



# Coordinated Utility Retro-Commissioning Offering Impact Evaluation Report

Energy Efficiency / Demand Response Plan:  
Program Year 2018 (CY2018)  
(1/1/2018-12/31/2018)

Presented to:  
ComEd  
Nicor Gas  
Peoples Gas  
North Shore Gas

**FINAL**

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of the Coordinated Utility Retro-Commissioning Offering for CY2018. It is a summary of the energy and demand impacts for the total offering and broken out by relevant structural details. The report provides detail by implementer showing total electric and gas savings as well as individual implementer savings by electric and gas. The CY2018 Retro-commissioning Offering combines the projects from two separate implementation contractors (ICs) who administered the offering for different market sectors. The research categories for this evaluation are based on two ICs, Nexant, Inc. (Nexant) and 360 Energy Group.

**Table 1-1. Offering Research Categories**

Contractor	Market Sector	Originator	Offering Tracks
Nexant	Private (primarily)	ComEd	4
360 Energy Group	Public	DCEO	1

*Source: ComEd tracking data and Navigant team analysis.*

360 Energy Group projects were started as part of a parallel offering for the public sector and managed by the Illinois Department of Commerce and Economic Opportunity (DCEO). These projects were subsumed by the Coordinated Utility Retro-Commissioning offering for CY2018 completion. Starting in CY2019 Nexant, offering four retro-commissioning tracks, will administer the Retro-Commissioning Offering for all eligible ComEd and gas utility customers, public and private.

The appendix presents the impact analysis methodology for both research categories. CY2018 covers January 1, 2018 through December 31, 2018.

## 2. OFFERING DESCRIPTION

The Coordinated Utility Retro-Commissioning (Retro-Commissioning) Offering has been part of the ComEd’s Energy Efficiency Program since 2007. In 2010, ComEd began coordinating the offering with gas utilities which also serve ComEd customers. ComEd manages and funds the offering, and the gas utilities have the option to share the costs and savings with ComEd on a project-by-project basis. The overlapping gas territories include Nicor Gas, Peoples Gas, and North Shore Gas. The Retro-Commissioning Offering is a natural fit for coordinated delivery with the gas providers due to the intensive investigation and analysis of heating, ventilation, and air-conditioning (HVAC) systems. Individual measures often save both electricity and natural gas so that analyzing one energy source, while neglecting the other, would fail to document all energy savings incented by the offering.

The offering helps commercial and industrial (C&I) customers below 10 MW improve the performance and reduce energy consumption of their facilities through the systematic analysis of *existing* building systems. Generally, the offering pays for 100 percent of a detailed study, contingent upon a participant’s commitment to spend a defined amount of their own money implementing a bundle of study recommendations having a simple payback of 18 months or less. The Nexant offering consists of four tracks, with three targeted to medium to large commercial buildings: traditional retro-commissioning (RCx), monitoring-based retro-commissioning (MBCx) and RCxpress.

- RCx projects typically require more than one year and result in a single comprehensive deliverable.
- MBCx projects are based on a multi-year agreement between the building owner and the Energy Efficiency Service Provider (EESP). This comprehensive approach identifies, analyzes, implements, and verifies measures on a rolling basis with the EESP monitoring Building Automation System (BAS) data periodically to ensure on-going savings. Measure savings are

counted toward offering goals in the calendar year they are submitted based on EESP monitoring since the prior submitted savings.

- RCxpress engagements last less than one year and typically have a more limited scope than RCx.

The RCx Building Tune-Up (Tune-up) track is more focused on the most common RCx measures in smaller commercial buildings and groceries and results in a briefer deliverable on a faster timeline.

Beginning in CY2018, the Nexant offering also serves public sector customers. This impact evaluation also includes public sector projects administered by 360 Energy Group, completed in CY2018, but initiated at an earlier time by public sector participants in the DCEO Retro-Commissioning Program. Because of substantive differences between the DCEO and Coordinated Utility Retro-Commissioning Offering offerings, the impact evaluation results are reported separately for Nexant- and 360 Energy Group-administered projects.

The offering had 167 projects in CY2018, including 44 DCEO projects. The 360 Energy Group offering did not track individual measures by project; therefore, summaries by measure reflect only the Nexant offering. In CY2018 Nexant implemented measures with both electric and gas savings as shown in Table 2-1 and Table 2-2 and the following graphs. Additional offering attributes are shown in Table 2-3, below.

**Table 2-1. CY2018 Volumetric Findings Detail by Utility\* Nexant-Administered†**

Participation	Electric Only	Nicor Gas	Peoples Gas	North Shore Gas	Total
Total Projects‡	73	25	23	2	123
Electric Measures	209	73	66	6	354
Gas Measures	5	32	26	3	66
Total Measures‡	216	83	70	6	375
Measures/Project	3.0	3.3	3.0	3.0	3.0

\*Project and measure counts exclude DCEO projects.

† Gas project totals include eight projects in Nicor Gas territory and seven projects in Peoples Gas territory with zero therms savings for the final set of measures installed.

‡Totals include some measures with both electric and gas savings.

Source: ComEd tracking data and Navigant team analysis.

Among 44 additional DCEO projects administered by 360 Energy Group, 35 have gas savings and five of these 35 are projects that are only eligible to receive gas company incentives. Nicor Gas, North Shore Gas and Peoples Gas had 22, seven and six gas-saving projects respectively, administered by 360 Energy Group. Nine 360 Energy Group projects had no gas savings. 360 Energy Group offering summary tracking files do not list individual measures. Individual project files contain measure details, but the evaluation team did not try to construct a measure level tracking database based on the detail in the project files.

**Table 2-2. CY2018 Volumetric Findings Detail by Track\***

Participation	MBCx	RCx	RCxpress	Tune-Up	Implementer A Total	Implementer B Total
Total Projects	21	6	22	74	123	44
Electric Measures	56	44	79	175	354	
Gas Measures	11	7	13	35	66	NA
Total Measures	57	48	84	186	375	
Measures/Project	2.7	8.0	3.8	2.5	3.0	NA

\* Some measures have both electric and gas savings.

NA = Not applicable

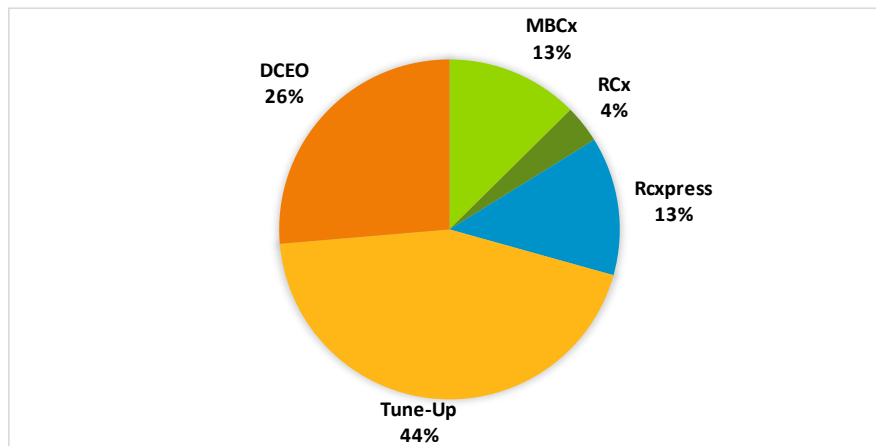
Source: ComEd tracking data and Navigant team analysis.

**Table 2-3. Offering Attributes – by Participation Track**

Participation Track	Target Facility Size	Incentives	Customer Commitment
Retro-Commissioning (RCx)	>500,000 ft <sup>2</sup> >10 GWh	100% Study \$60,000-\$100,000 Customer implementation bonuses	\$25,000 Operator Training
Monitoring Based (MBCx)	>150,000 ft <sup>2</sup> >3 GWh	Monitoring integration and \$0.08/kWh and per therm incentives	12-month monitoring contract
RCxpress	150,000-500,000 ft <sup>2</sup> 3-10 GWh	100% Study <\$60,000 Customer and Service Provider bonuses	\$5,000 - \$10,000
RCx Building Tune-Up	<150,000 ft <sup>2</sup> 0.5-3.0 GWh	\$25,000 max study Up to \$0.04/kWh with caps	Coordination
DCEO	No restrictions	100% Study with caps	\$10,000

