside of the ComEd and Nicor Gas programs⁶²

Due to the small number of participating sites, Navigant will perform the impact analysis on all participating customers. Sampling will be considered as number of participants grow.

Verified Net Impact Evaluation

The CY2019 net impact evaluation will apply the net-to-gross (NTG) ratio () deemed through the Illinois Stakeholders Advisory Group (SAG) consensus process. The deemed NTG ratios are provided in Table 3.

Table 3. Deemed NTG Values for CY2019

Program Channel	CY2019 Deemed NTG Value
All-Electric	1.00
All-Natural Gas	1.00

Source: http://www.ilsag.info/ntg_2019.html

Navigant will sample projects from the sites and apply the sample realization rates to the entire population to calculate overall savings. Navigant will consider several ways to stratify the SEM projects to design a sample once initial program data is received. Navigant will use a stratified ratio estimation sampling design to develop an efficient sample achieving 90/10 confidence/precision on the program-level realization rate. Once all sampled sites are evaluated, the realization rate of each stratum will be calculated. This realization rate will be applied to the total claimed savings within each stratum to calculate the final program savings.

As participating sites complete their one year of activities within the SEM Program, Navigant will collect the information regarding these sites and begin the evaluation. Navigant expects that the timing of this information will be dependent on the timing of the cohort training.

⁶² These measures are rebated separately from SEM program and savings for these measures are not counted in the SEM savings

Program Manager and Implementer Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges.

Participant Interviews

Participant interviews will focus on participant satisfaction, and any potential improvements to program processes such as the training and onsite visits. The site interviews will be coordinated with the impact evaluation team to address any major operational changes occurring at the site.

Navigant will complete the gross impact review before conducting the surveys to identify any site-specific issues that could be addressed in the interviews. Prior to the interviews, both Nicor Gas and ComEd will review the surveys to ensure they meet the needs of the program. Once the surveys are complete, Navigant will finalize the engineering review by making any additional changes identified by the surveys.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and CPAS for the measures installed in CY2019. The measure life of 5 years will be used for the SEM program. Evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Control Trial or Quasi-Experimental Design

The evaluation team will not evaluate this program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups.

The evaluation will not use quasi-experimental design because there are not enough participants for individual measures in this program to achieve statistically significant savings estimates using this method.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Process reporting will occur after April 30th each year and substantive process reporting will be provided in a timely manner.

Table 4. Evaluation Schedule – Key Deadlines

Activity/Deliverables	Responsible Party	Date Delivered
CY2019 Site Reports and Models available to Navigant	ComEd	Q3/Q4 2019*
Sample of sites determined and approved	Evaluation	Q3/Q4 2019
Project review	Evaluation	Q3/Q4 2019
Program manager interview	Evaluation	Q2/Q3 2019
Internal Navigant Draft Report Review	Evaluation	March 6, 2020
Draft Report to ComEd and SAG	Evaluation	March 13, 2020
Comments on draft (15 Business Days)	ComEd	April 3, 2020
Redraft of Report	Evaluation	April 10, 2020
Comments on Redraft (5 Business Days)	ComEd	April 17, 2020
Final Report to ComEd and SAG	Evaluation	April 27, 2020

* Timing of tasks depends on timing of data availability are to be determined later

ComEd Voltage Optimization Program CY2019 to CY2021 Evaluation Plan

Introduction

The ComEd Voltage Optimization (VO) Program comprises ComEd’s plan to install hardware and software systems on a significant fraction of its electric power distribution grid to achieve voltage and reactive power optimization (volt-var optimization, or VVO) over the 2018-2025-time frame. VVO is a smart grid technology that uses distributed sensors, two-way communications infrastructure, remote controls on substation transformer load-tap changers (LTCs) and capacitor banks, and integrating/optimizing software to flatten voltage profiles and lower average voltage levels on an electric power distribution grid. ComEd is working with an automation-optimization hardware and software vendor⁶³ to implement the VO program on selected parts of its distribution grid over the 2018-2025 period.

This evaluation plan covers the second through fourth years (CY2019 to CY2021) of the planned VO program roll-out and is based on the program description provided in ComEd’s 2018-2021 Portfolio Plan⁶⁴ as well as ongoing discussions with ComEd’s VO implementation team. The evaluation of this program will include a variety of data collection and analysis activities, including those shown in Table 1. Navigant will request SCADA and AMI data for CY2020 and CY2021 for the purpose of measuring impacts, but does not expect to conduct regression analysis after CY2019.

Table 1. Evaluation Approach – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking system review	X	X	X
Sample selection of test feeders	X		
Data collection – program manager and implementer interviews*	X	X	X
Data collection – AMI and SCADA data from VO substations/feeders [†]	X	X	X
Impacts – regression and simulation analysis of sample feeders	X		
Impacts – extend impact analysis results to non-sample feeders	X		
Impacts – extend impact analysis results to sample and non-sample feeders post-2019		X	X
TRM research – develop method for measuring VO impacts post-2019 [‡]	X	X	X

* These activities will be in the context of ongoing periodic meetings with the VO implementation team.
[†] SCADA and AMI data collected after CY2019 will not be used to estimate regression models but will be used (in combination with previously-estimated models) to simulate future impacts.
[‡] Following the evaluation of the CY2019 sample feeders, Navigant will submit findings and recommendations concerning VO EM&V to the IL-TRM Update Process for possible inclusion in future versions of the IL-TRM.

Coordination

Navigant will coordinate with the evaluation teams of other Illinois utilities, as well as with regulatory staff, on issues relevant to measurement and verification of VO impacts. Ameren Illinois is implementing a similar program. Navigant staff will be involved in the evaluation of both utilities’ programs and will identify and report on opportunities for collaboration, as well as any substantive differences in approach, when and as they arise.

⁶³ Open Systems International (OSI) of Medina, Minnesota.
⁶⁴ “Commonwealth Edison Company’s 2018-2021 Energy Efficiency and Demand Response Plan,” June 30, 2017.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s incremental and cumulative persistent annual verified energy savings?
2. What are the program’s incremental and cumulative peak demand reductions?
3. Other research topics:
 - a) What voltage reductions did the program achieve?
 - b) What are the program’s impacts on reactive power (or alternatively, power factor)?
 - c) What are the effects of season, time of day, day-type, customer load type, feeder length, and distributed energy generation penetration on the program’s energy and demand savings?

Process and Net-to-Gross Research

Navigant will limit its process research in CY2019 to interviews with the program manager and implementation team. The VO Program requires no actions by any affected ComEd customers, so net and gross impacts are identical; thus, net-to-gross research is not required.

Evaluation Approach

Navigant will measure energy and demand impacts on a representative sample drawn from the population of feeders on which ComEd plans to install VO over the CY2018-CY2025 period. The sample results will be used to estimate impacts for the remaining VO feeders.

The table below summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2: Evaluation Plan Summary for CY2019

Activity	CY2019
Target sample size (# of Test Feeders)	149*
Data collection (SCADA, AMI, tracking data, events log)	Sample and non-sample feeders
Gross impacts evaluation	Regression Analysis
Program manager interviews / review materials	Yes

* Sampling was split across CY2018 and CY2019, with the total sample size (149) based on an ex ante power analysis designed to achieve at least ±10% precision with 90% confidence on aggregate estimates. Total sample size, and thus the CY2019 sample size, will not be finalized until after the CY2018 impact results are known.

Gross Impact Evaluation

Measured Impacts on Sampled Feeders

Navigant will employ robust statistical techniques to measure the VO program’s annualized impacts for all feeders on which VO has been commissioned in each calendar year. We will work with ComEd to develop a statistically valid representative sample of the distribution feeders on which VO will be installed

during the CY2018-CY2025 period. The volt-var controls on the feeders in the sample will be operated on a pre-set, alternating (4-day-on/4-day-off) schedule⁶⁵, shifting periodically between the baseline (i.e., non-VO) and test (i.e., VO) control states, and 30-minute interval data collected on voltage, real power (P), and reactive power (Q). The sample of feeders will be drawn and tested over the roughly two-year period spanning CY2018 and CY2019, with each sampled feeder being operated on an alternating VO-on/VO-off schedule for a period sufficient to generate test data covering at least three meteorological seasons (summer, winter, and either spring or autumn). Once sufficient test data have been generated for a given sample feeder, it will then be released from the alternating schedule and remain continuously in VO mode.

Navigant will analyze the impacts of VO using a regression model of the form shown in Equation 1, applied to the sample feeders with sufficient test data available to support estimation, and use the fitted models to develop annualized impact estimates.⁶⁶

Equation 7.. VO Load/Voltage Model

$$\begin{aligned}
 X_{i,t,j} = & \sum_{j \in \left\{ \begin{smallmatrix} \text{weekday,} \\ \text{weekend} \end{smallmatrix} \right\}} \sum_{t=1}^{24} \beta_{i,t,j}^{\text{DayType} \cdot \text{Hr}} Hr_t \cdot \text{DayType}_j + \\
 & \sum_{j \in \left\{ \begin{smallmatrix} \text{weekday,} \\ \text{weekend} \end{smallmatrix} \right\}} \sum_{t=1}^{24} \beta_{i,t,j}^{\text{DayType} \cdot \text{Hr} \cdot \text{VO}} Hr_t \cdot \text{DayType}_j \cdot VO_{i,t,j} + \\
 & \beta_i^{FC} FC_{i,t} + \beta_{i,t}^{CDH} CDH_{i,t} + \beta_{i,t}^{HDH} HDH_{i,t} + \varepsilon_{i,t,j}
 \end{aligned}$$

where:

- i , t , and j index the feeder, time interval, and day-type, respectively
- $X_{i,t,j}$ is feeder load measured at the substation bus or feeder head-end – measured in MW for real power (P) and $|MVAR|$ for reactive power (Q) – or voltage (V) measured at the customer service points⁶⁷ on feeder i at time t on day-type j
- Hr_t consists of a set of 24 binary indicators, each of which equals 1 when observation t falls within the associated hour of the day, and 0 otherwise
- DayType_j is a set of binary variables indicating day-type (weekday vs. weekend)
- $VO_{i,t,j}$ is a variable that equals 1 when VO control on feeder i is enabled at time t in day-type j , 0 when VO controls are disabled
- $FC_{i,t}$ is a variable that equals 0 prior to feeder conditioning on feeder i , and 1 afterward

⁶⁵ Adherence to a pre-set alternating schedule will ensure that the volt-var control state on a sample feeder at a given point in time is exogenous with respect to systematic determinants of load or voltage (e.g., time of day, day-type, weather conditions, season).

⁶⁶ Navigant may determine that other variables or combinations of variables are needed besides those shown in Equation 7 once we have inspected the data and reviewed the quality of the model fits. We will employ cross-validation with holdout samples to select the best model.

⁶⁷ Interval voltage measurements on each feeder will consist of the load-weighted mean of all usable voltage readings (on a common 120V nominal basis) from all reporting AMI meters served by the feeder. Voltage readings at customer service points are preferred for measuring VO voltage reductions because the bulk of VO energy savings is expected to occur behind customers' meters, the result of more efficient operation of customer loads. Thus, the voltage reductions delivered to customer service points are the relevant statistic for measuring VO impacts.

- CDH_t is the cooling degree-hours accruing during time t
- HDH_t is the heating degree-hours accruing during time t
- $\varepsilon_{i,t,j}$ is a mean-zero random disturbance representing the variation in $X_{i,t,j}$ that is not otherwise captured by the model
- The β s are unknown parameters that are estimated by fitting the model to the experimental data on each feeder

The estimated VO impacts on each sample feeder will be derived by first fitting the regression model using all the available data to obtain unbiased estimates of the model coefficients for that feeder. With these coefficient values in hand, the fitted models will then be used to simulate annualized load and voltage profiles for each sample feeder under two scenarios: one assuming VO controls are engaged ($VO = 1$) and the other assuming baseline controls ($VO = 0$), both under normal weather conditions.⁶⁸ Differencing the two profiles will yield the forecasted impacts of VO on voltage and energy usage on each sample feeder: an annualized (8,760-hour) time-series of VO impacts for that feeder. Aggregating across feeders will yield the aggregate impact for a given period. To express these impacts in percentage terms, the estimated impacts for each feeder will be divided by the corresponding simulated usage, load or voltage value under the baseline ($VO = 0$) scenario. CVR factors, defined in Equation 8, will be calculated for each sample feeder to assess ComEd’s preliminary assumption that the CVR factor for its VO program would equal 0.80.

Equation 8. Definition of CVR Factor

$$CVRf_{i,p}^f = \% \Delta E_{i,p} / \% \Delta V_{i,p} .^{69}$$

Extrapolating Results Beyond the Sample in CY2019 and to Subsequent Years

Navigant will extrapolate the estimates of VO impacts to the non-sample feeders on which VO is installed during CY2019 by modeling the time-series of VO impacts as a function of feeder-level time-varying and static variables, as shown in Equation 9.

Equation 9. Extrapolation of Impacts Outside of Sample

$$\widehat{\Delta X}_{i,t,j} = \beta_i^{level} X_{i,t,j} + \sum_{j \in \{weekday, weekend\}} \sum_{t=1}^{24} \beta_{t,j}^{VO \cdot Hr} Hr_t \cdot DayType_j + \sum_{j \in \{weekday, weekend\}} \sum_{t=1}^{24} \beta_{t,j}^{VO \cdot HR \cdot VO} HR_t \cdot DayType_j \cdot VO_{i,t} + \beta_i^{FC} FC_{i,t} +$$

⁶⁸ Normal weather consists of typical meteorological year (TMY3) hourly temperature values for the Chicago region. Normal weather is preferred to observed weather for forecasting in order to avoid bias due to atypical weather conditions that may occur during the test phase. See http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ for more information.

⁶⁹ The CVR factor ($CVRf$), or voltage elasticity of energy consumption, in principle varies by feeder and season. It can be used to project VO energy savings to out-of-sample feeder circuits as its product with a measured or assumed percentage voltage reduction and baseline cumulative energy flow.

$$\beta_t^{CDH} CDH_t + \beta_t^{HDH} HDH_t + \sum_{k=1}^K \beta_k^{Char} FeederChar_i + \varepsilon_{i,t,j}$$

where $FeederChar_i$ is a vector of static feeder characteristics, including:

- # of capacitor banks
- # of voltage regulators (i.e., voltage control zones)
- Feeder length (in miles/kilometers)
- Load mix variables (i.e., %Res, %Com, %Ind)
- Load factor (i.e., ratio of average load to peak load)

We will initially fit the above pooled model to data from the sample feeders to obtain a set of unbiased coefficient estimates. With these coefficients in hand, we will then use them together with interval data from the non-sample feeders to predict VO savings for the feeders that received VO treatment during CY2019 but were not part of the test sample.

Following the evaluation of the CY2018 and CY2019 sample feeders, Navigant expects to have sufficient information on VO impacts in ComEd’s service territory that such on/off cycling could cease for the remainder of ComEd’s VO feeders for the duration of the system-wide roll-out.⁷⁰ We will develop and propose a method of measuring VO impacts in future years following CY2019. In so doing, we will compare the results of our robust statistical analysis on the entire sample of VO feeders to other M&V methods, including an approach based on deemed CVR factor values and measured voltage reductions proposed by ComEd⁷¹, the results of Ameren-Illinois’s VO research, and at least one additional method, and will report our findings and recommendations after the evaluation of the CY2019 portion of the VO sample is completed. Following the evaluation of the CY2019 sample feeders, we will submit our findings and recommendations concerning VO in a white paper to the IL-TRM Update Process for possible inclusion in future versions of the IL-TRM.

Verified Net Impact Evaluation

Since the VO Program will require no actions by any affected ComEd customers, net and gross impacts are identical.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS.

Process Evaluation

The process evaluation for this program will be limited to interviews with the program manager.

⁷⁰ We understand that ComEd expects to complete installation of VO throughout its distribution grid by the end of CY2025.

⁷¹ ComEd’s proposed method involves applying an assumed or estimated CVR factor to the empirically-estimated average VO voltage reduction achieved on a given feeder circuit and its average baseline cumulative energy flow.

$$\Delta \bar{E}_t = CVR_i \cdot \% \Delta V_i \cdot \bar{E}_i$$

Data Requirements

Table 3 shows the data Navigant will need for the CY2019 evaluation.

Table 3. Data Requirements for CY2019 VO Evaluation

Data Source	Information Required
AMI Meters of Customers on Each VO Feeder	• Feeder
	• Substation
	• Date / time stamp (30-minute intervals)
	• Load-weighted service voltage from all meters served by feeder
Substation SCADA System	• Feeder
	• Substation
	• Date / times stamp (30-minute intervals)
	• Voltage (at substation bus)
	• Real power (MW or MWh)
	• Reactive power (Mvar) / or power factor
Other	• Weather data (temperature, humidity, wind speed) *
	• VO control status
	• Capacitor status (for capacitor banks controlled by VO)
	• Log of substation / feeder status (outages, reconfigurations)
	• Static feeder characteristics

* Navigant will acquire required observed weather data from area NOAA weather stations and TMY3 weather data from NREL.

Evaluation Schedule

Table 4 below provides the schedule for key deliverables and data transfer activities for the work leading to the CY2019 results. Adjustments will be made, as needed, as evaluation activities progress.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Final CY2019 evaluation data delivered to Navigant	ComEd	January 30, 2020
Draft CY2019 report to ComEd and SAG	Navigant	March 13, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 3, 2020
Revised Draft by Navigant	Navigant	April 10, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 17, 2020
Final Report to ComEd and SAG	Navigant	April 24, 2020

APPENDIX C. INCOME ELIGIBLE PROGRAMS EVALUATION PLANS

ComEd Affordable Housing New Construction Program CY2019 to CY2021 Evaluation Plan

Introduction

The ComEd Affordable Housing New Construction (AHNC) Program provides technical assistance and incentives for energy-efficient construction and major renovation of single-family and multi-family affordable housing. The program targets affordable housing developers and owners for the construction of housing for customers with incomes at or below 80% of the Area Median Income. An additional goal of the program is to educate housing developers on cost-effective energy efficient building practices. The program has three participation levels: major renovation, new multi-family, and new single-family. The program is a coordinated program with Peoples Gas (PG), North Shore Gas (NSG), and Nicor Gas.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection - Program Materials Review	X		X
Data Collection - Program Manager and Implementer Interviews	X	X	X
Data Collection - Developer Interviews		X	
Impact - Engineering Review	X	X	X
Impact - Measure-Level Deemed Savings Review	X	X	X
Impact - Verification & Gross Realization Rate	X	X	X
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the CY2019-2021 period based on the needs of the program and the program’s prior history. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Program manager and implementer interviews will be conducted each year
- Program materials review will be routinely conducted every other year, starting in CY2019. This is contingent on whether there are significant changes, and if so may warrant an annual review as-needed.
- Interviews with affordable housing developers will be conducted in 2020
- CPAS will be calculated based on the requirements of the Future Energy Jobs Act (FEJA)

Coordination

Navigant will coordinate with the evaluation teams from other utilities on any issues relevant to this program. Specifically, as this is a coordinated program with Nicor Gas and Peoples and North Shore Gas, the evaluation team will coordinate closely with all gas utilities on issues common to this program. The evaluation activities and timing for each utility evaluation are the same for all utilities. Additionally, Navigant will solicit feedback from and coordinate with the Income Qualified Energy Efficiency Advisory Committee.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the gross annual energy and demand savings induced by the program?
2. Did the program meet its energy and demand savings goals? If not, why not?
3. What are the net impacts from the program?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. How can the program be improved? Are there changes or improvements which could be made to the educational component of the program?
2. Do program marketing materials effectively target affordable housing developers and owners?
3. Do program materials clearly guide affordable housing developers through the participation process?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
Gross Impact Evaluation	Early feedback review	As needed	Early feedback for large projects
Gross Impact Evaluation	Engineering review	All	Two waves*
Verified Net Impact Evaluation	Calculation using deemed net-to-gross (NTG) ratio	NA	
In-Depth Interviews	Program management and implementers	2	Augment with monthly calls
Program Materials Review	Program manuals, brochures, application forms, marketing materials	All	

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review

Since the implementer is transitioning to a new tracking system (e.g., eTrack) in CY2019, Navigant will perform a thorough review of the program tracking system data to ensure the new system gathers the data required to support evaluation activities and allows program managers to monitor key aspects of program performance at regular intervals. The evaluation team will review the tracking system data to ensure that all fields are populated and consistent with the values in the project savings calculators.

Gross Impact Evaluation

Since the AHNC Program savings are derived from deemed values contained in the TRM⁷², gross savings will be evaluated primarily by (1) reviewing the project savings calculators to ensure that all fields are appropriately populated; (2) reviewing measure algorithms and values in the project savings calculators to assure they are appropriately applied; and (3) cross-checking totals. This approach will be supplemented, where possible, with a review of project documentation in each program year to verify participation, installed measure quantities, and associated savings.

Navigant will perform a tracking system and project savings calculator review in two waves during the CY2019 evaluation period. Final program gross and net impact results will be based on the two waves combined. Proposed gross impact timelines for CY2019 are shown below:

- a) First wave drawn in May 2019 and completed in August 2019
- b) The final tracking data is provided by ComEd by January 30, 2020, with reporting finalized by April 30, 2020

Verified Net Impact Evaluation

The TRM deems the NTG ratio at 1.0 for income-eligible programs.

⁷² Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0 for 2019, available at: <http://www.ilsag.info/technical-reference-manual.html>

Research NTG Impact Evaluation

The program has historically seen a deemed NTG ratio of 1.0 because the program targeted the income-eligible sector. However, TRM v7.0⁷³ includes the following language,

“There has been general consensus among Illinois stakeholders that the NTG value for Income Eligible programs is not likely to be significantly different from 1.0, particularly where the person making the participation decision is the Income Eligible resident. Until the Stakeholder Advisory Group (SAG) establishes a different policy, the NTG value will be deemed at 1.0. Discussions will be held with SAG members on the value in and methods for performing such research and the timing of the application of such research.”

Per the TRM language, the SAG should consider whether the Affordable Housing New Construction Program should have NTG research performed. Potential NTG research activities and timeline will be coordinated with the other utilities. Navigant will coordinate the data collection and survey instruments design to capture the appropriate questions in the decision maker surveys. The coordinated program evaluation and reporting timelines will be the same for each utility.

In-Depth Implementer Interviews

Navigant will interview ComEd program staff and implementation contractors to gather essential information about program design, program changes, and the participant experience. The evaluation team will conduct interviews at the beginning of the evaluation and will communicate with program staff on an ongoing basis to gather additional information as needed.

Program Materials Review

Navigant will review program materials for consistency and effectiveness in messaging, program requirements, and the participation process. Program materials to review may include websites, brochures, application forms, newsletters, email blasts, and implementation manuals. Given the program is undergoing a program materials overhaul in Q1 of CY2019, Navigant will review all new marketing materials and include findings as part of the Wave 1 Interim Report.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report measure-specific and total ex post gross and net savings for the program, and the CPAS in CY2019 will be calculated for each measure along with the total CPAS for all measures. Additionally, the weighted average measure life will be estimated at the portfolio level.

Randomized Controlled Trial and Quasi-Experimental Design

Navigant is not evaluating the AHNC Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental design because it would not be possible to create a valid matched control group for the customers in this program.

⁷³ Table note in IL TRM v7.0 Volume 4, Section 4, Table 4-1

Evaluation Schedule

Table 3 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program manager and implementation contractor interviews	Evaluation, ComEd, Seventhwave	May 2019
CY2019 program tracking data, project savings calculators, and project documentation	ComEd	May 3, 2019
Program manuals and marketing materials	ComEd	August 9, 2019
Wave 1 findings	Evaluation	August 30, 2019
CY2019 program tracking data, project savings calculators, and project documentation	ComEd	January 30, 2020
Draft report to ComEd and SAG	Evaluation	March 6, 2020
Comments on draft (15 business days)	ComEd and SAG	March 27, 2020
Revised draft by Navigant	Evaluation	April 3, 2020
Comments on redraft (5 business days)	ComEd and SAG	April 10, 2020
Final report to ComEd and SAG	Evaluation	April 24, 2020

ComEd Income Eligible Retail Discounts Program CY2019 to CY2021 Evaluation Plan

Introduction

The Income Eligible Retail Discounts Program provides incentives to increase the market share of ENERGY STAR® certified LED bulbs and fixtures and efficient products such as window air conditioning units, air purifiers, and tier 1 advanced power strips (APS) sold through retail sales channels. The program includes instant discounts (at the time of sale) to decrease customer costs, and provides educational materials aimed at increasing customer awareness and acceptance of energy-efficient technologies. The incentives offered through this program for lighting bulbs and fixtures are larger than the incentives offered through the market rate lighting discounts program. Currently, ComEd does not offer in-store discounts for the other efficiency products through a market rate program. The program will target retail sale channels that serve, in part or in full, ComEd residential customers with incomes at or below 80% of the Area Median Income. Regardless of their choice of supplier, all income eligible residential customers taking delivery service from ComEd are eligible.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Data Collection - Program Manager and Implementer Interviews	X	X	X
Data Collection – In-Store Shelf Surveys		X	
Data Collection – Community Pulse Survey	X		

In CY2019 the evaluation will focus on improving on any gaps in impact methodology, program participation and geography identified in CY2018. The evaluation team will continue working to answer the following overarching questions from CY2018:

- Are there updates which should be made to the TRM specifically for the Income-Eligible Retail Discounts Program?
- Are the participating stores located in income eligible neighborhoods, or are program’s stores visited by income eligible population? Are there areas that are underserved? Where are eligible customers purchasing lighting and products are they purchasing LEDs or other energy efficient measures?

The answers to the above questions will inform additional impact and process evaluation priorities to be explored in CY2020-2021. Key evaluation activities may include in-store intercept interviews and shelf surveys. Additional activities, such as focus groups with retailers, may be proposed based on program needs.

Coordination

Navigant will coordinate with the ComEd Residential Lighting Discounts program on any LED bulb and fixture related issues relevant to this program. Ameren Illinois has a residential energy-efficient lighting program offering time of sale discounts to residential electric customers but does not have a similar program targeting income eligible participants and Navigant will coordinate as needed. Navigant will also collaborate with the Income Qualified Energy Efficiency Advisory Committee.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program's annual total verified gross and net energy savings (kWh) and peak demand (kW) savings?
2. Did the program meet savings goals, and if not, why?
3. What updates are recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

The process evaluation effort will focus on program delivery and will address the following questions:

1. What are the key barriers to energy efficient retail purchases and how can they the program address them?
2. What other channels can be leveraged to deliver discounted lighting and energy efficient products to ComEd customers?

Evaluation Approach

Table 2 below summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
Gross Impact Evaluation	Early Feedback Review	NA	Early Feedback for Wave 1 data
Verified Net Impact Evaluation	Calculation Using Deemed NTG Ratio	NA	Early Feedback for Wave 1 data
In-Depth Interviews	Program Management and Implementers	2	Augment with quarterly calls
Community Pulse Survey	Income Eligible Population	Sample	

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review

The CY2019 program tracking data review will allow for the verification of rebated measure sales and characteristics of the rebated measures. The program tracking data review will verify that all necessary information is included for the evaluation team to successfully conduct the CY2019 gross impact analysis.

Gross Impact Evaluation

The evaluation team will perform an engineering review of savings calculations. For all lighting measures, Navigant will calculate gross kWh, kW and summer and winter peak kW savings across all program bulbs based on the following equations:

$$\text{Annual kWh Savings} = \text{Program bulbs} * \text{Delta Watts}/1000 * \text{Annual HOU} * \text{Realization Rate}$$

$$\text{Annual kW Savings} = \text{Program bulbs} * \text{Delta Watts}/1000 * \text{Realization Rate}$$

$$\text{Annual Summer Coincident Peak kW Savings} = \text{Annual kW Savings} * \text{Summer Peak Load CF Factor}^{74}$$

$$\text{Annual Winter Coincident Peak kW Savings} = \text{Annual kW Savings} * \text{Winter Peak Load CF}^{75}$$

$$\text{Where Realization Rate} = \text{Installation Rate} * (1 - \text{Leakage Rate}) * \text{Interactive Effects}$$

For the verification analysis in CY2019, the evaluation team will calculate gross savings using the following parameter estimates:

- **Program Bulb Sales** data will be obtained from the CY2019 EM&V tracking database analysis.
- **Program Bulb Installation Rates** will be obtained from the IL TRM v7.0.
- **Delta Watts** will be calculated using the bulb type lumen-equivalence mapping in the IL TRM v7.0.

⁷⁴ Summer Peak CF is calculated as the percentage of lighting turned on in each room during peak hours of the summer months (1-6 pm on summer weekdays).

⁷⁵ Winter Peak CF is calculated as the percentage of lighting turned on in each room during peak hours of the winter months (6-8 am and 5-7pm, between January 1 and February 28).

- **HOU and Summer Peak CF** will be obtained from the IL TRM v7.0.
- **Winter Peak CF** will be determined based upon analysis done by the evaluation team.
- **Residential Bulb Installation Rate** will be obtained from the IL TRM v7.0.
- **Interactive Effects** will be obtained from the IL TRM v7.0.
- **Leakage** will be obtained from the in-store intercept analysis.

Navigant will also calculate gross kWh, kW, and summer and winter peak kW savings for all non-lighting measures (window air conditions, air purifiers and tier 1 APS) based on values deemed in the IL TRM. Navigant will (1) review the tracking system data to ensure that all fields are appropriately populated and savings are consistent with the implementation contractor workpapers and savings calculators that feed into the tracking system; (2) review new measures' algorithms and values in the tracking system and implementation contractor workpapers to ensure that they are appropriately applied; and (3) cross-check Navigant's calculated savings with the implementation contractor's calculated savings

Verified Net Impact Evaluation

The TRM deems NTG at 1.0 for Income Eligible programs.

Research NTG Impact Evaluation

Navigant will conduct NTG research for this program via the in-store intercepts. The Illinois Stakeholder Advisory Group (SAG) should discuss the possibility of using these results in the net savings analysis in the future.

In-depth Interviews

In-depth interviews will be conducted with program managers and implementers to understand current program design and implementation. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and focusing evaluation tasks to address program needs. CY2019 interviews will also follow up on issues from previous program years, including challenges related to selling bulbs and energy efficient products in independent hardware stores and non-traditional retail channels.

Community Pulse Survey

Navigant will conduct a very short, two question survey with members of the income eligible community at a high traffic event to determine where customers are shopping for lightbulbs and energy efficient products, and what types of lightbulbs and energy efficient products they are purchasing. This research will help determine whether the lower than expected percentage of customers meeting income-eligibility criteria determined by the in-store intercepts in 2018 is attributable to the population of stores surveyed or income eligible customers not shopping at participating retailers. This goal of this research is to help ComEd adjust program implementation to better reach the income-eligible segment.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), the total ex post gross savings and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated for each measure along with the total CPAS for all measures. Additionally, the weighted average measure life will be estimated at the portfolio level.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the Income Eligible Retail Discounts Program via a randomized controlled trial (RCT) or quasi-experimental design because the program is delivered upstream and it is not possible to select treatment and control groups for programs where the participants are unknown.

Evaluation Schedule

Table 3 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Manager and Implementer Interviews	Evaluation	April 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 15, 2019
Wave 1 impact memo	Evaluation	July 26, 2019
Data request for CY2019 final tracking data	Evaluation	November 15, 2019
CY2019 Program tracking data for final wave	ComEd	January 30, 2020
Draft Impact Report to ComEd and SAG	Evaluation	March 5, 2020
Comments on draft Impact Report (15 Business Days)	ComEd and SAG	March 25, 2020
Revised Impact Report Draft by Navigant	Evaluation	April 5, 2020
Comments on Impact Report redraft (5 Business Days)	ComEd and SAG	April 12, 2020
Final Impact Report to ComEd and SAG	Evaluation	April 26, 2020

ComEd Income Eligible Multi-Family Energy Efficiency Program CY2019 to CY2021 Evaluation Plan

Introduction

The Income Eligible Multi-Family Energy Efficiency Program offers direct installation of energy efficiency measures and replacement of inefficient equipment as well as educational information to further save money on energy bills. Eligible measures include LED and energy efficient lighting retrofits, programmable thermostats, advanced power strips, water efficiency devices, weatherization measures, pipe insulation, refrigerators, heating and cooling equipment and custom energy saving measures for eligible properties. The program also offers installation of health and safety measures, including installation of vents, electrical repairs, and asbestos and mold remediation.

There are two different components for this program. The Income Eligible Multi-Family Savings Program (IEMS) is administered by ComEd and Peoples Gas (PGL) and North Shore Gas (NSG) companies, and implemented by Elevate Energy. The Income Eligible Retrofits Multi-Family Program (IER-MF) is administered by ComEd, PGL and NSG, and Nicor Gas and implemented by Resource Innovations in partnership with the Illinois Home Weatherization Assistance Program (IHWAP).

