



ComEd Custom Program Impact Evaluation Report

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

Presented to
ComEd

FINAL

April 12, 2019

Prepared by:

Kumar Chittory
Itron, Inc

Ben Cheah
Itron, Inc



Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant Consulting, Inc.
150 N. Riverside Plaza, Suite 2100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
Randy.Gunn@Navigant.com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.Com

Rob Neumann, Associate Director
312.583.2176
Rob.Neumann@Navigant.com

Disclaimer: This report was prepared by Navigant Consulting, Inc. ("Navigant") for ComEd based upon information provided by ComEd and from other sources. Use of this report by any other party for whatever purpose should not, and does not, absolve such party from using due diligence in verifying the report's contents. Neither Navigant nor any of its subsidiaries or affiliates assumes any liability or duty of care to such parties, and hereby disclaims any such liability.

TABLE OF CONTENTS

| | |
|---|----|
| 1. Introduction | 1 |
| 2. Program Description | 1 |
| 3. Program Savings Detail | 1 |
| 4. Cumulative Persisting Annual Savings | 2 |
| 5. Program Savings by Measure..... | 7 |
| 6. Impact Analysis Findings and Recommendations | 9 |
| 6.1 Impact Parameter Estimates..... | 9 |
| 6.2 Other Impact Findings and Recommendations..... | 10 |
| 7. Appendix 1. Impact Analysis Methodology | 11 |
| 7.1 Gross Impact (M&V) Sample | 11 |
| 7.2 Roll-up of Savings | 12 |
| 8. Appendix 2. Impact Analysis Detail..... | 12 |
| 8.1 Savings by Strata | 12 |
| 8.2 Savings by Project | 13 |
| 9. Total Resource Cost Detail | 15 |

LIST OF TABLES AND FIGURES

| | |
|---|----|
| Figure 2-1. Distribution of Projects by Measure Type..... | 1 |
| Figure 4-1. Total Cumulative Persisting Annual Savings..... | 7 |
| Figure 6-1. Energy and Demand Realization Rates | 10 |
| Table 3-1. CY2018 Total Annual Incremental Electric Savings | 2 |
| Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric..... | 3 |
| Table 4-2. Cumulative Persisting Annual Savings (CPAS) – Gas | 4 |
| Table 4-3. Cumulative Persisting Annual Savings (CPAS) – Total..... | 5 |
| Table 5-1. CY2018 Energy Savings by Measure..... | 7 |
| Table 5-2. CY2018 Summer Peak Demand Savings by Measure..... | 8 |
| Table 5-3. CY2018 Energy Savings by Measure – Gas | 8 |
| Table 5-4. CY2018 Energy Savings by Measure – Total Combining Electricity and Gas | 9 |
| Table 6-1. Verified Gross Savings Parameters..... | 10 |
| Table 7-1. CY2018 Gross Impact Sample by Strata..... | 11 |
| Table 8-1. CY2018 Energy Savings by Strata | 12 |
| Table 8-2. CY2018 Demand Savings by Strata | 13 |
| Table 8-3. CY2018 Energy Savings by Project..... | 13 |
| Table 8-4. CY2018 Demand Savings by Project | 14 |
| Table 9-1. Total Resource Cost Savings Summary..... | 16 |

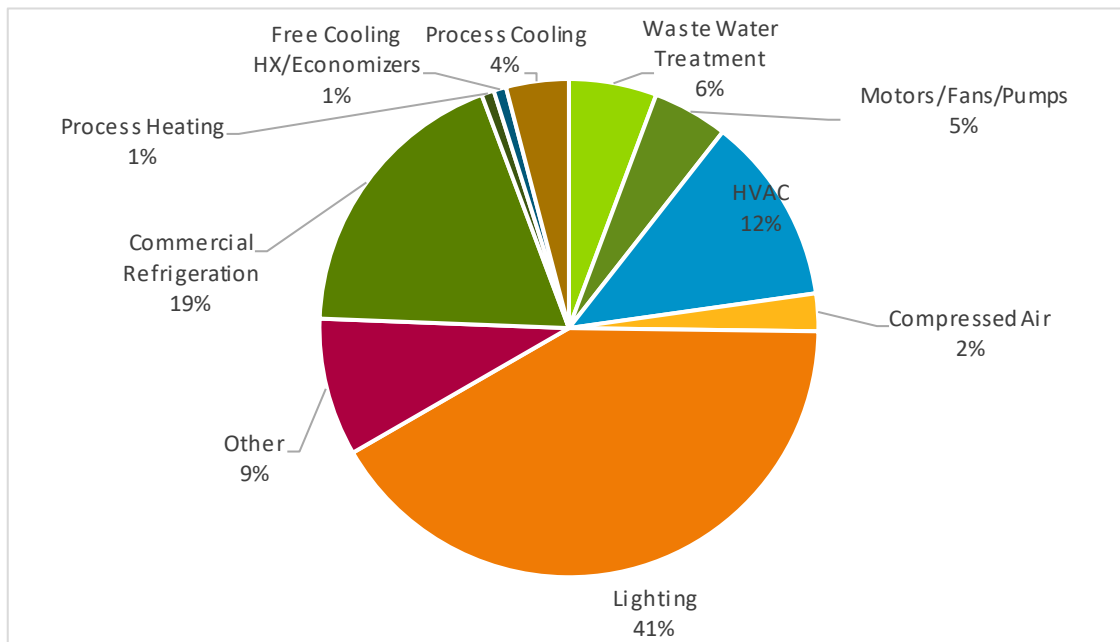
1. INTRODUCTION

This report presents ComEd’s CY2018 Custom Program impact evaluation results. It presents a summary of the energy and demand impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. CY2018 covers January 1, 2018 through December 31, 2018.