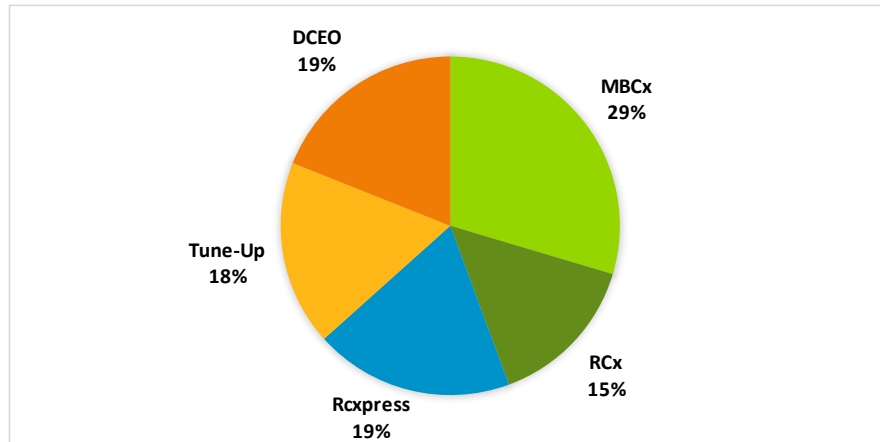
Source: ComEd program fact sheets

**Figure 2-1. Distribution of Projects Completed by Track**



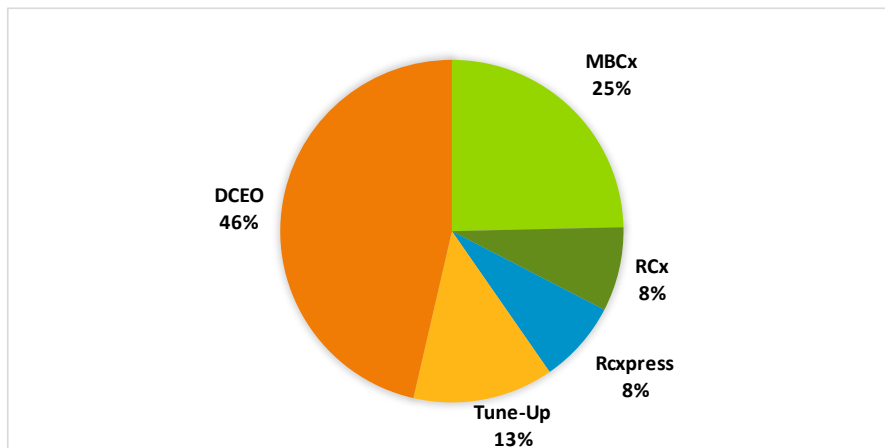
Source: ComEd tracking data and Navigant team analysis.

Figure 2-2. Distribution of Electric kWh Saved (ex ante gross) by Track



Source: ComEd tracking data and Navigant team analysis.

Figure 2-3. Distribution of Natural Gas Therms Saved (ex ante gross) by Track



Source: ComEd tracking data and Navigant team analysis.

### 3. OFFERING SAVINGS DETAIL

Table 3-1 summarizes the incremental energy and demand savings the Retro-Commissioning Offering achieved by ComEd in CY2018. Table 3-3 and Table 3-4 present the incremental electric savings by IC. The gas savings in these tables is only that which gas utilities may not be claiming and ComEd can claim.<sup>1</sup> Overall gas savings claimed by the gas utilities is shown in Table 3-2. Table 3-5 and Table 3-6 show gas savings by IC. Verified net electric savings are 34,519,759 kWh. Verified net gas savings converted to electric savings are 2,907,030 kWh.

In general, gas companies claimed most of the gas savings realized through the offering. In March 2019, ComEd informed evaluators that gas savings realized through the RCx Building Tune-Up track was not claimed by the gas utilities, and ComEd will claim that energy savings, converted to kWh (See Table 3-1 note).



**Table 3-1. CY2018 Total Annual Incremental Electric Savings**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
<b>Electricity</b>			
Ex Ante Gross Savings	39,558,104	1,069	1,069
Offering Gross Realization Rate	92%	145%	145%
Verified Gross Savings	36,336,589	1,550	1,550
Offering Net-to-Gross Ratio (NTG)	0.95	0.95	0.95
Verified Net Savings	34,519,759	1,472	1,472
<b>Converted from Gas*</b>			
Ex Ante Gross Savings	2,946,798	0	0
Offering Gross Realization Rate	97%	0%	0%
Verified Gross Savings	2,850,029	0	0
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02
Verified Net Savings	2,907,030	0	0
<b>Total Electric Plus Gas</b>			
Ex Ante Gross Savings	42,504,902	1,069	1,069
Offering Gross Realization Rate	92%	145%	145%
Verified Gross Savings	39,186,618	1,550	1,550
Offering Net-to-Gross Ratio (NTG)	0.96†	0.95	0.95
Verified Net Savings	37,426,789	1,472	1,472

\* Gas savings converted to kWh by multiplying therms by 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh). The evaluation team will determine which gas savings will be converted to kWh and counted toward ComEd's electric savings goal while producing the portfolio-wide Summary Report. According to Section 8-103B(b-25) of the Illinois Public Utilities Act, "In no event shall more than 10% of each year's applicable annual incremental goal as defined in paragraph (7) of subsection (g) of this Section be met through savings of fuels other than electricity."

† The combined NTG ratio in the 'Total Electric Plus Gas' section is not a deemed value, it is a weighted average effective NTG that falls out of the combined savings calculation in the CPAS spreadsheet for net electric savings (deemed NTG = 0.95) plus net gas-converted electric savings (deemed NTG = 1.02).

Note: The coincident Summer Peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and Navigant team analysis.

**Table 3-2. CY2018 Total Annual Incremental Therm Savings\***

Savings Category	Nicor Gas Therms	Peoples Gas Therms	North Shore Gas Therms	Total
<b>Natural Gas</b>				
Ex Ante Gross Savings	379,175	451,867	153,519	984,561
Offering Gross Realization Rate	92%	95%	54%	NA
Verified Gross Savings	348,318	427,610	82,297	858,226
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02	1.02
Verified Net Savings	355,285	436,162	83,943	875,390

\* Measure-level negative natural gas savings, caused by electric saving measure implementation, were removed in the process of verifying gross savings.

NA = Not applicable.

Source: ComEd, Nicor Gas, Peoples Gas, and North Shore Gas tracking data and Navigant team analysis.

**Table 3-3. CY2018 Total Annual Incremental Electric Savings – Nexant**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
<b>Electricity</b>			
Ex Ante Gross Savings	32,060,851	863	863
Offering Gross Realization Rate	90%	169%	169%
Verified Gross Savings	28,876,062	1,456	1,456
Offering Net-to-Gross Ratio (NTG)	0.95	0.95	0.95
Verified Net Savings	27,432,259	1,383	1,383
<b>Converted from Gas*</b>			
Ex Ante Gross Savings	2,946,798	0	0
Offering Gross Realization Rate	97%	0%	0%
Verified Gross Savings	2,850,029	0	0
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02
Verified Net Savings	2,907,030	0	0
<b>Total Electric Plus Gas</b>			
Ex Ante Gross Savings	35,007,649	863	863
Offering Gross Realization Rate	91%	169%	169%
Verified Gross Savings	31,726,092	1,456	1,456
Offering Net-to-Gross Ratio (NTG)	0.96†	0.95	0.95
Verified Net Savings	30,339,289	1,383	1,383

\* Gas savings converted to kWh by multiplying therms by 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh). The evaluation team will determine which gas savings will be converted to kWh and counted toward ComEd's electric savings goal while producing the portfolio-wide Summary Report. According to Section 8-103B(b-25) of the Illinois Public Utilities Act, "In no event shall more than 10% of each year's applicable annual incremental goal as defined in paragraph (7) of subsection (g) of this Section be met through savings of fuels other than electricity."

† The combined NTG ratio in the 'Total Electric Plus Gas' section is not a deemed value, it is a weighted average effective NTG that falls out of the combined savings calculation in the CPAS spreadsheet for net electric savings (deemed NTG = 0.95) plus net gas-converted electric savings (deemed NTG = 1.02). Note: The coincident Summer Peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and Navigant team analysis.

**Table 3-4. CY2018 Total Annual Incremental Electric Savings – 360 Energy Group**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
<b>Electricity</b>			
Ex Ante Gross Savings	7,497,253	207	207
Offering Gross Realization Rate	100%	45%	45%
Verified Gross Savings	7,460,527	94	93.67
Offering Net-to-Gross Ratio (NTG)	0.95	0.95	0.95
Verified Net Savings	7,087,500	89	89
<b>Converted from Gas*</b>			
Ex Ante Gross Savings	0	0	0
Offering Gross Realization Rate	NA	NA	NA
Verified Gross Savings	0	0	0
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02
Verified Net Savings	0	0	0
<b>Total Electric Plus Gas</b>			
Ex Ante Gross Savings	7,497,253	207	207
Offering Gross Realization Rate	100%	45%	45%
Verified Gross Savings	7,460,527	94	94
Offering Net-to-Gross Ratio (NTG)	0.95	0.95	0.95
Verified Net Savings	7,087,500	89	89

\* Gas savings converted to kWh by multiplying therms by 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).