Both the IEMS and IER-MF programs provide retrofits in common areas and tenant spaces to eligible multi-family properties in the ComEd service territory and serve as a “one stop shop” to multi-family building owners and managers whose buildings are targeted to income eligible residents.⁷⁶

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in the following table.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Impact - Custom Analysis to confirm TRM savings estimates		X	
Impact - Engineering Review	X	X	X
Impact - Measure-Level Deemed Savings Review	X	X	X
Impact - Verification & Gross Realization Rate	X	X	X
Impact - Field Work	X		
GIS research	X		
Data Collection - Community Action Agency Focus Groups	X		X
Data Collection - Program Manager and Implementer Interviews	X	X	X
Data Collection – Building Owner and Property Manager SurveysLead Lifecycle Analysis	X		X

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and program’s history. In CY2018, our impact evaluation focused on performing

⁷⁶ Multi-family properties served by the IHWAP, nonprofits that manage HUD 811 and HUD 202 housing, other federal or state subsidized housing, other building owners/managers and tenants in qualified geographic areas (e.g., Census tracts).

deemed energy savings calculations for TRM-based measures along with reviewing custom calculations for custom measures, and our process evaluation efforts focused on questions related to gaps in participation and the program transition. In CY2019, based on the program participation levels, we will conduct field work to confirm measure installation and we will also continue our process evaluation efforts to inform additional research. The three-year evaluation approach for this program is based on the following:

- Tracking system review and impact analysis each year to calculate gross and net impact and Cumulative Persisting Annual Savings (CPAS)
- Custom analysis (site specific billing analysis, on-site metering, modeling or other activities dependent on the type of projects incented by the program) conducted in CY2020 to confirm TRM savings estimates
- Process surveys conducted each year based upon client request, program performance and Energy Efficiency Service Provider (EESP) network details
- Field work in CY2019 or CY2020 based on program participation to confirm measure installation and to assess any missed energy savings opportunities.

Coordination

These are joint programs with the gas utilities and evaluation will coordinate closely with the gas utilities on issues common to the programs. We will pull our sample for field work and surveys with the aim of creating efficiencies between the programs and utilities, while still meeting statistical significance. Ameren Illinois has a suite of energy efficiency programs for income eligible customers and we will coordinate with Ameren on as-need basis (e.g., regarding possibility of NTG research). Additionally, Navigant will solicit feedback from and coordinate with the Income Qualified Energy Efficiency Advisory Committee.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual and lifetime total verified net and gross savings? What are the verified gross savings from lighting measures? What are the verified gross savings from non-lighting measures?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. For both program components, we will aim to address the following research questions:

1. What are property managers’ and building owners’ perspectives and overall satisfaction with the program?
2. Are there geographic or demographic gaps in participation? How can these be addressed?
3. Are there barriers to participation? Particularly barriers around incentive levels, health and safety issues, and master metered versus individually metered properties.

Evaluation Approach

The table below summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
Gross Impact Evaluation	Ex ante energy and demand savings estimates	all	Two Waves*
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	
GIS research	Participants	Census	Identify demographic and geographic gaps in participation
Focus Group	Community Action Agencies	Sample	IHWAP component
In-Depth Interviews	Program Management and Implementers	2	Both components
Benchmarking Research	Income Eligible Programs in Other Jurisdictions	NA	Will conduct for both program components
Lead Lifecycle Analysis	Implementer and Property Manager/Owner	Sample	Elevate component

* Navigant will coordinate with ComEd, PGL, NSG and Nicor to determine appropriate dates to pull tracking data extracts for each wave.

Tracking System Review and Gross Impact Evaluation

The IEMS and IER-MF savings verification will be based on using the applicable Illinois Technical Reference Manual (TRM) v7.0, or secondary research for any measure with custom savings input. Gross savings will be evaluated primarily by: (1) reviewing the tracking system data to ensure that all fields are appropriately populated; (2) reviewing measure algorithms and values in the tracking system to assure that they are appropriately applied; and (3) cross-checking totals. This approach will be supplemented where possible with a review of project documentation in each program year to verify participation, installed measure quantities, and associated savings, and verification of installation of energy efficient measures through participant surveys or field work. Verified gross savings will be estimated by multiplying deemed per unit kWh savings by the verified quantity of eligible measures.

The impact evaluation will quantify gas measures eligible for kWh conversion, and review the parameters ComEd used to estimate eligible gas savings

Verified Net Impact Evaluation

The TRM deems NTG at 1.0 for income eligible programs.

Research NTG Impact Evaluation

The program has historically seen a deemed NTG ratio of 1.0 because the program targeted the income eligible sector. However, TRM v7.0 includes the following language,

“There has been general consensus among Illinois stakeholders that the NTG value for Income Eligible programs is not likely to be significantly different from 1.0, particularly where the person making the participation decision is the Income Eligible resident. Until the Stakeholder Advisory Group (SAG) establishes a different policy, the NTG value will be deemed at 1.0. Discussions will be held with SAG members on the value in and methods for performing such research and the timing of the application of such research.”

Per the TRM language, the SAG should consider whether the Multi-Family Income Eligible Program should have NTG research performed. Potential NTG research activities and timeline will be coordinated with the other utilities. Navigant will coordinate the data collection and survey instruments design to capture the appropriate questions in the decision maker surveys. The coordinated program evaluation and reporting timelines will be the same for each utility.

GIS Research

Customer segmentation and geographic analysis will be used to map income eligible participation against a variety of demographic characteristics. The result will show any underserved segments or regions, which the program could expand to serve. The results will inform future process research.

Focus Group

A focus group will be used to collect information from the most active community action agencies (CAA) on perspectives and satisfaction with program implementation. The CAAs are implementation partners for the IHWAP portion of the program. The focus group will assess how reporting processes are working for CAAs, following the CY2018 transition.

In-depth Interviews

In-depth interviews will be conducted with program managers and implementers to understand current program design and implementation. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and focusing evaluation tasks to address program needs. CY2019 interviews will also follow up on issues from previous program years, including any challenges related to program tracking and reporting requirements or pipeline development.

Benchmarking Research

We will benchmark savings and spending for both the IHWAP component and the Elevate component against other income eligible retrofit programs to determine how ComEd's programs compare. We will include data on these programs when they were run by DCEO to understand how the additional funding from the utilities has impacted program cost-effectiveness.

SLead Lifecycle Analysis

Navigant will conduct a lead lifecycle analysis to understand when and why lead building owners and property managers decide not to participate in the IEMS program. ComEd has tried several marketing and outreach strategies to engage property owners and managers with this program. The lead lifecycle analysis will provide insight into the customer's decision-making process as they decide whether to participate. This analysis examines a customer's interactions with program marketing and outreach touchpoints to determine whether the program is being promoted at critical decision-making points, such as when equipment fails or when renovations are being planned. In addition, the analysis will examine whether the program is following up with interested customers to encourage participation. This analysis can be used to make targeted improvements to program marketing and outreach, allowing the program to convert more interested customers to participants.

The data collection for the lead lifecycle analysis start with the implementation contractor interview and extend to an estimated 1-3 additional discussions to finalize details of the analysis. In addition, the evaluation team will interview a small sample of building owners and property managers (estimated 3-5 interviews) to understand their experience.

Use of Randomized Controlled Trial and Quasi-Experimental Design

Navigant is not evaluating the IEMF Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. Navigant is not using quasi-experimental design because this program contains many unique measures with significant cross-participation. In this case, quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for all analysis.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the program level CPAS. Evaluation will include savings converted from gas savings to electric savings in the report.

Evaluation Schedule

Table below provides the schedule for key deliverables and data transfer activities. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Manager and Implementer Interviews	Evaluation	February-March, 2019
CY2019 program tracking data for Wave 1 early impact review and process	ComEd	June 30, 2019
Early impact findings memo	Evaluation	August 15, 2019
CY2019 Final Tracking Data Request	Evaluation	December 1, 2019
Final CY2019 Tracking Data to Navigant	ComEd	January 30, 2020
Draft Report to ComEd and SAG	Evaluation	March 5, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 26, 2020
Revised Draft by Navigant	Evaluation	April 5, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 12, 2020
Final Report to ComEd and SAG	Evaluation	April 20, 2020

ComEd Income-Eligible Single-Family Retrofit Program CY2019 to CY2021 Evaluation Plan

Introduction

The Income-Eligible Single-Family Retrofit (SFR) Program provides retrofits to single-family households in ComEd service areas with incomes at or below 80% of the Area Median Income. The program offers assessments, direct installation of energy efficiency measures, replacement of inefficient equipment, technical assistance, and educational information to further save money on energy bills through two program components. One program component is delivered with the Chicago Bungalow Association (“CBA”) and is offered jointly with Peoples Gas. The portion of the program offered outside of the City of Chicago is delivered by the Chicagoland Vintage Home Association (which is an extension of CBA) and is solely offered by ComEd. The other component is delivered leveraging the State of Illinois’ Home Weatherization Assistance Program (“IHWAP”). The IHWAP portion is offered jointly with both Peoples Gas, North Shore Gas, and Nicor Gas

Eligible program measures include, but are not limited to:

- LED lighting
- Smart and programmable thermostats
- HVAC equipment such as boilers, furnaces, central and room air conditioners and ductless heat pumps
- Water heaters
- Low-flow faucet aerators and showerheads
- Attic and wall insulation
- Air sealing
- Health and safety measures, such as installation of vents and electrical repairs

The following table shows the data collection and analysis activities over the coming three years.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Impact – Engineering Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Impact – Field Work		X	
Impact – Billing Analysis		X	
Data Collection - Program Manager and Implementer Interviews	X	X	X
Data Collection - Participant Surveys	X		X
Data Collection - Energy Efficiency Service Provider Interviews		X	
Data Collection - Community Action Agency Focus Groups	X		X
Benchmarking Research	X		
GIS research	X		

The evaluation team created the evaluation approach for the CY2019-CY2021 period based on the needs of the program and program's history. In CY2018, our impact evaluation efforts focused on conducting field work and verification of tracking data against the TRM⁷⁷ and our process evaluation efforts focused on questions related to gaps in participation and the program transition. In CY2019, we will apply those results from field work and continue those process evaluation efforts to inform additional research for upcoming years. Looking forward, the three-year evaluation approach for this program includes:

- Process evaluation conducted each year based upon client request, program performance, and any existing program barriers
- Tracking system review and analysis each year to calculate gross and net impact and Cumulative Persisting Annual Savings (CPAS)
- Field work in 2020 to confirm measure installation and to assess any missed energy savings opportunities
- Billing analysis in 2020 to confirm TRM savings estimates. This timeline will allow for one year of post-participation data collection on CY2018 participants.

Coordination

The evaluation team will coordinate closely with the Peoples Gas evaluation team on issues common to the CBA component and with the Nicor Gas evaluation team on issues common to the IHWAP component. The evaluation team will also coordinate with the Illinois Income Eligible Stakeholder Advisory Group and as needed, with Ameren Illinois, who administers the Residential Income Qualified Initiative. Similar to SFR, this initiative has two channels, a Moderate Income Implementation Contractor Channel a Low Income Community Action Agency Channel.

Evaluation Research Questions

The CY2019 evaluation will seek to answer the following key research questions:

Impact Evaluation

1. What are the program's annual total verified gross savings for lighting and non-lighting measures?
2. What are the program's verified net savings?

Process Evaluation and Other Research Topics

Process evaluation for CY2019 will focus on different objectives for each of the program components. Navigant may propose additional research topics based on the results of the CY2018 evaluation.

For the CBA component, the evaluation will delve into findings from the CY2018 customer and Energy Efficiency Service Provider? (EESP) interviews. In addition, the evaluation team will assess efforts to expand the program reach outside Chicago. We will address the following research questions:

1. Are there additional opportunities for energy savings in households served by the program? Could ComEd provide additional measures or education on energy efficient behavior?

⁷⁷ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 6.0, <http://www.ilsag.info/technical-reference-manual.html>

2. How do participants become aware of the Chicagoland Vintage Homes Association portion of the program, which launched midway through 2018 in the southern suburbs? What are their program perspectives and experience?
3. How can the Chicagoland Vintage Homes Association program in the southern suburbs address barriers, such as absorbing the cost of municipal permit fees?
4. Are there geographic or demographic gaps in participation? How can these be addressed?
5. How does cost-effectiveness of the Chicago Bungalow Associations component compare to other income-eligible programs?

For the IHWAP program component, the evaluation will focus on program delivery given the ramp-up period in CY2018. We will address the following research questions:

1. What are participant perspectives and customer experience with the program?
2. What is the impact of the CY2018 transition on the Community Action Agencies (CAAs)? Are the reporting processes working well for them? What are the CAAs perspectives and experience with the program?
3. How can program processes be streamlined within state and federal regulations?
4. Are there geographic or demographic gaps in participation? How can these be addressed?
5. How does the cost per kWh of the IHWAP component compare to other income-eligible programs?

Evaluation Approach

The team will conduct the evaluation tasks in Table 2 for both components to answer the above evaluation questions.

Table 2. CY2019 Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes	Notes
Gross Impact Evaluation	Engineering Impact Review	NA	Two waves* for each program component
Calculation of CPAS and Annual Savings	Engineering Impact Review	NA	Two waves* for each program component
GIS research	Participants	Census	Will conduct for both program components
Focus Group	Community Action Agencies	Sample	IHWAP component
In-Depth Interviews	Program Management and Implementers	2	Will conduct for both program components
Benchmarking Research	Income-Eligible Programs in Other Jurisdictions	NA	Will conduct for both program components
Surveys	Participants	Sample	Will conduct for both program components

*Navigant will coordinate with ComEd and Peoples Gas to determine appropriate dates to pull tracking data extracts for each wave.

Gross Impact Evaluation

Since the SFR Program derives savings from deemed values contained in the TRM⁷⁸, the team will continue to evaluate savings by reviewing:

- Tracking system data to ensure the accurate population of fields
- Measure algorithms and values in the tracking system to ensure accurate calculation of savings
- Totals to ensure accurate summation of savings

Where possible, we may also supplement the above approach by reviewing:

- Project documentation to verify participation, installed measure quantities, and associated savings
- Results from field work conducted in CY2018 to verify installation of energy efficient measures

These activities will also serve to assess program comprehensiveness and missed opportunities.

To conduct billing analysis in CY2020, Navigant will use a quasi-experimental design to confirm TRM savings estimates for groups of measures. We will not be evaluating the program via a randomized controlled trial because randomly assigned treatment and control groups are not part of the program's design.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), we will calculate measure-specific and total CPAS in addition to gross and net savings for the program. We will also include electric savings converted from gas savings and estimate the weighted average measure life at the portfolio level.

GIS Research

We will use customer segmentation and geographic analysis to map income-eligible participation against a variety of demographic characteristics. The result may show any underserved segments or regions for potential program expansion. This task will be conducted in 2018, but reporting will occur in 2019.

Focus Group

For the IHWAP component, we will conduct a focus group to collect information from the most active CAAs on perspectives and satisfaction with program implementation. The focus group will assess how reporting processes are working for them following the CY2018 transition.

In-Depth Interviews

We will continue to conduct in-depth interviews with program managers and implementers to understand current program design and implementation. Interviews will focus on progress to goals, program successes and challenges and their drivers, and evaluation tasks to address program needs. CY2019 interviews will also follow up on key matters from previous program years, including the status of the Chicagoland Vintage Homes Association portion of the program and streamlining processes for the IHWAP portion of the program.

⁷⁸ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 7.0, <http://www.ilsag.info/technical-reference-manual.html>

Best Practices Research

We will conduct best practices research to understand how income-eligible single-family retrofits in other jurisdictions address common barriers, including absorbing municipal permit fees and addressing health and safety concerns. This research can optionally include benchmarking savings and spending for both the IHWAP component and the CBA component against other income-eligible retrofit programs to determine how ComEd’s programs compare. We will include data on these programs

Surveys

For the CBA component, surveys will target participants living in the southern suburbs, a group which was not surveyed during CY2018 due to the program ramp-up period in this territory. For the IHWAP component, surveys will target all participants since the program’s ramp up June 2018. Surveys for both groups will focus on customer awareness, perspectives, and satisfaction. This survey research will be conducted in August 2019.

In addition to the above surveys, results from the CY2018 participant survey will be reported in CY2019. This survey targeted participants in the CBA component who live in Chicago. This survey will be conducted at the end of 2018 and reported in 2019.

Verified Net Impact Evaluation

The TRM deems NTG at 1.0 for Income Eligible programs.

Research NTG Impact Evaluation

No NTG research is planned for this income-eligible program.

Evaluation Schedule

Table 3 below provides the schedule for key deliverables and data transfer activities. If needed, we will adjust the schedule as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Manager and Implementer Interviews	Evaluation	April, 2019
CY2019 program tracking data for Wave 1	ComEd	July 2, 2019
Tracking System Ex Ante Review Findings and Recommendations	Evaluation	August 30, 2019
CY2019 Final Tracking Data Request	Evaluation	November 1, 2019
CY2019 Final Wave Data	ComEd	January 30, 2020
Draft Report to ComEd and SAG	Evaluation	March 15, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 26, 2020
Revised Draft by Navigant	Evaluation	April 5, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 12, 2020
Final Impact Report to ComEd and SAG	Evaluation	April 20, 2020

APPENDIX D. RESIDENTIAL PROGRAMS EVALUATION PLANS

ComEd Appliance Rebates Program CY2019 to CY2021 Evaluation Plan

Introduction

The Appliance Rebates Program is designed to increase the market share of ENERGY STAR® appliances sold through retail (in-store or online) sales channels by providing rebates to decrease customer costs as well as information and education to increase customer awareness and acceptance of energy efficient appliances. The program targets residential customers who purchase new or replacement ENERGY STAR® appliances including advanced power strips, advanced thermostats, air purifiers, electric clothes dryers, electric clothes washers, dehumidifiers, freezers, refrigerators, room air conditioners, ventilation fans, pool pumps, and water coolers.

The primary objectives of the evaluation of the ComEd Appliance Rebates (AR) Program are to: (1) determine gross and net program savings and (2) examine the effectiveness of program processes in achieving savings.

The CY2019 gross impact evaluation will be conducted similarly to previous years, with adjustments to accommodate changes to the measure mix.

Table 1 summarizes the data collection and analysis activities scheduled for the next three years.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys		X	
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Retailer Interviews		X	
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys		X	
Process Analysis	X	X	X

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program, including coordinating with Ameren’s evaluation team on NTG survey instruments used for free ridership and spillover research. Additionally, Navigant will coordinate with the evaluation team for Ameren’s Retail Products program as they begin to offer rebates on appliances in 2020.

Evaluation Research Topics

The CY2019 evaluation team will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s verified gross kWh, peak demand kW savings, and therm savings?
2. What are the program’s verified net kWh, peak demand kW, and therm savings?
3. What are the program’s Cumulative Persisting Annual Savings (CPAS)?
4. What updates are recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. Can customer satisfaction surveys from Navigant, the implementation contractor, and ComEd be combined to reduce participant survey fatigue? These surveys help ComEd and evaluators understand:
 - a. How did customers become aware of the program?
 - b. What is the level of participant satisfaction with the program?
 - c. What opportunities exist for program improvement?
2. What marketing strategies could boost program awareness? For instance, what scalable, low-touch solutions exist to educate as many retailers as possible?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sampling, and Analyses

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	Concurrent with gross impact analyses.
In-Depth Interviews	Program Management and Implementers	2	Augment with monthly calls
Gross Impact Evaluation	TRM Review	Census	Wave one and final data*
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	Census	

*Navigant will coordinate with ComEd to determine appropriate date to pull the “wave 1” tracking data extract.
 † FR refers to Free Ridership and SO refers to Spillover.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation

team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program's data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Key insights from in-depth interviews will drive process evaluation research topics. The process evaluation will (1) determine participant satisfaction with the program overall, and key program elements and (2) assess the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, and participation procedures. The process findings will be summarized in detail and a set of key findings and recommendations will be developed for ComEd's consideration.

Gross Impact Evaluation

Appliance Rebates Program measure savings are derived from deemed values contained in the TRM. Subsequently, gross savings will continue to be evaluated by (1) reviewing the tracking system data to ensure that all fields are appropriately populated and savings are consistent with the implementation contractor workpapers and savings calculators that feed into the tracking system; (2) reviewing new measures' algorithms and values in the tracking system and implementation contractor workpapers to ensure that they are appropriately applied; and (3) cross-checking Navigant's calculated savings with the implementation contractor's calculated savings.

Navigant will complete this process two times, once during the Wave 1 impact analysis and again during the final analysis in March 2020. The Wave 1 impact analysis provides an opportunity for Navigant to give early feedback to the implementation contractor and ComEd with ample time to discuss potential discrepancies and make adjustments prior to the end of the program year. Concurrently with the Wave 1 and final impact analyses, the evaluation team will review program data in ComEd's eTRACK system to ensure data is consistent. In addition to calculating electric savings, the evaluation team will also calculate gas savings for eligible measures.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program. Table 3 provides the recommended NTG ratios for use in CY2019.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Advanced Power Strip – Tier 1	0.86
Advanced Thermostat	NA*
Air Purifier	0.78
Clothes Dryer	0.66
Clothes Washer	0.62
Dehumidifier	0.78
Freezer	0.58
Pool Pump	0.80
Refrigerator – Time of Sale (TOS)	0.61
Room AC - TOS	0.67

* TRM-deemed savings represent net savings for this measure.

Source:

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report electric, gas, and total CPAS for CY2019. For measures that achieve gas savings, Navigant will convert gas savings to electric savings for inclusion in total CPAS. Additionally, the weighted average measure life will be estimated, and Navigant will calculate the weighted average measure life for the program.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the Appliance Rebates Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental design consumption data because the savings from the Appliance Rebates Program represent a small percentage of the total household’s savings and there are not enough participants in this program to achieve statistically significant savings estimates using this method.

Evaluation Schedule

Table 4 provides scheduling details for key impact and process evaluation deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 4. Schedule – Key Evaluation Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	April 5, 2019
CY2019 Program Tracking Data for Wave 1 Data Review and Analysis	ComEd	June 3, 2019
Program Manager and Implementation Contractor Interviews	Evaluation	July 15 – 30, 2019
Tracking System Wave 1 Ex Ante Review Findings and Recommendations	Evaluation	July 26, 2019
Draft NTG Report to ComEd and SAG	Evaluation Team	July 5, 2019
CY2019 Final Program tracking data	ComEd	January 30, 2020
Final TRM Review	Evaluation	February 15 2020
Draft Report to ComEd and SAG	Evaluation	February 25, 2020
Comments on Draft (15 Business Days)	ComEd and SAG	March 18, 2020
Revised Draft by Navigant	Evaluation	March 25, 2020
Comments on Redraft (5 Business Days)	ComEd and SAG	April 4, 2020
Final Report to ComEd and SAG	Evaluation	April 16, 2020

ComEd Fridge and Freezer Recycling Program CY2019 to CY2021 Evaluation Plan

Introduction

The Fridge and Freezer Recycling (FFR) Program offers free pickup and recycling services for older, working refrigerators, freezers and room air conditioners that households no longer want. Program savings are based on the accelerated removal, dismantling and recycling of these older, inefficient units. To encourage participation during CY2019, the program is providing \$50/unit incentives for up to two recycled refrigerators or freezers during all months of the year. Operational room air conditioner (AC) units are also eligible for pick up and recycling but can only be picked up from sites where the program implementer plans to collect a refrigerator or freezer (so the room AC unit can “ride for free”). Participants contributing these working room AC units receive a \$10 program incentive. Similarly, smaller refrigerators (capacity less than 10 cubic feet) can also be picked up at the time the program implementer collects a refrigerator or freezer. These small refrigerator units are ineligible for program rebates and are not assigned any program savings.

During CY2019, the full spectrum of traditional impact-related evaluation activities will be completed, including surveying retailers associated with replacement unit purchases. In addition, the evaluation team will conduct a process evaluation.

The objectives of the CY2019 evaluation are to quantify net energy and peak demand savings impacts from the program, determine program strengths and weaknesses, and assess free ridership associated with recycled units. CY2019 evaluation activities will include surveying participating customers and interviewing the largest and most active retailers reported to have sold new replacement units to participants. Survey findings will be used to update the net-to-gross ratio for future use.

In addition, a new joint metering study may be conducted in CY2019. This would be an update to the metering study conducted in PY4 studying soon-to be recycled appliances. The results of the PY4 study were used, in conjunction with metering data from a Michigan study, to develop the regression equation specified in the TRM for the unit energy consumption of recycled refrigerators and freezers. If ComEd decides to conduct an updated study in CY2019, the results of the joint metering study may be used to update the TRM measures.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1. We will conduct most evaluation activities each year, with the exception of process evaluation which may be skipped in alternating years.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Retailer Interviews	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X	X	X
Net-to-Gross Analysis	X	X	TBD
Process Evaluation and Analysis	X	TBD	X

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and the program’s history. The three-year evaluation approach for this program is based on the following:

- Annual gross and net impact analysis
- Optimized timing on when to conduct part-use, unit location and NTG research
- CPAS will be calculated based upon the requirements of the Future Energy Job Act (FEJA)
- Process evaluation will be conducted on an as-needed basis. Given that the program design has been relatively stable for many years, this affords an opportunity to conduct process evaluation every two to three years.

Coordination

Navigant will coordinate with the other utility evaluation teams on any issues relevant to this program. The approaches used by both the ComEd and Ameren Illinois evaluation teams to evaluate the FFR programs are closely coordinated. The methods used in both evaluations are specified by the Illinois TRM and are generally consistent. The one exception is the approaches being used to compute net-to-gross ratios, which differ somewhat. The ComEd team calculates a hybrid participating customer and Retailer-Based NTG ratio as its main method, which is consistent with the Enhanced method in the TRM. The Ameren team, with a more limited budget, calculates a Participating Customer-based NTG ratio as its main method and computes a Retailer-Based NTG ratio as a sensitivity case. The two teams then compare and discuss results at the end of the evaluation process.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s verified gross savings?
2. What are the program’s verified net savings (first year and lifetime)?

3. Did the program meet its energy and demand savings targets? If not, why?
4. Does spillover exist in the program? If so, how much spillover is occurring?
5. Should the program design be modified to reduce free ridership, and if so, how?
6. Are there any updates recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

Navigant will conduct process research for the FFR Program in CY2019. Navigant will consult with ComEd program leads on focused, key process questions to be answered to help improve and inform the program. Process research is planned for alternating years (CY2019, CY2021) and may also be conducted in the remaining years of this plan (CY2020), if justified. The process research will address the following questions:

1. What are the strengths and weaknesses of the program? How can the program be improved?
2. What are key barriers to participation by ComEd’s customers and how can they be addressed by the program? How do customers become aware of the program? What marketing strategies could be used to boost program awareness?
3. How satisfied are participating customers?
4. Is the program outreach to customers effective at increasing awareness of the program?
5. Is the program incentive level sufficient to encourage participation such that net savings targets are attained?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample and Analysis*

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
In-Depth Interviews	Program Management and Implementers	2	
Telephone and Web Surveys	Participating Customers	325	Focus on verification, process, and net-to-gross assessment
In-Depth Interviews	Retailers Associated with Appliance Replacements	5 - 7	Determine used appliance disposal practices by named retailers in the program’s absence. (CY2019 activity)
Gross Impact Evaluation			Bottom-up regression-based estimation. Part-use factor from surveys.
Verified Net Impact Evaluation			Deemed Value

Tracking System Review

Navigant will perform tracking system review in waves in CY2019, as well as reviewing the final tracking data. The Wave 1 of M&V sampling is expected to cover about half of the projects.

Program Management and Implementer Interviews

The evaluation team will interview the FFR program manager about program marketing and processes to better understand the goals of the program, implementation, and perceived effectiveness. The program implementer interview will focus on the recycling process and the details of appliance pickup and incentive distribution. Both interviews will focus on changes made in CY2019 in comparison to the prior program year.

Telephone and Web Surveys

A multi-modal approach will be used to conduct participant surveys, relying on both telephone and web surveys. This approach reflects the transition to a changing industry survey research environment and improved survey data quality and coverage. The participant survey will service both impact-related areas and process research. Impact-related questions will affect the evaluated part-use factor and NTG ratio. Participants will be asked how their units would have been disposed of if the program had not picked them up. Questions supporting the process evaluation will relate to sources of program awareness, program satisfaction, rebate satisfaction, and awareness of program features.

Retailer Interviews

As in previous years, the evaluation team will obtain contact information and conduct interviews with five to seven of the largest retailers associated with unit replacements. These interviews shed light on the disposition of used appliances absent the program for those participants that indicate through the telephone or web survey that absent the program they would have given the unit away to the retailer they bought their new unit from. In such cases, the NTG ratio is based on the retailer's own disposal practices absent the program, which are revealed during these interviews.

Gross Impact Evaluation

The CY2019 ex ante and evaluation-verified gross energy savings will be calculated directly using procedures specified in the Illinois Technical Reference Manual (TRM) version 7.0 (CY2019). The program tracking database and TRM v7 provide inputs needed to calculate verified gross savings. In addition to program tracking data, a telephone and web survey of program participants determines: (1) the unit's location (when used) prior to customer decision to participate in the program; and (2) a verification factor. The first term, the unit's prior location, is used directly in the regression-based calculation of unit energy savings. The second term, the verification factor, calculates the percentage of units that were verified as being recycled through the program. A mixed mode approach is being used, to achieve efficiencies in web-based survey data collection, while still obtaining results that mirror the characteristics of the population. Historically, telephone surveys have attracted older respondents, while web surveys attract younger respondents. Therefore, a mixed mode approach (50% web-based and 50% telephone-based) is planned to provide approximately the same balance between these two groups as is present in the program population.

The TRM v7 states that the most recent part-use-factor participant survey results available at the start of the program year shall be used in refrigerator and freezer recycling energy savings calculations. In CY2019, the source of the part-use factor is the PY9 evaluation. Savings estimates will be developed for the full population of units collected in CY2019 to estimate CY2019 Unit Energy Consumption (UECs).

The ex-post savings estimates of energy (kWh) savings will rely on regression equations as specified in the TRM v7. Gross energy savings are expressed in terms of full-year UECs. UEC estimates will be made using a regression-based approach that models full-year energy savings as a function of unit characteristics (i.e., age, size, configuration, defrost mode, and unit location prior to being recycled).

Gross peak demand (kW) savings will also be calculated according to the algorithm specified in the TRM v7. The coincidence factors in the TRM v7.0 were calculated using the regression equations to predict consumption on summer peak days. These values are based on the same peak period definitions as used by PJM.

Both energy (kWh) and peak demand (kW) savings estimates will be made based on the characteristics of the population of units collected by the program during CY2019. In addition, gross energy savings estimates will be adjusted for part-use, by applying part-use factors from the PY9 evaluation.

Verified Net Impact Evaluation

The evaluation team will apply the NTG ratio(s) approved by the Stakeholder Advisory Group (SAG) to the estimate of evaluation-verified gross savings to compute verified net savings. Separate estimates will be made for each appliance type – refrigerators, freezers, and window AC units.

This program is functioning in a dynamic market where there are an increasing number of disposal options outside the program. In addition to traditional methods (giving the unit away to a friend or relative, selling the unit to a used appliance dealer, or paying to have the unit taken away and permanently recycled or destroyed), there are other avenues for disposal, such as having an appliance retailer remove the unit after a new one is purchased, or using Craigslist.com or similar local market bulletin board systems to identify a purchaser or taker of the appliance.

As in previous evaluation cycles, our plan is to use the existing participant survey to guide the analytical approach for the retailer associated units, as well as the non-replaced units picked up by Reclaim at customers' homes. Specifically, for those participating customers surveyed that indicate they would otherwise have their appliance retailer remove the old unit after a new one is acquired, the NTG ratio is based on the results of the survey of the retailer that they bought the replacement unit from. This survey reflects the retailers' self-reported disposal practices absent the program.

Research NTG Impact Evaluation

The following data sources will be used:

1. *Telephone and web surveys with participating customers.* As in previous years, we will rely heavily on findings from telephone and web-based surveys participating customer surveys to understand how participants would have disposed of their units if the program had not picked them up. For participants that replaced their old units, surveys will include a question to determine who they bought the new unit from. We will include new response categories and related consistency checking questions to ensure the responses given to the question used to determine free ridership⁷⁹ includes the disposal options available to them via the retailer they bought it from.
2. *In-depth interviews with retailers associated with unit replacements.* We will conduct interviews with a sample of the most active retailers who sold FFR participants a new unit to replace the old one that was picked up by the program. These interviews will focus on their disposal practices absent the program during the past three years to provide information regarding trends and to characterize the robustness of utilized factors. These findings will be used to determine the disposition of used appliances absent the program for those that purchase a new unit from these non-participating

retailers. We will obtain the names of these retailers from the participating customer telephone surveys, wherein participants that replaced their unit will choose who they purchased it from.

Free Ridership – The NTG ratio will be computed using an algorithm approach which utilizes a blend of nonparticipating retailer and participating customer survey self-report data. The initial NTG ratio is adjusted for the fraction of units that would have been kept but not used and those that would have been discarded through a method in which the unit was destroyed absent the program.

Spillover – Based on our understanding of the program design, we do not see a program theory that supports an expectation of significant spillover. However, we will include questions in the participating customer survey to assess whether spillover has occurred because of their experience with FFR Program participation. Any spillover reported that is associated with a high degree of program influence will be incorporated into the NTG ratio calculation.

Calculation of CPAS and Annual Savings

As required by FEJA, Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the FFR program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental design consumption data because this program contains many unique measures with significant cross-participation. In this case, quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for analysis.