2. PROGRAM DESCRIPTION

The ComEd Custom Program provides a custom incentive, based on a formula, for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects for commercial and industrial customers. The Custom Program primarily consists of lighting, refrigeration and HVAC projects. They also had some very large waste water treatment projects which represented 6% of the total projects, but approximately 33% of the total ex ante energy savings in CY2018. Figure 2-1 below provides the distribution of projects by measure group.

Figure 2-1. Distribution of Projects by Measure Type



Source: Evaluation analysis

3. PROGRAM SAVINGS DETAIL

Table 3-1 summarizes the incremental energy and demand savings the Custom Program achieved in CY2018. The verified net savings for CY2018 is 15,283,465 kWh. ComEd did not claim any gas savings for this program, however, the evaluation team found gas savings for project 39252 and they are shown in the CPAS tables below. The CPAS table also shows dual baseline savings for couple of early replacement projects (38693 and 39251). Both the dual baseline projects have Remaining Useful Life (RUL) of two years, so the savings for measure category “Other” goes down slightly from year 2020.

Table 3-1. CY2018 Total Annual Incremental Electric Savings

| Savings Category | Energy Savings (kWh) | Demand Savings (kW) | Summer Peak Demand Savings (kW) |
|----------------------------------|----------------------|---------------------|---------------------------------|
| Electricity | | | |
| Ex Ante Gross Savings | 28,969,667 | NA | 3,046 |
| Program Gross Realization Rate | 0.91 | NA | 1.23 |
| Verified Gross Savings | 26,350,802 | NA | 3,750 |
| Program Net-to-Gross Ratio (NTG) | 0.58 | NA | 0.7 |
| Verified Net Savings | 15,283,465 | NA | 2,625 |
| Converted from Gas* | | | |
| Ex Ante Gross Savings | 0.00 | NA | NA |
| Program Gross Realization Rate | NA | NA | NA |
| Verified Gross Savings | 121,988 | NA | NA |
| Program Net-to-Gross Ratio (NTG) | 0.58 | NA | NA |
| Verified Net Savings | 70,753 | NA | NA |
| Total Electric Plus Gas | | | |
| Ex Ante Gross Savings | 28,969,667 | NA | 3,046 |
| Program Gross Realization Rate | 0.91 | NA | 1.23 |
| Verified Gross Savings | 26,472,790 | NA | 3,750 |
| Program Net-to-Gross Ratio (NTG) | 0.58 | NA | 0.70 |
| Verified Net Savings | 15,354,218 | NA | 2,625 |

*Gas savings converted to kWh by multiplying therms * 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.

4. CUMULATIVE PERSISTING ANNUAL SAVINGS

The measure-specific and total ex ante gross savings for the Custom Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2018 are shown in the following tables and figure.

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 | |
| Custom | Waste Water Treatment | 13.0 | 8,566,451 | 0.58 | 64,591,042 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | |
| Custom | Motors/Fans/Pumps | 20.0 | 2,680,542 | 0.58 | 31,094,291 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | |
| Custom | HVAC | 13.0 | 3,429,587 | 0.58 | 25,859,084 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | |
| Custom | Compressed Air | 13.0 | 1,856,378 | 0.58 | 13,997,087 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | |
| Custom | Lighting | 15.0 | 6,171,887 | 0.58 | 53,695,416 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | |
| Custom | Other | 13.0 | 1,855,243 | 0.58 | 13,961,968 | 1,076,041 | 1,076,041 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | |
| Custom | Commercial Refrigeration | 13.0 | 819,919 | 0.58 | 5,840,617 | 475,553 | 475,553 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 | |
| Custom | Process Heating | 13.0 | 294,433 | 0.58 | 2,220,024 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | |
| Custom | Free Cooling HX/Economizers | 16.0 | 177,647 | 0.58 | 1,648,568 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | |
| Custom | Process Cooling | 23.0 | 498,714 | 0.58 | 6,652,851 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | |
| CY2018 Program Total Electric CPAS | | | 26,350,802 | | 219,560,948 | 15,283,465 | 15,283,465 | 15,249,998 | 15,249,998 | 15,249,998 | 15,249,998 | 15,249,998 | 15,249,998 | 15,249,998 | |
| CY2018 Program Expiring Electric Savings‡ | | | | | | | | 33,467 | 33,467 | 33,467 | 33,467 | 33,467 | 33,467 | | |