NA = Not applicable

Note: The coincident Summer Peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and Navigant team analysis.

**Table 3-5. CY2018 Total Annual Incremental Therm Savings\* – Nexant**

Savings Category	Nicor Gas Therms	Peoples Gas Therms	North Shore Gas Therms	Total
<b>Natural Gas</b>				
Ex Ante Gross Savings	78,753	381,810	20,632	481,195
Offering Gross Realization Rate	97%	91%	101%	NA
Verified Gross Savings	76,342	348,895	20,882	446,119
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02	1.02
Verified Net Savings	77,869	355,873	21,300	455,041

\* Measure-level negative natural gas savings, caused by electric saving measure implementation, were removed in the process of verifying gross savings.

NA = Not applicable

Source: ComEd, Nicor Gas, Peoples Gas, and North Shore Gas tracking data and Navigant team analysis.

**Table 3-6. CY2018 Total Annual Incremental Therm Savings – 360 Energy Group**

Savings Category	Nicor Gas Therms	Peoples Gas Therms	North Shore Gas Therms	Total
<b>Natural Gas</b>				
Ex Ante Gross Savings	300,422	70,057	132,887	503,366
Offering Gross Realization Rate	91%	112%	46%	NA
Verified Gross Savings	271,976	78,716	61,415	412,107
Offering Net-to-Gross Ratio (NTG)	1.02	1.02	1.02	1.02
Verified Net Savings	277,416	80,290	62,644	420,349 *

Measure-level negative natural gas savings, caused by electric saving measure implementation, were removed in the process of verifying gross savings.

NA = Not applicable

Source: ComEd, Nicor Gas, Peoples Gas, and North Shore Gas tracking data and Navigant team analysis.

## 4. CUMULATIVE PERSISTING ANNUAL SAVINGS

The research category-specific and total ex ante gross savings for the Retro-Commissioning Offering and the cumulative persisting annual savings (CPAS) for the measures installed in CY2018 are shown in the following tables and figure. The total electric CPAS across all ICs installed in 2018 is 34,519,759 kWh net savings. The offering achieved 974,572 therms total net natural gas savings which includes 875,390 net therms cost-shared by the coordinated gas utilities<sup>2</sup> plus 99,182 net therms converted to kWh and claimed by ComEd as ComEd CPAS savings. The gas savings claimed by ComEd achieved 2,907,030 kWh net CPAS equivalent<sup>3</sup>. Adding the savings converted from gas savings to the electric savings produces a total of 37,426,789 kWh of total net ComEd CPAS savings.

<sup>2</sup> The gas savings for Nicor Gas, Peoples, and North Shore Gas are not reported in ComEd CPAS tables. The evaluation team will determine which gas savings will be counted toward goal while producing the portfolio-wide Summary Report. According to Section-8-103B of Act 99-0906, "In no event shall more than 10% of each year's applicable annual incremental goal as defined in paragraph (7) of subsection (g) of this Section be met through savings of fuels other than electricity."

<sup>3</sup> The conversion factor from gas to electric is mandated by IL SAG rule as 1 therm = 100,000 Btu. 1 kWh = 3,412 Btu.

1 therm = 100,000/3412 = 29.31 kWh equivalent.

**Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric**

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings	NTG*	Lifetime Net Savings†	Verified Net kWh Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Retro-Commissioning	Nexant	7.5	28,876,062	0.95	205,741,945	27,432,259	27,432,259	27,432,259	27,432,259	27,432,259	27,432,259	27,432,259	13,716,130	-	
Retro-Commissioning	360 Energy Group	7.5	7,460,527	0.95	53,156,251	7,087,500	7,087,500	7,087,500	7,087,500	7,087,500	7,087,500	7,087,500	3,543,750	-	
						-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
CY2018 Program Total Electric CPAS			36,336,589		258,898,196	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	17,259,880	-	
CY2018 Program Expiring Electric Savings‡							-	-	-	-	-	-	17,259,880	34,519,759	

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings	NTG*	Lifetime Net Savings†	Verified Net kWh Savings									
						2027	2028	2029	2030	2031	2032	2033	2034	2035	
Retro-Commissioning	Nexant	7.5	28,876,062	0.95	205,741,945	-	-	-	-	-	-	-	-	-	
Retro-Commissioning	360 Energy Group	7.5	7,460,527	0.95	53,156,251	-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
CY2018 Program Total Electric CPAS			36,336,589		258,898,196	-	-	-	-	-	-	-	-	-	
CY2018 Program Expiring Electric Savings‡						34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	34,519,759	

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY10\_Recommendations\_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

Note: The green highlighted cell shows program total first year electric savings.

Source: Navigant analysis

**Table 4-2. Cumulative Persisting Annual Savings (CPAS) – Gas**

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings (Therms)	NTG*	Lifetime Net Savings†	Verified Net Therms Savings									
						2018	2019	2020	2021	2022	2023	2024	2025	2026	
Retro-Commissioning	Nexant	7.5	97,237	1.02	743,866	99,182	99,182	99,182	99,182	99,182	99,182	99,182	49,591	-	
Retro-Commissioning	360 Energy Group	7.5	-	1.02	-	-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
						-	-	-	-	-	-	-	-	-	
CY2018 Program Total Gas CPAS (Therms)			97,237		743,866	99,182	99,182	99,182	99,182	99,182	99,182	99,182	49,591	-	
CY2018 Program Total Gas CPAS (kWh Equivalent)‡					21,802,723	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	1,453,515	-	
CY2018 Program Expiring Gas Savings (Therms)§							-						49,591	99,182	
CY2018 Program Expiring Gas Savings (kWh Equivalent)‡§													1,453,515	2,907,030	

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings (Therms)	NTG*	Lifetime Net Savings†	Verified Net Therms Savings									
						2027	2028	2029	2030	2031	2032	2033	2034	2035	
Retro-Commissioning	Nexant	7.5	97,237	1.02	743,866										
Retro-Commissioning	360 Energy Group	7.5	-	1.02	-										
CY2018 Program Total Gas CPAS (Therms)			97,237		743,866	-	-	-	-	-	-	-	-	-	
CY2018 Program Total Gas CPAS (kWh Equivalent)‡					21,802,723	-	-	-	-	-	-	-	-	-	
CY2018 Program Expiring Gas Savings (Therms)§						99,182	99,182	99,182	99,182	99,182	99,182	99,182	99,182	99,182	
CY2018 Program Expiring Gas Savings (kWh Equivalent)‡§						2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	2,907,030	

\* A deemed value. Sources: Nicor\_Gas\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx and PGL\_NSQ\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx, which are to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Lifetime savings are the sum of CPAS savings through the EUL.

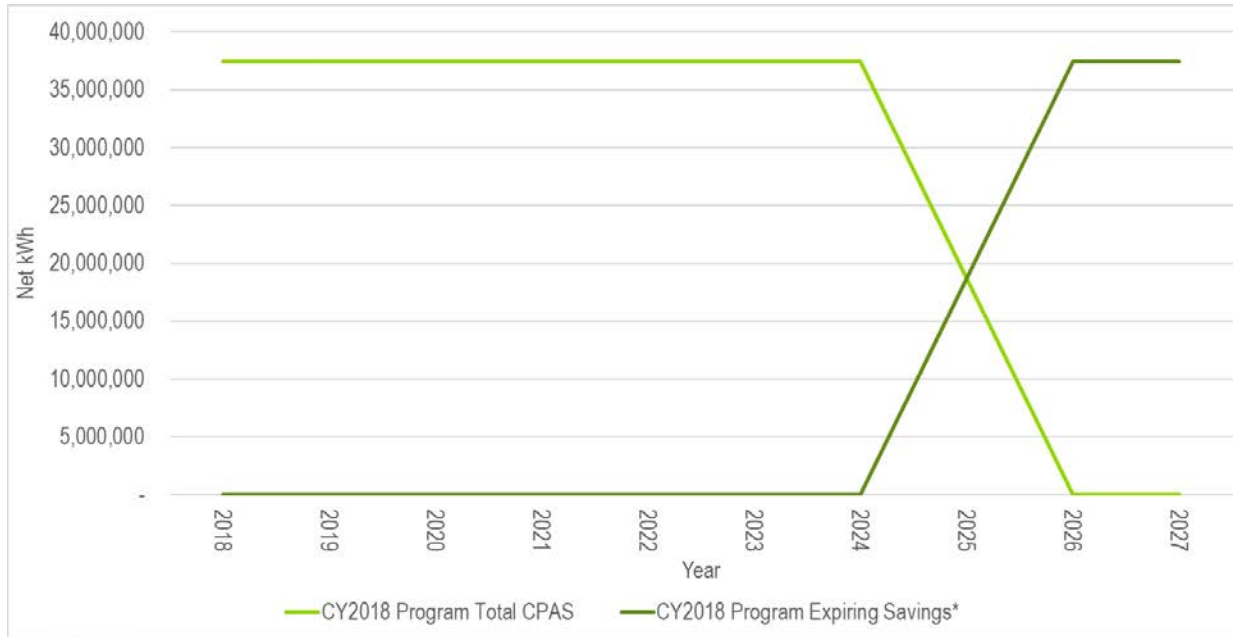
‡ kWh equivalent savings are calculated by multiplying therm savings by 29.31.

§ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

Note: The green highlighted cell shows program total first year gas savings in kWh equivalents.

Source: Navigant analysis

**Figure 4-1. Total Cumulative Persisting Annual Savings<sup>†</sup>**



\*Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

† Includes converted gas savings kWh claimed by ComEd.

Source: Navigant analysis

## 5. OFFERING SAVINGS BY RESEARCH CATEGORY

The evaluation researched savings for the Retro-Commissioning Offering by IC rather than by measure or track. Previously-started 360 Energy Group (DCEO) projects were subsumed by the Coordinated Utility offering in CY2018 for completion. The design of the 360 Energy Group offering and its delivery are different from the core Coordinated Utility offering; therefore, this evaluation researched each of those offerings separately. Both the Nexant projects and 360 Energy Group projects were stratified by size to optimize sampling. For more information about offering-, strata- and site-level savings see Appendix 2. Impact Analysis Detail.

The Retro-Commissioning Offering includes two research categories as shown in the following tables. Nexant offering has four delivery tracks, while 360 Energy Group offering has one delivery track.

**Table 5-1. CY2018 Energy Savings by Implementer – Electric**

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Electric Gross Realization Rate	Verified Gross Savings (kWh)	Electric NTG*	Verified Net Savings (kWh)	Effective Useful Life
RCx	Nexant	32,060,851	0.90	28,876,062	0.95	27,432,259	7.5
RCx	360 Energy Group	7,497,253	1.00	7,460,527	0.95	7,087,500	7.5
<b>Total</b>		<b>39,558,104</b>	<b>0.92</b>	<b>36,336,589</b>	<b>0.95</b>	<b>34,519,759</b>	<b>7.5</b>

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY10\_Recommendations\_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

Source: ComEd tracking data and Navigant team analysis.

**Table 5-2. CY2018 Demand Savings by Implementer – Electric†**

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Electric Gross Realization Rate	Verified Gross Demand Reduction (kW)	Electric NTG*	Verified Net Demand Reduction (kW)
RCx	Nexant	863	1.69	1,456	0.95	1,383
RCx	360 Energy Group	207	0.45	94	0.95	89
<b>Total</b>		<b>1,069</b>	<b>1.45</b>	<b>1,550</b>	<b>0.95</b>	<b>1,472</b>

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY10\_Recommendations\_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Implementers did not report summer-peak demand savings; therefore, Table 5-2 shows same savings as Table 5-3. Source: ComEd tracking data and Navigant team analysis.

**Table 5-3. CY2018 Summer Peak Demand Savings by Implementer – Electric†**

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Electric Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	Electric NTG*	Verified Net Peak Demand Reduction (kW)
RCx	Nexant	863	169%	1,456	0.95	1,383
RCx	360 Energy Group	207	45%	94	0.95	89
<b>Total</b>		<b>1,069</b>	<b>145%</b>	<b>1,550</b>	<b>0.95</b>	<b>1,472</b>

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY10\_Recommendations\_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Implementers did not report summer-peak demand savings; therefore, Table 5-2 shows same savings as Table 5-3. Source: ComEd tracking data and Navigant team analysis.

**Table 5-4. CY2018 Energy Savings by Implementer – ComEd Claimed Gas Savings**

End Use Type	Research Category	Ex Ante Gross Savings	Verified Gas Gross Realization Rate	Verified Gross Savings	Gas NTG*	Verified Net Savings	Effective Useful Life
RCx	Nexant	100,539	0.97	97,237	1.02	99,182	7.5
RCx	360 Energy Group	0	NA	0	1.02	0	7.5
<b>Total Therms</b>		<b>100,539</b>	<b>0.97</b>	<b>97,237</b>	<b>1.02</b>	<b>99,182</b>	<b>7.5</b>
<b>Total kWh Converted From Therms</b>		<b>2,946,798</b>	<b>0.97</b>	<b>2,850,029</b>	<b>1.02</b>	<b>2,907,030</b>	<b>7.5</b>

\* A deemed value. Source: Nicor\_Gas\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Gas savings converted to kWh by multiplying therms by 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).

NA = Not applicable

Source: ComEd tracking data and Navigant team analysis.



**Table 5-5. CY2018 Energy Savings by Implementer – ComEd Total Claimed Electricity and Gas (Gas Converted to kWh)**

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)
RCx	Nexant	35,007,649	0.91	31,726,092	0.96	30,339,289
RCx	360 Energy Group	7,497,253	1.00	7,460,527	0.95	7,087,500
	<b>Total†</b>	<b>42,504,902</b>	<b>0.92</b>	<b>39,186,618</b>	<b>0.96</b>	<b>37,426,789</b>

\* The combined NTG ratio is not a deemed value, it is a weighted average effective NTG that falls out of the combined savings calculation for net electric (deemed NTG = 0.95) plus net gas-converted (deemed NTG = 1.02) savings. found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>. Only Nexant had gas savings converted to kWh.

† The total includes the electric equivalent of the total therms.

Source: ComEd tracking data and Navigant team analysis.

**Table 5-6. CY2018 Natural Gas Energy Savings by Implementer – Nicor Gas**

Research Category	Ex Ante Gross Savings (therms)	Verified Gas Gross Realization Rate	Verified Gross Savings (therms)	Gas NTG*	Verified Net Savings (therms)	Effective Useful Life
Nexant	78,753	97%	76,342	1.02	77,869	7.5
360 Energy Group	300,422	91%	271,976	1.02	277,416	7.5
<b>Total</b>	<b>379,175</b>		<b>348,318</b>		<b>355,285</b>	

\* A deemed value. Source: Nicor\_Gas\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† The total excludes negative interactive gas savings caused by implementing electric-saving measures.

Source: Nicor Gas tracking data and Navigant team analysis.

**Table 5-7. CY2018 Natural Gas Energy Savings by Implementer – Peoples Gas**

Research Category	Ex Ante Gross Savings (therms)	Verified Gas Gross Realization Rate	Verified Gross Savings (therms)	Gas NTG*	Verified Net Savings (therms)	Effective Useful Life
Nexant	381,810	91%	348,895	1.02	355,873	7.5
360 Energy Group	70,057	112%	78,716	1.02	80,290	7.5
<b>Total</b>	<b>451,867</b>		<b>427,610</b>		<b>436,162</b>	

\* A deemed value. Source: PGL\_NS\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† The total excludes negative interactive gas savings caused by implementing electric-saving measures.

Source: Peoples Gas tracking data and Navigant team analysis.

**Table 5-8. CY2018 Natural Gas Energy Savings by Implementer – North Shore Gas**

Research Category	Ex Ante Gross Savings (therms)	Verified Gas Gross Realization Rate	Verified Gross Savings (therms)	Gas NTG*	Verified Net Savings (therms)	Effective Useful Life
Nexant	20,632	101%	20,882	1.02	21,300	7.5
360 Energy Group	132,887	46%	61,415	1.02	62,644	7.5
<b>Total</b>	<b>153,519</b>		<b>82,297</b>		<b>83,943</b>	

\* A deemed value. Source: PGL\_NS\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† The total excludes negative interactive gas savings caused by implementing electric-saving measures.

Source: North Shore Gas tracking data and Navigant team analysis.

## 6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

### 6.1 Impact Parameter Estimates

The offering-level impact parameter estimates for the Retro-Commissioning Offering are shown below. There are not standard or TRM-based estimates for RCx measures. Each implemented measure is analyzed individually for sampled projects, and reviewed savings is rolled-up to realization rate impact parameter estimates for electric energy, electric demand, and natural gas energy savings. Because of different delivery teams and methods, 360 Energy Group projects have their own realization rate estimates. Regardless of project delivery streams, service providers estimate energy and demand savings with custom algorithms, frequently using hourly weather data and time-series trend data. The Navigant team conducted research to validate the savings individually for all measures in the evaluation sample.