Evaluation Schedule

Table 3 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
CY2019 program tracking data request	ComEd	April 8, 2019
Program management and implementer in-depth-interviews	Evaluation	May 31, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 1, 2019
Tracking System Ex Ante Review Findings and Recommendations	Evaluation	July 31, 2019
Participant telephone and web surveys	Evaluation	October 15, 2019
Retailer Interviews	Evaluation	December 31, 2019
CY2019 program tracking data	ComEd	January 30, 2020
Internal Report Draft by Navigant	Evaluation	February 27, 2020
Draft Report to ComEd and SAG	Evaluation	March 5, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 26, 2020
Revised Draft by Navigant	Evaluation	April 2, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 9, 2020
Final Report to ComEd and SAG	Evaluation	April 16, 2020
NTG Draft Report to ComEd and SAG	Evaluation	June 19, 2020

ComEd Home Energy Assessment Program CY2019 to CY2021 Evaluation Plan

Introduction

The Home Energy Assessment (HEA) Program seeks to: (1) secure energy savings through direct installation of low-cost efficiency measures such as water efficient showerheads and faucet aerators, pipe insulation, programmable thermostats, LEDs and smart thermostats (with co-pays), and leave behind advanced power strips (at eligible single family residences) and (2) perform a brief assessment of additional energy-efficiency opportunities (e.g., furnace, boiler, air conditioning, insulation, and air sealing) from the respective utility portfolios.

For CY2019, the program is being offered jointly between ComEd, Peoples Gas (PGL) and North Shore Gas (NSG) and Nicor Gas. The program is marketed as the Home Energy Assessment Program for ComEd, Home Energy Jumpstart program for PGL and NSG, and Home Energy Savings Program for Nicor Gas. Franklin Energy Services LLC (Franklin Energy) is the implementation contractor for all the programs.

The ComEd CY2019 net savings forecast is around 28,000 MWh.

Possible program changes made from CY2018 to CY2019 include:

- Changing manufacturers and possibly price points for Smart Thermostats
- Adding a Tier 2 Advanced Power Strip in June 2019

The primary objectives of the evaluation of the Home Energy Assessment (HEA) Program are to: (1) quantify gross and net savings impacts from the program, and (2) as the program continues to evolve, make recommendations to enhance the program focused on the current priorities as determined by the program. Our evaluation report will capture the electric savings for ComEd, and the gas savings will be captured in separate reports for PGL and NSG and Nicor Gas. The CY2019 gross impact evaluation will not vary significantly from the previous years, but adjustments will be made to reflect specific measure and project characterizations. The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Participant Survey	X		
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Impact – NTG Research		X	
Process Analysis	X	X	X

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Specifically, the HEA Program is jointly offered by ComEd, Nicor Gas, PGL and NSG Companies with Franklin Energy as the implementation contractor. The evaluation tasks for this program over the next three years are similar for these utilities.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s verified gross savings?
2. What are the program’s verified net savings?
3. What updates, if any, are recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

The process research will address the following questions:

1. What are participants’ overall satisfaction levels regarding the program?
2. How are participants hearing about the program?
3. How can the program be improved?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
Survey	Program Participants	TBD	Process
In-Depth Interviews	Program Management and Implementers	2	
Gross Impact Evaluation	Tracking System Review	All	Wave 1 and Final data*
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	Deemed Value

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extract for Wave 1 data.

Tracking System Review

The tracking system review serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is accurately calculating savings defined by the IL TRM.

In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform tracking system review in waves in 2019. Wave 1 of M&V sampling is expected to cover about half of the projects.

Survey

Provided there are enough email addresses in the tracking data, Navigant will conduct an online survey with CY2019 participants to learn about customers’ satisfaction and program experience. If that is not the case, Navigant will conduct this research through a phone survey.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementation contractors. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and marketing tactics.

Gross Impact Evaluation

The key gross impact evaluation activities for the program in CY2019 will be based on (1) reviewing the tracking system to determine whether all fields are appropriately populated, (2) reviewing measure algorithms and savings values in the tracking system to assure that the TRM is appropriately applied, and (3) cross-checking measure totals and savings recorded in the tracking database.

Verified Net Impact Evaluation

For CY2019, the primary method to determine net and gross savings will be a program tracking system review and applying measure-level net-to-gross ratios (NTGR) that are deemed through a consensus process by the Illinois Stakeholder Advisory Group (IL SAG).

The verified net impact evaluation will apply the NTGR accepted by IL SAG consensus to estimate the verified net savings for the program. Those NTG values are shown in the following table.

Table 3. Deemed NTG Values for CY2019

Measure	CY2019 Deemed NTG Value
Lighting	0.84
Bath Aerators	1.04
Kitchen Aerators	1.04
Showerheads	1.04
Programmable Thermostats	0.90
Pipe Wrap	0.80
Advanced Power Strips	0.85
Co-Pay Smart Thermostats	NA

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Research NTG Impact Evaluation

Evaluation will conduct NTG research in CY2020.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. The evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the Home Energy Assessments Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental design because the savings from the program measures represents less than 5% of whole home usage, and the program does not have sufficient participation to achieve statistically significant savings estimates using this method.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	January 2, 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 28, 2019
Tracking System Wave 1 Ex Ante Review Findings and Recommendations	Evaluation	July 31, 2019
CY2019 Final Program tracking data	ComEd	January 30, 2020
Internal Report Draft by Navigant	Evaluation	March 2, 2020
Draft Report to ComEd and SAG	Evaluation	March 11, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 1, 2020
Revised Draft by Navigant	Evaluation	April 8, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 15, 2020
Final Report to ComEd and SAG	Evaluation	April 22, 2020

ComEd Home Energy Report Program CY2019 to CY2021 Evaluation Plan

Introduction

The Home Energy Report (HER) Program is a behavioral-based energy efficiency program implemented by Oracle.

In CY2019⁸⁰, ComEd’s HER Program will consist of 13 waves of varying sizes. Table 1 lists start dates for each wave.

Table 1. Summary of Program Waves

Wave	Start
Wave 1 (pilot)	Summer, 2009
Wave 2 (filling in for inactive accounts)	Fall, 2010
Wave 3	Spring, 2011
Wave 4 (filling in for inactive accounts)	Winter, 2011-2012
Wave 5	Summer, 2012
Wave 6	Summer, 2013
Wave 7 – Low (low usage customers)	Summer, 2014
Wave 7 – High (high usage customers)	Summer, 2014
Wave 8	Summer, 2015
Wave 9	Fall, 2016
Wave 10	Summer, 2017
Wave 11	Winter, 2018
Wave 12	Summer, 2018
New Mover Wave	Fall, 2014 with new customers added periodically

Any new waves added in 2019 will be included in the CY2019 analysis.

Waves 1, 3, and 5 are part of a persistence study to determine the degree to which savings persist after report termination. Waves 1 and 3 each have 10,000 randomly-chosen customers who stopped receiving reports in October 2012 and began receiving them again in August 2013; these customers are referred to as “lapsed report” (LR) customers. In addition, Waves 1, 3, and 5 each have 10,000 randomly-chosen customers who stopped receiving reports in October 2013 and did not receive reports through the duration of PY9; these customers are referred to as “terminated report” (TR) customers.

The HER Program also includes a High Usage Alert (HUA) component. HUAs notify customers when their usage is at least 30% higher than during the same billing period of the previous year. Customers for whom ComEd can model rates can also assign a dollar amount threshold that triggers an HUA. With this feature, customers receive an HUA when their projected bill trends above this threshold. Energy savings from HUAs will be included in the overall HER impact analysis.

⁸⁰ CY2019 spans January 1, 2019 to December 31, 2019.

The primary objective of the evaluation is to estimate energy savings generated by regularly mailing customers reports that provide information about energy use and conservation.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in the following table.

Table 2. Evaluation Approaches – Four Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Impact – Regression Analysis	X	X	X

Over CY2019-2021, the evaluation team expects:

- To conduct the same type of analysis for each of the three years in this evaluation cycle as we have in the past
- To conduct an impact evaluation to estimate net savings each year
- Net-to-gross research is not needed for this program as the results are inherently net due to the randomized controlled trial (RCT) design of the program
- Not to conduct any process research

Coordination

The evaluation team will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Opinion Dynamics will be leading this evaluation and they are also the lead evaluator for Ameren’s HER Program. Our team also has regular discussions with the lead evaluators for People Gas and North Shore Gas to ensure consistency in our annual evaluations. As needed, we will continue to coordinate research for this program across the utilities.

Evaluation Research Topics

The evaluation will seek to answer the following questions:

Impact Evaluation

1. How much energy do customers in the program save during CY2019?
 - a. What is the apparent long-run trend in program savings?
 - b. Are CY2019 energy savings flat, increasing, or falling compared to prior program years?
2. What is the uplift in other ComEd energy efficiency programs due to the reports?

Evaluation Approach

The table below summarizes the evaluation tasks for CY2019 that will be used to answer the evaluation research questions. Final activities will be determined annually as program detail and requirements become known.

Table 3. Evaluation Plan Summary

Activity	CY2019
Gross Impact Approach	Regression analysis
Net-to-gross Approach*	Uplift analysis
Calculation of CPAS and Annual Savings	Yes
Program Manager and Implementer Interviews	Yes

*The billing analysis produces impacts which are intrinsically net savings, aside from uplift.

Gross Impact Evaluation

For all waves, the evaluation team will measure CY2019 program impacts through billing analysis using a lagged dependent variable (LDV) model. The evaluation will use a weather normalization method that includes cooling degree day and heating degree day interaction terms in the LDV regression model. This method is described in detail in the 2017 HER weather normalization study.⁸¹ Billing analysis implicitly estimates net impacts, so no net-to-gross adjustment is necessary.

The New Mover Wave evaluation will be slightly different from the other waves because this wave does not have full year pre-program customer data. The New Mover Wave is created by randomly assigning customers who just moved into their home in ComEd’s service territory to participant (80% of customers) or non-participant (20% of customers) groups. Customers are placed into one of these two groups one month after they move into their home, meaning only one month of consumption data is available from before they were placed in the program. For this wave, pre-period data will come from the home’s previous occupant, as identified by the service point identification, for one year before the new occupant was placed in the HER Program. Therefore, the twelve months of pre-program data will consist of eleven months of consumption data from the previous occupant and one month from the current occupant. Using data from the previous occupant as the pre-program data will act as a stand-in for the effects of fixed household characteristics on energy usage. Using this pre-program data, the evaluation team will run the same LDV model as for the other waves.

Net-to-gross Approach

Enrollment uplift in other energy efficiency programs due to the HER Program will be estimated the same way as in previous evaluations. Uplift savings will be netted out of HER results to avoid double counting. The evaluation team will consider both uplift that occurs in CY2019 and legacy uplift from PY4 to CY2018. A key feature of the RCT design of the HER Program is that the analysis inherently estimates net savings because there are no participants who would have received the individualized reports in the absence of the program. While some customers receiving reports may have taken energy-conserving actions or purchased high-efficiency equipment anyway, the random selection of program participants (as opposed to voluntary participation) implies that the control group of customers not receiving reports would be expected to exhibit the same degree of energy-conserving behavior and purchases. Therefore, this method estimates net savings and no further net-to-gross adjustment is necessary.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), the evaluation team will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) for CY2019 will be calculated. Converted gas savings will not be calculated for this program.

⁸¹ Navigant Consulting, Inc. 2017. *Home Energy Report Weather Normalization Study*. Presented to Commonwealth Edison Company.

Program Manager and Implementer Interviews

The evaluation team will conduct interviews with the ComEd program manager and implementation contractors to ensure an up to date understanding of the program and any changes occurring in CY2019 or expected for CY2020 or CY2021.

TRM Research

Regarding measure 6.1.1 in the IL-TRM,⁸² Navigant will update the decay rate and persistence study done in CY2018⁸³ with a fifth year of data. We will calculate annual decay rates for the fifth year after reports were discontinued (October 2017 – September 2018) for the terminated report groups in Waves 1, 3, and 5. The decay rate will be equal to one minus the ratio of the percentage savings in the second year after the reports were discontinued to percentage savings in the last year before the reports were discontinued.

After the CY2018 persistence analysis, Navigant, ComEd, and other stakeholders will determine whether to continue TRM research the following calendar year (CY2019). Stakeholders will, likewise, decide whether to continue this TRM research in CY2020 and CY2021. Each year in which Navigant conducts persistence analysis, the IL TRM behavior working group (administered by VEIC) will consider how to apply those results to TRM persistence values. For example, the CY2018 persistence results would be included in v8 of the TRM.

Data Requirements

Table 4 shows the data the evaluation team will need for the CY2019 evaluation.

Table 4. Core Data Collection Activities and Sample

Required Data	Relevant Information Requested
Customer Usage and Tracking Data	For all HER participants (treatment and control):
	• Account ID
	• Treatment indicator
	• Terminated report customer indicator
	• Program start date
	• Opt out date (if applicable)
	• Meter type
	• Usage value
	• Estimate indicator
	• Wave identifier
	<ul style="list-style-type: none"> • Lapsed report customer indicator • Flag for customers to exclude • Move out date (if applicable) • Bill end date • Usage units • Bill duration in days • Zip code • HUA indicator • Electronic HER (eHER) indicator

⁸² Measure 6.1.1 is “Adjustments to Behavior Savings to Account for Persistence” in Illinois Statewide Technical Reference Manual, Version 6.0, Volume 4.

⁸³ Navigant Consulting, Inc. 2018. *ComEd Home Energy Report Program Decay Rate and Persistence Study – Year Four*. Presented to Commonwealth Edison Company.

Evaluation Schedule

Table 5 below provides the schedule for key deliverables and data transfer activities for the CY2019 evaluation. Table 6 shows the same for TRM research. Adjustments will be made, as needed, as evaluation activities progress.

Table 5. CY2019 Evaluation Schedule – Key Deadlines

Activity/Deliverables	Responsible Party	Date Delivered
Interviews with program manager and IC	Evaluation	Jun 28, 2019
Mid-year data request	Evaluation	Jul 12, 2019
Mid-year data delivery	ComEd	Aug 9, 2019
Early data characterization memo	Evaluation	Aug 30, 2019
Final data request	Evaluation	Dec 6, 2019
Final data delivery ⁸⁴	ComEd	Jan 30, 2020
Draft report to ComEd and SAG	Evaluation	Mar 13, 2020
Comments on draft (15 Business Days)	ComEd	Apr 3, 2020
Revised draft to ComEd and SAG	Evaluation	Apr 10, 2020
Comments on redraft (5 Business Days)	ComEd/SAG	Apr 17, 2020
Final report to ComEd and SAG	Evaluation	Apr 24, 2020

Table 6. TRM Research Schedule – Key Deadlines

Activity/Deliverables	Responsible Party	Date Delivered
Draft Decay Rate and Persistence Study and draft workpaper to ComEd and SAG	Evaluation	Sep 20, 2019
Comments on draft (15 Business Days)	ComEd	Oct 11, 2019
Revised draft to ComEd and SAG	Evaluation	Oct 18, 2019
Comments on redraft (5 Business Days)	ComEd	Oct 25, 2019
Final to ComEd and SAG	Evaluation	Nov 1, 2019

⁸⁴ This data will include approximately 70% of bills ending on or before December 31, 2018.

ComEd Heating and Cooling Rebates Program CY2019 to CY2021 Evaluation Plan

Introduction

The Heating and Cooling Rebates Program offers incentives for the installation of qualifying, high efficiency heating and cooling equipment. The measures incentivized through the HVAC Rebates Program are air source heat pump (ASHP), central air conditioner (CAC), ductless mini-split heat pump (DMSHP), furnace blower motor (ECM⁸⁵), ground source heat pump (GSHP), and ENERGY STAR[®] thermostats. The program is implemented as a “closed network” Energy Efficiency Service Provider (EESP) program, meaning that only installations completed by a contractor in the ComEd Residential EESP Network qualify for a rebate. ComEd Residential EESPs must be Illinois Commerce Commission (ICC) Energy Efficiency Installer certified and meet the program eligibility requirements.

Notable program changes made transitioning from CY2018 to CY2019 include:

- Establishing a new energy efficiency rebate tier for CACs and air-source heat pumps at 18 SEER (to align with the ENERGY STAR Most Efficient category).
- Heat Pump Water Heaters no longer being incentivized through the program. They will now be incentivized through a midstream pilot rebate program.

The primary objectives of the evaluation of the HVAC Rebates Program are to: (1) determine gross and net program savings and (2) examine the effectiveness of program processes in achieving savings.

The CY2019 gross impact evaluation will not vary significantly from the previous years, but adjustments will be made to reflect specific measure and project characterizations. The evaluation will include a participating customer free ridership and spillover survey in CY2019. The findings from the surveys will inform recommended net-to-gross (NTG) values for the Illinois Stakeholder Advisory Group (SAG) approval and future program application, as well as participant perspectives and satisfaction with the program, incentive offerings, potential non-energy impacts, and how to improve the program in the future.

The evaluation of this program over the next three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

⁸⁵ Electronically commutated motors

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – EESP Interviews	X		X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		X
Net-to-Gross – EESP Interviews	X		X
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the CY2019-CY2021 period based upon the needs of the program and program’s history. The three-year evaluation approach for this program is based on the following:

- Annual gross and net impact analysis
- Process evaluation questions will be included in the free ridership and spillover surveys
- NTG research on free ridership will be conducted in CY2019. This research will be conducted using telephone interviews rather than online surveys, which were previously used. This switch is necessary because the program participants who received their rebate through an instant discount from their EESP have a low percentage of valid email addresses in the program tracking data.
- We conducted NTG research on participant spillover in CY2018 with PY9 participants and will conduct participant spillover again in CY2020 with CY2019 participants. We will not conduct NTG research on participant spillover in CY2019.
- Interviews with participating EESPs will be conducted in CY2019 to inform program spillover and seek opportunities to improve program processes and expand program savings.

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. This will include coordinating with evaluation teams for Ameren and the gas utilities on survey instruments for NTG research on participating customer free ridership and spillover as well as on survey instruments, samples, and administration for NTG and process research on participating EESPs.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s verified gross savings?
2. What are the program’s verified net savings?
3. What is the researched value for net-to-gross (NTG) ratio?
4. What updates are recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery and address the following questions:

1. How did customers become aware of the program?
2. What is the level of participant satisfaction with the program?
3. What is the level of satisfaction with the program amongst participating EESPs?
4. What marketing strategies could boost program awareness?
5. What opportunities exist for program improvement?

Evaluation Approach

Table 3 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 3. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	One interim and one final
In-Depth Interviews	Program Management and Implementers	2	
Gross Impact Evaluation	TRM Review	Census	One interim and one final
Surveys: NTG and Process – FR †	Participating Customers	70 per measure group	Telephone interviews
EESP Interviews	Participating EESPs	TBD	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	Deemed Value

Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for each wave.

† FR refers to Free Ridership.

Tracking System Review

Navigant will perform an interim tracking system review in the summer of 2019 in line with program changes and an accelerated evaluation schedule for delivering tracking data to the evaluation team. Navigant will perform final tracking system review in February 2020 once Navigant receives the end of year tracking data from ComEd in preparation for the final CY2019 report.

In-Depth Interviews

We will conduct in-depth interviews with program managers and implementers. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

Gross Impact Evaluation

The gross impact analysis will include a review of deemed savings estimates for all measures in the program, in compliance with the Illinois TRM. Navigant will document how the deemed measures differ from ComEd's existing planning or ex ante tracking estimates and provide guidance as to how these differences will impact ComEd's programs. If new measures are included in CY2019, Navigant will perform a desk review of program calculations and compare savings to the Illinois TRM. The evaluation team will also calculate gas savings achieved by the program and convert it to electric savings.

Surveys

Navigant will field surveys to estimate free ridership in CY2019. A battery of process questions will be included in the surveys to (1) determine participant satisfaction with the program overall and with key program elements and (2) assess the effectiveness of various program elements, such as incentive levels, marketing procedures, application processes, and participation procedures.

EESP Interviews

The evaluation will conduct NTG research via EESP interviews in CY2019 to capture non-participant spillover and EESPs' perspective of participant free ridership that will inform NTG recommendations. We will also add process related questions to the interview guide to answer key research questions.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 4. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Central AC	0.65
Advanced Thermostat	NA
Air Source Heat Pump	0.57
Ductless Mini-Split	0.68
ECM Furnace Motor – with Furnace Upgrade	0.68
ECM Furnace Motor – without Furnace Upgrade	0.80
Geothermal Heat Pump	0.59
Heat Pump Water Heater	0.76

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.pdf

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the HVAC Rebates Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental design consumption data because this program contains many unique measures with significant cross-participation. In this case, quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for analysis.

Evaluation Schedule

Table 5 provides the schedule for key deliverables and data transfer activities. Adjustments will be made as needed as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 5. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual	ComEd	January, 2019
Participating customer NTG-FR and process survey fielding	Evaluation	February, 2019
EESP Interviews	Evaluation	March 2019 – June 2019
CY2019 Wave 1 program tracking data for Interim Review	ComEd	June 1, 2019
Tracking System Wave 1 Ex Ante Review Findings and Recommendations	Evaluation	July 30, 2019
Program Management and Implementers Interviews	Evaluation	July 2019
Draft NTG Report to ComEd and SAG	Evaluation	August 1, 2019
CY2019 EOY program tracking data for Final Review	ComEd	January 30, 2020
Internal Report Draft by Navigant	Evaluation	February 21, 2020
Draft Report to ComEd and SAG	Evaluation	February 25, 2020
Comments on draft (15 Business Days)	ComEd and SAG	March 17, 2020
Revised Draft by Navigant	Evaluation	March 24, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	March 31, 2020
Final Report to ComEd and SAG	Evaluation	April 10, 2020

ComEd Lighting Discounts Program CY2019 to CY2021 Evaluation Plan

Introduction

The ComEd Residential Lighting Discounts Program provides incentives to increase the market share of qualified LED bulbs and fixtures sold through retail sales channels. The Lighting Discounts Program also provides educational materials to retailers to increase customer awareness and acceptance of energy-efficient lighting technologies and promote proper bulb disposal. In CY2019, savings from the program will be included within ComEd’s Residential Energy Efficiency portfolio.

The primary objectives of the evaluation of the Lighting Discounts Program are to: (1) quantify net savings impacts from the program, (2) identify ways the program can be improved, and (3) ascertain the impact of the significant market shift to LEDs on ComEd residential customers’ lighting purchasing decisions.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in the following table. As the table below shows, many of the evaluation data collection activities will only occur every other year.⁸⁶

Table 1. Evaluation Approaches —Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – In-store Intercept Participant Surveys		X	
Data Collection – In-store Shelf Surveys		X	
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Trade Ally Interviews		X	
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys		X	
Process Analysis		X	

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and the program’s prior history. The three-year evaluation approach for this program includes:

- Annual gross and net impact analysis
- In-store NTG analysis every other year as the lighting program is slated to be drastically reduced starting in 2019 (the program will only be incentivizing LED specialty bulbs and LED fixtures).
- Cumulative Persisting Annual Savings (CPAS), calculated based upon the requirements of the Future Energy Job Act (FEJA).
- Bi-Annual process evaluation via in-store intercept surveys conducted with program participants in the aisles of lighting program retailers

⁸⁶ In-store intercept participant surveys and trade ally interviews were both conducted in 2018. Shelf surveys were last conducted in PY9 but will skip two years to align with the next round of in-store intercepts.

Coordination

Navigant will coordinate with the evaluation teams for other Illinois utilities on any issues relevant to this program.

Evaluation Research Topics

The evaluation will seek to answer the following key questions:

Impact Evaluation

1. What is the level of gross annual energy (kWh) and peak demand (kW) savings induced by the program?
2. Did the program meet its energy and demand savings goals? If not, why not?
3. What are the net impacts from the program? What is the level of free ridership associated with this program? What is the level of participant and nonparticipant spillover from the program? What is the researched value for net-to-gross (NTG) ratio? (CY2020 Only)
4. What updates are recommended for the Illinois Technical Reference Manual (TRM)? (CY2020 Only)

Process Evaluation and Other Research Topics

The process evaluation effort for CY2020 will focus on program delivery. The process research will address the following items:

1. How aware are customers of the ComEd-sourced LED bulb discounts? How effective are the in-store displays and marketing materials?
2. How have customers' lighting purchasing decisions been affected by the changes in the program options available for purchase?
3. Assess changes to the program in the face of rapid market changes and upcoming standard changes. Determinization of what areas (bulb types or market segments) are still in need of ComEd incentives to encourage efficient light bulb purchase.
4. What continue to be the key barriers to LED purchases and how can they be addressed by the program?
5. What is the current level of LED availability and pricing in ComEd territory for common retail channels? How does this compare to similar regions (with or without lighting programs) and how is this changing over time?
6. What are ComEd customers' preferences, acceptance, and use of various efficient lighting technologies, and what are the primary factors influencing them?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target Population	Target Completes CY2019
Upstream Tracking Data	All Program Sales	NA
In-Depth Interviews	Program Management	2
Gross Impact Evaluation	Tracking System Verification	NA
Verified Net Impact Evaluation	Calculation Using Deemed NTG Ratio	NA

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extracts for Wave 1.

Upstream Tracking Data

The CY2019 Program Tracking System Review will verify the rebated measures sold and analyze the characteristics of the installed measures that drive savings (such as bulb type and wattage). The results of the program tracking data analysis will drive CY2019 gross and net impacts.

In-Depth Interviews

Each year, two conference calls will be conducted with the ComEd program manager and CLEAResult program implementation staff. These calls will be focused on the current status of the Lighting Discounts Program, recent changes to the program, and changes likely to occur to the program in CY2019 and beyond.

Gross Impact Evaluation

Gross kWh, kW and summer and winter peak kW savings will be calculated across all program bulbs based on the following equations:

$$\text{Annual kWh Savings} = \text{Program bulbs} * \text{Delta Watts}/1000 * \text{Annual HOU} * \text{Realization Rate}$$

$$\text{Annual kW Savings} = \text{Program bulbs} * \text{Delta Watts}/1,000 * \text{Realization Rate}$$

$$\text{Annual Summer Coincident Peak kW Savings} = \text{Annual kW Savings} * \text{Summer Peak Load CF Factor}^{87}$$

$$\text{Annual Winter Coincident Peak kW Savings} = \text{Annual kW Savings} * \text{Winter Peak Load CF}^{88}$$

Where Realization Rate = Installation Rate * (1-Leakage Rate) * Interactive Effects

For the verification analysis in CY2019, the evaluation team will calculate gross savings using the following parameter estimates:

- **Program Bulb Sales** data will be obtained from the CY2019 EM&V tracking database analysis.
- **Program Bulb Installation Rates** will be obtained from the IL TRM v7.0.
- **Delta Watts** will be calculated using the bulb type lumen-equivalence mapping in the IL TRM v7.0.

⁸⁷ Summer Peak CF is calculated as the percentage of lighting turned on in each room during peak hours of the summer months (1-6 pm on summer weekdays).

⁸⁸ Winter Peak CF is calculated as the percentage of lighting turned on in each room during peak hours of the winter months (6-8 am and 5-7pm, between January 1 and February 28).

- **HOU and Summer Peak CF** will be obtained from both the residential and non-residential sections of the IL TRM v7.0. The non-residential HOU and Peak CF will be determined based upon the business activities conducted in the non-residential locations where program bulbs are reportedly installed.
- **Winter Peak CF** will be determined based upon analysis done by the evaluation team and presented to ComEd in a memorandum titled “Winter Peak Coincidence Factor Recommendation for Residential Lighting”, dated February 2nd, 2015.
- **Residential and Non-Residential Bulb Installation** will be obtained from the IL TRM v7.0.
- **Interactive Effects** will be obtained from the IL TRM v7.0.
- **Leakage** will be obtained from the IL TRM v7.0.

The calculation of carryover savings will be based on the following parameter estimates:

- **Delta Watts** – Verified Savings estimate from the year of installation (source: IL TRM v7.0)
- **Residential and Non-Residential Split** - Evaluation Research from the year of purchase (source: PY9/CY2018 report)
- **HOU and Peak CF** – Verified Savings estimate from the year of installation (source: IL TRM v7.0)
- **Interactive Effects** – Verified Savings estimate from the year of installation (source: IL TRM v7.0)
- **Installation Rate** - Verified Savings estimate from the year of purchase (source: PY9/CY2018 report)
- **NTG** – Evaluation Research from the year of purchase (source: PY9/CY2018 report)

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program in CY2019. The CY2019 EM&V NTG estimates are shown in the table below and available on the IL SAG Website: <http://www.ilsag.info/net-to-gross-framework.html>.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Omni-Directional LED Bulbs and Fixtures	0.67
Directional LED Bulbs and Fixtures	0.61
Specialty LED Bulbs	0.53

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Research NTG Impact Evaluation

In CY2019 the evaluation team will not conduct any primary research to update the NTG ratio. The evaluation team recommends that due to the significantly reduced scope in 2019 (standard LEDs will be removed from the program and it will only be offering incentives on Specialty LEDs and LED fixtures) the evaluation move to an every other year NTG research schedule. Ameren for years has only conducted in-store intercepts surveys and NTG research bi-annually.

Lifecycle Savings Estimation – Effective Useful Life Research

In addition to first year (annual) savings, ComEd will be reporting lifecycle savings in CY2019 and beyond. Lifecycle savings are calculated in the same manner as the gross and net impacts described above except that the annual savings value is then multiplied by the effective useful life (EUL) of the measure to account for savings that accrue over the lifetime of the product. In CY2019 and beyond, EULs will continue to be refined through a combination of primary or secondary research, as needed.

Calculation of CPAS and Annual Savings

As required by the Federal Energy Job Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and CPAS in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated..

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the Residential Lighting Discounts Program via a randomized controlled trial (RCT) or quasi-experimental design because the program is delivered upstream and it is not possible to select treatment and control groups for programs where the participants are unknown.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities for the CY2019 evaluation. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 4. CY2019 Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
In-depth Interviews with Program Managers and Implementers	Evaluation	May 1, 2019
Wave 1 CY2019 Data Available for Ex Ante Review and Analysis	ComEd	June 5, 2019
Wave 1 CY2019 Ex Ante Review Assessment Memo	Evaluation	July 7, 2019
CY2019 EUL Assessment Memo	Evaluation	January 15, 2020
CY2019 Tracking system is final	ComEd	January 30, 2020
Preliminary Impacts Memo	Evaluation	February 15, 2020
CY2019 Draft Report to ComEd and SAG	Evaluation	February 28, 2020
Comments on CY2019 Draft (15 Business Days)	ComEd	March 21, 2020
CY2019 Revised Draft Report to ComEd and SAG	Evaluation	March 28, 2020
Comments on Revised Draft (5 Business Days)	ComEd	April 4, 2020
CY2019 Final Report to ComEd and SAG	Evaluation	April 14, 2020

ComEd Multi-Family Market Rate Program CY2019 to CY2021 Evaluation Plan

Introduction

The Multi-Family Market Rate Program is jointly implemented by ComEd and Nicor Gas Company, and ComEd and Peoples Gas (PGL) and North Shore Gas (NSG) companies. Franklin Energy is the implementation contractor for the joint program. Franklin Energy staff install various energy-saving measures, which may include LEDs in tenant units, water-saving devices, programmable thermostats, pipe insulation, and LEDs in common area screw-in fixtures. The program further provides trade ally installs in common areas and exterior areas lighting retrofits and gas measures, such as pipe wrap. Measures not covered by the Multi-Family Market Rate Program are transferred as leads to other programs.

The Multi-Family Market Rate Program serves as a “one stop shop” to multi-family building owners and managers to generate electricity and natural gas savings throughout the property. Program components include:

- Electric and gas energy assessments and provision of educational information.
- Information to building owners and managers as part of the assessment that explains how they can self-register for Business Energy Analyzer (BEA).
- Direct installation of electric and gas saving measures in tenant and common area spaces.
- Energy Efficiency Service Provider (EESP) installation of electric and gas saving measures at no cost to customer, following agreed upon program pricing.

ComEd’s CY2019 net savings target is 18,394 MWh of cumulative persisting annual savings (CPAS). The CY2019 filing goal for participants is 14,000 residential units.

The primary objectives of the CY2019 evaluation are to: (1) quantify gross and net savings impacts from the program; (2) conduct research to support the program’s transition in response to the Future Energy Jobs Act (FEJA)⁸⁹; and (3) determine key process-related program strengths and weaknesses and identify ways in which the program can be improved. The evaluation of this program over the next three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

⁸⁹ Illinois Public Act 099-0906 (<http://www.ilga.gov/legislation/publicacts/99/099-0906.htm>).

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Building Owner and Property Manager Surveys		X	
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – EESP Interviews	X		
Impact – Engineering Review	X	X	X
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net to Gross		X	
Process Analysis	X	X	X

The evaluation team determined the evaluation approach for the 2019-2021 period based upon the needs of the program and program’s history. The 3-year evaluation approach for this program is based on the following:

- Annual gross and net impact analysis
- Conducting bi-annual process surveys based upon client requests and program performance
- Optimizing timing regarding which years to conduct NTG research based on potential changes to the program design or installed measures
- Calculating CPAS based upon the requirements of FEJA

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this joint program. Specifically, the ComEd NTG research activities and timeline will be coordinated with similar research to be conducted by the Peoples and North Shore Gas, and the Nicor Gas multi-family programs. Navigant will coordinate the data collection and survey instruments design for consistency and capture the appropriate questions in the decision maker surveys. The joint program evaluations and reporting timelines will be the same.

In addition, Navigant will coordinate with the evaluation team for Ameren regarding research topics in their Multifamily initiative, such as on-site verification for advanced power strip in-service rates.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual total verified gross savings?
2. What are the program’s verified net savings?

3. What is the estimated free-ridership and spillover for participating customers? What is the research estimate for participant spillover for this program?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. What are building owners' and property managers' perspectives and overall satisfaction with the program?
2. What are EESP's perspectives, suggestions for improvement and overall satisfaction with the program?
3. How can the program be improved?
4. How is the measure mix anticipated to change in response to the reduced ability to claim savings for lighting measures due to changing lighting standards?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
In-Depth Interviews	Program Management and Implementers	2	
In-Depth Interviews	EESPs	4	
Gross Impact Evaluation	Wave 1 Data Review and Analysis	Census	Wave 1 and Final data*
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	Census	

† FR refers to Free Ridership and SO refers to Spillover.