| End Use Type | Research Category | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|--|-----------------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Custom | Waste Water Treatment | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | - | - | - | - | - | - | - | - |
| Custom | Motors/Fans/Pumps | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | - |
| Custom | HVAC | 1,989,160 | 1,989,160 | 1,989,160 | 1,989,160 | - | - | - | - | - | - | - | - |
| Custom | Compressed Air | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | - | - | - | - | - | - | - | - |
| Custom | Lighting | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | - | - | - | - | - | - |
| Custom | Other | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | - | - | - | - | - | - | - | - |
| Custom | Commercial Refrigeration | 444,501 | 444,501 | 444,501 | 444,501 | - | - | - | - | - | - | - | - |
| Custom | Process Heating | 170,771 | 170,771 | 170,771 | 170,771 | - | - | - | - | - | - | - | - |
| Custom | Free Cooling HX/Economizers | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | - | - | - | - | - |
| Custom | Process Cooling | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 |
| CY2018 Program Total Electric CPAS | | 15,249,998 | 15,249,998 | 15,249,998 | 15,249,998 | 5,526,699 | 5,526,699 | 1,947,004 | 1,843,969 | 1,843,969 | 1,843,969 | 1,843,969 | 289,254 |
| CY2018 Program Expiring Electric Savings‡ | | 33,467 | 33,467 | 33,467 | 33,467 | 9,756,766 | 9,756,766 | 13,336,461 | 13,439,496 | 13,439,496 | 13,439,496 | 13,439,496 | 14,994,211 |

| End Use Type | Research Category | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 |
|--|-----------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Custom | Waste Water Treatment | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Motors/Fans/Pumps | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | HVAC | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Compressed Air | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Lighting | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Other | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Commercial Refrigeration | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Heating | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Free Cooling HX/Economizers | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Cooling | 289,254 | 289,254 | - | - | - | - | - | - | - | - | - | - |
| CY2018 Program Total Electric CPAS | | 289,254 | 289,254 | - | - | - | - | - | - | - | - | - | - |
| CY2018 Program Expiring Electric Savings‡ | | 14,994,211 | 14,994,211 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 | 15,283,465 |

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

* 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.

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 | |
| Custom | Waste Water Treatment | 13.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Motors/Fans/Pumps | 20.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | HVAC | 13.0 | 4,162 | 0.58 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | |
| Custom | Compressed Air | 13.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Lighting | 15.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Other | 13.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Commercial Refrigeration | 13.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Process Heating | 13.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Free Cooling HX/Economizers | 16.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| Custom | Process Cooling | 23.0 | 0 | 0.58 | - | - | - | - | - | - | - | - | - | - | |
| CY2018 Program Total Gas CPAS (Therms) | | | 4,162 | | 31,381 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | |
| CY2018 Program Total Gas CPAS (kWh Equivalent)‡ | | | | | 919,791 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | |
| CY2018 Program Expiring Gas Savings (Therms)§ | | | | | | | | | | | | | | | |
| CY2018 Program Expiring Gas Savings (kWh Equivalent)‡§ | | | | | | | | | | | | | | | |

| End Use Type | Research Category | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|-----------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Custom | Waste Water Treatment | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Motors/Fans/Pumps | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | HVAC | 2,414 | 2,414 | 2,414 | 2,414 | - | - | - | - | - | - | - | - |
| Custom | Compressed Air | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Lighting | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Other | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Commercial Refrigeration | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Heating | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Free Cooling HX/Economizers | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Cooling | - | - | - | - | - | - | - | - | - | - | - | - |
| CY2018 Program Total Gas CPAS (Therms) | | 2,414 | 2,414 | 2,414 | 2,414 | - | - | - | - | - | - | - | - |
| CY2018 Program Total Gas CPAS (kWh Equivalent) | | 70,753 | 70,753 | 70,753 | 70,753 | - | - | - | - | - | - | - | - |
| CY2018 Program Expiring Gas Savings (Therms)‡ | | - | - | - | - | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 | 2,414 |
| CY2018 Program Expiring Gas Savings (kWh Equ) | | - | - | - | - | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 | 70,753 |

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

* 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.

‡ 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.

Source: Navigant analysis

Table 4-3. Cumulative Persisting Annual Savings (CPAS) – Total

| End Use Type | Research Category | EUL | CY2018 Verified Gross Savings | NTG* | Lifetime Net Savings† | Verified Net kWh Savings (Including Those Converted from Gas Savings) | | | | | | | | |
|---|--------------------------|------|-------------------------------|------|-----------------------|---|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Custom | Waste Water Treatment | 13.0 | 8,566,451 | 0.58 | 64,591,042 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 |
| Custom | Motors/Fans/Pumps | 20.0 | 2,680,542 | 0.58 | 31,094,291 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 |
| Custom | HVAC | 13.0 | 3,551,575 | 0.58 | 26,778,875 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 |
| Custom | Compressed Air | 13.0 | 1,856,378 | 0.58 | 13,997,087 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 |
| Custom | Lighting | 15.0 | 6,171,887 | 0.58 | 53,695,416 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 |
| Custom | Other | 13.0 | 1,855,243 | 0.58 | 13,961,968 | 1,076,041 | 1,076,041 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 |
| Custom | Commercial Refrigeration | 13.0 | 819,919 | 0.58 | 5,840,617 | 475,553 | 475,553 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 | 444,501 |
| Custom | Process Heating | 13.0 | 294,433 | 0.58 | 2,220,024 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 | 170,771 |
| Custom | Free Cooling HX/Econ | 16.0 | 177,647 | 0.58 | 1,648,568 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 |
| Custom | Process Cooling | 23.0 | 498,714 | 0.58 | 6,652,851 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 |
| CY2018 Program Total CPAS | | | 26,472,790 | | 220,480,739 | 15,354,218 | 15,354,218 | 15,320,751 | 15,320,751 | 15,320,751 | 15,320,751 | 15,320,751 | 15,320,751 | 15,320,751 |
| CY2018 Program Expiring Savings‡ | | | | | | | | 33,467 | 33,467 | 33,467 | 33,467 | 33,467 | 33,467 | 33,467 |