Most often energy savings are determined with engineering relationships of temperature and mass transfer on an hourly basis or summarized by outdoor temperature bins. Occasionally, service providers and evaluators determine savings by regressions of energy use versus outdoor temperature and other independent variables. When energy efficiency measures have a climate component to usage, service providers and evaluators use standard weather data sets (TMY3)<sup>4</sup> for proximal locations to estimate weather-normalized savings.

The offering only reports electric demand savings with respect to the summer peak. Some measures have demand savings tied to the time of day. Other measures have demand savings that are weather-dependent. For the latter, the offering is based on the Weighted Temperature Humidity Index (WTHI) method, promulgated by the PJM Interconnection. This method estimates a dry-bulb temperature that is representative of the whole of summer PJM peak hours for a region. Measure demand savings for weather-dependent measures are based on the estimated demand savings at this temperature. For the ComEd service territory PJM has determined the WTHI value is 81.6.

The lifetime energy and demand savings are estimated by multiplying the verified savings by the effective useful life for each measure. The EM&V team conducted research to validate the parameters that were not specified in the TRM. The results are shown in the following table.

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<sup>4</sup> Typical Meteorological Year, version 3, were produced by NREL's Electric and Systems Center under the Solar Resource Characterization Project, which is funded and monitored by the U.S. Department of Energy's Energy Efficiency and Renewable Energy Office. Source data for all 239 TMY3 locations draw on data from 1991 through 2005.

**Table 6-1. Savings Parameters**

Gross Savings Input Parameters	Value Units	Deemed * or Evaluated?	Source
Quantity Coordinated Utility	123 Projects	Evaluated	
Quantity DCEO participants	44 Projects	Evaluated	
Program Tracks	5	Evaluated	
NTG Electric	95 %	Deemed	IL SAG Consensus†
NTG Gas	102 %	Deemed	IL SAG Consensus†
Gross Savings (kWh) Sampled Measures	21,629,552 kWh	Evaluated	
Gross Savings (therms) Sampled Measures	864,072 therms	Evaluated	
Verified Realization Rate on Ex Ante Gross Savings (Electric) Nexant	90 %	Evaluated	
Verified Realization Rate on Ex Ante Gross Savings (Electric) 360 Energy Group	100 %	Evaluated	
Verified Realization Rate on Ex Ante Gross Savings (Natural Gas) Nexant	93 %	Evaluated	
Verified Realization Rate on Ex Ante Gross Savings (Natural Gas) 360 Energy Group	82 %	Evaluated	
Effective Useful Life (EUL)	7.5 Years	Deemed	IL TRM v7.0 for RCx

\* State of Illinois Technical Reference Manual version 6.0 from <http://www.ilsag.info/technical-reference-manual.html>

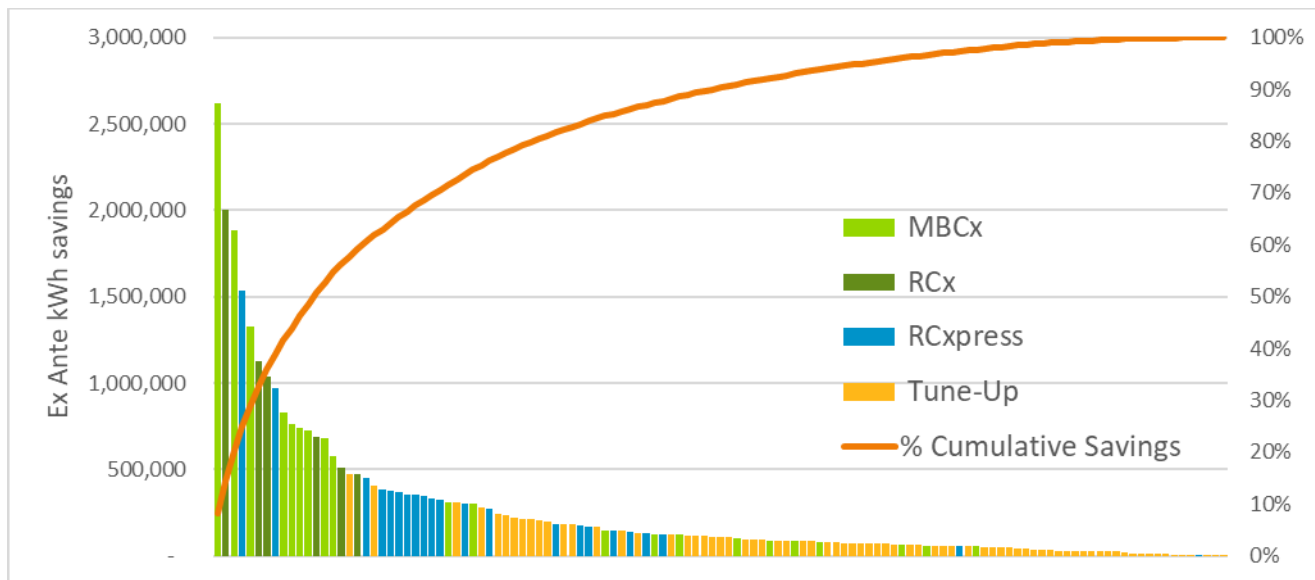
† A deemed value. Sources: ComEd\_NTG\_History\_and\_PY10\_Recommndations\_2017-03-01.xlsx, Nicor\_Gas\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx , and PGL\_NSJ\_GPY7\_NTG\_Values\_2017-03-01\_Final.xlsx which are to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

## 6.2 Other Impact Findings and Recommendations

Navigant reviewed the overall offering population from the offering tracking data and performed a detailed analysis of a representative sample of projects.

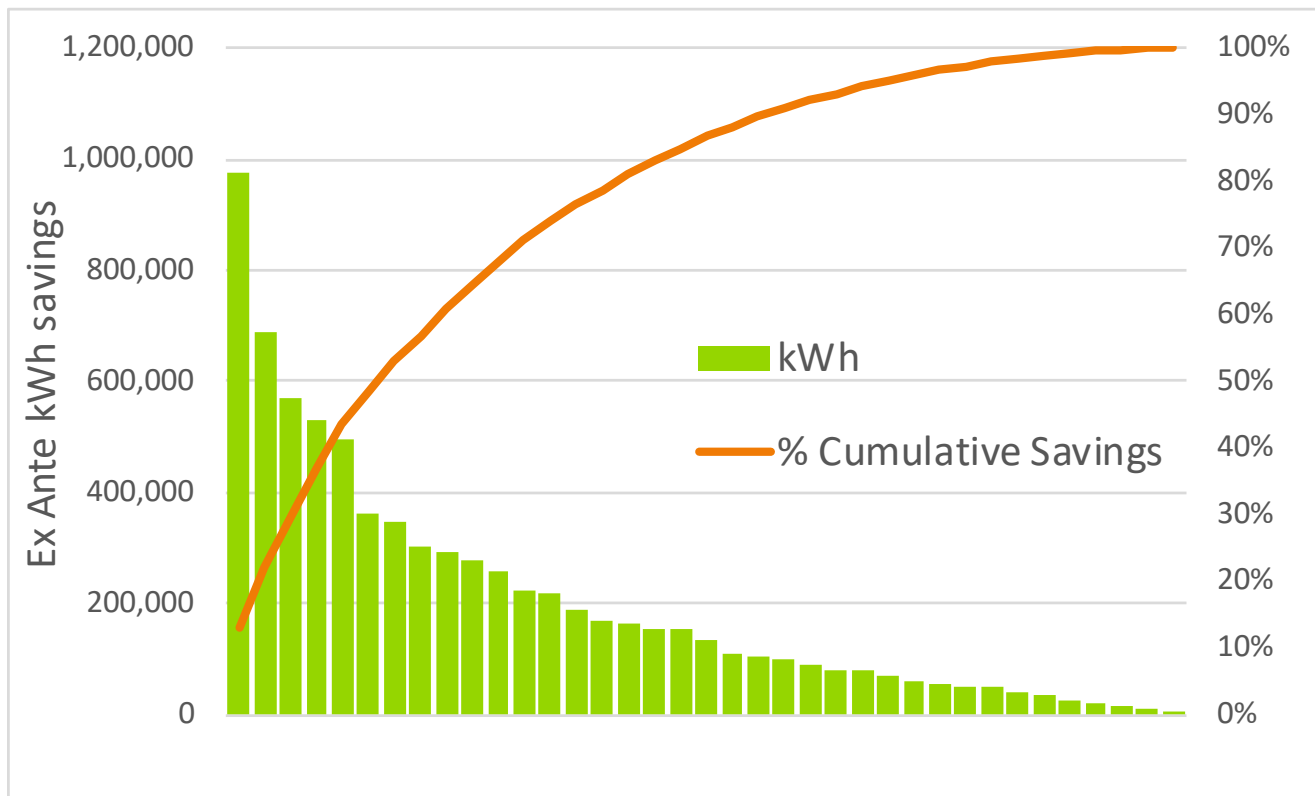
Figure 6-1 and Figure 6-2 show the breakdown of electric savings in the Retro-Commissioning Offering by project and track. One project, administered by Nexant, had more than twice the savings of any others and made up over 14 percent of offering savings. As expected, larger projects are generally in the MBCx and RCx offerings, but some RCxpress projects are also quite large. For electricity, project savings ranged from over 3,700 kWh to 2,600,000 kWh, ex ante, with the largest 13 projects making up slightly over half of the offering savings. A similar pattern is seen for 360 Energy Group-administered projects.