* Navigant will coordinate with ComEd to determine appropriate date to pull a Wave 1 tracking data extract.

Tracking System Review

The tracking system review, concurrent with the start of the impact analysis cycle, serves two key purposes. Primarily, it ensures that the fields provided in the tracking data are sufficient for the evaluation team to calculate savings for the targeted measures. Additionally, this review helps guarantee that the tracking data is consistent with the program's data in eTRACK. This latter task will become increasingly important as eTRACK undergoes development and more closely reflects the tracking data Navigant receives.

Program Manager and Implementer Interviews

We will conduct in-depth interviews with program managers and implementers. Interviews will focus on progress to goals, identifying program successes and challenges, identifying drivers of those successes and challenges, and retailer education and marketing tactics.

EESP Interviews

The implementation contractor, Franklin Energy Services, maintains a network of seven Energy Efficiency Service Providers. These EESPs are selected via a competitive application process, and install measures deemed too complex for Franklin Energy Service direct install field teams. Navigant will interview these EESPs to gain insight into program processes and to explore areas for potential improvements.

Gross Impact Evaluation

The Multi-Family Market Rate Program savings verification will be completed using the Illinois TRM (v7.0) or secondary research for any measure with custom savings inputs. Gross savings will be evaluated primarily by (1) reviewing the tracking system data to ensure that all fields are appropriately populated; (2) reviewing measure algorithms and values in the tracking system to assure that they are appropriately applied; and (3) cross-checking totals. This approach will be supplemented where possible with a review of project documentation in each program year to verify participation; installed measure quantities; and associated savings. Verified gross savings will be estimated by multiplying deemed per unit kWh savings by the verified quantity of eligible measures.

The evaluation team will calculate gas savings achieved by the program. .

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Program Path/Measure	CY2019 Deemed NTG Value
LED	0.84
Showerhead	1.00
Bathroom Faucet Aerator	1.00
Kitchen Faucet Aerator	1.00
Programmable Thermostat	0.90
Reprogram Thermostat	0.90
Advanced Power Strip (Tier 1)	0.95
Advanced Power Strip (Tier 2)	0.95
DWH Pipe Insulation	0.95
Other Measures, Direct Installed in Units	0.95
LED Lighting (Common Area)	0.95
High Performance T8 (Common Area)	0.95
Occupancy Sensor Lighting Control (Common Area)	0.95
LED Exit Sign (Common Area)	0.95
Programmable Thermostat (Common Area)	0.95
Beverage and Snack Control (Common Area)	0.95
Other Measures, Direct Installed in Common Areas	0.95

Source:

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated.

Use of Randomized Controlled Trial and Quasi-Experimental Design

Navigant is not evaluating the Multi-Family Market Rate Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. Navigant is not using quasi-experimental consumption data because this program contains many unique measures with significant cross-participation. In this case, quasi-experimental consumption data analysis would produce savings estimates for bundles of commonly-installed measures, rather than for each measure individually, which is not the desired output for all analysis.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 4. Schedule – Key Deadlines

Activity/Deliverables	Responsible Party	Date Delivered*
Program Operations Manual and Workbook Review	ComEd	March 15 – April 15, 2019
Program Manager, Implementer and EESP Interviews	Evaluation Team	March 15 – April 15, 2019
CY2019 Wave 1 Tracking Data	ComEd	June 30, 2019
Wave 1 data review and analysis memo	Evaluation Team	August 31, 2019
Sample Projects Documentation for Review	ComEd	September 30, 2019
Final CY2019 Tracking Data to Navigant	ComEd	January 30, 2020
Internal Report Draft by Navigant	Evaluation Team	March 2, 2020
Draft Report to ComEd and SAG	Evaluation Team	March 8, 2020
Comments on draft (15 Bus. Days)	ComEd / SAG	March 29, 2020
Revised Draft by Navigant	Evaluation Team	April 5, 2020
Comments on redraft (5 Bus. Days)	ComEd / SAG	April 12, 2020
Final Report to ComEd and SAG	Evaluation Team	April 22, 2020

ComEd and Nicor Gas Residential New Construction CY2019 to CY2021 Evaluation Plan

Introduction

The Residential New Construction (RNC) Program is jointly offered by ComEd and Nicor Gas. Residential Science Resources (RSR) implements the program for Nicor Gas. Slipstream (with RSR as their subcontractor) implements the program for ComEd. Program participation requires a minimum efficiency of 15 percent above code for each home, and program homes are ranked in tiers based on performance:

- Tier 1: 15.00-19.99 percent above code
- Tier 2: 20.00-24.99 percent above code
- Tier 3: 25.00-29.99 percent above code
- Tier 4: 30.00 percent or more above code

RSR uses energy modeling to calculate whole-house energy savings. The program relies on networks of builders and Home Energy Rating System (HERS) raters to garner participation and continues to attract raters and builders to the program.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities (detailed in Table 1). For each program year, Navigant will complete a tracking system review, interview program managers and implementers, and calculate gross realization rates. Navigant plans to perform simulation modeling for the gross impact analysis and conduct net-to-gross (NTG) research when the residential energy code changes from IECC 2015 to IECC 2018. Because the energy code will change in March 2019, some CY2019 homes will still be permitted under the 2015 version of the energy code. As a result, these activities will likely occur in late CY2020 when the majority of program homes are permitted under the new IECC 2018 code.

Table 1. Evaluation Approaches – Three Year Plan*

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – Builder and Rater Interviews	-	X	
Impact – Calibrated Simulation Modeling		X**	
Impact – Verification & Gross Realization Rate	X	X	X
IProcess – Net-to-Gross		X	
Process – Analysis	X	X	X

* The program design as it exists today will likely change in CY2020, therefore future research may need to be revisited.

** Planned to conduct the work in Q4 CY2020.

The evaluation team determined the evaluation approach for the 2019-2021 period based on the needs of the program and the program’s prior history. The three-year evaluation approach for this program is based on the following:

- Gross and net impact analysis will be conducted each year
- Program manager and implementer interviews will be conducted each year
- Calibrated simulation modeling and NTG research will be completed when a significant portion of completed homes have been permitted under the 2018 residential energy code, likely in late CY2020
- Builder and rater interviews will be conducted in CY2020 as part of the NTG research and to explore their perspectives and satisfaction with the program
- Cumulative persisting annual savings (CPAS, electric only) will be calculated based on the requirements of the Future Energy Jobs Act (FEJA). CPAS is not a requirement for gas saving measures and will not be calculated.

Coordination

Navigant will coordinate with the evaluation teams for other utilities on any issues relevant to this program. Specifically, the Residential New Construction Program is jointly offered by ComEd and Nicor Gas. The evaluation activities and timing for each utility evaluation are the same, as this is one evaluation effort for both utilities.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

4. What are the gross annual energy and demand savings induced by the program?
5. Did the program meet its energy and demand savings goals? If not, why not?
6. What are the net impacts from the program?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. How can the program be improved?
2. Are builders and raters satisfied with the program? What improvements, if any, would builders and raters like to see implemented?

Evaluation Approach

Table 2 summarizes the proposed data collection activities for CY2019 including data collection methods, data sources, timing, and targeted sample sizes that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Tracking System Review	Tracking system	Census	
In-Depth Interviews	Program management and implementers	4	Augment with monthly calls
Gross Impact Evaluation	Use CY2018 realization rate to adjust claimed savings for CY2019 homes	Census	
Verified Net Impact Evaluation	Calculation using deemed NTG ratio	NA	

Tracking System Review

Navigant will review program tracking system data to ensure these systems gather the data required to support evaluation activities and allow program managers to monitor key aspects of program performance at regular intervals. Additionally, the evaluation team will review the tracking system data to ensure that all fields are appropriately populated and are consistent with the savings generated in the submitted energy modeling files.⁹⁰

In-Depth Interviews (Program Management and Implementer)

Navigant will interview ComEd and Nicor Gas program managers and implementation contractors to gather essential information about program design, program changes, and builder and rater experience. The evaluation team will conduct interviews at the beginning of the evaluation and will communicate with program staff on an ongoing basis to gather additional information as needed.

Gross Impact Evaluation

The CY2018 evaluation used a rigorous approach of calibrated energy simulation to determine gross realization rates for gas and electric savings and to estimate gross electric demand savings. As the calculation method for determining ex ante savings will not change for CY2019, the evaluation team plans to apply the CY2018 realization rates to the ex ante savings to determine verified gross impacts for CY2019.

Use of Randomized Controlled Trial and Quasi-Experimental Design

Navigant is not evaluating the Residential New Construction program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental consumption data because it would not be possible to create a valid matched control group for the customers in this program.

⁹⁰ REM/Rate and Ekotrope are the two-planned approved software modeling tools beginning in CY2019.

Verified Net Impact Evaluation

The evaluation will apply the NTG ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Program Measure	CY2019 Deemed NTG Value
Residential New Construction	0.65

Source:

http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.pdf, and
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Final_Values/Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final.pdf.

Researched NTG Impact Evaluation

Navigant plans to complete NTG research as part of the CY2020 evaluation. The findings will inform recommended NTG values for Illinois SAG approval and future program application. Navigant will conduct in-depth interviews with both participating and non-participating builders. The evaluation team will attempt to contact a census of builders and aim to complete interviews with as many as possible up to 20 participating builders and up to 20 non-participating builders. Navigant will target the top builders to obtain results for a large share of program homes.

Navigant will use a self-report approach to estimate the program’s NTG ratio following the statewide approach included in the TRM. The analysis will cover the following components:

- Free-ridership
- Participant spillover
- Non-participant spillover
 - Including evaluation of potential prescriptive measures including: Clothes washers, Dishwashers

Participant spillover refers to spillover from participating builders in non-program homes and non-participant spillover refers to spillover from builders who are exposed to the program but are not participating. The builder interviews will also assess the current level of energy efficiency knowledge among participating builders to provide a “baseline” for any future spillover or market effects research.

Calculation of CPAS and Annual Savings (Electric Only)

As required by the Future Energy Job Act (FEJA), Navigant will report ex post gross and net savings for the program, and the CPAS in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. Navigant will not be calculating CPAS for gas savings measures and it is not a requirement.

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. Navigant plans to conduct process evaluation activities early

in the program year and report results to ComEd and Nicor Gas as valuable information becomes available.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
CY2019 program tracking data for Wave 1 review	ComEd and Nicor Gas	April 5, 2019
Program manager and implementation contractor interviews	Evaluation, ComEd, Nicor Gas, Slipstream, RSR	May 2019
Tracking system ex ante review findings and recommendations	Evaluation	July 30, 2019
CY2019 program tracking data	ComEd and Nicor Gas	January 30, 2020
Draft report to ComEd, Nicor Gas, and SAG	Evaluation	March 6, 2020
Comments on draft (15 business days)	ComEd, Nicor Gas, and SAG	March 27, 2020
Revised draft by Navigant	Evaluation	April 3, 2020
Comments on redraft (5 business days)	ComEd, Nicor Gas, and SAG	April 10, 2020
Final report to ComEd, Nicor Gas, and SAG	Evaluation	April 24, 2020

ComEd Weatherization Rebates Program CY2019 to CY2021 Evaluation Plan

Introduction

The Weatherization Rebates Program offers incentives for the installation of qualifying weatherization improvements such as attic and wall insulation, and air and duct sealing. The weatherization rebates are instant rebates that are applied to the customer invoice by a participating contractor. Contractors must have certain credentials (for example, analyst or envelope professional certification from Building Performance Institute, specific insurance thresholds, and one-on-one training on program implementation with a program specialist) and a signed agreement with the implementer to be in the closed ComEd Energy Efficiency Service Provider (EESP) network, allowing their weatherization project to be eligible for a ComEd rebate.

The primary objectives of the evaluation of the ComEd Weatherization Rebates Program are to: (1) determine gross and net program savings and (2) examine the effectiveness of program processes in achieving savings.

The CY2019 gross impact evaluation will not vary significantly from the previous years, but adjustments will be made to reflect specific measure and project characterizations. The evaluation team conducted free ridership research in CY2018 on customers that participated between October 2017 and June 2018. The free ridership survey covered attic insulation, air sealing, and duct sealing measures, and the targeted number of completes was 70 per measure. Out of around 200 participants in our sample, we achieved 14 completes for duct sealing, so we propose continuing this research in 2019 after we receive final 2018 tracking data. For wall insulation, Navigant will conduct a literature review of researched net-to-gross (NTG) values because the magnitude of savings and level of participation for this measure are too low to warrant primary research. The findings from this research will inform recommended NTG values for the Illinois Stakeholder Advisory Group (SAG) approval and future program application.

The evaluation of this program over the coming three years will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – Three Year Plan

Tasks	CY2019	CY2020	CY2021
Tracking System Review	X	X	X
Data Collection – Participant Surveys	X		
Data Collection – Program Manager and Implementer Interviews	X	X	X
Data Collection – EESP Interviews*	X		
Impact – Measure-Level Deemed Savings Review	X	X	X
Impact – Verification & Gross Realization Rate	X	X	X
Net-to-Gross – Customer Self-Report Surveys	X		
Literature Review – NTG Values for Wall Insulation	X		
Process Analysis	X	X	X

*Energy Efficiency Service Provider

The evaluation team determined the evaluation approach for the CY2019-2021 period based upon the needs of the program and program's history. The three-year evaluation approach for this program is based on the following:

- Annual gross and net impact analysis
- NTG research on free ridership for duct sealing measures will be completed during 2019
- Literature review of researched NTG values for wall insulation measures will be conducted during 2019
- Process analysis will be conducted in 2019 and 2020 through interviews with program participants and participating energy efficiency service providers (EESPs) to determine opportunities to improve program processes and expand program savings.

Coordination

Navigant will coordinate with the evaluation teams from other utilities on any issues relevant to this program, including coordinating with evaluation teams for Ameren and the gas utilities on survey instruments for NTG research on participating customer free ridership as well as on survey instruments and samples for process research on participating EESPs.

Evaluation Research Topics

The CY2019 evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program's verified gross savings?
2. What are the program's verified net savings?
3. What updates, if any, are recommended for the Illinois Technical Reference Manual (TRM)?

Process Evaluation and Other Research Topics

The process evaluation effort for CY2019 will focus on program delivery. The process research will address the following questions:

1. What is the level of satisfaction with the program amongst participants?
2. What opportunities exist for program improvement?
3. Are service providers (EESPs) satisfied with the program? Do they recommend any areas for improvement?

Evaluation Approach

Table 2 summarizes the evaluation tasks for CY2019 including data collection activities and target audiences that will be used to answer the evaluation research questions.

Table 2. Core Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Notes
Surveys: NTG and Process	Participating Customers	70 FR Duct Sealing	CY2018 Participating Duct Sealing customers.
Literature Review	NTG Values for Wall Insulation	TBD	
Interviews	EESPs	10 – 15	Process evaluation.
Tracking System Review	Tracking system	Census	One interim and one final. *
In-Depth Interviews	Program Management and Implementers	2	
Gross Impact Evaluation	TRM Review	Census	Measure-Level Deemed Savings Review. One interim and one final.
Verified Net Impact	Calculation using deemed NTG ratio	NA	Deemed Value.

Note: FR = Free Ridership

* Navigant will coordinate with ComEd to determine appropriate dates to pull tracking data extract for Wave 1 data.

Participant Surveys

We will conduct telephone surveys with participating customers to assess free ridership for duct sealing measures. We will conduct this survey via telephone with CY2018 participants in the Spring of 2019.

Literature Review

Because the magnitude of savings and level of participation for wall insulation measures are too low to warrant primary research, Navigant will conduct a literature review of researched NTG values for this measure to inform NTG recommendations for future use.

EESP Interviews

Navigant will conduct interviews with 10 to 15 EESPs in 2019 to determine if there are any opportunities to improve program processes and expand program savings.

Tracking System Review

In line with program changes and accelerated evaluation schedule for delivering tracking data to the evaluation team, Navigant will perform an interim tracking system review in the summer of 2019. This will be the primary method to determine net and gross savings and apply a measure-level net-to-gross ratio (NTGR) that is deemed through a consensus process by the Illinois Stakeholder Advisory Group (IL SAG).

Program Manager and Implementer Interviews

Navigant will conduct program manager and implementer interviews to learn about the current status of the program, if any changes to program offerings or implementation have occurred, and if any program changes are planned for the future.

Gross Impact Evaluation

The gross impact analysis will include a review of deemed savings estimates for all measures in the program. All program measures will be reviewed for compliance with the Illinois TRM and identify the changes necessary to meet TRM compliance. Navigant will document how the deemed measures differ from ComEd’s existing planning or ex ante tracking estimates and provide guidance as to how these differences will impact ComEd’s programs. For any new measures, Navigant will perform a desk review of program calculations and compare savings to the Illinois TRM.

Verified Net Impact Evaluation

The verified net impact evaluation will apply the net-to-gross (NTG) ratio accepted by Illinois Stakeholders Advisory Group (SAG) consensus to estimate the verified net savings for the program.

Table 3. Deemed NTG Values for CY2019

Measure	CY2019 Deemed NTG Value
Air Sealing + Attic Insulation	NA
Other Weatherization Measures	1.01

Source:
http://ilsagfiles.org/SAG_files/NTG/2017_NTG_Meetings/Final/ComEd_NTG_History_and_CY2019_Recommendations_2018-10-01.xlsx

Research NTG Impact Evaluation

The evaluation will conduct NTG research through telephone surveys in CY2019 on free ridership for duct sealing measures to inform NTG recommendations for future use.

Calculation of CPAS and Annual Savings

As required by the Future Energy Jobs Act (FEJA), Navigant will report ex post gross and ex post net savings for the program and the cumulative persisting annual savings (CPAS) in CY2019 will be calculated along with the total CPAS. Additionally, the weighted average measure life will be estimated. The evaluation will also add the savings converted from gas savings to the electric savings so that it is documented in the report.

Use of Randomized Controlled Trial and Quasi-Experimental Design

We are not evaluating the Weatherization Rebates Program via a randomized controlled trial because the program was not designed with randomly assigned treatment and control groups. We are not using quasi-experimental consumption data because there are not enough participants in this program to achieve statistically significant savings estimates using this method.

Evaluation Schedule

Table 4 below provide the schedule for key deliverables and data transfer activities Adjustments will be made, as needed, as evaluation activities progress. We plan to conduct process evaluation activities early in the program year and report results to ComEd as valuable information becomes available.

Table 4. Schedule – Key Impact Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	March 4, 2019
Field Participant Free Ridership Surveys	Evaluation	February – April 2019
Literature Review of Researched NTG Values for Wall Insulation	Evaluation	April – May 2019
Energy Efficiency Service Provider Interviews	Evaluation	April – May 2019
CY2019 program tracking data for sampling Wave 1	ComEd	June 28, 2019
Tracking System Wave 1 Ex Ante Review Findings and Recommendations	Evaluation	July 31, 2019
Final NTG Recommendations to ComEd and SAG	Evaluation	August 1, 2019
Program Manager and Implementer Interviews	Evaluation	August 3, 2019
CY2019 Final Program tracking data	ComEd	January 31, 2020
Internal Report Draft by Navigant	Evaluation	March 2, 2020
Draft Report to ComEd and SAG	Evaluation	March 11, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 1, 2020
Revised Draft by Navigant	Evaluation	April 8, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	April 15, 2020
Final Report to ComEd and SAG	Evaluation	April 22, 2020

APPENDIX E. PILOT PROGRAMS

ComEd HVAC SAVE Pilot Program Evaluation Plan

Introduction

HVAC SAVE is a pilot program that focuses on the savings associated with specially-trained trade allies installing qualified central air conditioning (CAC) units at ComEd customer homes. In CY2018, ComEd provided training (via MEEA and CLEAResult) to trade allies and had a goal of 400 CAC installations out of 13,000 were “quality installed” via this HVAC SAVE pilot program. CLEAResult also provided the QA/QC support of the program.

Evaluation Objectives

Navigant’s objective is to evaluate savings related to the quality installation (QI) process associated with the HVAC SAVE Program. The IL TRM has included a temporary two-year HVAC QI measure which is the current IL TRM CAC measure with a 10% derating factor applied to non-quality installed units. Depending on the results of this pilot evaluation, the temporary two-year HVAC QI measure will either be verified, modified, or removed. The process evaluation effort will focus on program design and participant satisfaction.

Key impact research questions are:

1. What are the energy and peak demand savings associated with the HVAC SAVE measure?
2. Are the HVAC SAVE trained contractors abiding by the HVAC SAVE training and installation protocols?
3. Are these savings cost effective enough to incorporate the measure into ComEd’s Heating & Cooling Rebates program?
4. If the program continues with this measure, what parameters should be used to calculate savings for future program participants?

The process research will address the following questions:

1. What are participants’ perspectives and overall satisfaction with the program?
2. How can the program be improved?

Evaluation Approach

To evaluate this measure, Navigant will conduct three activities: (1) Ride alongs with ComEd Residential trade allies installing CAC systems in summer 2018; (2) metering at ten homes, five with HVAC SAVE installed CAC systems and five without; and pending ComEd’s decision to continue the pilot or not, a regression analysis on a census of participants and a quasi-experimental control group following the cooling season in CY2019. For this regression analysis, Navigant will request cooling season AMI data for participant and non-participant customers.

To accommodate sampling for the metering of ten homes, Navigant requested pilot and non-pilot participant program tracking data. Once the sample was drawn, Navigant requested contact information for sampled pilot and non-pilot customers.

Installation Review

A Navigant representative conducted “ride alongs” with a sample of CAC installations in summer 2018 with three groups of installations:

- QI
- Non-QI by trained HVAC SAVE trade allies
- Non-QI by untrained trade allies

Navigant conducted a total of ten ride alongs: five QI, one Non-QI by a trained HVAC SAVE trade ally, and four Non-QI by untrained trade allies

During each installation the Navigant representative conducted a brief contractor interview and an installation audit.

The contractor interview gathered qualitative data on the general practices (typical processes, materials used, and checks completed) of the specific contractor. The installation audit objectively recorded the key procedures and measurement metrics used throughout the installation.

The ride-along data recorded during installation reviews provided qualitative evidence of the efficacy and consistency of QI and non-QI air conditioner installations.

At the time of this evaluation plan update, Navigant understands that ComEd may choose to include trade ally interviews in the baseline study. Navigant will send ComEd a short questionnaire that could be added to the survey conducted with trade allies that perform CAC installations. This questionnaire seeks to determine the level and type of training that trade allies have received for performing CAC installations. The responses to the survey will help in developing a robust understanding of the baseline (i.e., trade allies who have not had formal training and/or do not use industry best practices for CAC installations).

Metered Data Collection and Analysis

Navigant installed meters in ten customer homes—five homes with QI installed CAC and five homes with non-QI installed CAC. This preliminary phase did not determine quantifiable energy savings for QI installed CAC, but determined if savings were achieved from the HVAC SAVE installed systems. This ten-home metering study was completed in the fall of 2018 and Navigant delivered the results in December 2018.

The metered sample was drawn both from the pilot program participants and from the control group. Once sampled, a Navigant representative contacted the resident for recruitment and scheduling and offered a \$100 gift card for a team of Navigant field techs to meter their air conditioning unit at the electrical panel. The field team also metered the heating and cooling occupied and unoccupied temperatures in the home. During the initial visit, the Navigant team collected data relevant to the air conditioner’s efficiency, including unit nameplate data and power consumption, system set points and schedules (where available), supply and return air temperature and humidity, airflow, static pressure at points throughout the system, refrigerant line temperatures and pressures, and (perhaps) condensate production rate.

Navigant left the meters in place for least two months to monitor electricity usage by the AC unit at varying outdoor conditions and during peak temperatures. The Navigant team analyzed this data, supported by program tracking data, to determine if savings has occurred from the pilot.

Regression Analysis

If ComEd continues the pilot into CY2019 and has significant participation (approximately 300 QIs) early in the cooling season, Navigant will conduct a regression analysis to determine savings from the pilot since the pilot did not reach the target of 400 QIs in CY2018. The participant group will comprise all customers who have the QI treatment while the potential non-participant group will comprise customers in the HVAC SAVE Program who did not receive QI. Navigant will select matched controls from the potential non-participant group to use for the evaluation in a quasi-experimental design approach. Matches will be selected using AMI data from the summer of 2017 and 2018 (before the installations occurred); each participant will be assigned the non-participant match with the closest usage profile during the matching period.

After matching, savings will be estimated through a regression model. The regression will use AMI data and will take the form of a lagged dependent variable (LDV) model similar to that shown in Equation 1. The coefficient on the QI indicator (β_1) will give savings for the program. Navigant will also test incorporating cooling degree hours (CDH) directly into the model and considering whether the customers in the control group who did not get a QI used a trade ally trained in the QI or not.

Equation 1. Lagged Dependent Variable Model

$$Usage_{kht} = \beta_1 QI_k + \sum_L \beta_2 Hour_{lh} + \beta_3 Weekday_t + \sum_j \beta_{4j} Month_{jm} + \sum_j \beta_{5j} Month_{jm} \cdot LagUsage_{ktm} + \beta_6 Zip_k + \omega_h + \varepsilon_k$$

Where,

- $Usage_{kt}$ = Usage by household k in hour h on day t
- QI_k = A binary variable taking a value of 1 if customer k receives QI and 0 otherwise
- $Hour_h$ = A binary variable taking a value of 1 in hour h when $h=l$ and 0 otherwise (in other words, a set of hourly fixed effects)
- $Weekday_t$ = A binary variable taking a value of 1 if day t is a weekday and 0 otherwise
- $Month_{jm}$ = A binary variable taking a value of 1 when day t is in month m and $j = m$ and 0 otherwise (in other words, a set of monthly fixed effects)
- $LagUsage_{ktm}$ = The average use by household k in hour t during the most recent month before household k (or its match) enrolled in the program that is also the same calendar month as day t . For instance, if household k enrolled in August 2017, the value of $LagUsage_{ktm}$ for 12pm in June 2018 is average hourly usage at 12pm in June 2017.
- Zip_k = The zip code of household k
- ω_t = A vector of hourly weather variables
- E_k = Model error term

Deliverables and Outcomes

The deliverables from this evaluation include a presentation of results and recommendations to either leave the measure in the TRM “as is”; or remove the measure due to lack of evidence of savings;. Navigant will also produce a CY2018 pilot evaluation report with verified savings.

Potential Timeline

- Planning: January-June 2018
- TRM v7 Workpaper review and comment: May – June 2018
- Conduct ride alongs: August 2018

Sampling for ten metered homes: June-July 2018
Execution/Metering: August 2018 – October 2018
Regression Analysis, if conducted: September – November 2019
CY2018 Impact Report: January - April 2019

ComEd Midstream Heat Pump Water Heater Pilot Program CY2019 Evaluation Plan

Introduction

In CY2019, ComEd is launching a midstream Heat Pump Water Heater (HPWH) Pilot Program. This technology has seen limited participation and savings within downstream programs. ComEd hopes to increase participation and savings by moving up the supply chain and involving manufacturers and distributors as well as end users in the program. Purchases of this type of equipment are largely influenced by first costs and by distributor stocking practices which make HPWHs a good candidate for a midstream program.

The HPWH Pilot Program design utilizes the same incentive levels currently being offered to customers in the traditional downstream program. However, the new program provides the incentive to the installing contractor. The end use customer does not directly receive any incentives but receives the energy efficient equipment at a more competitive price. This contractor incentive is coupled with a distributor administrative incentive for each unit sold, allowing the distributor to recover some of the added administrative costs associated with their participation, thereby increasing the distributors likelihood to participate. Over time, the pilot program will attempt to transform the market through improving market awareness, increasing energy efficient product availability, and subsequently sales volume of efficient products.

The table below shows the activities related to the evaluation plan.

Table 1. Evaluation Approaches

Tasks	CY2019
Program Initiation Meetings	X
Program Manager and Implementer Interviews	X
Energy Savings Analysis	X
Net to Gross Secondary Research	X
Identifying Market Transformation (MT) Indicators	X

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

1. What are the gross and net energy savings from this midstream program?
2. How can participation and savings from the program be improved?
3. How is this program transforming the market?

Evaluation Approach

The following subsections summarize the evaluation tasks that Navigant will complete to answer the evaluation research questions. The detailed plan outlines activities for this research in five tasks as summarized in Table 2.

Table 2. Summary of Tasks and Activities

Tasks	Activities
Task 1: Program initiation meetings & literature review	<ul style="list-style-type: none"> • Telecoms • Literature review
Task 2: Staff and IC interviews	<ul style="list-style-type: none"> • Develop interview guide • Conduct interviews
Task 3: Develop market transformation indicators and associated baselines	<ul style="list-style-type: none"> • Review program theory, logic model and market transformation indicators • Establish data sources • Determine baselines
Task 4: Energy/demand savings analysis	<ul style="list-style-type: none"> • Impact analysis using sales data and TRM savings algorithms
Task 5: Net to gross development	<ul style="list-style-type: none"> • Secondary research on NTG for midstream programs

Project Initiation Meetings

Navigant participated in a planning meeting with ComEd and the implementers to gather important context for the HPWH Pilot Program evaluation via conference calls in September of 2018. We will meet again in early CY2019 when the program launches to learn the specifics of the final program design.

Impact Evaluation

Gross Impact Evaluation

Navigant suggests a sales data analysis to determine savings for the program year. We plan to use tracking data and sales data from the participating market actors (manufacturers) which should contain equipment and customer information. Customer demographic data is important for several reasons such as to confirm that each unit is getting installed within the utility service area. We will utilize the savings values and algorithms from the Illinois Technical Reference Manual (IL TRM) to develop energy savings estimates for each equipment type.

For heat pump water heaters, energy and demand saving equations are provided in the IL TRM, and the required inputs to the equations include energy factor and rated volume (there are no default values provided). Navigant will request the necessary tracking and sales data that contains the key parameters of the equipment and will combine it with independent third-party research data sources. Other key parameters needed include demographic information of the customers, customer counts, equipment units and purchase date. Navigant will request the necessary tracking and sales data that contains the key parameters of the equipment and customer information.

Net Impact Evaluation

Currently there is no NTG value for midstream programs provided in the IL TRM. As the program is new and small, and its success and longevity are as yet unknown, Navigant will conduct secondary research

on NTG for this first year of the program. We will perform a literature review for NTG on midstream programs in similar regions to find a reasonable proxy.

Process Evaluation

Staff & Implementer Interviews

ComEd staff and the implementation contractor will be interviewed to ascertain essential information about the program design and customer experience. The evaluation team will develop interview instruments to include questions of interest for the evaluation and to allow for a free-flowing conversation to obtain candid feedback from the interviewee. Navigant plans to conduct two interviews of roughly an hour in length with the implementer (CLEAResult) and the ComEd program lead.

Derivation of Market Transformation Impacts

To help ComEd develop a robust market transformation (MT) evaluation framework, Navigant will review the program theory and logic model (PTLM) to identify MT indicators that can be tracked and measured. If a PTLM has not been developed, we will develop one together with ComEd and the implementer. Tracking MT indicators will allow ComEd to monitor where they are transforming the market and enacting change.

The following activities will be conducted this year to set up this framework and begin tracking market transformation indicators.

Program Theory and Logic Model

Navigant will either create or review a program theory and logic model (PTLM) depending on availability. Once the PTLM has been developed, Navigant will facilitate a working session with ComEd and the implementer to identify MT indicators and potential information sources to track them.

Identify Market Transformation Indicators

Navigant will then identify a MT indicator for each output and outcome from the logic model and a data source for each indicator. These indicators will become the evaluation roadmap to determine what data we need to collect and how we collect it. The indicators will be measurable and will focus on non-energy related outputs and outcomes to track MT progress. Navigant will solicit and compile suggestions for specific tracking data that will enable program managers to monitor ongoing program performance.

Methodology for Tracking MT Metrics

Navigant will collect and analyze primary and secondary data to establish a methodology for tracking MT metrics. The collected data may include sales information, stocking patterns, customer and other market actor interviews. The data will be analyzed using a variety of tools as needed to establish a Year 1 baseline. The baseline results will be used in future evaluation years to measure MT progress and see how the market has changed over time as a result of the program's activities.

Evaluation Schedule

Table 3 below provides the schedule for key deliverables and activities. Adjustments will be made, as needed, as evaluation activities progress.

Table 3. Schedule

Activity	Timeline
Task 1 – HPWH Program Kick-off Meeting	TBD
Task 2 – Staff & Implementer Interviews	Mar 2019
Task 3 – Identify Market Transformation Indicators and Data Collection Needed for Program Performance Tracking	Mar Apr 2019
Task 4 – Establish a Methodology for Tracking Indicators	May Jun 2019
Task 5 – Establish a First Year Baseline	Jul-Aug 2019
Wave 1 Sales Data	May 2019
Wave 2 Sales Data	Sep 2019
Wave 3 Sales Data	Jan 30 2020
Task 6 Sales Data Analysis	Feb 2020
Draft report to ComEd and SAG	March 5 2020
Comments on draft	March 19 2020
Revised draft	Mar 29 2020
Comments on re-draft	Apr 12 2020
Final report to ComEd and SAG	Apr 20 2020

ComEd Save and Share Pilot CY2019 Evaluation Plan

Introduction

The ComEd Save and Share Pilot uses a digital customer engagement platform to help customers save energy. The app sets weekly energy-reduction goals based on participants' past usage, tracks their progress, provides electricity consumption data in 30-minute intervals, links participants to relevant ComEd energy efficiency programs (i.e., Residential, Small Business, and Income Eligible), and shares energy-saving tips and reminders to help reduce energy use. A key feature of the platform is that each week participants are notified of their electricity usage target for that week, and if the participant uses less than that target, they will earn money for a local community organization based on how much electricity they save.