| End Use Type | Research Category | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 |
|---|--------------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Custom | Waste Water Treatment | 4,968,542 | 4,968,542 | 4,968,542 | 4,968,542 | - | - | - | - | - | - | - | - |
| Custom | Motors/Fans/Pumps | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | 1,554,715 | - |
| Custom | HVAC | 2,059,913 | 2,059,913 | 2,059,913 | 2,059,913 | - | - | - | - | - | - | - | - |
| Custom | Compressed Air | 1,076,699 | 1,076,699 | 1,076,699 | 1,076,699 | - | - | - | - | - | - | - | - |
| Custom | Lighting | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | 3,579,694 | - | - | - | - | - | - |
| Custom | Other | 1,073,626 | 1,073,626 | 1,073,626 | 1,073,626 | - | - | - | - | - | - | - | - |
| Custom | Commercial Refrigeration | 444,501 | 444,501 | 444,501 | 444,501 | - | - | - | - | - | - | - | - |
| Custom | Process Heating | 170,771 | 170,771 | 170,771 | 170,771 | - | - | - | - | - | - | - | - |
| Custom | Free Cooling HX/Econ | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | 103,035 | - | - | - | - | - |
| Custom | Process Cooling | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 | 289,254 |
| CY2018 Program Total CPAS | | 15,320,751 | 15,320,751 | 15,320,751 | 15,320,751 | 5,526,699 | 5,526,699 | 1,947,004 | 1,843,969 | 1,843,969 | 1,843,969 | 1,843,969 | 289,254 |
| CY2018 Program Expiring Savings‡ | | 33,467 | 33,467 | 33,467 | 33,467 | 9,827,520 | 9,827,520 | 13,407,214 | 13,510,249 | 13,510,249 | 13,510,249 | 13,510,249 | 15,064,964 |

| End Use Type | Research Category | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 |
|---|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Custom | Waste Water Treatment | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Motors/Fans/Pumps | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | HVAC | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Compressed Air | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Lighting | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Other | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Commercial Refrigeration | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Heating | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Free Cooling HX/Econ | - | - | - | - | - | - | - | - | - | - | - | - |
| Custom | Process Cooling | 289,254 | 289,254 | - | - | - | - | - | - | - | - | - | - |
| CY2018 Program Total CPAS | | 289,254 | 289,254 | - | - | - | - | - | - | - | - | - | - |
| CY2018 Program Expiring Savings‡ | | 15,064,964 | 15,064,964 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 | 15,354,218 |

Note: The green highlighted cell shows program total first year electric savings (including direct electric savings and those converted from gas).

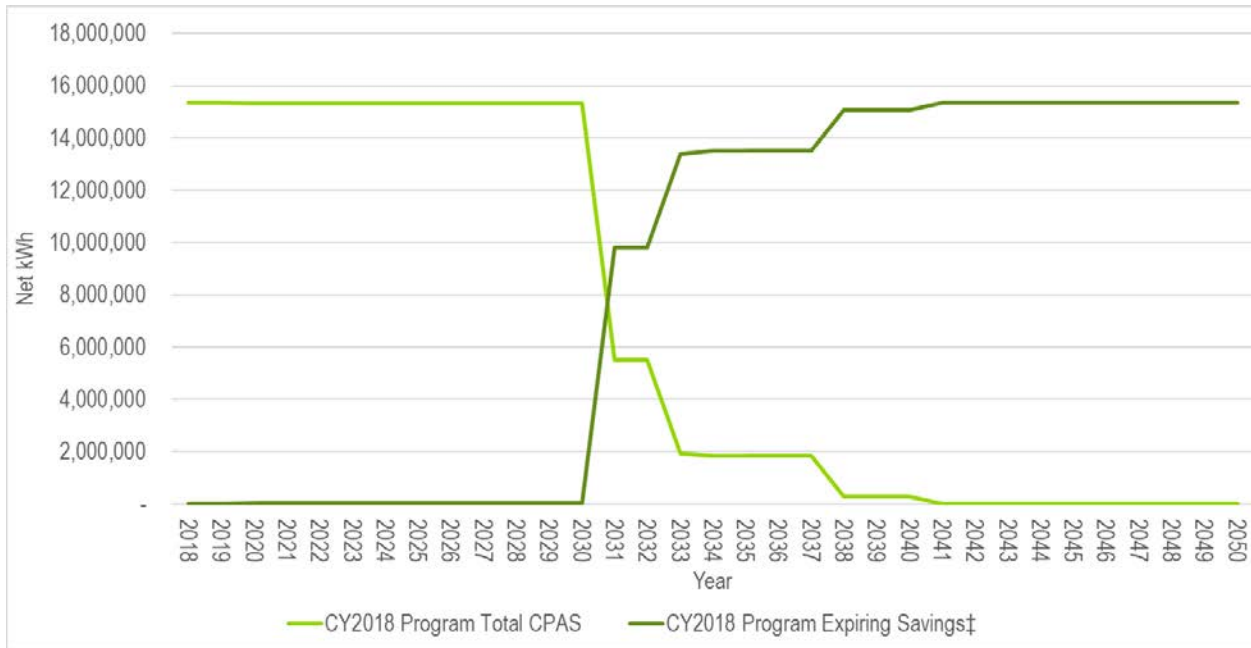
* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

‡ 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.