Figure 6-1. CY2018 Ex Ante Electric Energy Savings by Project – Nexant



Source: ComEd tracking data and Navigant team analysis

Figure 6-2. CY2018 Ex Ante Electric Energy Savings by Project – 360 Energy Group



Source: ComEd tracking data and Navigant team analysis

Figure 6-3 shows ex ante gas savings by project and track for Nexant. As with electric savings, larger projects are generally in the RCx and MBCx offerings. For natural gas, ex ante savings per project ranged





The total offering verified gross savings are in Table 6-2 and Table 6-3. The table presents savings at the utility-level. Realization rates are the results of analyzing 49 projects, made up of more than 190 measures.

**Table 6-2. Verified Gross Savings Realization Rates\* - Nexant**

Savings Category	ComEd kWh	ComEd kW	Nicor Gas therms	Peoples Gas therms	North Shore Gas therms
Ex Ante Project Counts	123	56	17	16	2
Ex Ante Gross Savings	32,060,851	863	78,753	381,810	20,632
Verified Gross Realization Rate	0.90	1.69	0.97	0.91	1.01
Verified Gross Savings	28,876,062	1,456	76,342	348,895	20,882

\*Electric energy in kWh, electric demand in kW, gas in therms  
 Source: ComEd tracking data and Navigant team analysis

**Table 6-3. Verified Gross Savings Realization Rates - 360 Energy Group**

Savings Category	ComEd kWh	ComEd kW	Nicor Gas therms	Peoples Gas therms	North Shore Gas therms
Ex Ante Project Counts	39	-	22	6	7
Ex Ante Gross Savings	7,497,253	207	300,422	70,057	132,887
Verified Gross Realization Rate	1.00	NA	0.91	1.12	0.46
Verified Gross Savings	7,460,527	94	271,976	78,716	61,415

\*Electric energy in kWh, electric demand in kW, gas in therms  
 NA = Not applicable  
 Source: ComEd tracking data and Navigant team analysis

There are several reasons why realization rates are other than 1.0, including:

- On-site verification determined measures were implemented differently than reported. This can include modified schedules or set points. Changes in schedules or set points were mostly due to operator adjustments to maintain occupant comfort.
- Some measures saved energy on the base-building systems by pushing air-conditioning loads onto tenant-operated equipment, thus saving little or no energy in aggregate.
- Some projects continued to implement additional recommended measures or finish implementing measures after projects were verified and closed by the service provider and implementation contractor.
- Evaluators could not verify any measures installed at one site by Nexant. Photos submitted for implementation documentation were not from the project site, but likely from one of several similar sites.
- Some projects generated gas savings that the offering did not track accurately.
- Some measures did not include demand savings even when warranted and others claimed demand savings not found during verification. Demand calculations also used a variety of

conditions that did not conform to the weighted temperature-humidity index (WTHI) method for summer demand savings for weather dependent measures in the ComEd service territory.

- Occasional calculation or engineering errors also affected realization rates. Several types of calculation errors were encountered this year:
  - Unsubstantiated baseline assumptions for one very large project
  - Weather datasets were not consistently applied. Some projects used different weather data for different measures at the same site.
  - Discrepancies in set points or hours of operation between reported conditions and those used in calculations resulted in numerous, but generally small, changes in savings.
  - A few calculations included mis-typed hard-coded values.
  - Other engineering or spreadsheet calculation errors.

## 6.2.1 Findings and Recommendations

Though the process for estimating savings has evolved and become more consistent since the offering was launched in PY1, there is still room for improvement, as detailed in the following list of findings and recommendations. The evaluation team has developed several recommendations based on findings from the CY2018 evaluation, as follows:

**Finding 1.** Service Providers are inconsistent in their selection of normalizing weather data for downtown Chicago, as neither Midway nor O’Hare airports are truly representative.

**Recommendation 1.** Navigant recommends the implementer give the EESPs explicit recommendations for preferred weather datasets. Include weather dataset selection in QC steps for ex ante savings. Require references for all weather data sources.

**Finding 2.** Some projects use different weather datasets for different measures at the same location.

**Recommendation 2.** Navigant recommends the implementer include weather dataset selection in QC steps for ex ante savings. Require the EESP to document references for all weather data sources.

**Finding 3.** Some projects calculate average fan power incorrectly, based on average speed in a temperature bin. This is inaccurate

**Recommendation 3.** Navigant recommends the implementer specifies best practices to the EESPs that when using trend data for variable speed drive (VSD) speed, kW should be calculated before averaging data into bins.

**Finding 4.** Several calculations use hard-coded values in spreadsheets without adequate (or any) reference to sources.

**Recommendation 4.** Navigant recommends the implementer require the EESPs to source hard-coded data. If sourced from a trend data or weather data file, include that file with the project documentation.

**Finding 5.** Some descriptions of measure verification do not clarify whether a measure is physically observed or whether the verification is only from the BAS screen.

**Recommendation 5.** Navigant recommends that where physical adjustments are integral to the measure implementation, e.g. damper adjustment for minimum outdoor air, require the EESPs to physically verify and unambiguously describe how the measure was verified to be operational in the report.

**Finding 6.** Too often VSD power is estimated from nameplate data and speed only. While adequate when motors and drives are inaccessible, the method is prone to mis-estimation.



Frequently, VSD kW is observable on the device itself and the service provider can calibrate observed VSD power to the observed speed. Evaluators frequently make this correction.

**Recommendation 6.** Navigant recommends the Nexant apply higher documentation and quality control standards to VSD power as these devices strongly modulate system power. Require EESPs to calibrate VSD power to at least one observed operating speed and two points if possible.

**Finding 7.** Several measures relaxed setpoints to condition fresh air supplied to residential corridors in high-rise buildings. The building design intent is to ventilate the living units with the fresh corridor air via transfer grills. As a result, the tenant systems end up doing the work of the base-building systems to finish conditioning the ventilation air and no net energy is saved.

**Recommendation 7.** Review measures in the context of whole-building systems when estimating energy savings and not just isolated equipment. Consider using whole-building energy models to estimate savings for situations such as this.

## 7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

The impact evaluation consists of a review of a representative sample of projects: both an engineering desk-review and on-site verification for a subset of projects. Evaluators review gross offering impacts with a project-by-project and measure-by-measure approach. Savings calculation reviews ensure the savings estimates are accurately modeled, use consistent inputs and include reasonable assumptions, as required. In some cases, evaluators acquired additional trend data or interval meter data to verify savings with both more data and data concurrent with expected savings, e.g. winter data for night set-back measures. In most cases, the impact evaluation involves analysis of time-series trend and measured data, both pre- and post- implementation.

For a nested sample of projects (selected from projects sampled for engineering review), Navigant performed on-site inspections to determine whether implemented measures were still operating as described in project documentation (set points, affected equipment, hours of operation, etc.). Where we found differences, our research findings estimate reflect those new inputs.

Due to the number of projects and the compressed schedule between offering year-end and reporting, Navigant began project reviews in waves. We constructed an impact sample in early July 2018 based on projects completed to-date and expected to be completed prior to year-end. ComEd and the implementation contractors provided project files in waves as they were completed: August 2018, mid-December 2018 and January 2019.

Results from the impact evaluation were rolled up by sampling strata and extrapolated to the participant population to determine gross researched impacts. Nexant and 360 Energy Group projects were rolled-up and summarized separately. Deemed net-to-gross (NTG) ratios were applied to verified gross results to arrive at net researched impacts.

### 7.1 Sampling Methodology

The sample draw for CY2018 gross impact evaluation was done in two waves. The first wave of sampling was conducted on projects with a planned completion during CY2018 based on the Operations Report from June 2018, when the offering had completed a sizable portion the CY2018 participation target. The second and final wave of sampled projects adjusted the first wave sample based on projects completed as of the final CY2018 Operations Report. Table 7-1 is the population of projects completed in the CY2018 offering per the Operations Report dated January 2, 2019.