Save and Share was soft-launched in August 2018 and ComEd is actively working to recruit non-profit community partners. The pilot is expected to be evaluated for a 12-month period, but the timeline may vary depending on when a critical mass of partners and participants are enrolled. Navigant's evaluation plan may be modified based on how many customers enroll.

This is a one-year pilot and, as such, no evaluation activities are planned for CY2020 through CY2021. The evaluation of this pilot will include a variety of data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches – for CY2019 (one year pilot)

Tasks	CY2019
Tracking System Review	X
Program Manager and Implementer Interviews	X
Materials Review	X
Gross Impact Evaluation	X
Net Impact Evaluation	X
Participant Surveys	X
App Analytics	X

Coordination

At this time there are no equivalent programs at other Illinois utilities. We will continue to monitor program development and make adjustments as needed.

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What were the net verified savings from the pilot?
2. How effectively did the pilot channel customers into ComEd's other energy efficiency programs?
3. How accurate were the implementer's weekly projections of usage?

Process Evaluation and Other Research Topics

1. What were the biggest influences for why customers decided to participate in the pilot (e.g., the community-based outreach, the ability to access AMI data, the ability to earn money for a local organization, etc.)?
2. At the end of the pilot, how satisfied were customers with the various pilot components?
3. How did customers engage with the interactive digital platform over the course of the pilot?

Evaluation Approach

The team will conduct the evaluation tasks in Table 2 to answer the evaluation research questions. These are subject to change based on changes to the pilot design, size, and discussions with ComEd and the program implementer.

Table 2. Evaluation Plan Summary

Activity	CY2019
Gross Impact Evaluation	Regression analysis
Verified Net Impact Evaluation	Regression analysis
NTG Approach*	Uplift analysis
Program Manager and Implementer Interviews	Yes
Materials Review	Yes
Participant Surveys	Yes
App Analytics	Yes

*This program is for low income customers, so the net-to-gross ratio is one. The only adjustment to the billing analysis results will be to account for uplift.

Gross Impact Evaluation

The Save and Share Pilot is an opt-in program targeted to Bronzeville, IL. Bronzeville consists of four zip codes, all of which are considered low income, and is primarily made up of multi-family housing. Because of the opt-in design, Navigant expects to evaluate savings for this program based on a quasi-experimental regression analysis. We will likely evaluate the program with a matched control group (MCG) design that also relies on the geographic discontinuity of offering the program in Bronzeville but not to communities just outside Bronzeville. This method may be modified if the pilot does not enroll enough participants to effectively employ this method.

The MCG design will choose non-participants who have energy usage similar to the participants in the period before they join the program. These matched non-participants (controls) will create the counterfactual usage for the participants in the program period. Self-selection bias (bias caused by the fact that customers who choose to join a program are different from those who do not) can never be eliminated in a quasi-experimental design but will be mitigated by the fact that the non-participants were not given the option to join the program.

To ensure that the matched control group is an appropriate counter-factual for the participants, Navigant will use customers in low income zip codes surrounding Bronzeville. We will also match on or control for dwelling type (single-family versus multi-family) and Home Energy Report program status.

Navigant will also conduct an uplift analysis to look at how effectively the pilot channeled customers into ComEd's other energy efficiency programs. Assuming the data is available, we will look at the month-by-month channeling so that we can see how effective certain program promotions were through time.

Finally, Navigant will examine how accurate the program implementer's projections of weekly usage were. It is our understanding that the implementer will be creating projections for all the pilot eligible customers in Bronzeville. For the non-participants in Bronzeville, Navigant will examine how well the projections aligned with weekly usage which will help ComEd assess whether these projections are reliable enough to utilize in other programs.

Verified Net Impact Evaluation

The TRM deems NTG at 1.0 for Income Eligible programs.

Program Manager and Implementer Interviews

Navigant will conduct interviews with the ComEd program manager and implementation contractors to understand the pilot design and goals. Since the pilot is expected to evolve throughout its implementation, the evaluation team expects to conduct formal and informal interviews at various times throughout the year.

Materials Review

Navigant will request and review pilot materials to ensure a thorough understanding of the pilot design and how it was presented to community partners and ComEd customers. This review may include documents such as marketing plans, marketing materials sent to community partners and customers, program information shared with customers upon sign up; as well as review of the functionality of the app through a demonstration.

Participant Surveys

Navigant expects to conduct two customer surveys for this pilot. The first is a brief post-enrollment survey fielded shortly after an individual customer joins the program. This survey launched on Navigant's web survey platform (Qualtrics) in August 2018 and focuses on the reasons customers chose to join the program. The second survey will be an end of pilot survey asking customers about their experience with the program and satisfaction with the various program components. We expect that Navigant will administer this survey via web (a phone component could also be included if there are concerns about web access).

App Analytics

The process evaluation will also include an analysis of customer engagement with the digital platform. This will examine things like:

- How frequently and what time of the day, week, and month customers visited various pages of the platform
- How much money customers earned to share with local community organizations and how they chose to distribute it (i.e., to a single partner organization or multiple organizations)
- Percentage of participants that create a web account
- Percentage of participants that download the mobile app

- Percentage of participants that opt out of emails
- Percentage of participants that open emails
- Percentage of participants meeting or exceeding weekly goal

Use of Randomized Control Trial and Quasi-Experimental Design

The evaluation team will use a regression-based quasi-experimental design (QED) evaluation method for this pilot.

Data Requirements

Table 3 shows the data Navigant will need for the CY2019 evaluation.

Table 3. Data Requirements

Data Type	Variables	Notes
Participant and non-participant customer information	<ul style="list-style-type: none"> • Customer ID • Premise ID • Customer Name • Customer Phone Number • Customer Email Address • Customer Address • Customer Zip Code • Customer dwelling type (single- versus multi-family) • Customer type (residential versus small business) • Customer segmentation profile (if available) • Customer service start date (if after January 1, 2017) • Customer inactive/move out/service end date (if applicable) • Exclusion indicator marking any customers who should be excluded from the evaluation (this should include, for example, ComEd or program implementer employees who worked on the pilot and joined the program) 	Needed for all pilot participants and potential non-participant matched controls
Participation information	<ul style="list-style-type: none"> • Program enrollment date • First web login date • App download date • Email opt-out information 	Needed for all pilot participants
Billing data	<ul style="list-style-type: none"> • Customer ID • Premise ID • Monthly kWh usage • Flag for estimated reads • At least two of: <ul style="list-style-type: none"> ○ Bill period start date ○ Bill period end date ○ Number of days in billing period 	Needed for all pilot participants and potential non-participant matched controls

Data Type	Variables	Notes
Interval AMI data	<ul style="list-style-type: none"> Customer ID Premise ID kW demand in, at most, one hour increments Date of interval read Hour end time of interval read (e.g. usage from 10 am to 11 am would be recorded as 11 and usage from 1 pm to 2 pm would be recorded as 14) 	Needed for all pilot participants and potential non-participant matched controls
App usage data	<ul style="list-style-type: none"> Page usage (“events”) by Customer ID; including timestamp, page description, platform, device Information on money raised and shared with local community organizations Email open and click-through information Weekly goals and recorded actual usage 	Needed for all pilot participants

Evaluation Schedule

Table 4 provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress. We have not included dates for surveys and app analytics, but we expect to conduct the end of pilot survey and app analytics when the pilot ends or in the beginning of 2019 if the pilot is ongoing. The post enrollment survey is ongoing and will be analyzed when we have a critical mass of respondents.

Table 4. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Manager and Implementer Interviews	Navigant	As needed*
Materials Review	Navigant	As needed*
Final evaluation data request sent to ComEd	Navigant	December 6, 2019
Final evaluation data delivered to Navigant	ComEd	January 30, 2020
Draft Report to ComEd and SAG	Navigant	Mar 13, 2020
Comments on draft (15 Business Days)	ComEd and SAG	Apr 3, 2020
Revised Draft by Navigant	Navigant	Apr 10, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	Apr 17, 2020
Final Report to ComEd and SAG	Navigant	Apr 24, 2020

*Navigant will conduct interviews and materials review as needed as the pilot design progresses.

**ComEd Upstream Commercial Food Service Equipment Pilot Program
CY2019 Evaluation Plan**

Introduction

In CY2019, ComEd is launching an Upstream Food Service Equipment Pilot Program. These products have seen limited participation and savings within downstream programs. ComEd hopes to increase participation and savings by moving up the supply chain and involving manufacturers and distributors as well as end users in the program. Purchasing decisions for food service equipment are largely influenced by first costs and by distributor stocking practices which make them good candidates for an upstream program.

The Upstream Commercial Food Service Equipment (CFSE) Pilot Program represents the first stage of a proposed multi-year incentive program offering by ComEd, Nicor Gas, North Shore Gas and Peoples Gas (referred to as the “Utilities”). The goal of the pilot program is to increase the uptake of energy efficient CFS equipment among Chicagoland food service operators (referred to as “end users” or “utility customers”) through the utilization of point-of-sale (POS) customer rebates, upstream incentives, and a simplified administrative process. The goal of the program is to ease barriers to efficient equipment uptake by end users, thereby reducing gas and electricity usage in the CFS sector; the goal of the pilot program is to gauge the program’s potential efficacy and refine the pilot program approach for full program implementation. This pilot emphasizes the importance of an upstream incentive approach as well as how the pilot will be administered to ensure its success⁹¹.

The table below shows the activities related to this evaluation plan.

Table 1. Evaluation Approaches

Tasks	CY2019
Program Initiation Meeting	X
Program Manager and Implementer Interviews	X
Energy Savings Analysis	X
Net to Gross Research and Analysis	X
Identifying Market Transformation Indicators and creating a baseline	X

Evaluation Topics

The evaluation will seek to answer the following key researchable questions:

1. What are the gross and net energy savings from the upstream programs?
2. How can participation and savings from the programs be improved?
3. How are these upstream programs transforming the market?

⁹¹ Excerpted from “CNP Upstream Commercial Food Service Pilot Program: Implementation Plan” December 2018. Prepared by Frontier Energy for Gas Technology Institute

Evaluation Approach

The following subsections summarize the evaluation tasks that Navigant will complete to answer the evaluation research questions. The detailed plan outlines activities for this research in five tasks as summarized in Table 2.

Table 2. Summary of Tasks and Activities

Tasks	Activities
Task 1: Program initiation meetings & literature review	<ul style="list-style-type: none"> • Virtual meetings • Literature review
Task 2: Staff and IC interviews	<ul style="list-style-type: none"> • Develop interview guide • Conduct two interviews
Task 3: Develop market transformation indicators and associated baselines	<ul style="list-style-type: none"> • Collaborative work to review program theory, logic model and MT indicators • Establish data sources • Determine baselines
Task 4: Energy savings analysis	<ul style="list-style-type: none"> • Impact analysis using sales data and TRM savings algorithms
Task 5: Net to gross development	<ul style="list-style-type: none"> • Secondary research on NTG for upstream programs

Project Initiation Meetings

Navigant participated in the program initiation meetings with ComEd, the implementers, and other stakeholders to gather important context for the upstream evaluation via conference call. These meetings took place in October and November of 2018. We will meet again when the program goes live to learn the specifics of the final program design.

Impact Evaluation

Gross Impact Evaluation

Navigant suggests a sales data analysis of each program to determine savings for the program year. We will use program tracking data and sales data from the participating market actors (distributors of food service equipment) which should contain equipment and customer information. Customer demographic data is important for several reasons such as to confirm that each unit is getting installed within the utility service area. We will utilize the savings values and algorithms from the Illinois Technical Reference Manual (IL TRM) to develop energy savings estimates for each equipment type.

Based on the report⁹² prepared by Gas Technology Institute (GTI), food service equipment includes steam cookers, convection ovens, combination ovens, conveyor ovens, rack ovens, fryers, griddles, rotisserie ovens, broilers and others. The IL TRM lists energy savings calculation equations for these and other food service equipment. The inputs to these equations are the primary equipment specifications, such as input energy rate of the efficient and baseline cases, annual operating hours, and duty cycle (If these key parameters are unknown, the TRM also provides default values). Navigant will request the necessary tracking/sales data that contains the key parameters of the equipment and customer information.

⁹² CNP Upstream Commercial Food Service Pilot Program: Phase I.pdf, October 2018

Net Impact Evaluation

Currently there is no net-to-gross (NTG) value for upstream programs provided in the IL TRM. As the program is new and small, and its success and longevity are yet unknown, Navigant will conduct secondary research on NTG for this first year of the program. We will perform a literature review for NTG on upstream programs in similar regions to find a reasonable proxy.

Process Evaluation

Staff & Implementer Interviews

ComEd program staff and the implementation contractor will be interviewed to ascertain essential information about the program design and customer experience. The evaluation team will develop interview instruments to include questions of interest for the evaluation and to allow for a free-flowing conversation to obtain candid feedback from the interviewee. Navigant plans to conduct two interviews of roughly an hour in length with the implementers, GTI, and the ComEd program lead.

Derivation of Market Transformation Impacts

To help develop a robust market transformation evaluation framework, Navigant will review the program theory and logic model shown in the Implementation Plan to identify market transformation indicators that can be tracked and measured. Tracking market transformation indicators will allow ComEd to monitor where they are transforming the market and enacting change.

The following activities will be conducted this year to set up this framework and begin tracking market transformation indicators.

Program Theory and Logic Model

Navigant will review the program theory and logic model (PTLM) found in the implementation plan. The program logic model diagram in the Implementation Plan shows the intended linkages between activities, outputs and outcomes, and identifies potential external influences. Navigant will facilitate a working session with ComEd and the implementer to identify market transformation indicators that they wish to track, and potential information sources to track them.

Identify Market Transformation Indicators

Navigant will identify a market transformation indicator for each output and outcome from the logic model and a data source for each indicator. These indicators will become the evaluation roadmap to determine what data we need to collect and how we will collect it. The indicators will be measurable and will focus on non-energy related outputs and outcomes to track market transformation progress. Navigant will solicit and compile suggestions for specific tracking data that will enable program managers to monitor ongoing program performance.

Methodology for Tracking MT Metrics

Navigant will collect and analyze primary and secondary data to establish a methodology for tracking MT metrics. The collected data may include sales information, stocking patterns, customer and other market actor interviews. The data will be analyzed using a variety of tools as needed to establish a Year 1 baseline. The baseline results will be used in future evaluation years to measure market transformation progress and see how the market has changed over time as a result of the program's activities.

Evaluation Schedule

Table 3 below provides the schedule for key deliverables and activities. Adjustments will be made, as needed, as evaluation activities progress.

Table 3. Schedule

Activity	Timeline
Task 1 – Upstream Program Kick-off Meetings	Feb 2019
Task 2 – Staff & Implementer Interviews	Mar 2019
Task 3 – Identify Market Transformation Indicators and Data Collection Needed for Program Performance Tracking	Mar- Apr 2019
Task 3 – Establish a Methodology for Tracking Indicators	May -Jun 2019
Task 3 – Establish a First Year Baseline	Jul-Aug 2019
Wave 1 Sales Data	May 2019
Wave 2 Sales Data	Sep 2019
Wave 3 Sales Data	Jan 30, 2020
Task 5 – Sales Data Analysis	Feb 2020
Draft report to ComEd and SAG	March 5, 2020
Comments on draft	March 19, 2020
Revised draft	Mar 29, 2020
Comments on revised-draft	Apr 12, 2020
Final report to ComEd and SAG	Apr 20, 2020

APPENDIX F. CROSS-CUTTING RESEARCH EVALUATION PLANS

ComEd AMI Evaluation 2019 Research Plan

Introduction

This detailed research plan describes the proposed methods the Navigant team will use to advance the use of advanced metering infrastructure (AMI) data in energy efficiency (EE) and demand response (DR) evaluations beyond standard practices. Navigant is conducting this work at the request of ComEd, the Illinois Commerce Commission, and regional stakeholders.

Navigant has historically used AMI for evaluation of commercial and industrial (C&I) custom programs. The tasks identified in this plan focus on where the distinguishing characteristics of AMI can extend the benefits of EE and DR evaluation beyond its current uses.

Overall Study Goal

The overarching goal of this work is to strategically advance the use of AMI data in EE/DR evaluations beyond standard practices. For 2019, the Navigant team will focus on the following objectives:

- Engaging with regional stakeholders to help prioritize evaluation research efforts
- Monitoring the progress in establishing the data link between ComEd and Navigant for fast, efficient transfer of large volumes of AMI data
- Supporting the AMI runtime and econometric analyses for residential advanced thermostats
- Piloting bulk regression analysis of C&I custom projects to support better sampling and potential evaluation cost reduction
- Support other evaluations using AMI data

Research Questions

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

1. How can Navigant best align its efforts to use AMI with the needs of the state?
2. Can AMI data support more reliable results for savings from residential advanced thermostats?
3. Can bulk regression analysis of C&I custom projects reduce the overall cost of evaluation?
4. How can AMI data be cost-effectively used in program evaluation?

This research will provide value to ComEd by supporting the statewide focus on using Illinois ratepayers' investment in advanced metering infrastructure in new, innovative ways.

Summary of Evaluation Research Activities

Table 1 shows the proposed research activities for 2019.

Table 1. Proposed 2019 Research Activities

Activity	Rationale	Timing
Engage with regional stakeholders	Ensure that Navigant’s efforts are aligned with needs of the state	Quarterly 2018-2019
Establish AMI data transfer infrastructure	Fast, efficient and secure transfer of billions of data points..	Spring 2019
Support AMI analyses of residential advanced thermostats	Better understand the electric energy impacts from residential advanced thermostats incentivized through IL EE programs	Dependent on data availability
Pilot a bulk regression analysis of C&I custom projects	Better understand the level of rigor required to evaluate custom projects. Potentially reduce evaluation costs.	Spring 2019
Support evaluations using AMI data	Explore the use of AMI in evaluation to produce more reliable results	2019

Methodology

This plan outlines activities for this research into seven discrete tasks, as summarized in Table 2.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 1: Engage with regional stakeholders	<ul style="list-style-type: none"> Host quarterly calls to discuss AMI Respond to stakeholder inquiries 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Meeting minutes Actions from quarterly calls 	Duration: Quarterly throughout 2019
Task 2: Monitor progress on AMI data transfer infrastructure	<ul style="list-style-type: none"> Propose options for transferring AMI big data sets Coordination with ComEd’s energy efficiency and IT teams 	<ul style="list-style-type: none"> Customer AMI data sets reaching billions of data points 	<ul style="list-style-type: none"> Written description of the data link, specifications, and frequency of data transfer 	Duration: 9-12 months
Task 3: Support AMI analyses of residential advanced thermostats	<ul style="list-style-type: none"> Establishing AMI data link Facilitating data transfer to evaluation team 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Data requests 	Duration: 9-12 months
Task 4: Pilot a bulk regression analysis of C&I custom projects	<ul style="list-style-type: none"> Coordination with C&I Custom evaluation team Request AMI data Regression analysis 	<ul style="list-style-type: none"> C&I Custom program participant data AMI data 	<ul style="list-style-type: none"> Presentation of pilot results 	Duration: 6-8 months
Task 5: Support evaluations using AMI data	<ul style="list-style-type: none"> Facilitate data transfer to evaluation team 	<ul style="list-style-type: none"> AMI data 	<ul style="list-style-type: none"> Regular status updates to ComEd and stakeholders 	Duration: 3-6 months
Time to Complete the Project	-	-	-	9-12 months

Task 1: Engage with regional stakeholders

Navigant will engage with regional stakeholders by hosting regular meetings every quarter. The purpose of these calls is to ensure that Navigant’s efforts are aligned with the needs of the state, as represented by regional stakeholders. Navigant will distribute detailed meeting minutes after the calls, and respond to any requests from the stakeholder group as appropriate.

Task 2: Monitor progress on AMI data transfer infrastructure

The Navigant team will monitor the establishment of the data link for the transfer of big AMI datasets. The team will coordinate with ComEd’s energy efficiency team and the IT team as appropriate to facilitate the connection to Navigant’s teams.

Task 3: Support AMI analyses of residential advanced thermostats

The Navigant AMI team will support the residential advanced thermostats evaluation team by establishing the data link as outlined in Task 2 above and facilitating the data transfer. This team's proposed analysis is the first of the Navigant evaluation team to require big data on the order of billions of data points. The processes established in the data link task will be tested and refined with the data request from the advanced thermostats team.

Task 4: Pilot a bulk regression analysis of C&I custom projects

Navigant's Scheduled Meter Analytics Regression Test (SMART) tool automatically creates site-specific regression models from that site's AMI data and local weather data to produce site-specific savings for a population of participants. Projects with good fit regressions may ultimately require less evaluation rigor than traditional evaluation would customarily apply. This tool's application may even lead to reduced sample sizes. These benefits would result in lower cost evaluation.

Navigant will pilot this tool with ComEd's C&I Custom program participants in parallel with the traditional evaluation. The goal of the pilot is to determine whether this first screening step of bulk regression analysis on all sites can provide a reliable indication of site-specific savings.

Task 5: Support evaluations using AMI data

The Navigant AMI team will support Navigant's other energy efficiency evaluations as appropriate. This could take the form of facilitating the AMI data transfer, or consulting on AMI analysis methods. The team will focus its support on measures where the use of AMI could improve the reliability of the results over standard evaluation practice.

Schedule

The timeline in Figure 1 lays out expected time and dates to complete each task of the project. Navigant anticipates the stakeholder engagement process to be ongoing. As new activities are identified and prioritized, Navigant will add them to future years' AMI research efforts. This timeline is approximate, and adjustments to the stated deadlines are possible.

Figure 1. Project Schedule by Task

TASK	2018												2019						2020		
	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	
Task 1: Engage with regional stakeholders	█			█			█			█			█			█			█		
Task 2: Establish AMI data transfer infrastructure			█	█	█	█	█	█	█	█	█	█	█	█	█						
Task 3: Support AMI analyses of residential advanced thermostats			█	█	█	█	█	█	█	█	█	█	█	█							
Task 4: Pilot a bulk regression analysis of C&I custom projects			█	█	█	█	█	█	█	█											
Task 5: Support evaluations using AMI					█	█	█	█	█	█											

ComEd BOC Evaluation CY2018 and CY2019 Research Plan

Introduction

Building Operator Certification (BOC) is a training and certification program for commercial building operators which teaches participants how to make a building more comfortable and efficient by making its systems work better together. The program has been in operation for several years and is being implemented throughout the region by the Midwest Energy Efficiency Alliance (MEEA). Administration of this regional program shifted in 2018 from Department of Commerce and Economic Opportunity (DCEO) to the utilities (Ameren Illinois, ComEd, Nicor Gas, Peoples Gas and North Shore Gas). To increase program effectiveness and enhance market transformation, a broad coalition of stakeholders, led by Resource Innovations (under contract to Nicor Gas), is now working to identify opportunities to improve the program's design. Design changes will be implemented by June of 2019 and may impact future program evaluation approaches.

This evaluation research plan details evaluation activities for the ComEd BOC Program in CY2018 and CY2019. In CY2018, the ComEd program is expected to serve approximately 50 participations. The approach to evaluation of this program involves a sample of participants self reporting of primarily maintenance and operations (M&O) actions taken as a result of the program. These actions are then assigned a deemed savings value corresponding to a specific building type. These savings per action are added up to arrive at total savings value per participant. Savings associated with energy efficiency capital improvement projects that were motivated by the program and that do not go through other EE incentive programs are also added to the cumulative program savings. Total savings from the sample are calculated on a per-participant and per-square-foot basis to enable extrapolation to all program participants.

This evaluation plan includes the following evaluation activities:

- Impact activities
 - Primary research
 - Interviews/surveys
 - Secondary research
 - Review of previous BOC evaluations
 - Measure life research
- Process activities
 - Participant interviews
- Market transformation measurement activities
 - Identify market transformation metrics to measure program progress

Evaluation activities for this program will include a variety of research, data collection and analysis activities, including those indicated in Table 1.

Table 1. Evaluation Approaches Over Time

Tasks	CY2018	CY2019
Tracking System Review	X	X
Data Collection – Participant Surveys	X	X
Data Collection – Program Manager and Implementer Interviews	X	X
Impact – Engineering Review	X	X
Impact – Net Savings Verification	X	X
Process Analysis	X	X
Measure Life Research		X
Market Transformation Research		X

Data request

- Program materials
- Current program database, including class student listings with contact information
- Facility energy use data for 2018

Evaluation Research Topics

The evaluation will seek to answer the following key researchable questions:

Impact Evaluation

1. What are the program’s annual total verified gross savings?
2. What are the program’s verified net savings?
3. What is the estimated free-ridership and spillover?
4. What is the appropriate measure life for O&M measures?

Process Evaluation and Other Research Topics

1. What are participants’ perspectives and overall satisfaction with the program?
2. How can the program be improved?
3. How does the program function after implementing the revised (after June 2019) program design?
4. What are the typical savings from other BOC evaluations by building use type?

Market Transformation Effects

1. What are the market transformation indicators that the evaluation should track over time?

Evaluation Approach

The table below summarizes the evaluation tasks including data collection methods, data sources, and approximate timing that will be used to answer the evaluation research questions.

Table 2. Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes per Year	Timeline
Tracking System Review	Tracking system	Census	As soon as possible after year end
Interviews/Surveys	Program Participants	20	10 in Jan-Feb - 10 in Aug-Sept
Interviews/Surveys	Program Management and Implementers	2	Jan-Feb
Verified Net Impact	Calculation using program attribution determined through surveys	NA	March
Research Measure Life	Secondary Research	NA	Feb – March
Impact Research on Other BOC Evaluations	Literature review, secondary research		March
Market Transformation Indicator Research	ComEd staff and Other Program Stakeholders	NA	June
Process Research – Program Design, Strategy, Logic Model	ComEd staff and Other Program Stakeholders	NA	June

Evaluation activities for CY2019 will be determined once the program has completed its program re-design in 2019.

Gross Impact Evaluation

Savings will be based on M&O actions taken and EE capital improvements made that did not receive incentives through other EE programs. Navigant will take these actions and apply pre-determined savings estimates for O&M activities based on end use and building type.

We will reach out to all participants via survey and/or telephone interview and ask a series of questions to assess whether the participants had undertaken any energy efficiency activities after the training that could be attributed to the BOC course content. The questions will ask about both equipment retrofit or replacement measures and operational changes that were a result of the BOC Training. The participants will be asked to rate the influence of the training on their energy efficiency activities. This information will be used to attribute net savings to the BOC program.

Impact related questions for interviews with program participants will include, but are not limited to the following:

- What kind of building do you operate (Municipal, university, school, hospital, warehouse, office, restaurant...?)
- What is the size of the building you operate?
- What O&M actions did you take as a result of your training?
- Did you make any capital improvements as a result of your participation?

Calculations used to assess energy impacts will be based on both the survey answers and the following secondary sources:

- The Commercial Building Energy Consumption Survey⁹³ (CBECS), which provides a breakdown of energy use by end use for types of commercial building represented by program participants.
- The Illinois Technical Reference Manual to estimate savings from retrofit and equipment replacement measures.
- Program materials for the BOC courses, including secondary sources used during courses such as Motor Master and Compressed Air Master.

Findings from interviews and deemed savings analysis will be enhanced by secondary research of other BOC program evaluations. Navigant will estimate savings values per square foot that are specific to building end use type such as municipal, food service, education, health care, lodging or office.

Navigant will use a variety of resources, combined with engineering analyses, to estimate energy and demand impacts for the various actions taken by the respondent sites. Both electric and natural gas savings will be included in the analyses, as appropriate.

Baseline lighting and HVAC load intensities (kWh and Therms/ft²) will be primarily based on the Commercial Buildings Energy Consumption Survey (CBECS)⁹⁴ and adjusted to match the specifications of individual sites.

The ratio of energy savings to demand savings (kWh/kW) for specific end-uses and other savings calculation factors such as hours of operation will be estimated based on a review of ratios of energy savings to demand savings from the Illinois TRM.

Engineering analysis will be used to estimate energy savings from motor and compressed air measures.

Energy Savings = End-Use Intensity (kWh/ft²) x Savings ratio x affected area (ft²).

Where:

Energy Use Intensity: based on CBECS

Savings ratio: Navigant estimate based on survey responses and IL TRM

Affected Area: survey response

Finally, total savings from the sample will be calculated on a per-participant and per-square-foot basis to enable extrapolation to all program participants.

Verified Net Impact Evaluation

Participant interviewees will be asked to rate, on a scale of 0 to 10, the influence of the BOC training on each action taken. Actions with an influence rating of less than 3 are assumed to be only marginally influenced by the BOC training; no savings are credited to the program for these actions. For actions with ratings of 3 or greater, the percentage of savings attributed to the training will be estimated to be ten percent times the stated influence score. For example, if a respondent assigned an influence score of 6 to a particular action, then 60% of the gross savings from that action were attributed to the training and credited to the BOC program.

⁹³ US Department of Energy - Energy Information Agency 2012 Commercial Building Energy Consumption Survey http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2012/detailed_tables_2012.html

⁹⁴ Commercial Buildings Energy Consumption Survey, Public Use Microdata, U.S. Department of Energy, Energy Information Administration. <http://www.eia.doe.gov/emeu/cbecs/contents.html>

BOC Attributable Savings = Gross Savings x BOC influence (%)

This methodology is in accordance with the IL TRM, Version 7, Volume 4, section 3.6 “Technical Assistance Protocol” which states that a determination of program-attributable savings is made based on self-reported findings from surveys of program participants. Program savings are achieved when a program participant undertakes energy efficiency improvements on their own without financial incentives as a result of the program.

Process Evaluation

The program is currently undergoing a redesign being driven by Nicor for all statewide MT programs to orient it toward achieving more market transformative impacts. Navigant will participate as needed in the program re-design process. After the changes to the program design have been implemented (approximately June 2019) we will conduct some process evaluation activities to assess the effectiveness of the new program design. These activities will include interviews with participants and program implementers at MEEA.

The CY2018 process evaluation research will include a synthesis of both qualitative and quantitative data collected during the participant, program staff and implementer interviews and meetings. Navigant will conduct interviews with:

- MEEA BOC program manager
- Program manager at ComEd
- A sample of 10 individuals who completed the course
- SEM and RCx program managers to explore possible overlap with these programs

In addition to impact related questions, participant process and attribution survey questions might include:

- The influence that the BOC course had on their EEM installation decisions and maintenance practice changes.
- Barriers participants faced in getting EEMs installed.
- How students and supervisors first heard about the course.
- Reasons why they originally took the course.
- The importance of tuition rebates in their ability to take the course.
- Students satisfaction with the course.
- Students suggestions for course improvements
- Students perceptions on how taking the course has influenced their careers, including raises and promotions.

Navigant will perform additional process research, upon the request of the program manager, to support the program manager and implementer.

Market Transformation Metrics Development

In the interest of measuring the programs impacts on the market in addition to energy impacts, it is necessary to identify what metrics will get measured to track these impacts. This process will involve review of program logic and associated outputs and outcomes in order to match evaluation strategy to program logic. This will begin the process of determining market baselines in attitudes, awareness, behavior and/or other market transformation indicators as defined in collaboration with ComEd. The specific methodology for tracking market effects is dependent on the effects to be measured and will be elaborated once they have been defined.

Evaluation Schedule

Table 3 below provides the schedule for key deliverables and data transfer activities. (See Table 2 for other schedule details.) Adjustments will be made, as needed, as evaluation activities progress.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Annual Date Delivered
Program Operations Manual and Workpapers	ComEd	January 2, 2019
CY2018 program tracking data	ComEd	January 30, 2019
CY2018 participating customer survey design	Evaluation	January 30, 2019
Process Analysis Findings	Evaluation	March 1, and October 1 2019
Attribution Analysis Findings	Evaluation	March 1, 2019
Market Transformation Metrics Research Findings	Evaluation	March 1, 2019
Internal Report Draft by Navigant	Evaluation	March 1, 2019
Draft Report to ComEd and SAG	Evaluation	March 5, 2019
Comments on draft (15 Business Days)	ComEd and SAG	March 26, 2019
Revised Draft by Navigant	Evaluation	April 4, 2019
Comments on redraft (5 Business Days)	ComEd and SAG	April 25, 2019
Final Report to ComEd and SAG	Evaluation	April 30, 2019

ComEd Code Baseline Studies CY2019 Evaluation Research Plan

Introduction

While energy codes are mandated by the state of Illinois, enforcement is up to local jurisdictions. Often code enforcement personnel focus on health and safety issues and do not always prioritize the energy code. Buildings built below energy code standards represent lost savings opportunities that last for decades. Several states have successfully implemented code support programs that have generated savings towards goals. The Enhanced Codes Baseline studies are an essential first step in the design and implementation of a code compliance support program. Navigant will follow the Illinois baseline studies (commercial and residential) as they are designed and implemented and provide input to the process from the perspective of the evaluator.

Previous Illinois baseline studies conducted by (APEC) in 2011 and (ADM) in 2014 lacked the rigor necessary to serve as a baseline studies for code compliance programs that intend to claim savings. These baseline studies are being implemented by MEEA with strategic and analytic support from Pacific Northwest National Laboratory (PNNL).

Once a baseline compliance rate has been established for residential and commercial buildings, energy savings that could be generated by a compliance enhancement program can be estimated. If it appears that there is a substantial savings opportunity, ComEd plans to proceed with the development of a code compliance enhancement program. Navigant will follow this process and provide input as the evaluator to help ensure savings will be able to be claimed. This program will not be implemented in 2019. This evaluation plan pertains only to 2019 activities.