Source: Navigant analysis

Figure 4-1. Total Cumulative Persisting Annual Savings



‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.
Source: Navigant Analysis

5. PROGRAM SAVINGS BY MEASURE

The evaluation analyzed savings for the Custom Program at a strata level rather than the measure level or installation type. For more information about strata- and site-level savings see Appendix 2. The tables below show savings by measure type, but reflect the gross realization rate for the program, as the evaluation did not calculate a measure-level gross realization rate.

Table 5-1. CY2018 Energy Savings by Measure

| End Use Type | Research Category | Ex Ante Gross Savings (kWh) | Verified Gross Realization Rate | Verified Gross Savings (kWh) | NTG* | Verified Net Savings (kWh) | Effective Useful Life |
|--------------|-----------------------------|-----------------------------|---------------------------------|------------------------------|-------------|----------------------------|-----------------------|
| Custom | Waste Water Treatment | 9,417,825 | 0.91 | 8,566,451 | 0.58 | 4,968,542 | 13.0 |
| Custom | Motors/Fans/Pumps | 2,946,947 | 0.91 | 2,680,542 | 0.58 | 1,554,715 | 20.0 |
| Custom | HVAC | 3,770,435 | 0.91 | 3,429,587 | 0.58 | 1,989,160 | 13.0 |
| Custom | Compressed Air | 2,040,873 | 0.91 | 1,856,378 | 0.58 | 1,076,699 | 13.0 |
| Custom | Lighting | 6,785,278 | 0.91 | 6,171,887 | 0.58 | 3,579,694 | 15.0 |
| Custom | Other | 2,039,626 | 0.91 | 1,855,243 | 0.58 | 1,076,041 | 13.0 |
| Custom | Commercial Refrigeration | 901,407 | 0.91 | 819,919 | 0.58 | 475,553 | 13.0 |
| Custom | Process Heating | 323,695 | 0.91 | 294,433 | 0.58 | 170,771 | 13.0 |
| Custom | Free Cooling HX/Economizers | 195,303 | 0.91 | 177,647 | 0.58 | 103,035 | 16.0 |
| Custom | Process Cooling | 548,279 | 0.91 | 498,714 | 0.58 | 289,254 | 23.0 |
| Total | | 28,969,667 | 0.91 | 26,350,802 | 0.58 | 15,283,465 | 14.4 |

* 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 Summer Peak Demand Savings by Measure

| End Use Type | Research Category | Ex Ante Gross Peak Demand Reduction (kW) | Verified Gross Realization Rate | Verified Gross Peak Demand Reduction (kW) | NTG* | Verified Net Peak Demand Reduction (kW) |
|--------------|-----------------------------|--|---------------------------------|---|-------------|---|
| Custom | Waste Water Treatment | 1,288 | 1.23 | 1,585 | 0.70 | 1,110 |
| Custom | Motors/Fans/Pumps | 42 | 1.23 | 52 | 0.70 | 36 |
| Custom | HVAC | 290 | 1.23 | 357 | 0.70 | 250 |
| Custom | Compressed Air | 220 | 1.23 | 271 | 0.70 | 190 |
| Custom | Lighting | 692 | 1.23 | 852 | 0.70 | 596 |
| Custom | Other | 222 | 1.23 | 273 | 0.70 | 191 |
| Custom | Commercial Refrigeration | 64 | 1.23 | 79 | 0.70 | 56 |
| Custom | Process Heating | 111 | 1.23 | 137 | 0.70 | 96 |
| Custom | Free Cooling HX/Economizers | 24 | 1.23 | 30 | 0.70 | 21 |
| Custom | Process Cooling | 92 | 1.23 | 113 | 0.70 | 79 |
| Total | | 3,046 | 1.23 | 3,750 | 0.70 | 2,625 |

* 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 5-3. CY2018 Energy Savings by Measure – Gas

| End Use Type | Research Category | Ex Ante Gross Savings | Verified Gross Realization Rate | Verified Gross Savings | NTG* | Verified Net Savings | Effective Useful Life |
|--|-----------------------------|-----------------------|---------------------------------|------------------------|-------------|----------------------|-----------------------|
| Custom | Waste Water Treatment | 0 | NA | 0 | 0.58 | 0 | 13.0 |
| Custom | Motors/Fans/Pumps | 0 | NA | 0 | 0.58 | 0 | 20.0 |
| Custom | HVAC | 0 | NA | 4,162 | 0.58 | 2,414 | 13.0 |
| Custom | Compressed Air | 0 | NA | 0 | 0.58 | 0 | 13.0 |
| Custom | Lighting | 0 | NA | 0 | 0.58 | 0 | 15.0 |
| Custom | Other | 0 | NA | 0 | 0.58 | 0 | 13.0 |
| Custom | Commercial Refrigeration | 0 | NA | 0 | 0.58 | 0 | 13.0 |
| Custom | Process Heating | 0 | NA | 0 | 0.58 | 0 | 13.0 |
| Custom | Free Cooling HX/Economizers | 0 | NA | 0 | 0.58 | 0 | 16.0 |
| Custom | Process Cooling | 0 | NA | 0 | 0.58 | 0 | 23.0 |
| Total Therms | | 0 | NA | 4,162 | 0.58 | 2,414 | 14.4 |
| Total kWh Converted From Therms | | 0 | NA | 121,988 | 0.58 | 70,753 | 14.4 |

NA = Not applicable

* 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>.