**Table 7-1. Population of CY2018 RCx Offering Projects**

Participation	ComEd	Nicor Gas	Peoples Gas	North Shore Gas
<b>Nexant Projects</b>				
Monitoring-based MBCx	21	0	6	0
Retro-Commissioning	6	1	1	0
RCxpress	22	2	5	1
Tune-Up	74	14	4	1
<b>360 Energy Group Projects</b>				
Public Sector RCx*	37	22	6	7
<b>Total</b>	<b>160</b>	<b>39</b>	<b>22</b>	<b>9</b>

\* Seven Public sector projects have no ComEd electric savings and nine have no gas savings  
 Source: ComEd tracking data and Navigant team analysis.

The sample design grouped all Nexant tracks in sample frames by utility. Similarly, all 360 Energy Group projects were grouped by utility. Navigant further defined strata within each sample frame by project size based on ex ante gross energy savings. The ComEd sample had three strata while the gas utility samples contained two or three strata. Navigant randomly sampled within size strata as shown in Table 7-2 below. The stratification helps reduce overall sample size and tends to enhance the number of large savers in the final sample with a balance of medium and small savers.

Sampling was targeted to provide a 90/10 level confidence and relative precision for gross impact realization rate results for the ComEd and gas utilities overall offerings.

Table 7-2 below provides the ComEd sample selection by offering track and size strata. Overall the sample represents 28 percent of the project count and 55 percent (21,629,552 kWh) of the population ex ante savings of 39,558,104 kWh. A total of 44 projects were selected from the population of 160 completes *with electric savings*. Though sampling was not based on track, the final sample for Nexant included: seven MBCx, four RCx, five RCxpress and 11 Tune-up projects.

**Table 7-2. Profile of the CY2018 Electric Gross Savings Verification Sample by Strata\***

Evaluated Group	Population Summary			Sampled Summary		
	Sampling Strata	Qty Projects (N)	Ex ante kWh	Qty Projects (n)	Ex ante kWh	Sample % of Population
Nexant	1	8	12,508,158	7	11,181,671	89%
	2	24	11,384,537	9	4,422,878	39%
	3	91	8,168,156	11	1,471,297	18%
Sub-Total		123	32,060,851	27	17,075,846	53%
360 Energy Group	1	5	3,259,780	4	2,688,003	82%
	2	8	2,282,097	4	1,140,898	50%
	3	24	1,955,376	9	724,805	37%
Sub-Total		37	7,497,253	17	4,553,706	61%
<b>Offering Total</b>		<b>160</b>	<b>39,558,104</b>	<b>44</b>	<b>21,629,552</b>	<b>55%</b>

\* A total of 167 projects were completed in CY2018. Seven had no ComEd-claimed electric savings.  
 Source: ComEd tracking data and Navigant team analysis.

Table 7-3 and Table 7-4 show the breakdown of the sample disposition for the gas utilities by IC.

**Table 7-3. Profile of the CY2018 Gas Gross Savings Verification Sample by Strata – Nexant**

Evaluated Group	Sampling Strata	Population Summary		Sampled Summary		
		Qty Projects (N)	Ex ante therms	Qty Projects (n)	Ex ante therms	Sample % of Population
Nicor Gas	1	2	101,790	2	101,790	100%
	2	15	73,475	5	41,264	56%
Sub-Total		17	175,265	7	143,054	82%
Peoples Gas	1	1	112,325	1	112,325	100%
	2	7	242,343	5	199,050	82%
	3	8	31,169	2	5,605	18%
Sub-Total		16	385,837	8	316,980	82%
North Shore Gas	1	2	20,632	2	20,632	100%
Sub-Total		2	20,632	2	20,632	100%
<b>Offering Total</b>		<b>35</b>	<b>581,734</b>	<b>17</b>	<b>480,666</b>	<b>83%</b>

Source: ComEd tracking data and Navigant team analysis.

**Table 7-4. Profile of the CY2018 Gas Gross Savings Verification Sample by Strata – 360 Energy Group**

Evaluated Group	Sampling Strata	Population Summary		Sampled Summary		
		Qty Projects (N)	Ex ante therms	Qty Projects (n)	Ex ante therms	Sample % of Population
Nicor Gas	1	2	95,911	2	95,911	100%
	2	7	131,187	4	70,415	54%
	3	13	73,324	5	34,244	47%
Sub-Total		22	300,422	11	200,570	67%
Peoples Gas	1	1	28,342	1	28,342	100%
	2	5	41,715	3	36,714	88%
Sub-Total		6	70,057	4	65,056	93%
North Shore Gas	1	2	75,185	2	75,185	100%
	2	5	57,702	3	42,595	74%
Sub-Total		7	132,887	5	117,780	89%
<b>Offering Total</b>		<b>35</b>	<b>503,366</b>	<b>20</b>	<b>383,406</b>	<b>76%</b>

Source: ComEd tracking data and Navigant team analysis.

For each sampled project, Navigant reviewed all measures. All measure savings for a project were rolled up into project-level realization rates. Navigant subsequently rolled-up project-level results by stratum weighted on savings for strata-level realization rates. These rates were then applied to the population of projects in each stratum to determine research findings gross realization rates for the offering.

## 8. APPENDIX 2. IMPACT ANALYSIS DETAIL

Offering impacts are tracked through the several phases of the offering with the implementation contractor (IC) giving feedback to Energy Efficiency Service Providers (EESPs) and requiring changes at each phase. Thus, the evaluator’s task is to check a sample of measures verified by the EESPs and IC and ensure that measures are indeed complete, and savings are accurately estimated.

The evaluators conclude that the investigation, reports, verification reports, supporting data, and calculations provided sufficient confirmation that the measures were installed as described. Navigant identified 22 projects, comprising more than 11,000,000 kWh and 250,000 therms, within the impact sample for on-site verification.<sup>5</sup> Evaluators visited all 22 of these sites between August 2018 and February 2019 and verified implementation and observed actual operation of measures. In most cases, measure implementation persists. In some cases, the facility had modified set points and schedules due to facility requirements, including adjustments to refrigeration systems at a grocery site. In a couple of cases, evaluators learned that the participating site was continuing to make recommended improvements after the project was formally verified and closed.

The evaluation team reviewed 55 percent of electric energy savings and 81 percent of gas savings. Table 8-1 details the evaluation by research category.

**Table 8-1. Savings Evaluated by Offering**

Evaluated Group	Nexant Projects	360 Energy Group Projects	Total
Number of projects	123	44	167
Evaluated projects	27	22	49
Population ex ante kWh savings	32,060,851	7,497,253	39,558,104
Sample ex ante kWh savings	17,075,846	4,553,706	21,629,552
Evaluated percent of kWh	53%	61%	55%
Population ex ante therm savings	581,734	503,366	1,085,100
Sample ex ante therm savings	480,666	383,406	864,072
Evaluated percent of therms	83%	76%	80%

*Source: ComEd tracking data and Navigant team analysis*

### 8.1 Evaluation Research Gross Impact Findings

For all 49 projects in the sample, Navigant reviewed measure implementation plans, assumptions and calculations in detail. In general, Navigant found the calculations accurately constructed, based on clearly measured data rather than rules-of-thumb, and reasonably transparent in spreadsheet form. In some instances, we found calculation errors due to spreadsheet equation errors, erroneous inputs, omissions of relevant impacts and inconsistencies in assumptions from measure-to-measure on the same system, but most of these errors resulted in only minor changes to overall savings. Some of the spreadsheets contained hard-coded input values but these were generally based on external trend data files and standard TMY3<sup>6</sup> data that we could inspect.

<sup>5</sup> On-site verification projects were selected based on project savings size, measure type and facility type. Large projects were selected because of their impact on program goals. Diverse facility types were selected to capture a range of operating strategies and participant requirements (for example year-round cooling for equipment intensive sites or 24-hour operation for hospitals).

<sup>6</sup> TMY3 is the most recent version of the Typical Meteorological Year weather data sets.

Savings estimation approaches among EESPs were mostly consistent. Most calculation spreadsheets were comprehensive, though some were excessively complex and others overly simple. Despite the range of approaches in CY2018, there were very few lapses in engineering methods. When faced with the need to make engineering assumptions, EESPs are often more conservative than the offering guidelines. Where there was no further justification for overly conservative estimates, the evaluation team restored guideline defaults or supplemented estimated savings with secondary effects of the measures as could be determined with available data.

In cases where Navigant-verified inputs were inconsistent with EESP reported data, such as set points or operational hours, Navigant re-estimated savings with available data, additional data requested from the participant or EESP or offering guideline inputs. Research findings gross realization rates are the result of analysis of individual measures for each project in the impact sample. Table 8-2 details the realization rates of all sampled projects.