Code support programs assist builders and code officials with building codes implementation and compliance improvement through education such as energy code trainings and events as well as on-site support through circuit riders. There are several other states implementing code support programs and generating savings toward goals.

For this code compliance baseline study project, Navigant will undertake the following activities in 2019. If the study results are positive and a code compliance support program is launched, we will revise our evaluation plan accordingly.

Table 1. Evaluation Approaches

Tasks	CY2019
Review study design and sampling methodology	X
Attend code collaborative meetings	X
Review proposed savings estimation methodology	X
Review proposed program design	X
Develop evaluation methodology for code support program	X

Evaluation Research Topics

The evaluation will seek to verify the following key questions the baseline studies are addressing:

1. What is the current compliance rate of commercial and residential building energy codes in the service territory?
2. What is the savings potential of a code compliance support program?

3. What are examples of successful code support programs from other jurisdictions?

The evaluation research will also address the following key questions:

4. How would such a program be evaluated?
5. How is the energy codes collaborative supporting code compliance?

Evaluation Approach

The table below summarizes the evaluation tasks for CY2019 that will be used to answer the evaluation research questions.

Table 2. Core Activities and Timing

Activity	Timeline	Notes
Review Baseline study design, sampling methodology and data collection instruments	Q1 2019	Residential study commenced in 2018
Attend code collaborative meetings with other key stakeholders	2019	By telephone, throughout the year
Review proposed savings estimation methodology	2019	PNNL to develop this, Navigant to review
Review other code compliance enhancement programs and evaluation methods	Q2 2019	Navigant to provide
Develop an evaluation methodology including attribution for verifying savings resulting from the program	Q4 2019	Involvement of the ICC will be necessary to ensure acceptance of savings

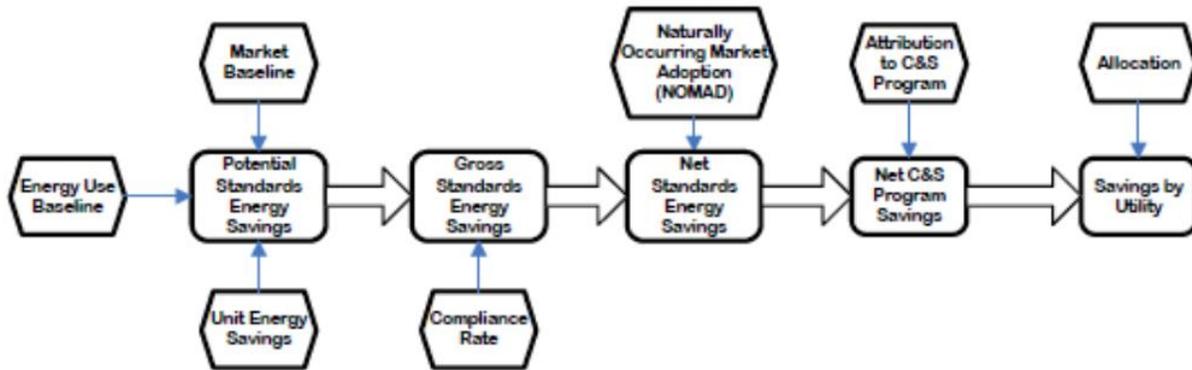
Savings Estimation and Verification

For utilities to claim savings from a code compliance enhancement program, close communication with the ICC is necessary - third-party evaluation of these savings is also necessary. An example process for generating and verifying savings is as follows:

1. A new building energy code is enacted. The utility undertakes an energy code compliance baseline study across its service territory. Compliance is hypothetically found to be 70%.
2. The utility undertakes a code compliance support program, including education for building officials and training for building trades people. This program runs for three years.
3. The utility undertakes another code compliance study after the three years of the implementation of the code support program. Compliance rates are hypothetically found to be 80%.
4. The program implementation contractor develops a savings estimate from a 10% increase in compliance by all buildings built during the three years of program operation. The utility EE program evaluator verifies these savings. This value is multiplied by an attribution factor based on the utility program's influence on the savings attained. The utility's share of the resulting savings are claimed toward EE goals.

Practitioners in California have developed an industry standard codes and standards (C&S) program evaluation protocol, which Navigant uses as a template for C&S program evaluations (see Figure 1). All the following factors warrant consideration but may not be assessed for each measure of interest based on availability of data, the specific characteristics of the measure, and the relative magnitude of the C&S savings for each measure.

Figure 1. C&S Advocacy Program Evaluation Protocol



Source: Lee, A. et al. Utility Codes and Standards Programs: How Much Energy do they Save? 2008 ACEEE Summer Study on Energy Efficiency in Buildings.

Evaluation Schedule

Table 3 below provides the schedule for this work. Some activities were completed in 2018.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Date
Review baseline study design and implementation plan	Q1 2019
Review sample plan	Q1 2019
Review data collection instruments	Q1 2019
Review proposed savings estimation methodology	Q2 2019
Participate in IL Codes Collaborative meetings	Q1-Q4 2019
Participate in code enhancement program design	Q4 2019
Develop evaluation methodology including attribution	Q4 2019

ComEd EUL and Persistence CY2019 Research Detailed Plan

Introduction

This research work plan details the specific tasks, activities, deliverables, and schedule associated with CY2019 persistence and effective useful life (EUL) evaluation research for the ComEd Energy Efficiency Program. The work plan addresses measure persistence in a manner consistent with Illinois Future Energy Job Act (FEJA) legislation and the goals set out by this legislation for attaining “cumulative persisting annual savings” (CPAS) by electric utilities. The work outlined in this plan is designed to estimate EUL values that take into consideration its full definition, which considers the technical life, measure persistence, and savings persistence.⁹⁵ Previous research for ComEd has made use of the best available literature to update Illinois TRM EUL estimates for 2018 and define the measures that have sufficient uncertainty in the existing EUL with high value potential for redefining the EUL.

Overall Study Goal

The research objective is to improve EUL estimates for the identified priority measures in a cost-effective manner. This research will allow for increased accuracy in the CPAS calculations. This proposed plan will implement primary research activities for prioritized measures that were considered to have high uncertainty in the existing EUL estimates.

In Phase 1, completed in 2018, Navigant completed a thorough review of TRM and non-TRM measures in the ComEd portfolio. The review found that most of the EUL values currently in use are not supported by rigorous research sources or data. As part of that work, Navigant prioritized measures to research further for more accurate assessment of their EULs. Measures were selected if they had potential high impact to future portfolio savings and had poor quality sources for their EUL values. These measures underwent further sensitivity analysis by outlining the EUL uncertainty, the factors that may affect their persistence, and the costs for improving the EUL values with higher certainty.

This plan describes Phase 2 of the research which will build on work completed in Phase 1.

Research Questions

This initiative seek to answer the following key researchable questions:

- If there is quantifiable measure and savings persistence, what is it and how does it vary throughout the measure’s technical life?
- What are the persistence characteristics that affect the measure EUL and is there a way to increase the EUL by addressing savings persistence?

Summary of Evaluation Research Activities

The research goal is to reduce the uncertainty in EUL values for the prioritized measure list for more accurate CPAS quantification. This next step will occur in three tasks per measure or measure category:

1. Develop customized research plans per measure
2. Test the research plan for a small sample for each measure
3. Roll out research for larger sample, as appropriate

⁹⁵ Violette, Dan M., Uniform Methods Project - Uniform Methods Project (Uniform Methods Project: Methods for Determining EE Savings for Specific Measures. Ch. 13: Assessing Persistence and Other Evaluation Issues Cross-Cutting Protocols, 2013.

Methodology

The EUL research is being conducted in two phases. This phased approach ensures that the research will produce meaningful results and will be cost effective by implementing a layered approach for improving these estimates. Phase I has been completed and this plan is Phase II, the field work, as summarized in Table 1.

Table 1. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
PHASE II		Field Work		
Task 1: Measure Level Research Plan	<ul style="list-style-type: none"> Draft research plan per measure or measure category 	<ul style="list-style-type: none"> Measure prioritization results 	<ul style="list-style-type: none"> Plan per measure 	Duration: 4 weeks
Task 2: Small-Sample Verification	<ul style="list-style-type: none"> Visit or survey 10 to 20 customers per measure 	<ul style="list-style-type: none"> Site visit suggestions 	<ul style="list-style-type: none"> Presentation(s) Memo summarizing key findings 	Duration: 8-10 weeks
Task 3: Large Scale Surveys and In-field Research	<ul style="list-style-type: none"> Conduct extensive surveys and site visits 	<ul style="list-style-type: none"> Customer and site visit suggestions 	<ul style="list-style-type: none"> Presentation(s) Report 	Duration: 12 – 20 weeks
Time to Complete				6 - 8 months

The work plan involves field work that will be performed for those high priority measures (to be selected by December 2018) that are also determined to have a high value of information (VOI) relative to the cost of the research. A high VOI occurs when 1) a measure has an uncertain EUL value based on the analyses in Phase I, and 2) we can design a field study to produce reliable updated EUL values estimates, i.e., the field study is expected to provide estimates that will be better than the EUL values currently available.

Field research will be tiered such that initial research will be conducted on small samples that can produce information to assess the consistency of the initial EUL estimate against the initially collected field data. For those measure EULs where field data shows that the initial estimate is not consistent with the small-sample field data, a larger, more in-depth survey will be conducted. As much as possible, the EUL research team will coordinate with other field work efforts to minimize customers impacted by research work and to leverage other evaluation research efforts.

Task 1: Develop Field Research Plan per Selected Measure

Each measure may have a unique research plan. The structural model, as outlined in Phase I, will help inform the research approach for each unique measure, in which Navigant proposes one or more of the approaches:

- Web survey
- Phone survey
- Field visits
- Field studies with metering

Each measure requires a unique research plan since each measure presents different challenges and data needs to properly quantify persistence and EUL. For example, in lighting, we want to know how much of the equipment is still installed and if specific attributes affect its life, such as remodeling activities in commercial buildings. To do this, we can conduct a web survey of past program participants and ask questions such as:

- Of the lighting you installed in xx year, what percent are still installed? If any were removed, what were the reasons?
 - Remodel
 - Burn out
 - Part of a group relamp to prevent individual burnouts
 - Other?
- If they were removed, do you know when?

For smart or programmable thermostats, we may ask respondents to provide their user settings and ask them why they might change any settings. This measure is a good example of the need to coordinate with other thermostat research to minimize duplicative efforts and disruption to customers.

Task 2: Small-Sample Verification

In this task, Navigant may visit or survey 10 to 20 customers or sites per measure to assess EULs and influential persistence issues.

- A survey of a small set of customers can more quickly estimate the “common practice” and infield realization rates for the key influential persistence characteristics identified in Phase 1. For example, we will investigate whether the fixtures were changed out with the tenant turnover or remodeling. This small-sample verification effort will generate a sample distribution of EUL results that will be used to examine how consistent these new EUL data points are with the initial EUL estimates. These small sample studies are used as tests for the consistency of the initial EUL estimates with the collected field data.
- Where the EULs are found to be inconsistent with these data at a given level of confidence; then, a larger data collection effort may be warranted. This tiered approach helps ensure the overall cost-effectiveness of the research. The small sample studies may also inform the larger sample study planning by illustrating what challenges and opportunities occur during data collection.
- If the small sample tests show that the measured value differs from the currently assumed EUL by a given delta ($\pm 10\%$)^{96,97}, it will be classified as having a high likelihood of being incorrect and will be further investigated during the large sample verification.

Task 3: Large Scale Surveys and In-field Research

Building on the Task 2 results, the evaluation team will undertake larger survey and in-field evaluations for measures where the small sample data shows that the initial field data are inconsistent with the current EUL estimate and that it is likely that the field research will produce a meaningfully different EUL estimate at an acceptable cost.

⁹⁶ Tiering or staging the research in this manner would help ensure we are addressing estimation and validation of persistence in a cost-effective manner and help ensure that the value of the research exceeds its costs in terms of producing accurate CPAS validated estimates. That is, we are reducing the risk of expensive field research that may be unnecessary.

⁹⁷ This range estimation uses a 0 – 1 binominal distribution. It is a 1 if it falls in the $\pm 10\%$ range (e.g., for an EUL of 10, the range is 9 to 11), and a value of zero if it falls outside this range. It does not give us a new median value but tells us where large-scale research is most important.

- Larger in-field studies will be designed for the measures that are most likely to benefit from the more expensive research efforts.
- Each of these studies will leverage all the existing data collection and model development. The research will be designed to leverage the existing EUL estimates, incorporate data collected for other evaluation tasks, and use the influential persistence characteristic analyses from Phase I above to determine what information should be collected in the field (e.g., a focus on changing operating conditions or frequency of remodels, etc.).

The final deliverable will be a table, using the template in Table 2, for each measure category that quantifies the measure and savings persistence annually. This amount of detail must be collected as part of a field data collection effort. This is the ideal format of quantifying persistence. If a varying persistence value per year is not quantifiable or there is insufficient information to develop a survival curve, then an overall EUL value will be the defined value used for CPAS.⁹⁸

Table 2. Template for Quantifying Measure and Savings Persistence

Year	Savings	Measure Persistence	Savings Persistence
1	kWh	1 = yes installed & operating	1
2		1	1
...		1	1-d ₁ *
N-1		1	1-d ₂
N = technical life		0 = removed from operation	1-d ₃

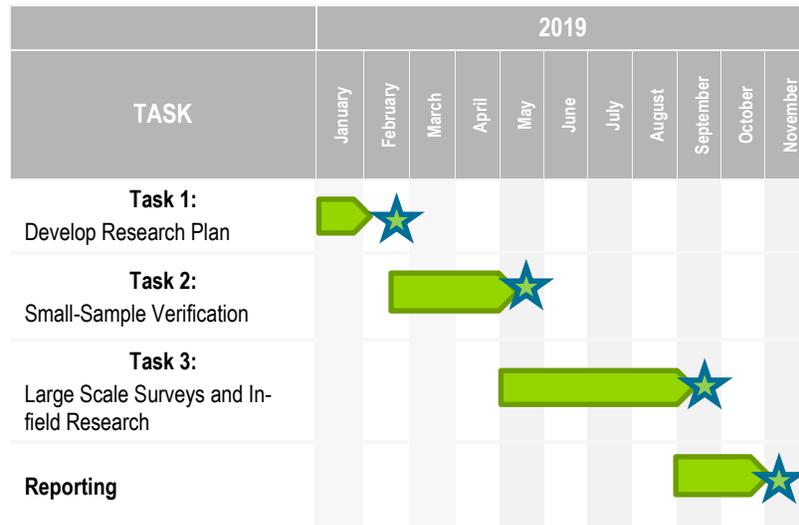
d = the reduction in savings from factors affecting persistence. This value may vary year over year.

Schedule

The timeline shown in Figure 1 lays out expected time and dates to complete each task of the project. In January 2019, Navigant will work with the stakeholders in selecting the measures for fielding surveys or on sites. This timeline is approximate, and adjustments to the stated deadlines are possible. The following figure provides the high-level overview timeline for Phase II.

⁹⁸ This approach is consistent with the 2018 RCx Seventhwave research findings. The findings were inconclusive to define a year 3 and year 6 persistence, however, there was sufficient primary research to quantify an agreed upon EUL.

Figure 1. Project Schedule by Task for Phase II



Priority Measures

Table 3 is a list of EUL priority measures currently under discussion for Phase II research.

Table 3. Priority Measures

Research Grouping	Sector	End Use	Measure Name
1. AC Tune-up	Commercial	HVAC	AC Tune-up
2. C&I Lighting	Commercial	Lighting	Lighting Controls
C&I Lighting	Commercial	Lighting	Advanced Lighting Control Systems
C&I Lighting	Commercial	Lighting	LED Fixtures
C&I Lighting	Commercial	Lighting	LED Lamps
3. C&I Thermostat/HVAC controls	Commercial	HVAC	Smart Thermostat
C&I Thermostat/HVAC controls	Commercial	HVAC	Programmable Thermostat
C&I Thermostat/HVAC controls	Commercial	HVAC	HVAC Controls
4. Energy Management System	Commercial	Whole Building	Energy Management System
6. Compressed Air	Industrial	Compressed Air	Compressed Air Leak Repair
7. Res Thermostat	Residential	HVAC	Programmable Thermostats
Res Thermostat	Residential	HVAC	Smart Thermostat
8. Residential Lighting	Residential	Lighting	LED Fixtures
Residential Lighting	Residential	Lighting	LED Lamps
9. Street Lighting	Other	Lighting	LED Street Lighting

Source: Navigant

ComEd Fridge and Freezer Recycling Evaluation CY2019 Research Plan

Introduction

This evaluation plan describes proposed methods for evaluation research to enhance the Illinois Technical Reference Manual (IL TRM) savings algorithm and input parameter assumptions for Refrigerator and Freezer Recycling.

Background for Research Prioritization

Navigant identified Refrigerator and Freezer Recycling as high priority research item based on the TRM Evaluation Prioritization process. Below is additional detail on the basis for prioritizing this measure for evaluation research:

1. **The measure is one of the largest portions of residential portfolio savings after lighting.**
The portion of savings attributed to refrigerator and freezer recycling in PY9 is approximately 5.2%. This is the largest percentage of measure savings after lighting in the residential portfolio.
2. **The IL TRM administrator has identified this measure as a high priority update in 2019.**
Vermont Energy Investment Corporation (VEIC) has noted this as a high priority measure for update in 2019. VEIC notes the reason for the high priority ranking is that the measure was last updated in 2014. As the program continues to penetrate the market, evaluation should test whether the efficiency of retired units is increasing and adjust the savings algorithm and input parameter assumptions accordingly.

Study Goals

The primary goal of this research effort is to conduct evaluation research to determine appropriate updates for the refrigerator and freezer recycling measure.

Research Questions

This study will seek to answer the following questions:

- Are there any updates needed to weather data for the refrigerator and freezer recycling measure in the IL TRM?
- How do the IL TRM methods for calculating energy savings for refrigerator and freezer recycling compare to the Uniform Methods Projects methodology for calculating savings?
- How do the IL TRM energy savings for refrigerator and freezer recycling compare to other regional and state TRMs?
- What are the typical efficiencies and ages of refrigerators and freezers being recycled through the program? Are there any program trends to be aware of? Are there program design changes which could improve cost effectiveness?

Summary of Evaluation Research Activities

Table 1 summarizes tasks, activities, and deliverables planned for this study.

Table 1. Summary of Tasks, Deliverables, and Timelines

Tasks	Activities	Deliverables
Task 1: Conduct Secondary Research to update IL TRM	Secondary research to update IL TRM	Memo detailing research findings and proposed IL TRM updates
Task 2: Review previous program year data to determine current efficiencies of measures being rebated through the program	Review refrigerator and freezer recycling data from previous years	
Task 3: Reporting	Submit results for review and finalize for TRM workpaper	Final memo on proposed changes; TRM workpaper

Methodology

The following sections provide detailed descriptions of all tasks outlined in Table 1.

Task 1. Conduct Secondary Research to update IL TRM

Navigant will conduct a secondary literature review in order to determine if updates are necessary for the refrigerator and freezer recycling measure. We will perform the following two activities as a part of this review:

- **Review regional and state TRMs and compare savings values.** Navigant will review a sample of region and state TRMs in order to compare the savings values to what is currently included in the IL TRM. Navigant will reference the SEE Action Technical Reference Manual Guide for States⁹⁹ to ensure we have accurate and thorough representation of different regional and state TRMs included in our secondary review. Navigant will look at all aspects of the TRM measure including the weather assumptions and Unit Energy Consumption.
- Review the Uniform Methods Project savings methodology and compare to the IL TRM savings value. Navigant will review the current Uniform Methods Project refrigerator recycling evaluation protocol¹⁰⁰ and will compare savings and unit attribute assumptions from that protocol to the savings generated by the IL TRM. Navigant’s review of this protocol will focus on Unit Energy Consumption.

Task 2. Review previous program year data to determine current efficiencies of measures being rebated through the program

In addition to reviewing secondary literature sources, Navigant will review current and previous years program data to determine if the ages and efficiency of appliances being recycling through the program are changing and at what rate. Navigant will look for and report on any trends occurring with the appliances being recycling through the program.

Task 3. Reporting

Reporting for this evaluation research effort includes a final research memo and eventually submitting a TRM workpaper. The research memo will summarize all relevant findings and will include the preliminary updates to the IL TRM measure and any other proposed changes regarding the refrigerator and freezer

⁹⁹ https://www4.eere.energy.gov/seeaction/system/files/documents/TRM%20Guide_Final_6.21.17.pdf

¹⁰⁰ <https://www.nrel.gov/docs/fy17osti/68563.pdf>

recycling measure. Once the report and any updates are finalized, Navigant will submit a TRM workpaper to the Illinois Technical Advisory Committee for inclusion in v8 of the IL TRM.

The table below summarizes the key deadlines for the fridge and freezer secondary literature review.

Table 2. Project Schedule

Activity or Deliverable	Responsible Party	Date Delivered
Conduct Secondary Research to update IL TRM	Evaluation	December 2018 – April 2019
Review program data	Evaluation	December 2018 – April 2019
Final Memo with IL TRM secondary research results and findings and recommendations	Evaluation	April 2019
TRM workpaper	Evaluation	May 15, 2019

ComEd Illinois Home Performance with ENERGY STAR CY2019 Evaluation Research Plan

Introduction

Illinois Home Performance with ENERGY STAR (IHP) Program is a statewide program implemented by the Midwest Energy Efficiency Alliance (MEEA) since 2010. The administration of this and all market transformation (MT) programs was recently transferred from the Department of Commerce and Economic Opportunity (DCEO) to the utilities (Ameren Illinois, ComEd, Nicor Gas, Peoples Gas and North Shore Gas). So, this is the first year for ComEd to be administering this program.

The program is intended to promote a "whole-home" approach to energy efficiency improvements. This means taking the entire home and all its systems into account when diagnosing performance issues and making recommendations for improvements. After the improvements are complete, the program acknowledges each home with a Certificate of Completion to help document and communicate the value of the investment that has been made.

The purpose of the program is to increase the energy efficiency of homes through increasing the capacity and expertise of the energy efficiency contractor base via training, certification, and accreditation. Through these activities, the Program Administrator (PA) fosters "one-stop shopping" for home efficiency and facilitates customers' implementation of recommended measures.

The IHP Program is market-based, meaning it builds on the capabilities of local private contractors to deliver services by expanding their expertise (be it in HVAC systems or weatherization) through training in building science, energy efficiency, environmental skills, and technology applications. Contractors are provided a quality seal of approval by receiving training and certification from the Building Performance Institute (BPI). Participating firms must have BPI certified technicians on staff. The program includes stipends to assist contractors in paying for participation in BPI trainings.

IHP is a process, as well as a set of contractor and performance standards, used by a variety of utility and nonprofit residential programs across Illinois. The first step is a comprehensive home energy assessment (audit) which includes blower door and combustion safety tests at a minimum (both pre and post) and specifies how to address comfort issues and save energy. Next, qualified and approved contractors perform the improvements, which often include sealing up drafts and leaks in ductwork, installing wall and attic insulation, and tuning up or replacing heating and cooling equipment. IHP specifies that the home energy upgrades should be completed following Building Performance Institute (BPI) standards, which include health and safety considerations as well as sound building science principles. Homeowners receive documentation of the assessment, completed upgrades, and a "test-out," which provides verified data on the home's improved performance and results in a statewide IHP certification.

IHP can only be offered by IHP Participating Contractors. Each IHP project must follow this three-step process:

Assessment

First, a qualified energy professional will interview the homeowner and visually inspect the home. Next, he or she will use specialized diagnostic equipment, including a blower door, to identify hard-to-detect issues such as missing insulation and air leaks. The customer receives a set of recommendations unique to their home, which explains how to fix comfort and safety issues and stop wasting energy.

Upgrade

The homeowner decides to undertake some, or all of the improvements outlined in the work order.

Verification and Quality Assurance

Before leaving the home, the contractor will repeat the diagnostic tests from the assessment to ensure the work was completed correctly and will result in energy savings. Also, Illinois Home Performance partners conduct third-party quality assurance inspections to maintain consistently successful results.

The measurers installed through the IHP program accrue savings through their respective ComEd Energy Efficiency Programs as follows:

Direct install measures through the Home Energy Assessment Program:

- Water efficient showerheads
- Faucet aerators
- Pipe insulation
- Programmable thermostats
- LEDs
- Advanced power strips

HVAC Program measures:

- Air Source Heat Pump
- Central Air Conditioner
- Ductless Mini-Split Heat Pump
- ECM Furnace Motor
- Heat Pump Water Heater
- Smart Thermostat

Weatherization Program measures:

- Air Sealing
- Attic Insulation
- Basement/Sidewall Insulation
- Duct Sealing
- Wall Insulation

Appliances Program measures:

- Appliances and Room ACs

Lighting Program measures:

- Lighting fixtures and bulbs

Savings from these measures are verified through their respective program evaluations. This evaluation research is not designed to duplicate M&V of other programs.

The program implementer works toward achieving the program goals through several means including educating real estate professionals and appraisers in the value of energy efficiency and the IHP Certificate of Completion. The implementer offers a 2-day course to realtors that is approved by the National Association of Realtors (NAR). NAR's Green Designation provides advanced training in green building and sustainable business practices to enable realtors to seek out, understand, and market properties with green features. The course for appraisers is recognized by the Appraisal Institute and teaches how to value energy efficiency (EE) in the home and how to populate the Green Appraisal Addendum. Both courses qualify for continuing education credits for their respective organizations. And

finally, the program implementer conducts various marketing and outreach activities intended to drive participation in the local utility energy efficiency programs.

Activities for this program evaluation research will include:

- Meet with program implementers and administrators and discuss evaluation objectives
- Review program theory and logic model (PTLM)
 - If there is a current logic model for this program, Navigant will review it and if sufficient, will use it instead of developing one from scratch.
- Collect and analyze baseline and post retrofit energy use simulation models from the implementer and compare aggregate savings from the deemed measures with savings estimated from the modeling approach.
- Identify, quantify and establish a baseline of MT progress indicators. The selection of specific MT metrics will be informed through the logic modeling process and other data collection methods and ultimately determined through iteration with ComEd, but may include the following:
 - Sales data
 - Price data
 - Attitudes toward and awareness of new technologies and EE methods
 - Understanding of EE’s value
 - Average energy intensity of homes
 - Contractor practices
- Conduct customer and trade ally interviews

Table 1 summarizes evaluation activities.

Table 1. Evaluation Approaches

Tasks	CY2019
Program Review and Initiation Meeting	X
Review Program Theory and Logic Model	X
Additional Impact Analysis	X
Identify Baseline Market Transformation Indicators	X
Process Analysis	X

Evaluation Research Topics

How is the IHP Program changing the residential homes market in ways which will enable future energy savings? To address this high-level question, the evaluation will pursue impact and process research as follows:

Impact Evaluation – Key Researchable Questions

1. What are the program’s annual total verified gross savings?
2. How much of those savings can be attributed to the program’s actions?

3. Are there more savings resulting from the program that are not currently accounted for?
4. What is the program theory and logic?
5. What other impacts is the program having on the market? What are the market transformation indicators that should be tracked for this program?

Process Evaluation – Key Researchable Questions

1. What are participants’ perspectives and overall satisfaction with the program?
2. What are the Energy Efficiency Service Provider (EESP’s) perspectives on the program?
3. How can the program be improved?

Evaluation Approach

Table 2 below summarizes the evaluation tasks for CY2019 and approximate timing that will be used to answer the evaluation research questions.

Table 2. Data Collection Activities, Sample, and Analysis

Activity	Target	Target Completes CY2019	Timeline
Program review and evaluation initiation	ComEd and program Implementer		Q1 2019
In Depth Interviews	Program Management and Implementers	2	Q1 2019
Energy use simulation modeling	Participating Homes	5	Q2 2019
Identify MT indicators and data sources	EE Market	N/A	Q2 2019
Research into program satisfaction	Telephone Survey with Participating Customers	5	Q3 2019
Research into program function	Telephone Interviews with Influential EESPs Triggered by Customer Responses	2-4	Q4 2019
Other research	Literature review, secondary research		Q3 2019

Gross Impact Evaluation

Savings from measures installed as a result of this program are estimated from the IL TRM and are accounted for through their respective programs; HVAC, Home Energy Assessment (which includes direct install lighting), Weatherization etc. This evaluation research plan does not seek to replicate gross impact evaluation activities from other ComEd programs.

To test if this program might be generating energy savings that are not currently being counted by other programs, Navigant proposes to review energy use simulation models created by the EESPs for the implementation contractor. We will confirm the accuracy of the baseline model and will re-run the models with all the improvements implemented as a result of the program using per measure evaluated energy savings values. Through this process, we will determine if the sum of the deemed savings per measure is greater than, less than or roughly equal to the savings estimated by the whole house models. We will conduct this analysis for a random sample of five program homes. If this sample indicates there is unaccounted for saving, we will discuss with ComEd the possibility of expanding the sample.

Derivation of Market Transformation Indicators

If ComEd has already created a program theory and logic model for this program, Navigant will use this model to identify MT progress metrics.

A part of the process of logic modeling involves identifying the outputs and outcomes. These interim and long-term indicators of market effects will become the metrics by which progress will be measured this year and in future years. Tracking MT indicators will allow ComEd to define the overall program goals and monitor where they are transforming the market and enacting change.

The program logic model diagram will show the intended linkages between activities, outputs and outcomes, and identify potential external influences. The logic model outputs and desired outcomes will drive the process of identifying MT indicators. Data sources will then be determined, and baseline measurements taken. Some examples of possible MT indicators to measure progress include:

- Realtor, appraiser and lender knowledge and awareness of EE
- Number of BPI certified contractors and firms
- Success and expansion of participating firms relative to non-participating firms
- Number of whole house upgrades year over year
- Non-participating contractors use of advanced diagnostics and HP services
- Home appraiser's recognition of the value of IHP certificates
- Loan to value ratio or other indicator of recognition of value by lending community
- The value of program homes, and/or time on market

Verified Net Impact Evaluation

The program does not currently claim savings. If unaccounted for savings are found through the modeling exercise described above, then a net to gross ratio will need to be developed.

Process Evaluation

The CY2019 process evaluation research will include interviews with program managers, implementers, participants and EESPs to learn about their perspectives and satisfaction with the program. In this first year of ComEd's management of this program, we will not be seeking a representative sample of customers, but instead, a small sample to determine if there are any significant, pressing issues that the program should address.

Evaluation Schedule

This program will not claim savings for 2018. The evaluation activities described in this document are to take place during 2019. It is not known at this time if the program will claim savings for 2019.

Table 3 below provides the schedule for key deliverables and data transfer activities. Adjustments will be made, as needed, as evaluation activities progress.

Table 3. Schedule – Key Deadlines

Activity or Deliverable	Responsible Party	Date Delivered
Program Operations Manual and Workpapers	ComEd	
Meet with program implementers and ComEd	All	February 15, 2019
Contact information for survey participants	ComEd	February 1, 2019
Energy use simulation models from sample homes	ComEd	February 1, 2019
CY2019 participating customer survey design	Evaluation	March 30, 2019
Create/review program theory and Logic Model	Evaluation	April 30, 2019
Identify MT indicators and data sources	Evaluation	May 30, 2019
Determine baseline levels of MT metrics	Evaluation	August 30, 2019
Conduct customer interviews	Evaluation	September 30, 2019
Conduct EESP interviews	Evaluation	October 30, 2019
Process Analysis Findings	Evaluation	December 1, 2019
Internal Report Draft by Navigant	Evaluation	March 15, 2020
Draft Report to ComEd and SAG	Evaluation	April 15, 2020
Comments on draft (15 Business Days)	ComEd and SAG	April 30, 2020
Revised Draft by Navigant	Evaluation	May 15, 2020
Comments on redraft (5 Business Days)	ComEd and SAG	May 20, 2020
Final Report to ComEd and SAG	Evaluation	May 30, 2020

ComEd CY2019 to CY2021 TRM Evaluation Research Plan

Introduction

The purpose of the IL TRM is to provide a transparent and consistent basis for calculating energy and demand savings in Illinois.¹⁰¹ The overall goal of TRM evaluation research is to improve IL TRM input parameter assumptions. All evaluators in Illinois, including Navigant, are part of the Illinois Stakeholder Advisory Group (SAG) Technical Advisory Committee (TAC) and are charged with providing materials to continually update and improve the IL TRM to provide the most accurate input parameter assumptions and impact evaluation methodology.

This evaluation research plan summarizes Navigant's approach for conducting evaluation research to update measures in the Illinois Technical Reference Manual (IL TRM). The purpose of this plan is to provide a summary of the prioritization framework and to outline the methodology for secondary and primary research efforts. We expect these activities to occur on a rolling basis each year during the three-year period.

Evaluation Research Topics

The objectives of IL TRM evaluation research are:

1. Develop a framework for ongoing evaluation research contributions to IL TRM updates, including scope and schedule for such activities.
2. Promote statewide coordinated evaluation research efforts through the TAC.
 - a. Outline status update and communication processes to keep interested stakeholders apprised of this work and provide stakeholders meaningful opportunities to comment.
 - b. Work with the TAC and IL TRM administrator to provide valuable input while avoiding duplication of efforts.
 - c. Share results with ComEd, the Illinois gas utilities, Ameren IL and their evaluator, and other relevant stakeholders.
 - d. Participate in annual prioritization for TRM evaluation research in conjunction with the TAC, including attending and providing feedback during research prioritization and TRM measure prioritization meetings.
3. Review current IL TRM measures and priority recommendations from TAC to develop evaluation research based on energy savings, historical realization rates, variability and uncertainty in measure impacts, feasibility to update, relative contributions of measures and planned future use, among others.
4. Conduct secondary research to develop comparable industry benchmarks for selected measures and propose standardized deliverables for secondary research including inputs to IL TRM measure work papers.
5. Determine appropriate thresholds for determining when to conduct primary evaluation research. Upon selection, develop appropriate methods to conduct such research.