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

Source: ComEd tracking data and Navigant team analysis.

Table 5-4. CY2018 Energy Savings by Measure – Total Combining Electricity and Gas

| End Use Type | Research Category | Ex Ante Gross Savings (kWh) | Verified Gross Realization Rate | Verified Gross Savings (kWh) | NTG* | Verified Net Savings (kWh) |
|---------------|---------------------------|-----------------------------|---------------------------------|------------------------------|-------------|----------------------------|
| Custom | Waste Water Treatment | 9,417,825 | 0.91 | 8,566,451 | 0.58 | 4,968,542 |
| Custom | Motors/Fans/Pumps | 2,946,947 | 0.91 | 2,680,542 | 0.58 | 1,554,715 |
| Custom | HVAC | 3,770,435 | 0.91 | 3,551,575 | 0.58 | 2,059,913 |
| Custom | Compressed Air | 2,040,873 | 0.91 | 1,856,378 | 0.58 | 1,076,699 |
| Custom | Lighting | 6,785,278 | 0.91 | 6,171,887 | 0.58 | 3,579,694 |
| Custom | Other | 2,039,626 | 0.91 | 1,855,243 | 0.58 | 1,076,041 |
| Custom | Commercial Refrigeration | 901,407 | 0.91 | 819,919 | 0.58 | 475,553 |
| Custom | Process Heating | 323,695 | 0.91 | 294,433 | 0.58 | 170,771 |
| Custom | Free Cooling HX/Economize | 195,303 | 0.91 | 177,647 | 0.58 | 103,035 |
| Custom | Process Cooling | 548,279 | 0.91 | 498,714 | 0.58 | 289,254 |
| Total† | | 28,969,667 | 0.91 | 26,472,790 | 0.58 | 15,354,218 |

* 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>.

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

Source: ComEd tracking data and Navigant team analysis.

6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

6.1 Impact Parameter Estimates

The evaluation team performed engineering calculations to derive evaluated gross energy and demand savings based on data collected during the on-site M&V visit or the desk review process. The savings are site specific and therefore require site-specific calculators and algorithms in conjunction with data collected from the site. The evaluation team used the data obtained during the M&V efforts to verify measure installation, determine installed measure characteristics, assess operating hours and relevant modes of operation, identify the characteristics of the replaced equipment support the selection of baseline conditions and perform ex post savings calculations. Each site-specific evaluation used peak kW savings calculation methodology consistent with PJM summer peak demand requirements¹ to calculate the peak kW reduction. 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 non-deemed parameters for the Custom Program that were not specified in the Illinois Technical Reference Manual (IL TRM). The results are shown in Table 6-1

¹ PJM defines the coincident summer peak period as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, during the months of June through August.

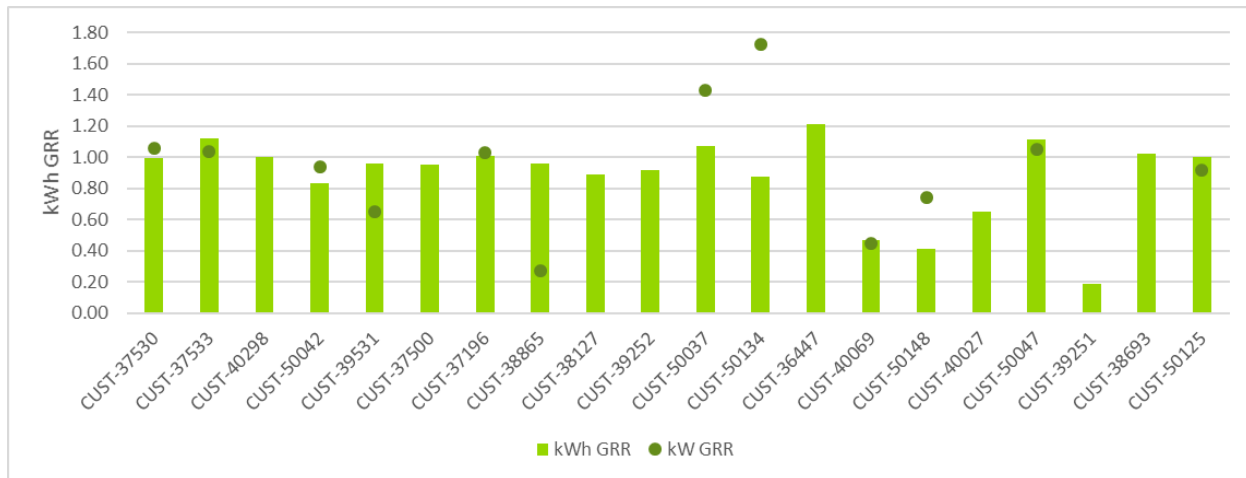
Table 6-1. Verified Gross Savings Parameters

| Gross Savings Input Parameters | Value | Deemed * or Evaluated? |
|--|------------|------------------------|
| Gross Energy Savings Realization Rate | 0.91 | Evaluated |
| Gross Peak Demand Savings Realization Rate | 1.23 | Evaluated |
| NTG Ratio (kWh) | 0.58 | Deemed* |
| NTG Ratio (kW) | 0.70 | Deemed* |
| Net Energy Savings (Electric Only) (kWh) | 15,283,465 | Evaluated |
| Net Peak Demand Savings (kW) | 2,625 | Evaluated |

* 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>.