**Table 8-2. Project Level Realization Rates**

Project	Realization Rates			Notes on evaluation adjustments
	kWh	Therms	Gas Co	
16-102	98%	100%	Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-103* (two project bundles)	85%			The estimate assumes 100% loaded heaters below 25F in the baseline. Metered data show loading closer to 49% at 15F.
16-026	88%	100%	Peoples Gas	A measure in a high-rise residential building reduces the conditioning of the fresh air supplied to the hallways and claims savings based on the reduced heating. This fresh air, though, is make-up air to the living units and ultimately most of the air is still conditioned to a comfort temperature in the living units, effectively pushing building expense and energy use onto residents, but not saving energy. Latent cooling was not included properly, and fan energy was not converted from horsepower-hours to kWh.
16-038	69%	111%	Peoples Gas	A measure in a high-rise residential building reduces the conditioning of the fresh air supplied to the hallways and claims savings. Most of this fresh air though is ultimately still conditioned to a comfort temperature in the living units, effectively pushing building expense and energy use onto residents, but not saving energy. On-site inspection determined that reduced fresh air volume was less than planned.
17-507	96%	94%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-519	232%	71%	Peoples Gas	Evaluation-metered compressor power determined much greater savings from scheduling than ex ante estimates. Schedule changes reduced gas savings.

Project	Realization Rates			Notes on evaluation adjustments
	kWh	Therms	Gas Co	
17-115	59%			A night set-back measure claims savings during all un-occupied heating hours. Interval data show that the set-back is disabled below 15F. A major fan failure in November 2018 prompted disabling measure during the period of evaluation analysis. Fate of ongoing measure implementation after repair in 2019 is unclear, thus less than full credit given.
16-040	87%			Inappropriate weather data were used for normalization.
17-007	69%			A supply air temperature reset measure caused comfort complaints and was un-done by building operators.
17-005	63%	100%	Peoples Gas	On-site observations determined that economizer measures were not implemented as effectively as planned, thus limiting available free-cooling. A measure to repair a leaking chilled water valve assumed savings for all cooling hours but should only count savings when required flow is less than leak flow.
17-008	81%	106%	North Shore Gas	On-site observations revised schedules and inputs to some calculations affecting both electric and gas savings. Chiller efficiency was not consistent across measures.
17-499	100%	100%	North Shore Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-520	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-531	100%			Ex ante estimates are adequate or required minor changes from evaluation.
18-402	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
18-404	95%			Ex ante estimates are adequate or required minor changes from evaluation.
15-108	103%	102%	Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-118	83%	25%	Peoples Gas	Airflow for one calculation is wrong by a 10x factor affecting both electric and gas savings. Evaluation observed that efforts to reduce preheat and minimize simultaneous heating and cooling are only partially effective as pre-heat control is erratic.
17-121	100%			Ex ante estimates are adequate or required minor changes from evaluation.
17-010	90%	97%	Nicor Gas	An equipment failure required disabling a key measure mid-year.
17-011	92%	100%	Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.

Project	Realization Rates			Notes on evaluation adjustments
	kWh	Therms	Gas Co	
18-029	100%	92%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-465	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-501	34%			Claimed resets were not implemented or enabled on the equipment, though some setpoints were changed marginally.-
17-509	100%		Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
17-512	50%	96%	Nicor Gas	On-site verification determined that redundant lighting systems have been reconnected. HVAC calculations assume continuous RTU operation during occupied hours. The equipment cycles on demand.
30164	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30165	118%	44%	Nicor Gas	A hot water pump sequencing measure is not working in the heating season. Motors are assumed to be 100% loaded. A hot water mixing valve measure reduces conductive losses but does not reduce the building heating load as estimated. Key equations map the wrong inputs. Ex ante calculation does not include eliminating false chiller loads
30166	94%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30169	98%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30175	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30177		103%	Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30181		100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30184	84%	245%	Nicor Gas	On-site observation corrected inputs for schedules, fan speed, and air handler temperatures affecting both gas and electric savings. Discharge air reset measure did not change the mixed air temperature, thus merely changing the heating from the terminal units to the air handler. Static pressure reset measure is not working.
30189	91%		Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30196		115%	Peoples Gas	Weather data for normalization was from an unknown source. Removed unnecessary safety factor.



Project	Realization Rates			Notes on evaluation adjustments
	kWh	Therms	Gas Co	
30211		100%	Peoples Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30212	130%	124%	Peoples Gas	Flawed calculations. Fan power mis-estimated; fan heating subtracted from cooling load rather than added to load; latent cooling loads are not estimated.
30215			North Shore Gas	No measures were implemented. Participant was expecting an LED lighting system recommendation from the program. Baseline building energy use otherwise very good.
30218	100%	100%	Nicor Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30225	23%	73%	Nicor Gas	An optimal start measure is implemented incorrectly and may increase unit run time and energy use. Demand controlled ventilation measure is still in the trouble-shooting stage and may never work. Observed motor loading is much less than assumed in the calculations.
30229	113%	156%	Nicor Gas	Flawed calculations. Unknown weather dataset used. In accurate use of affinity laws. Failure to estimate heating savings for one measure.
30230	89%	75%	Nicor Gas	Inaccurate use of fan affinity laws and latent cooling estimates. A progressive calculation of multiple measures uses the wrong baseline from one measure to the next affecting gas and electric savings. Chilled water reset, which was listed as abandoned, was in fact implemented.
30231	97%	84%	North Shore Gas	Weather data are from an unknown source. On-site verification determined schedules have changed from initial implementation and verification.
30232	122%	113%	North Shore Gas	Weather data are from an unknown source.
30237	103%	90%	North Shore Gas	Ex ante estimates are adequate or required minor changes from evaluation.
30239	81%	15%	North Shore Gas	Two calculations did not include inputs for chiller efficiency, boiler efficiency, latent cooling and temperature rise across the supply fan. Boiler temperature reset savings estimates were unreasonable, gas savings were substantially lower than claimed. Together two measures were to save about 50% of project gas consumption when the effect is only a couple percent improvement in boiler efficiency.



Project	Realization Rates			Notes on evaluation adjustments
	kWh	Therms	Gas Co	
30240	100%	13%	North Shore Gas	Boiler temperature reset savings estimates were unreasonable, gas savings were substantially lower than claimed. Together two measures were to save about 50% of project gas consumption when the effect is only a couple percent improvement in boiler efficiency.

\* Project 17-103 was an MBCx project with two different measure bundles which counts for two distinct projects  
 Source: Evaluation research

## 8.2 Evaluation Research Net Impact Findings

After gross offering impacts have been assessed, net offering impacts are derived by applying the deemed NTG ratio that quantifies the percentage of the gross offering impacts that can be reliably attributed to the offering. Currently, deemed NTG ratios for electric savings is 0.95 for all electric offerings and 1.02 for all gas savings.

## 9. APPENDIX 3. TOTAL RESOURCE COST DETAIL

Table 9-1, below, shows the Total Resource Cost (TRC) table for ComEd electricity savings, not including gas equivalent kWh. It includes only the cost-effectiveness analysis inputs available at the time of finalizing this impact evaluation report. Additional required cost data (e.g., measure costs, offering level incentive and non-incentive costs) are not included in this table and will be provided later.

**Table 9-1. Total Resource Cost Savings Summary\*†**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Retro-Commissioning	Combined tracks	Projects	160	7.5	36,336,589	1,550	97,237	0	0	0.95	0.95	1.02	34,519,759	1,472	99,182	0	0

\* A total of 167 projects were completed in CY2018. Seven had no ComEd-claimed electric savings.

† Totals in this table do not include gas equivalent kWh savings claimed by ComEd. Gas equivalent kWh savings are not explicitly included in any of the TRC calculations because they do not result in electric generation avoided costs.

Source: ComEd tracking data and Navigant team analysis.

Table 9-2, Table 9-3, and Table 9-4 show the TRC inputs for the gas utilities. The tables only include savings for projects where the gas companies shared program costs with ComEd. The tables exclude the savings from 14 Nicor Gas Tune-Up projects and one Peoples Gas Tune-Up project since the gas companies did not share program costs with ComEd for these 15 projects therefore the TRC inputs should not include the savings for these projects.

**Table 9-2. Total Resource Cost Savings Summary for Nicor Gas**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Retro-Commissioning	Combined tracks	Projects	25	7.5	-	-	348,318						1.02		355,285		

Source: Navigant analysis of tracking data.

**Table 9-3. Total Resource Cost Savings Summary for Peoples Gas**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Retro-Commissioning	Combined tracks	Projects	21	7.5			427,610						1.02		436,162		

Source: Navigant analysis of tracking data.

**Table 9-4. Total Resource Cost Savings Summary for North Shore Gas**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
Retro-Commissioning	Combined tracks	Projects	9	7.5			82,297						1.02		83,943		

Source: Navigant analysis of tracking data.