¹⁰¹Policy Document for the Illinois Statewide Technical Reference Manual for Energy Efficiency, http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Policy%20Document%20for%20IL%20TRM%2010-25-12.pdf

Evaluation Approach

The evaluation plan outlines activities for TRM research into four discrete activities, as summarized in Table 1 below. As stated above, we expect to conduct these activities on an ongoing basis, resulting in an updated list of measures for evaluation research each year.

Table 1. Summary of Tasks, Activities and Deliverables

Activity	Tasks	Deliverables
Statewide Coordination	<ul style="list-style-type: none"> • Participate in Illinois SAG and TAC meetings • Participate in statewide coordination among utilities, evaluators and stakeholders 	<ul style="list-style-type: none"> • TAC meeting to discuss planned secondary and primary research • Evaluation plans and activities reflect statewide coordination
TRM Research Prioritization	<ul style="list-style-type: none"> • Define framework for determining high impact measures for secondary and primary research • Determine gaps in current TRM research plan 	<ul style="list-style-type: none"> • Annual List of secondary and primary research priorities
Secondary Research	<ul style="list-style-type: none"> • Conduct literature review • Conduct engineering review, including review of past measure participation 	<ul style="list-style-type: none"> • Secondary Research Memo • TRM Work Paper
Primary Research	<ul style="list-style-type: none"> • Conduct primary research effort through metering, data collection, modeling, or other engineering method 	<ul style="list-style-type: none"> • Primary Research Evaluation Plan • Primary Research Memo • TRM Work Paper

Statewide Coordination

Navigant coordinates evaluation research with relevant stakeholders to prioritize and conduct a coordinated research effort, including the following:

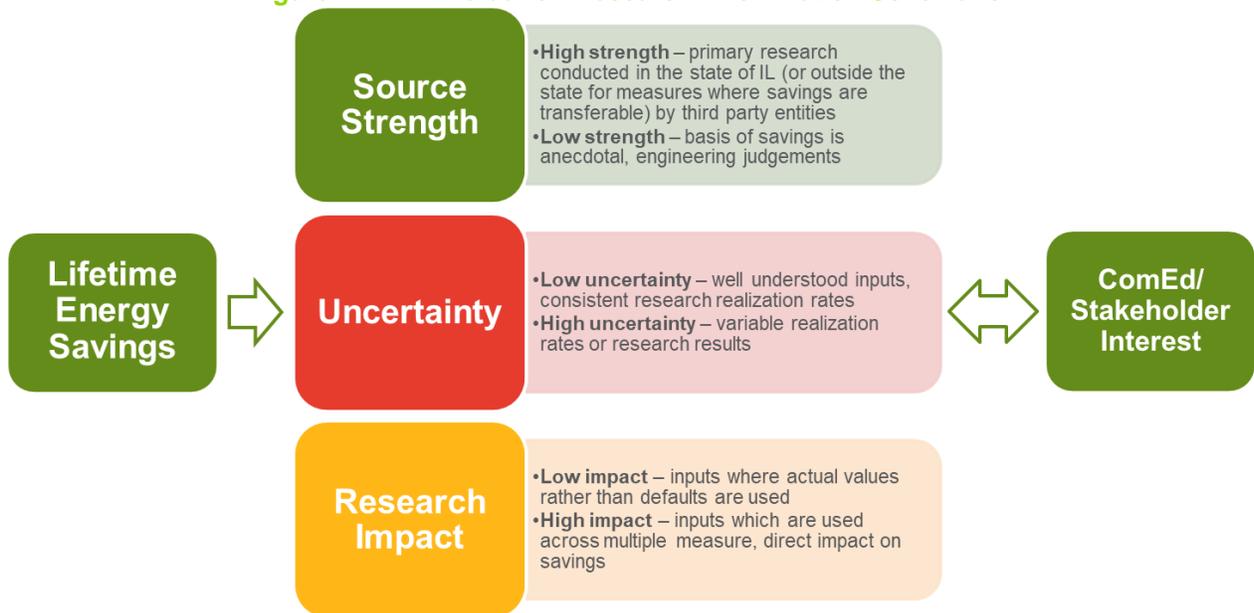
- **Ameren Illinois evaluation team.** Navigant holds monthly calls with the Ameren Illinois evaluation team and coordinates on statewide evaluation research.
- **Illinois Gas Utilities.** Navigant also evaluates Nicor Gas', Peoples Gas' and North Shore Gas' energy efficiency programs and will coordinate with our internal team on research items of interest to the gas utilities.
- **Continued IL SAG and TAC participation.** Navigant will continue to participate in IL SAG and TAC meetings to engage stakeholders at key stages of evaluation research plan development to ensure that objectives and methodology align with statewide and regional goals and other ongoing research. Additionally, Navigant will notify the TAC of the primary research planned during the TRM update process and will report out on research efforts during TAC calls.

Measure Prioritization

Navigant has developed a prioritization framework for TRM evaluation research tasks. The purpose of this framework is to aid the IL TRM Administrator and TAC in identifying current TRM measures that have the highest potential for updating current TRM algorithms or savings estimates. Figure 1 below provides a schematic of the prioritization framework. Navigant will update this framework as needed, based on new information about technologies, measures or programs. The framework considers the following:

- **Energy Savings.** Prioritize measures with significant planned Cumulative Persisting Annual Savings (CPAS) and/or high anticipated planned savings
- **Measure Research Criteria.** Rank each measure based on three criteria. Navigant uses a one to five ranking for the three below criteria, where a five represents a high need for research and a one represents a low need for research.
 - **Source strength** – Focus on measures which have not been well-studied recently. We will prioritize updates to measures with references noted by industry as “weak”, e.g., values based on another state, values based on engineering simulations instead of primary data collection, or values which do not count for significant interactive effects.
 - **Uncertainty of measure savings** – Consider evaluated research realization rates over time, program changes, or measure mix changes
 - **Research impact** – Consider how likely the results from the research will develop into significant TRM updates.
- **Stakeholder and utility interest.** Consider interest from ComEd or other stakeholders in developing measure research priorities.

Figure 1. TRM Evaluation Research Prioritization Schematic



The framework will assist Navigant in (1) identifying gaps in our current TRM research plans and (2) determining the appropriate level of rigor for each research effort. Table 2 and Table 3 below present results from the 2018 prioritization process and outlines our current or planned research initiatives.

Table 2. Commercial Industrial Measure Prioritization

Measure*	% lifetime savings	Source Strength	Uncertainty Score	Research Impact Score	Total Score	Prioritization	Current Research Initiative?
Lighting	51.3%	3	3	5	11	High	Effective Useful Life (EUL) study. C&I loadshape literature review.
LED Lamps	18.3%	3	3	5	11	High	
VSD	2.7%	1	3	4	8	High	Secondary engineering review
LED Fixture	2.6%	2.5	3	5	10.5	High	C&I loadshape literature review
Building EMS	1.6%	NA	5	4	9	High	EMS Working Group. EUL study.
Air Compressor	0.6%	3	3	3	9	High	EUL study.
Programmable Thermostat	0.6%	3	4	4	10	High	Smart Commercial Programmable Thermostat Study. EUL study.
HVAC Tune-Up	0.5%	3	4	3	10	High	HVAC Tune-Up Study. EUL study.
LED Exit Signs/Channels/Traffic Signal	0.5%	3	3	3	9	Medium	
Fluorescent Retrofit/Relamp	0.4%	3	3	1	7	Low	

*Custom measures are not included
 Source: Navigant Analysis

Table 3. Residential Measure Prioritization

Measure	% lifetime savings	Source Strength	Uncertainty Score	Research Impact Score	Total Score	Prioritization	Current Research Initiative?
LED Lamps	62.0%	1	2	5	8	Medium	EUL study
LED Fixtures	10.6%	1	2	5	8	Medium	
Fridge Recycling	5.0%	3	3	4	10	High	Secondary research initiative
Behavioral	4.7%	1	2	4	7	Medium	
Other Lighting	3.4%	1	2	5	8	Medium	EUL study
CFL	3.4%	1	2	1	4	Low	
Advanced Thermostat	2.9%	2	4	3	9	High	Advanced Thermostat working group
Furnace Blower Motor (ECM)	2.0%	2	2	3	7	Low	
Room & Central Air Conditioner	1.3%	2	2	3	7	Low	
Air Purifier	0.8%	2	3	3	8	Medium	

Source: Navigant Analysis

Secondary Evaluation Research

Secondary evaluation research efforts will (1) inform near-term updates to the TRM and (2) assess need for a primary research effort. Secondary evaluation research efforts may include reviewing applicable state TRMs, conference papers (e.g., IEPEC, ACEEE), consulting internal and external industry experts, reviewing previous measure level evaluation findings, and reviewing available cost or technology data from stakeholders.

There are two deliverables typically associated with the secondary evaluation research effort; a research findings memo and TRM measure workpaper, outlined in the table below.

Table 4. Secondary Evaluation Research Deliverables

Deliverable	Description
Secondary Research Memo	<p>The secondary research memo will typically include the following sections:</p> <ul style="list-style-type: none"> • Background <ul style="list-style-type: none"> ○ Measure prioritization, i.e., why Navigant conducted secondary research on this measure ○ Description of measure technology and role in ComEd portfolio • Methodology <ul style="list-style-type: none"> ○ Sources reviewed (research papers, TRMs, conference papers, industry experts) ○ Type of engineering/econometric review performed • Findings <ul style="list-style-type: none"> ○ Findings from literature review ○ Findings from engineering/econometric review • Recommendations <ul style="list-style-type: none"> ○ Changes recommended to the TRM in the short term ○ Recommendations for additional primary or other type of research
TRM Work Paper	<p>A TRM work paper will include TAC submittal procedure and deadlines to share this information with statewide stakeholders and to submit work papers to the TAC by May 15 of each year to be incorporated into future versions of the TRM. An example is embedded here:</p> <div style="text-align: center;">  <p>Illinois_Statewide_TRM_Workpaper_Rev</p> </div>

Source: Navigant

Primary Evaluation Research

Once a need for primary evaluation research is identified, Navigant will work with ComEd, and relevant stakeholders as appropriate, to plan and deliver primary evaluation research. Primary evaluation research could include any ComEd territory specific data collection or analysis effort including:

- On-site metering
- Billing analysis
- Modeling
- Surveys/Interviews/Observations
- Collection of cost data

Evaluation Schedule

The table below includes a general schedule for IL-TRM evaluation research that we expect to implement on a rolling basis, using the CY2019 timeframe as an example.

Table 5. TRM Evaluation Research Schedule by Task

Activity or Deliverable	Responsible Party	Date
2019 IL TRM research priorities established by stakeholders (complete)	Evaluation/ComEd/ Stakeholders	September 26, 2018
Evaluation review/prioritization (complete)	Evaluation	October 2018
Secondary research (in progress)	Evaluation	May 15, 2019
Develop TRM work papers (in progress)	Evaluation	May 15, 2019
2019-2020 primary research planning	Evaluation	June-July 2019
Feedback to inform next TRM prioritization	Evaluation	August 2019
2020 IL TRM research priorities established by stakeholders	Evaluation/ComEd/ Stakeholders	September 2019

Source: Navigant

ComEd Load Shape Evaluation CY2019 Research Plan

Introduction

This detailed evaluation research plan describes the proposed methods that Navigant will use to update the load shape library and energy and demand savings parameters for select end uses and measures in the Illinois Technical Reference Manual (IL TRM). The proposed evaluation research in this plan includes a sensitivity analysis to identify future evaluation research and is an extension of end use load shape evaluation research activities completed in 2018, details of which are included below.

Background for Research Prioritization

The IL TRM load shape library contains hourly consumption profiles for all major end uses in the residential, commercial, and industrial customer segments. The Illinois Technical Advisory Committee (TAC) identified end use load shape research as a medium-priority research item during its research prioritization process in 2018¹⁰². In 2018, Navigant performed an engineering review of the current IL TRM load shape library to understand the sourcing of the existing load shapes and limitations of the current data set.¹⁰³ Navigant's high-level findings from the load shape library review included:

- **The current load shape library is missing some documentation.** Navigant reviewed all material in the IL TRM v6 and all load shape files hosted on the IL SAG website and was unable to determine the precise sourcing of load shapes, or alternatively, the methods used to calculate the load shapes. The load shape library does not have an accompanying memo or report to document sources and assumptions for the end use load shapes. To remedy this, Navigant submitted accompanying methodology memos with the residential and commercial lighting load shapes IL TRM workpapers in 2018. All future research to update the load shape library should include detailed documentation of sources, study methods, and assumptions.
- **The load shapes in the library are not based on primary data from Illinois customers.** Instead of metered or AMI data, most of the current load shapes rely on prototypical building energy simulation models and reference secondary studies conducted in other regions around the country. The exact sources of these load shapes are unclear.
- **The current load shapes are likely outdated.** The load shape library was last reviewed and updated in 2012 using data from earlier research studies. End use load shapes may change over time as customer behavior changes, equipment efficiency improves, and sophisticated controls are used to alter the temporal consumption of equipment.
- **Several end use load profiles differ considerably from actual metered load shapes.** For example, the residential indoor lighting load profile in the IL TRM v6, sourced from building simulation input assumptions, suggests a much larger difference between on-peak and off-peak consumption than load profiles from several metering studies, including the recently completed Opinion Dynamics residential LED lighting metering study in Illinois¹⁰⁴ and the NMR Northeast Residential Lighting Hours-of-Use Study.¹⁰⁵

¹⁰² VEIC IL TRM v7 Evaluation Priorities Memo:

http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_7/Evaluation_Priorities_for_Illinois_TRM_v.7_09-21-2018.pdf

¹⁰³ Illinois Load Shape Library Engineering Review Memo 2017-04-30.docx

¹⁰⁴ http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/2018_Loadshape_Files.zip; IL Res Indoor LED Lighting Load Shape Methodology_2018-05-18

¹⁰⁵ <https://neep.org/sites/default/files/resources/Northeast-Residential-Lighting-Hours-of-Use-Study-Final-Report1.pdf>

Based on the results of this engineering review, Navigant completed several end use load research tasks in 2018 for measures with a large contribution to ComEd's energy efficiency portfolio savings, including:

- Commercial lighting secondary literature review and analysis
- Residential lighting metering study in Illinois, completed by ODC and overseen by Navigant

This memo is an extension of the end use load research performed in 2018 including Navigant's recommendations for further research studies in 2019.

Overall Study Goal

The two primary goals for the end use load shape evaluation research efforts in 2019 are to:

1. Inform prioritization of secondary or primary evaluation research efforts to improve the accuracy of the load shape library and other impact parameters
2. Use the best available secondary data to provide near-term updates to the IL TRM load shape library and applicable Hours of Use (HOU), Coincidence Factors (CFs), and other impact parameters

Research Questions

This initiative will seek to answer the following questions:

- How should ComEd direct further evaluation research dollars to reduce uncertainty of end use load shapes and impact estimates?
- Using a secondary literature review, what are the best available load shapes to update the IL TRM load shape library?
- For load shapes referenced from secondary data sources and different regions, what load profiles are non-weather-dependent and could therefore be used to approximate end use load profiles in the ComEd territory?
- How do daily load profiles (e.g. 24-hour profiles) vary by day type (i.e. weekday or weekend), month, and season?
- How do end use load shapes vary by building type?
- Which baseline HOU and CF estimates can be improved using the updated end use load shapes in the IL TRM?

Summary of Evaluation Research Activities

Navigant will complete a memo providing options and recommendations for end use load research in 2019 and beyond. Navigant will also conduct a secondary literature review of end use load shapes data sources to provide near term updates to the IL TRM. Table 1 below shows the activities planned for this research study.

Table 1. Summary of Evaluation tasks, Deliverables, and Timelines

Task	Activity	Rationale	Deliverables	Timeline
Task 1: Sensitivity Analysis	Sensitivity analysis; measure prioritization	Inform prioritization of further primary or secondary research efforts to improve the accuracy of the load shape library and other impact parameters	PowerPoint slides and/or memo detailing results of sensitivity analysis and recommendations for future end use load research	January- March 2019
Task 2: Secondary Literature Review	Review best available secondary data sources to update IL TRM load shape library	Provide near-term updates to the IL TRM load shape library and reduce the uncertainty of applicable impact parameters such as HOU and CF	TRM workpapers; Excel load shape library workbooks	March-May 2019

Methodology

The following sections provide detailed descriptions of all tasks outlined in Table 1.

Task 1: Sensitivity Analysis

In Task 1, Navigant will perform a sensitivity analysis to discern end use load shape impacts on cost effectiveness test results, such as the Total Resource Cost (TRC) test. For this task, Navigant will apply variable avoided cost (8760) data from ComEd in the Navigant’s cost effectiveness tool to test the sensitivity of the input data (end use load shapes) on the resulting outputs (TRC test results). Navigant will test various end use load shapes in the cost effectiveness tool to identify if changes in the load shape inputs have a measurable impact on the resulting cost effectiveness of the measure.

The final deliverable from this work will be PowerPoint slides and/or a memo with sensitivity analysis results and recommendations for future load shape research using the results of this analysis.

Task 2: Secondary Literature Review

In Task 2, the evaluation research team will conduct a secondary literature review to update the IL TRM load shape library and impact parameters as applicable. Based on a preliminary review of available resources in 2018, Navigant identified the following end uses to update in 2019 with recently published end use metering studies:

- Commercial lighting
- Residential end use, including laundry, kitchen, water heating, and miscellaneous plug loads

Commercial Lighting

In 2018, Navigant submitted a workpaper to update seven commercial lighting load shapes in the IL TRM, including the education, grocery, health, office, retail, warehouse/industrial, and ‘other’ building types.

In addition to the IL TRM workpaper, Navigant submitted an accompanying memo detailing the data sources and methods used in the analysis.¹⁰⁶ Navigant developed these updated load shapes by summarizing commercial lighting logger data collected during a recent EmPOWER Maryland lighting metering study capturing both summer and winter peak periods. Notably, Navigant was able to summarize differences in lighting consumption month-over-month for building types with distinct seasonal operation, like the 'education' sector.

In 2019, Navigant proposes using the EmPOWER Maryland lighting metering study to also update the HOU and CF impact parameter assumptions in the IL TRM for the seven building types listed above. Navigant will ensure CFs are calculated with the Illinois peak period definition. This update will add value to ComEd because the current IL TRM v7 HOU and CF impact parameters currently reference building simulation input assumptions (simplified hourly schedules) and contribute a large portion to overall portfolio energy savings.

Residential End Use

In 2019, Navigant also proposes applying the recently completed Massachusetts Baseline Load Shape Study¹⁰⁷ to update select residential end uses in the IL TRM. Navigant proposes using load shapes that are non-weather-dependent, as these are most transferable to other jurisdictions. Navigant will reference the following load shapes for possible inclusion in the IL TRM:

- Laundry – clothes washer, clothes dryer
- Kitchen – refrigerator, freezer, dishwasher
- Water Heating – electric water heater
- Miscellaneous – primary TV and peripherals, primary desktop computer

Navigant will reference the HOU and CF values from the Massachusetts Baseline Study if the evaluation research team thinks these impact parameter estimates are an improvement over the current estimates in the IL TRM (i.e. developed via metering or other primary data collection, more recent study, or more representative of the ComEd building stock). Navigant will ensure CFs are calculated with the Illinois peak period definition.

Navigant will also complete additional secondary evaluation research to update other load shapes at the request of ComEd or ICC Staff.

The final deliverable from this task will be end use or measure-specific work papers to update the load shapes in the IL TRM. Navigant will submit these work papers into the IL TRM review process. As applicable, Navigant will submit Excel workbooks with hourly load shapes values for upload to the IL SAG website.

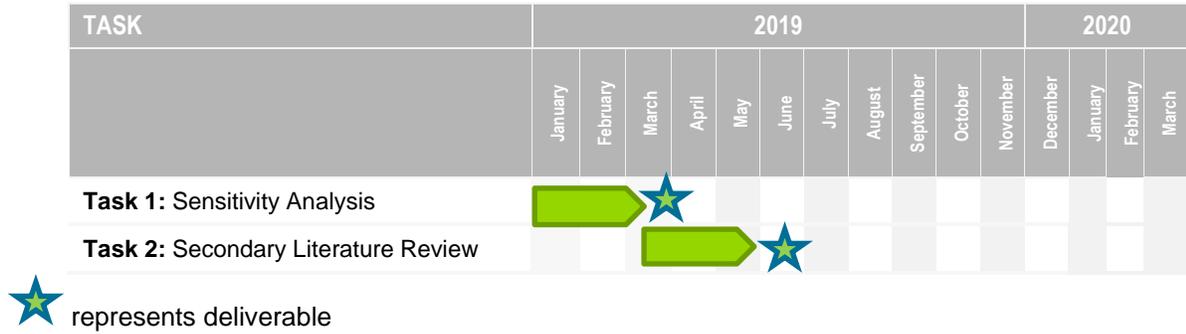
Schedule

Figure 1 below shows the expected timeline to complete each task of the project. Navigant anticipates completing all evaluation research tasks by the end of June 2019. This timeline is approximate, and adjustments to the stated deadlines are possible.

¹⁰⁶ http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/2018_Loadshape_Files.zip; IL Commercial Lighting Load Shape Development Methodology_2018-06-28.

¹⁰⁷ <http://ma-eeac.org/wordpress/wp-content/uploads/RES-1-FINAL-Comprehensive-Report-2018-07-27.pdf>

Figure 1. Project Schedule by Task



ComEd Non-Energy Impacts CY2019 Research Plan – Part 1

Introduction

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 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.

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 programs¹⁰⁸.

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 Stipulation¹⁰⁹:

"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 states¹¹⁰:

"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..."

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

¹⁰⁸ 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.

¹⁰⁹ Page 7: http://ilsagfiles.org/SAG_files/Landing_Page/ComEd_EE_Plan_5_Stipulation_Final.pdf

¹¹⁰ Page 33: <http://www.ilga.gov/legislation/publicacts/99/PDF/099-0906.pdf>

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

Table 1. Evaluation Plan Summary

Activity	Rationale	Timing
Agreement on Methods	<p>Navigant proposes to have two rounds of the following to achieve satisfactory agreement on the proposed evaluation plan:</p> <ul style="list-style-type: none"> • Comments from stakeholders • Navigant response, including: <ul style="list-style-type: none"> ○ 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	<p>Navigant will submit a data request for CY2018 participants that includes required data and optional data fields (with descriptions) to complete the analysis.</p>	August 2018
IE Surveys	<p>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:</p> <ul style="list-style-type: none"> • Quantify NEIs <p>Navigant will collect ComEd territory specific values to:</p> <ul style="list-style-type: none"> • 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

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	<ul style="list-style-type: none"> • Draft and final research plan • Face to face meeting 	Duration: 4 weeks
Task 5: Quantify and Monetize IE Participant / Societal NEIs	<ul style="list-style-type: none"> • Draft telephone and online survey instruments • Quantify NEIs • Monetize NEIs 	<ul style="list-style-type: none"> • Customer contact information • Specific healthcare values from ComEd's territory 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Payment transaction dates • Actual billed amounts by billing period • Source and amount of external assistance by billing period • Arrearage amount • Reconnections by billing period 	<ul style="list-style-type: none"> • Memo summarizing findings • IL TRM workpaper 	Duration: 4 months
Task 7: Quantify and Monetize Economic NEIs	Modeling	<ul style="list-style-type: none"> • Number of jobs and average compensation for PMs • Budget for each program 	<ul style="list-style-type: none"> • 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

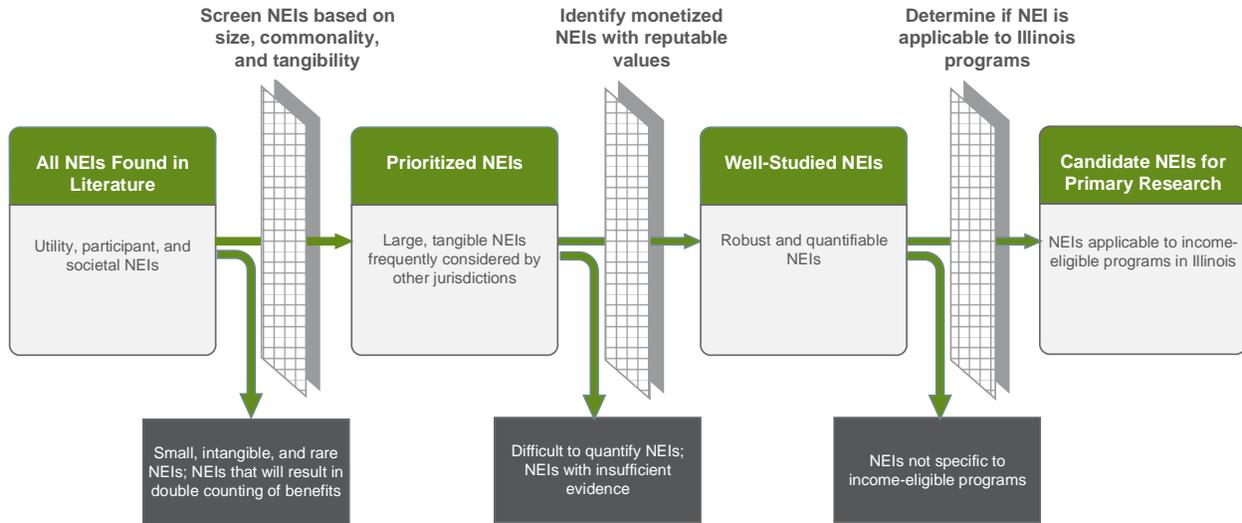
Task 2: IE Secondary Research

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

Figure 1. NEIs Screening Process



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 2014¹¹¹: 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 Three³ in 2016¹¹²: 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.

¹¹¹ Oak Ridge National Laboratory (2014). *Health and Household-Related Benefits Attributable to the Weatherization Assistance Program*

¹¹² Three³, 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 later detail 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-weatherization¹¹³.

- **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 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?
- **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:

¹¹³ Terminology adopted from ThreeCubed / Seventhwave JPB Foundation research effort (See Appendix B)

- 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 marketing¹¹⁴?

Navigant will develop the survey instrument questions primarily focusing on the objectives listed above. NEI equations are mapped to research questions at the end of this plan. Additional data points required to monetize NEIs are also outlined at the end of this plan.

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

¹¹⁴ Question for multifamily building owners only

- Arrearage amount
- Reconnections by billing period

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

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 and the stakeholders 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.

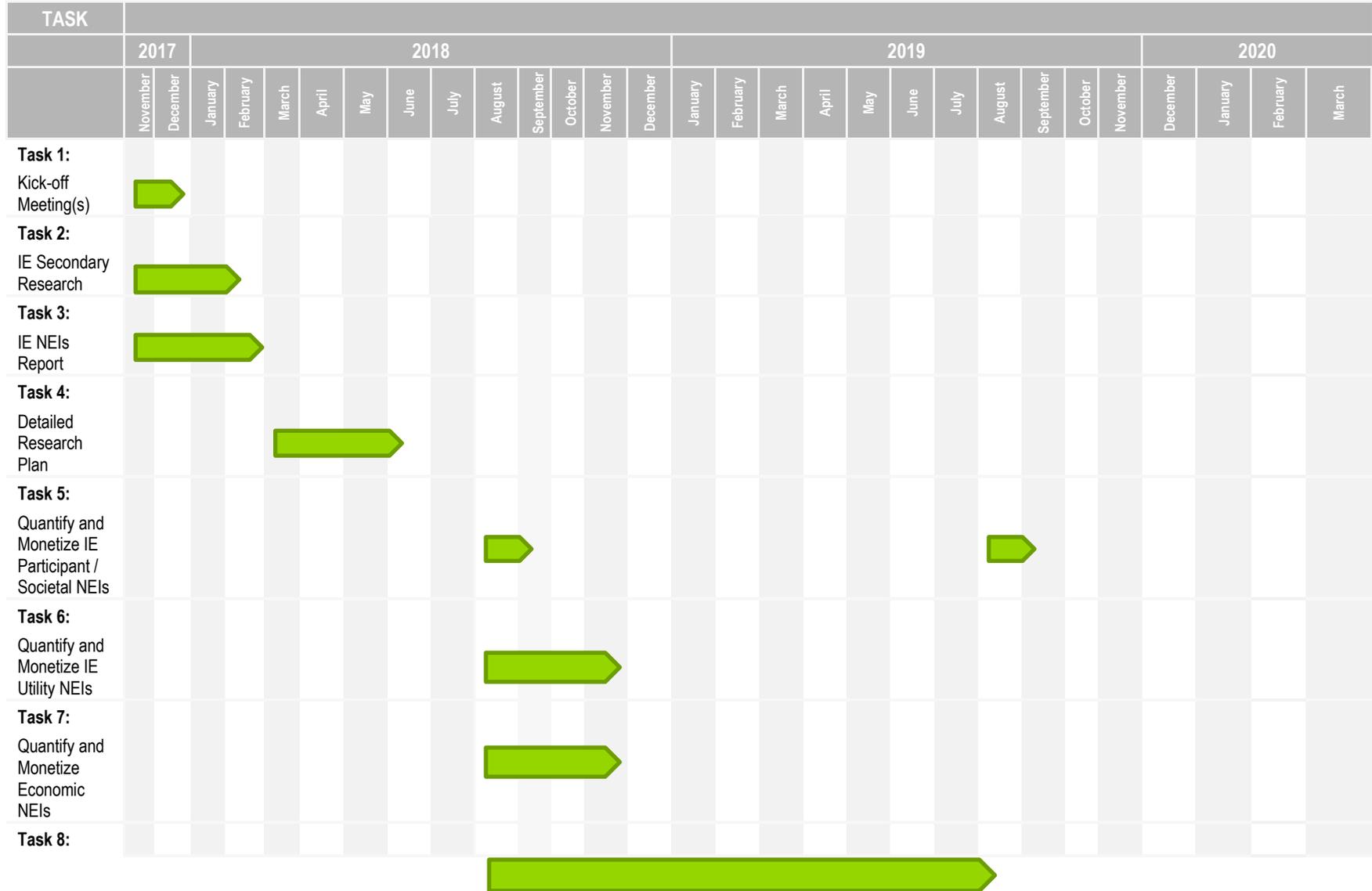
Task 11: TRC Workpapers

Navigant would recommend how ComEd incorporate the monetized NEI values in the cost effectiveness test. Currently ComEd has an adder for CO₂ 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.

Figure 2. Project Schedule by Task



TASK	2017		2018												2019												2020			
	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	
Secondary Research																														
Task 9: Add-on Survey Questions																														
Task 10: IL TRM Workpapers																														
Task 11: TRC Workpapers																														

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:

$$\text{Reduction in instance} = [(Pre\text{-}treatment - Post\text{-}treatment) + (Pre\text{-}treatment - Comparison\ group)] / 2$$

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:

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

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-pocket payers:

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

And finally, the benefit associated:

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

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:

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

$$\text{Total benefit of avoided deaths} = [\# \text{ of avoided deaths} * \text{VSL}]$$

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:

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

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

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

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:

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

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:

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

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:

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

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:

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

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:

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

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:

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

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)*

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:

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

Overview of Seventhwave/Threecubed Research

Three³, 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.¹¹⁵ 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)
- 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)

¹¹⁵ 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.

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 Three³, Inc. and Seventhwave to ensure the same customers are not contacted for the separate survey efforts. Additionally, after Three³, Inc. and Seventhwave publish their results they will share the raw data from ComEd respondents to bolster Navigant's results.

ComEd PJM Evaluation CY2019 Research Plan

Introduction

This evaluation research plan describes proposed methods to support verification of Energy Efficiency (EE) Resources and Capacity Performance (CP) resources into PJM capacity market.

Study Goal

The goal of this work is to support ComEd's measurement and verification of Energy Efficiency (EE) Resources submitted into the PJM capacity market. For 2019, the Navigant team will focus on the following objectives:

1. Determine the Nominated EE and Capacity Performance (CP) Resources for the M&V Plan and PIMV Report.
2. Continue to develop the reporting spreadsheets for the M&V Plan and PIMV Report so that:
 - a. the data and sources are clearly documented and traceable,
 - b. the data can move seamlessly from spreadsheet to PJM reporting document
3. Work with ComEd to develop quarterly reporting if data is available

Research Questions

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

1. What is the forecasted portfolio- and end-use-level MW savings for the PJM capacity market for the next four years via the M&V Plan?
2. What was the actual portfolio- and end-use-level MW savings from the last four years that can be documented in the PIMV Report?

Summary of Evaluation Research Activities

Table 1 shows the proposed research activities for 2019.