Figure 6-1 shows a comparison of the energy and demand realization rates for every site. The CY2018 energy savings realization rate results ranged from 0.19 to 1.21, which resulted in a program level weighted realization rate of 0.91. The energy gross realization rate was at or above 1.0 for eight of the 20 projects examined. For 10 projects, the energy gross realization rates were within 10% of one for the energy savings. There were only three projects with energy gross realization rates of less than 0.5. The demand savings realization rates for the twenty projects in the gross sample ranged from 0.27 to 1.72, resulting in a program level realization rate of 1.23.

Figure 6-1. Energy and Demand Realization Rates



6.2 Other Impact Findings and Recommendations

The evaluation team has developed several recommendations based on findings from the CY2018 evaluation, as follows:

Finding 1: There were a few projects (50042, 50148 and 40027) with some issues surrounding the methodology or assumptions used in the ex ante savings calculation.

Recommendation 1: The evaluation team recommends using additional quality control procedures to identify the deficiencies in the ex ante calculations. Whenever possible, the savings should be validated using an alternate approach as a validity check. If there are any doubts about the methodology or savings calculations, the implementation team should pass it through the evaluation team for early feedback before the savings are finalized.

Finding 2: Installed equipment for 39251 did not have all of the efficiency measures that were claimed in the application.

Recommendation 2: The implementation team should ensure that all the measures are installed as per the scope of the project. The equipment specification should be validated by vendor literature or through confirmation from the vendor or manufacturer.

Finding 3: There are lot of measures in the end of year population tracking document that do not match with the Effective Useful Life (EUL) listed in the guidance document² provided by Navigant.

Recommendation 3: The measure-level EULs claimed by the program should match the EUL provided in the Navigant EUL guidance memo. Similarly, the measure description should be indicative of what EUL is being claimed. If there are measures in the program where no EUL guidance is provided, ComEd should work with Navigant to determine how the EUL should be claimed for that measure.

Finding 4: Based on previous recommendations, the implementation team has been claiming ex ante demand savings for projects. However, there were three projects in the 2018 evaluation sample where the ex ante demand savings were not claimed. For these three projects, the evaluation team found non-zero savings.

Recommendation 4: Savings should be claimed for all projects that save energy over the PJM peak summer period of 1:00-5:00 P.M. Central Prevailing Time on non-holiday weekdays, during the months of June through August and reported in the tracking system.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

7.1 Gross Impact (M&V) Sample

Consistent with the evaluation plan, the evaluation team used a stratified random sampling approach to select the gross impact sample of 20 projects. The evaluation team sorted projects based upon the level of ex ante kWh savings and placed the projects in three strata.

Table 7-1 provides a profile of the gross impact M&V sample for the Custom Program in comparison with the program population. Shown below is the resulting sample that was drawn that consists of 20 projects. These projects make up approximately 15 million kWh, which represents 51% of the ex ante impact claim for the program population. Also shown are the ex ante-based kWh sample weights for each of the three strata.

Table 7-1. CY2018 Gross Impact Sample by Strata

| Sampling Strata | Population Summary | | | | Sample | | |
|-----------------|--------------------------------|----------------------------|-------------|--------------------------------|-------------|-----------------------------|--|
| | Number of Tracking Records (N) | Ex ante kWh Impact Claimed | kWh Weights | Number of Tracking Records (n) | Ex ante kWh | Sampled % of Population kWh | |
| 1 | 4 | 9,860,019 | 0.34 | 4 | 9,860,019 | 100% | |
| 2 | 20 | 9,847,860 | 0.34 | 8 | 4,042,003 | 41% | |
| 3 | 99 | 9,261,787 | 0.32 | 8 | 890,425 | 10% | |
| CY2018 Total | 123 | 28,969,667 | - | 20 | 14,792,448 | 51% | |

Source: Navigant Team Analysis

² Navigant memo to ComEd "Effective Useful Life of Custom and Data Center Measures" dated Aug 30, 2018.

7.2 Roll-up of Savings

There are two basic statistical methods for combining individual gross realization rates from the sample projects into an estimate of verified gross kWh savings for the population when stratified random sampling. These two methods are referred to as “separate” and “combined” ratio estimation.³ In the case of a separate ratio estimator, a separate gross kWh savings realization rate is calculated for each stratum and then combined. In the case of a combined ratio estimator, evaluation completes a single gross kWh savings realization rate calculation without first calculating separate gross realization rates by stratum.