Table 1. Proposed 2019 Research Activities

Activity	Rationale	Timing
Review PJM Schedule and Deadlines	Plan 2019 schedule	January 2019
Verify Nominated EE and CP Resources for the PIMV Report	PJM reporting requirement	May 2019
Reporting for the M&V Plan	PJM reporting requirement	July 2019

Methodology

This detailed plan outlines activities for this research into seven discrete tasks, as summarized in Table 2.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 1: Review PJM schedule and deadlines	<ul style="list-style-type: none"> Review PJM website Contact PJM directly as needed for confirmation 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> List of PJM deadlines 	Duration: 4 weeks
Task 2: Verify Nominated EE and CP Resources for PIMV Report	<ul style="list-style-type: none"> Request data from program leads Compile data and QC Update PJM reporting spreadsheets and documents 	<ul style="list-style-type: none"> Evaluation data 	<ul style="list-style-type: none"> PIMV Report spreadsheet PIMV Report document 	Duration: 12 weeks
Task 3: Verify EE and CP Resources for M&V Plan	<ul style="list-style-type: none"> Request data from ComEd Apply evaluation factors Compile data and QC Update PJM reporting spreadsheets and documents 	<ul style="list-style-type: none"> ComEd 4-year projections Evaluation factors 	<ul style="list-style-type: none"> M&V Plan spreadsheet M&V Plan document 	Duration: 12 weeks
Task 4: Develop quarterly reporting mechanism and templates	<ul style="list-style-type: none"> Formalize and promulgate quarterly updates 	<ul style="list-style-type: none"> Program tracking data 	<ul style="list-style-type: none"> Quarterly reports 	Duration: 8 weeks

Task 1: Review PJM schedule and deadlines

The Navigant PJM team will review the PJM annual schedule to ensure that the work aligns with PJM’s deadlines. In particular, Navigant will look for changes to the deadlines for the PIMV report, the M&V plan, and for informing PJM about whether ComEd’s intends to forego nominating summer-only savings into the capacity market.

Task 2: Verify Nominated EE and CP Resources for PIMV Report

The Navigant PJM team will compile program-level data from the evaluation leads into the PIMV reporting spreadsheet. The reporting spreadsheet will automatically produce the portfolio-level data in PJM’s required reporting template. Navigant will further support ComEd’s written PIMV Report for submission to PJM.

Task 3: Verify EE and CP Resources for M&V Plan

The Navigant team will request data from ComEd regarding planned installations for the next four years, and evaluation factors from the program leads. These data will be compiled into the M&V Plan reporting spreadsheet, which will automatically produce the portfolio-level data in PJM’s required reporting template. Navigant will further support ComEd’s written M&V Plan for submission to PJM.

Task 4: Develop a quarterly reporting mechanism and templates

If data is available, we will work with ComEd to implement quarterly updates to track PJM progress.

Schedule

The timeline shown in Figure 1 lays out expected time and dates to complete each task of the project. Navigant anticipates completing all proposed tasks on an annual basis, with an example of the 2018-2020 timeline below. The recurring tasks to compile M&V Plan and PIMV report data will happen annually, with timing to be verified with PJM each year.

Figure 1. Project Schedule by Task

TASK	2018					2019								2020						
	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March
Task 1: Review PJM Schedule and Deadlines																				
Task 2: Verify EE and CP Resources for PM Report																				
Task 3: Verify EE and CP Resources for M&V Plan																				
Task 4: Develop a quarterly reporting mechanism and templates																				

ComEd Residential Advanced Thermostat Evaluation CY2019 Research Plan

Introduction

This evaluation research plan describes the proposed methods the Navigant team will use to better understand the electric energy impacts from residential advanced thermostats incentivized through IL energy efficiency (EE) programs. This research is being conducted at the request of Illinois Commerce Commission (ICC) staff, ComEd and regional stakeholders as a component of a consensus agreement for the IL Technical Reference Manual (TRM) version 7.0.

Navigant will conduct this research in coordination with the Advanced Thermostat Subcommittee, a subcommittee of the IL TRM Technical Advisory Commission (TAC). The Advanced Thermostat Subcommittee includes members of a variety of organizations, such as Navigant, Opinion Dynamics, ICC staff, VEIC, ComEd, Ameren, Nest, Ecobee, and ELPC.

This research will extend beyond previous IL advanced thermostat evaluation research studies by:

- Providing demand savings as well as annual electric savings
- Providing evidence to support or refute plausible explanations behind the savings results
- Incorporating advanced metering infrastructure (AMI) data and thermostat data
- Providing additional evidence beyond those provided in previous studies as to the representativeness of any comparison groups used in the study

IL TRM v7.0 Stipulation

ICC staff, ComEd and regional stakeholders reached an agreement as part of the TRM update process for version 7.0, which will guide the current research effort for Advanced Thermostats. The stipulation is as follows:

In an effort to resolve potential disputes regarding the cooling reduction value in the IL-TRM for advanced thermostats, the Stipulating Parties agree to retain the 8% cooling reduction value for the 2019 IL-TRM Version 7.0, subject to completion of a statewide advanced thermostat evaluation utilizing AMI data. Specifically, the Stipulating Parties agree to work collaboratively with ComEd independent evaluator Navigant and Ameren Illinois independent evaluator Opinion Dynamics and other interested stakeholders to develop an Illinois-specific advanced thermostat evaluation method(s) that utilizes pre- and post-advanced thermostat participant AMI data and is developed with consideration of all proposed evaluation strategies, consistent with best industry practices, to be completed as soon as feasible for consideration in updating the IL-TRM. In developing the evaluation strategy, consideration will be given to adopting approaches that estimate cooling run time changes from the actual participants' pre-advanced thermostat AMI data, along with actual post-advanced thermostat run time data provided by both the thermostat manufacturers and AMI data, as well as performing an econometric analysis on the AMI data using total home electricity consumption rather than estimated run time to provide another estimate and a comparison between the two methods. The Stipulating Parties further agree that nothing in this agreement precludes consideration of other evaluation approaches.

Below is proposed language that would be included as a footnote next to an 8% cooling reduction value for advanced thermostats in the 2019 IL-TRM Version 7.0:

In an effort to resolve potential disputes, without the need for litigation regarding the cooling reduction value in the IL-TRM for advanced thermostats, Stakeholders have

reached through negotiation a separate stipulation that retains the 8% cooling reduction value in the 2019 IL-TRM Version 7.0, pending completion of a statewide advanced thermostat evaluation utilizing participant AMI data, and consistent with a Stipulation reached among stakeholders and the Program Administrators. Specifically, the parties have agreed to work collaboratively to develop an Illinois-specific advanced thermostat evaluation framework that utilizes AMI data, for consideration in updating the IL-TRM as soon as feasible, but no later than completing the evaluation in time for the 2021 IL-TRM Version 9.0, if practicable and, for Ameren Illinois, in a manner consistent with the timing of its AMI installation schedule.

Overall Study Goal

This research focuses on measure 5.3.16 Advanced Thermostats.¹¹⁶ The goals of this study include:

- Evaluated estimate of annual electric savings and coincident demand savings, which will be available to inform the IL TRM as a part of the IL TRM TAC process coordinated by VEIC
- Research to understand and contextualize findings, including understanding those that are unexpected, such as the effect of advanced thermostats on non-weather-related energy use
- Estimate of demand response capacity made available through rebated residential smart thermostats.

Research Questions

This initiative will seek to answer the following key researchable questions at a minimum. Additionally, some research questions may be added or edited as Navigant coordinates this research with the Advanced Thermostat Subcommittee.

- What is the approximate AC runtime for participants before and after installing advanced thermostats?
- What is the impact of residential advanced thermostats on annual electric consumption?
- How much of the annual energy impact is related to cooling, heating and baseload?
- What is the impact of residential advanced thermostats on electric demand at certain critical times?
- What may be driving advanced thermostats' effect on baseload (e.g., do they cause less on/off behavior for cooling? do they cause customers to use cooling later or earlier in the season? are these results the by-product of methodological issues like self-selection bias?)

Summary of Evaluation Research Activities

Navigant will finalize the research activities included in this study through touch-point meetings with the Advanced Thermostat Subcommittee. Navigant has created a list of research activities to address the objectives of this study. The proposed activities listed below will be conducted pending data availability.

¹¹⁶ For more information on this measure, please review the IL TRM v6.0: http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_3_Res_020817_Final.pdf

Table 1. Itemized Analysis Activities

Activity	Rationale	Timing
Advanced Thermostat Subcommittee Coordination	Creates opportunity for stakeholders to provide input on the analysis methods and creates a mechanism for shared understanding of methods and research questions prior to delivering analysis results	Fall 2018 through conclusion of the study
Runtime Analysis using AMI and Thermostat Data	Better understand changes in runtime before and after installing advanced thermostats ¹¹⁷	Dependent on timing of data availability
Econometric Analysis using AMI Data	Provide a benchmark savings estimate from advanced thermostats	Dependent on timing of data availability
Participant and General Population Surveys	Provide indication of how participants compare to previous studies, provide indication of how participants compare to the general population, and provide an indication of other interesting metrics, such as in-service rate	Fall, Winter 2018

Methodology

This plan outlines activities for this research into 6 discrete tasks, as summarized in Table 2.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 1: Request AMI and Thermostat Data	<ul style="list-style-type: none"> Request AMI data from ComEd Request thermostat data from Ecobee and Nest Coordinate with Opinion Dynamics to request AMI data from Ameren Coordinate with Opinion Dynamics to request thermostat data from Ecobee and Nest 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Data requests 	Duration: 3 weeks
Task 2: Launch Subcommittee Coordination	<ul style="list-style-type: none"> Touch-point meeting 1-on-1 meetings 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Presentation deck 	Duration: 6 weeks
Task 3: Participant and General Population Surveys	<ul style="list-style-type: none"> Receive feedback on survey instruments Field and analyze participant survey Field and analyze general population survey 	<ul style="list-style-type: none"> Customer contact information 	<ul style="list-style-type: none"> Draft survey instrument Presentation deck 	Duration: 8 weeks

¹¹⁷ Navigant will coordinate meetings to discuss alternate interpretations of the runtime analysis which may involve running the ENERGY STAR metric.

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 4: Reach Agreement on Methods	<ul style="list-style-type: none"> • 3 or 4 Touch-point meetings • 1-on-1 meetings 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Detailed slide deck • Electronic agreement from stakeholders 	Duration: 24 weeks
Task 5: Receive Data	<ul style="list-style-type: none"> • Receive data • Validate data • Address issues as needed 	<ul style="list-style-type: none"> • AMI data • Thermostat data 	<ul style="list-style-type: none"> • Presentation deck validating received data 	Duration: 24 weeks, dependent on data availability
Task 6: Produce Draft Results	<ul style="list-style-type: none"> • Econometric analysis • Runtime analysis • Touch-point meeting • 1-on-1 meetings 	<ul style="list-style-type: none"> • AMI data • Thermostat data 	<ul style="list-style-type: none"> • Presentation deck of draft findings 	Duration: No less than 24 weeks
Task 7: Finalize Results	<ul style="list-style-type: none"> • Additional minor analyses as needed to understand results • Touch-point meeting • 1-on-1 meetings 	<ul style="list-style-type: none"> • AMI data • Thermostat data 	<ul style="list-style-type: none"> • Presentation deck of final results • Report of final results 	Duration: 12 weeks
Time to Complete the Project	-	-	-	Approximately 80 weeks, dependent on data availability

Task 1: Request AMI and Thermostat Data

Navigant sent data requests for ComEd advanced thermostat participants to ComEd, Nest and Ecobee in Summer 2018. Navigant will coordinate with Opinion Dynamics to request data from Ameren IL, Nest and Ecobee for Ameren IL advanced thermostat participants.

Task 2: Launch Subcommittee Coordination

For Fall 2018, Navigant will coordinate an Advanced Thermostat Subcommittee meeting as well as 1-on-1 meetings with individual subcommittee members to launch this research.

Task 3: Participant and General Population Surveys

Navigant received feedback on a draft survey instrument in Fall 2018. Navigant and Opinion Dynamics will survey ComEd participants and general ComEd customers in 2018 to provide an indication of how more recent participants compare to participants from previous studies, how participants compare to the general population, and to provide indications for other interesting metrics, such as in-service rate. For both of these surveys, customers will be invited to complete the survey online. The participant survey will invite customers through e-mail, while the general population survey will invite customers to take the survey via postcards. Navigant acknowledges that survey results are not as reliable as other sources of data and will discuss these results with the Advanced Thermostat Subcommittee with that understanding.

Task 4: Reach Agreement on Methods

Over several touch-point meetings and 1-on-1 meetings, Navigant will coordinate with the Advanced Thermostat Subcommittee to reach agreement on the methodology. While the IL TRM version 7.0 stipulation explicitly describes runtime and econometric analyses, the specific details of these methods will need to be defined. Additionally, the stipulation calls for the consideration of other evaluation pathways. Examples of such pathways include developing an adjusted version of the ENERGY STAR method for calculating field savings, or a study involving submetering.

Agreement on methods prior to seeing results serves several purposes: (1) to create a transparent record of the research to be conducted and questions to be answered (2) to make sure stakeholders understand the methods to be employed; (3) to create a framework with which to assess the validity of the research results, including understanding the assumptions and limitations of the agreed upon methods prior to seeing results; and (4) this framework enables Navigant (the independent evaluator) to be inclusive of input from financially vested parties without risking the objectivity of the research. While this process does not guarantee accuracy of the results, it will facilitate the interpretation and assessment of results in a consistent way among all stakeholders. Reaching agreement on the methods does not predicate that the results will be automatically adopted in the TRM. VEIC will coordinate a separate process for interpreting the results for the TRM.

Task 5: Receive Data

Navigant will work with parties from whom data has been requested to receive and validate AMI and thermostat data. This task will include addressing any issues that arise and ensuring data quality and completeness.

Task 6: Produce Draft Results

After completing the runtime analysis and econometric analysis using AMI data and thermostat data, Navigant will coordinate a touch-point meeting, and 1-on-1 meetings as needed, to review the draft results. During these meetings, Navigant and Opinion Dynamics will consider additional, minor analyses proposed by the group that can inform the group's interpretation of the results.

Task 7: Finalize Results

Navigant will conduct any additional analyses as warranted and document the findings in a report. Navigant will coordinate a final touch-point meeting, and 1-on-1 meetings as needed, to discuss the study's findings. Separate from this study, VEIC will coordinate a process through IL TRM TAC for how best to update the IL TRM in light of the findings from this study.

Schedule

The timeline of this research is dependent on the availability of AMI and thermostat data. This research will not be finished in time to inform the IL TRM v8.0 and may not be finished in time to inform IL TRM v9.0 if data is received later than March 20, 2019. Navigant will start coordinating meetings with the Advanced Thermostat Subcommittee in 2018 (prior to receiving AMI or thermostat data) in an effort to expedite the study and reach agreement on the methodology as soon as possible.

Throughout this study, Navigant will work with the TRM Administrator to share documents on a publicly available SharePoint site.

ComEd Small Commercial Programmable Thermostat CY2019 Research Detailed Plan

Introduction

This research plan describes the proposed methods the Navigant team will use to estimate expected electric and gas savings for programmable thermostats installed in small commercial applications. SCPTs are defined in section 4.4.18 of the IL TRM version 6.

Navigant will evaluate savings achieved by SCPTs to support initiatives to update the Illinois TRM with deemed savings for the measure. The research team initially sought to include advanced thermostats in the research study but concluded that there is insufficient data available from ComEd and Ameren tracking files to support the separate measurement of expected savings from advanced thermostats distributed to small commercial customers through energy efficiency (EE) programs. Navigant made this determination in consultation with Ameren's evaluator, Opinion Dynamics (ODC).¹¹⁸ Navigant will leverage data from ComEd, People's Gas and North Shore Gas (PGL-NSG), and Nicor Gas to evaluate savings achieved by SCPTs.

Overall Study Goal

The research objective is to estimate expected savings for SCPTs in small commercial applications. Navigant will deliver a report and presentation of the findings. Pending findings, Navigant may develop a TRM workpaper to update the TRM with deemed savings estimates for SCPTs.

Research Questions

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

- What are the annual expected electric and gas savings for SCPTs in small commercial applications?
- What are the annual expected electric and gas savings for SCPTs by building type defined in the TRM for the available building types represented in program tracking data?

Summary of Evaluation Research Activities

Navigant will propose a regression model specification used to estimate savings for SCPTs and would like to collaborate with the relevant ComEd and ICC staff and stakeholders to finalize the methodology and model specification. In addition, sufficiency of participant data will determine the extent to which we will be able to estimate expected savings by building type. Participant data will consist of energy usage readings collected through ComEd's Advanced Metering Infrastructure (AMI) as well as monthly billing data from PGL-NSG and Nicor Gas. Table 1 provides an overview of the high-level activities involved in this research study.

¹¹⁸ ODC indicated Ameren-Illinois (AIC) will not be involved in the section of the study focusing on TRM Measure 4.4.18 (programmable thermostat) due to minimal percentage of AIC savings and lower total number of installations. However, ODC is interested on collaborating on advanced thermostat study in the future when sufficient data is available (email from ODC on 7/20/2018).

Table 1. Evaluation Research Activities

Activity	Rationale	Timing
Secondary Research	Review similar research studies to determine if Navigant's proposed research methodology should be revised. Use relevant results of studies with similar methodologies to benchmark Navigant's research results.	Fall 2018
Analysis of AMI and Billing Data	Use AMI and billing usage data and specified model to estimate expected savings.	Pending receipt of data

Methodology

This detailed plan outlines activities and timing for the SCPT research study into five discrete tasks, as summarized in Table 2.

Table 2. Summary of Tasks, Deliverables, and Timeline

Tasks	Activities	Data Needs	Deliverables	Timeline
Task 1: Secondary Research	<ul style="list-style-type: none"> Literature review to identify other similar studies Evaluate methods used by similar studies Align with a method or describe why a different method is better suited 	None	None	September 2018 through November 2018
Task 2: Methodology and Model Specification	<ul style="list-style-type: none"> Review proposed model specification Gather feedback from stakeholders 	None	Presentation deck	August 2018 through October 2018
Task 3: Data Request	Navigant will provide ComEd with a request for lists of accounts and a timeframe. Navigant will work with PGL-NSG and Nicor Gas to find relevant accounts.	Customer AMI and billing data	Customer AMI and billing data	September 2018
Task 4: Savings Estimation	Estimate participant savings achieved through installing SCPTs.	None	None	Two months after receiving data*
Task 5: Reporting	Compile findings and recommendations into report.	None	<ul style="list-style-type: none"> Research report Findings presentation TRM workpaper (TBD) 	Three months after receiving data*
Time to Complete the Project	-	-	-	3 months after receiving data*

*Navigant recognizes that acquiring data may take some time, so the schedule reflects practical timing for Navigant completing the analyses after verifying that data received is complete.

Task 1: Secondary Research

Navigant will perform a literature review to identify similar research, determine whether Navigant's proposed methodology is the optimal choice for this research study, and establish benchmark savings values. Navigant will survey methods used in similar research studies and may revise the proposed method if another method proves to be more accurate in estimating savings for SCPTs. For studies with similar methodologies, the research team will use relevant results to benchmark the results of this study. Navigant will focus the literature review on studies conducted in regions with similar climates as the ComEd service territory. The research team welcomes suggested studies to review from ComEd, ICC staff, and other stakeholders.

Task 2: Methodology and Model Specification

Navigant will rely on the results of the literature review as well as collaboration with stakeholders to finalize the methodology and regression model used to estimate annual savings for SCPT participants. Prior to the literature review and subsequent discussions with ComEd and research study stakeholders, Navigant proposes a quasi-experimental approach and a lagged-dependent variable (LDV) regression model to estimate annual expected savings for SCPT participants.

The research team proposes quasi-experimental approach rather than a randomized controlled trial (RCT) due to the participant self-selection intrinsic to the design of the EE programs through which participants install SCPTs. For more information on the eligible participants, please see section 0. This approach will compare the energy consumption of the treatment group (customers that installed SCPTs) to that of a matched control group consisting of customers that have not installed SCPTs or participated in an EE program using regression analysis.

The method Navigant proposes to match customers in the treatment group with customers in the control group will rely on energy usage data (AMI data for electric participants and billing data for gas participants) for the pre-installment period, or period before a participant installed a SCPT. For each customer in the treatment group, Navigant will compare the average daily energy consumption in each month during a participant's pre-installment period to that of all customers in the pool of potential matches over the same period. For each comparison, Navigant will calculate the difference in average daily energy use in the given month, D_{PM} (Difference between Participant and potential Match). The quality of the potential match is indicated by the Euclidean distance between the potential control's usage and that of the participant calculated over the matching period. Euclidean distance is defined as \sqrt{SSD} where SSD denotes the Sum of Squared D_{PM} over the matching period. The non-participant whose energy usage minimizes the Euclidean distance during the participant's respective pre-installment period is then chosen as the match for that participant. Matching will be done with replacement.¹¹⁹ Navigant will find two matched control groups, one based on electric energy consumption and the other based on gas energy consumption. Navigant will then estimate annual expected savings separately for each fuel type.

This method, known as regression with pre-program matching (RPPM), is described in Ho, Imai, King, and Stuart.¹²⁰ The proposed LDV regression model is defined in Equation 1.

¹¹⁹ Matching with replacement implies that the same matched control customer may be matched to more than one participant, and thus that there may be fewer (unique) matched controls than participants.

¹²⁰ Daniel Ho, Kosuke Imai, Gary King, Elizabeth A. Stuart, "Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference," *Political Analysis* (2007) 15: 199-236. Downloadable at: <http://gking.harvard.edu/files/matchp.pdf>. See also Guido W. Imbens and Donald B. Rubin, *Causal Inference for Statistics, Social and Biomedical Sciences: An Introduction*, Cambridge University Press 2015; Paul J. Gertler et al., *Impact Evaluation in Practice*, International Bank for Reconstruction and Development 2011; and Joshua D. Angrist and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press 2009.

Equation 1. SCPT Lagged-Dependent Variable Regression Model

$$ADU_{kt} = \beta_1 Treatment_k + \sum_j \beta_{2j} Month_{jt} + \sum_j \beta_{3j} Month_{jt} \cdot ADU_{lag_{kt}} + \varepsilon_{kt}$$

where:

ADU_{kt}	is average daily energy used by customer k on day t of the post-installment period (either kWh or therms)
$Treatment_k$	denotes whether customer k is a participant (=1) or a matched control (=0)
$ADU_{lag_{kt}}$	is customer k 's mean daily energy use (kWh or therms) in the same month of the pre-installment period as that of the current observation
$Month_j$	comprises a set of binary variables indicating which month the current observation (indexed by t) falls into
ε_{kt}	is a cluster-robust disturbance term for customer k

In the above model, β_1 , the regression coefficient on the $Treatment_k$ variable, estimates the average difference in *daily* energy use between the treatment and control groups in the post-installment period. To estimate expected annual energy savings achieved by SCPTs, Navigant will multiply the value β_1 for variable $Treatment_k$ by 365.

Task 3: Data Request

Navigant will request pre-installment and post-installment data for customers in both the treatment group and the pool of potential matched controls for each respective fuel type. Ideally, the pool of potential matched controls would be at least 10 times larger than the treatment group to ensure high-quality matches. To identify potential participants for the study, Navigant reviewed EE program tracking data for customers that satisfied the following conditions:

- The customer did not receive energy efficient measures other than a SCPT
- The SCPT was installed at a time where a year of post-installation data will be available
- The customer is a small business (monthly peak load of 100 kW or less)

Navigant determined the first condition was necessary to isolate the energy impacts of SCPTs without including impacts of other energy efficient measures or behaviors.

The treatment group used to estimate electric impacts will consist of PY8 and PY9 ComEd Air Care Plus program participants. The control group will consist of small business customers that haven't installed a SCPT or participated in an EE program in the current year or the pre-install year. The research team will rely on participant-control match quality rather than a potential control not participating in an EE program as the latter is not a guarantee that the customer hasn't installed a SCPT. Since matching will take place before the participant has installed a SCPT, if energy consumption is similar between the participant and potential control customers then the research team can reasonably assume that the potential control has not installed a SCPT. Navigant will use the list of customers from the Air Care Plus program as a base to identify gas participants for the study. Navigant will work with ComEd, PGL-NSG, and Nicor Gas to find the gas account numbers for these participants then use small business program tracking data from the gas utilities to further refine this list of customers based on the conditions outlined above.

Navigant reviewed tracking data from the PY8 and PY9 Air Care Plus and Small Business Energy Services (SBES) programs to identify a preliminary list of approximately 340 SCPT participants for this

study. ComEd and AIC combined have fewer than 20 advanced thermostat participants that potentially meet the criteria below designed for this study. Navigant found there were no eligible SCPT study participants in the SBES tracking data due to customers receiving multiple energy efficient measures through the program. Subsequently, the research team decided the focus of the current research should be based on Air Care Plus SCPT participants.

Task 4: Savings Estimation

Pending the results of the literature review and collaboration with stakeholders, Navigant plans to estimate savings using a regression model. For the proposed model defined in Equation 1, expected annual savings achieved by SCPTs are estimated by annualizing the average daily energy savings for the treatment group. Average daily energy savings for the treatment group are represented by the coefficient value, β_1 , for the variable $Treatment_k$. Dependent upon the availability of data for given building types defined in the TRM, Navigant will evaluate the feasibility of estimating expected savings by building type.

Task 5: Reporting

Navigant will produce a report detailing the results of the analysis and literature review. Additionally, the research team will present the results to the ICC and research stakeholders. Pending the results of the analysis, Navigant will produce a TRM workpaper to inform updates to the TRM for the SCPT measure.

Schedule

The timeline shown previously in Table 2 lays out the expected time to complete each task of the project. Because the main analytical tasks depend on receiving customer usage data from ComEd, PGL-NSG and Nicor, Navigant's anticipated completion dates are necessarily dependent on receipt of complete data necessary to perform the analysis.

ComEd VSD CY2019 Evaluation Research Plan

Introduction

This research plan describes the proposed methods the Navigant team will use to conduct evaluation research to enhance the Illinois Technical Reference Manual (IL TRM) savings algorithm and input parameter assumptions for Variable Speed Drives (VSDs) applied to HVAC Pumps and Cooling Tower Fans (CTFs).

Background for Research Prioritization

Navigant identified VSDs on HVAC Pumps and CTFs as a high priority research item based on the TRM Evaluation Prioritization process. based on the TRM Evaluation Prioritization process. The TRM Evaluation Prioritization process is an annual review of the TRM based measures to determine which measures are high priority candidates for secondary or primary research.. Below is additional detail on the basis for the prioritization of this measure:

1. **The measure is one of the largest portions of commercial and industrial portfolio non-lighting savings.** The portion of savings attributed to VSDs in the ComEd Standard Program portfolio has increased in recent years from 7% in PY8 to 12% in PY9. Of the total PY9 Standard Program savings attributed to VSDs: Supply and Return fans accounted for the largest share (50%) and HVAC Pumps and CTF VSD installations accounted for another 30%.
2. **The realization rates for this measure have been variable.** The HVAC Pumps and CTF VSD measure realization rate in the PY9 ComEd Standard Program was 55%. In comparison, the PY9 realization rate for Supply and Return Fans was 104%. With HVAC Pumps and CTFs, Navigant found several discrepancies between reported and verified parameter values including: hours of use, part-load ratio, and load factor. Also, numerous projects received zero verified savings due to improper use of the VSD according to current program rules (incentivized units lacking proper controls). These discrepancies are the primary driver of the low realization rate for VSDs used in HVAC Pump and CTF applications.
3. **The TRM input assumptions for HVAC pumps and CTFs are older, not regionally specific to Illinois, and not well-documented.** The HVAC pump energy savings factors are based on the 2013 Connecticut TRM, which derived the values using a temperature bin analysis, referencing ASHRAE 90.1-1989. The energy savings factors are based on eQuest models for VSD vs. one-speed fan, however the fan load profiles reference in the IL TRM are not publicly available.

As noted above, the supply and return fan VSDs contribute the largest percentage of savings for VSD applications; however, they are not the primary focus of this study as this measure group has more consistent realization rates (104%) and a more recent and robust TRM reference. Therefore, Navigant will focus this research on VSDs on HVAC Pumps and CTFs, which have greater variability in their realization rates and an older TRM reference.

Study Goals

The two primary goals of this research effort are:

1. Conduct secondary research to fortify referencing in the IL TRM HVAC Pumps and CTF VSD measure. If possible, this task would include updating the IL TRM values and referencing for Energy Savings Factor (ESF), Demand Savings Factor (DSF), Hours of Use (HOU), and motor efficiency (EFFi).

2. Review previous ComEd Standard Program data and evaluation analyses to determine what is driving the low VSD HVAC Pumps and CTF projects' realization rates, and what changes can be made to increase these realization rates.

Research Questions

This study will seek to answer the following questions:

- What are the average **ESF and DSF** for Hot Water Pump (HWP), Chilled Water Pump (CWP), condenser water pumps (CDWP), and Cooling Tower Fan (CTF) applications? What is the winter peak coincidence factor?
- How do actual **HOU** (found through previous Standard program field work) for HVAC Pumps and Cooling Tower Fans with installed VSDs compare to the TRM values?
- What **baseline control methods** do VSDs typically replace for HVAC Pumps and CTF?
- What are the typical **motor efficiencies** of HVAC Pump and Cooling Tower Fan systems with VSDs?¹²¹

Summary of Evaluation Research Activities

Table 1 summarizes tasks, activities, and deliverables planned for this study.

Table 1. Summary of Tasks, Deliverables, and Timelines

Tasks	Activities	Deliverables
Task 1: Conduct Secondary Research to update IL TRM	Secondary research to update IL TRM Pumps & CTF algorithm factors (ESF, DSF, HOU, EFFi)	Memo detailing research findings and proposed IL TRM updates
Task 2: Review previous Standard Program Data, Impact Analyses, and Evaluation Protocols	Review Standard program research findings from past years; Working group sessions with ComEd and Implementation Contractor program managers	
Task 3: Reporting and TRM update	Finalize research memo. Draft and submit TRM workpaper	Final Memo; TRM Workpaper

Although the research tasks are separate endeavors, Navigant will combine the findings and recommendations from the different tasks into a comprehensive final research report. This research report will inform a TRM workpaper to increase the accuracy of prescriptive HVAC Pumps and Cooling Tower Fan VSD savings.

Methodology

The following sections provide detailed descriptions of all tasks outlined in Table 1.

¹²¹ IL TRM currently deems 93% motor efficiency if unknown. However, Supply and Return Fan IL TRM measure utilizes the NEMA Premium Efficiency Motor Default table, which deems motor efficiencies for varying motor types, sizes, and speeds. This table could be used for HVAC Pumps and Cooling Tower Fans as well. NEMA Premium Motor Default table: Douglass, J. (2005). Induction Motor Efficiency Standards. Washington State University and the Northwest Energy Efficiency Alliance, Extension Energy Program, Olympia, WA. Retrieved October 17, 2013, from http://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/motor_efficiency_standards.pdf

Task 1. Conduct Secondary Research to update IL TRM

Navigant will conduct a secondary literature review to update impact parameters below.

Navigant will conduct secondary research to **update the IL TRM VSD for HVAC Pumps and CTF measure energy savings factors (ESFs) and demand savings factors (DSFs)**. Navigant will focus research on applications which are most common in the ComEd Standard Program.

Navigant will update the Motor Efficiency (EFFi) factor. The IL TRM currently states to use a deemed value of 93% if the actual efficiency is unknown. To correctly update the motor efficiency value the single deemed value of 93% should be replaced with a dynamic table of efficiencies based on the properties of the motor.

Task 2. Review Standard Program Data, Impact Analyses, and Evaluation Protocols

Navigant conducted an initial review of the ComEd Standard Program research and verified realization rates. We found that verified savings adjustments were commonly based on the following:

- VSDs were found to be operating at a fixed speed in the field
- VSDs were installed in process applications instead of on HVAC pumps or fan motors
- VSDs were found without automatic modulation per feedback controls
- Adjusting VSD HOU to actual based on project files or field work

According to ComEd Standard Program eligibility requirements, VSDs on HVAC Pumps or Fans must be controlled with automatic control technology¹²². Due to program requirements, when the evaluation team finds projects through file reviews or on-site visits which are operating at fixed speeds, not modulating on feedback controls, or installed on the wrong technology, no verified savings are counted for that project.

Navigant will hold working group sessions with ComEd, the implementer, and customers to discover why these persisting issues are occurring and if increased customer engagement, measure education, or other actions could limit these issues. Additionally, Navigant will review the changes made to projects based on research findings to determine if there are any additional trends related to the bulleted list above.

Navigant will use previous ComEd Standard Program data and evaluation reports to further investigate why realization rate issues are occurring for HVAC Pump and CTF VSDs. The goal of this research task will be to increase HVAC Pumps and CTF VSD realization rates exclusive of updating the IL TRM energy savings measure itself.

Task 3. Reporting

Reporting for this secondary research effort includes a final research memo, and submitting a TRM workpaper to the Technical Advisory Committee (TAC). The research memo will summarize all relevant findings and will include the preliminary updates to the IL TRM measure, ComEd Standard Program eligibility requirements, and any other proposed changes regarding VSDs on HVAC Pumps and CTFs. Once the report and any updates are finalized, Navigant will submit an updated TRM workpaper to the (TAC) for HVAC Pumps and CTFs.

¹²² ComEd Variable Speed Drives Incentives Worksheet (January 1, 2018 through December 31, 2018)

Schedule

Table 2 below summarizes the key deadlines for the VSD study.

Table 2. Project Schedule

Activity or Deliverable	Responsible Party	Date Delivered
Conduct Secondary Research to update IL TRM	Navigant	December 2018 – April 2019
Review previous Standard Program Data, Impact Analyses, and Evaluation Protocols	Navigant	December 2018 – April 2019
Final Memo with IL TRM secondary research results and VSD/Standard Program findings and recommendations	Navigant	April 2019
TRM workpaper	Navigant	May 15, 2019