The evaluation team used the separate ratio estimation technique to estimate verified gross impacts for the Custom Program. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework⁴, which identifies best practices in program evaluation. The evaluation team matched these steps to the stratified random sampling method that they used to create the sample for the program. The evaluation team used the standard error to estimate the error bound around the estimate of verified gross impacts.

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

8.1 Savings by Strata

The Custom Program sample includes 20 sites, across three strata. Breakdown of energy and demand savings by strata are shown in Table 8-1 and Table 8-2

Table 8-1. CY2018 Energy Savings by Strata

| Sample Strata | Sample Size | Ex Ante Gross Savings (kWh) | Verified Gross Realization Rate | Verified Gross Savings (kWh) | NTG * | Verified Net Savings (kWh) |
|---------------|-------------|-----------------------------|---------------------------------|------------------------------|-------|----------------------------|
| 1 | 4 | 9,860,019 | 1.02 | 10,047,424 | 0.58 | 5,827,506 |
| 2 | 8 | 9,847,860 | 0.96 | 9,414,722 | 0.58 | 5,460,539 |
| 3 | 8 | 9,261,787 | 0.74 | 6,888,656 | 0.58 | 3,995,420 |
| Total | | 28,969,667 | 0.91 | 26,350,802 | 0.58 | 15,283,465 |

* 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: Navigant Team Analysis

³ A full discussion and comparison of separate vs. combined ratio estimation can be found in Sampling Techniques, Cochran, 1977, pp. 164-169.

⁴ Tec Market Works, “The California Evaluation Framework,” Prepared for the California Energy Commission, June 2004. Available at <http://www.calmac.org>

Table 8-2. CY2018 Demand Savings by Strata

| Sample Strata | Sample Size | Ex Ante Gross Demand Reduction (kW) | Verified Gross Realization Rate | Verified Gross Demand Reduction (kW) | NTG* | Verified Net Demand Reduction (kW) |
|---------------|-------------|-------------------------------------|---------------------------------|--------------------------------------|------|------------------------------------|
| 1 | 4 | 1,125 | 1.04 | 1,166 | 0.70 | 816 |
| 2 | 8 | 894 | 1.17 | 1,044 | 0.70 | 731 |
| 3 | 8 | 1,027 | 1.50 | 1,539 | 0.70 | 1,078 |
| Total | | 3,046 | 1.23 | 3,750 | 0.70 | 2,625 |

* 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: Navigant Team Analysis

8.2 Savings by Project

The Custom Program sample consists of 20 projects. Table 8-3 provides the ex ante and ex post energy savings for all the projects in the sample.

Table 8-3. CY2018 Energy Savings by Project

| Sampled Application ID | Sample Strata | Ex Ante Gross Savings (kWh) | Verified Gross Realization Rate | Verified Gross Savings (kWh) | NTG * | Verified Net Savings (kWh) |
|------------------------|---------------|-----------------------------|---------------------------------|------------------------------|-------|----------------------------|
| CUST-37530 | 1 | 3,870,929 | 0.99 | 3,834,868 | 0.58 | 2,224,223 |
| CUST-37533 | 1 | 3,312,721 | 1.12 | 3,711,811 | 0.58 | 2,152,850 |
| CUST-40298 | 1 | 1,608,318 | 1.00 | 1,608,318 | 0.58 | 932,824 |
| CUST-50042 | 1 | 1,068,052 | 0.84 | 892,427 | 0.58 | 517,608 |
| CUST-39531 | 2 | 880,195 | 0.96 | 846,823 | 0.58 | 491,157 |
| CUST-37500 | 2 | 869,295 | 0.95 | 824,531 | 0.58 | 478,228 |
| CUST-37196 | 2 | 488,247 | 1.01 | 491,722 | 0.58 | 285,199 |
| CUST-38865 | 2 | 395,041 | 0.96 | 378,740 | 0.58 | 219,669 |
| CUST-38127 | 2 | 369,948 | 0.89 | 327,676 | 0.58 | 190,052 |
| CUST-39252 | 2 | 353,473 | 0.92 | 325,148 | 0.58 | 188,586 |
| CUST-50037 | 2 | 352,492 | 1.07 | 378,324 | 0.58 | 219,428 |
| CUST-50134 | 2 | 333,312 | 0.87 | 291,260 | 0.58 | 168,931 |
| CUST-36447 | 3 | 228,320 | 1.21 | 277,349 | 0.58 | 160,862 |
| CUST-40069 | 3 | 205,359 | 0.47 | 96,360 | 0.58 | 55,889 |
| CUST-50148 | 3 | 147,491 | 0.41 | 60,175 | 0.58 | 34,902 |
| CUST-40027 | 3 | 122,850 | 0.65 | 80,223 | 0.58 | 46,529 |
| CUST-50047 | 3 | 78,921 | 1.11 | 87,779 | 0.58 | 50,912 |
| CUST-39251 | 3 | 58,859 | 0.19 | 11,124 | 0.58 | 6,452 |
| CUST-38693 | 3 | 25,588 | 1.02 | 26,227 | 0.58 | 15,212 |
| CUST-50125 | 3 | 23,036 | 1.00 | 23,036 | 0.58 | 13,361 |
| Total | | 14,792,448 | 0.91 | 14,573,921 | 0.58 | 8,452,874 |

* 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>.

Gas savings converted to electricity are not included because they are not rolled up to the population.

Source: Navigant Team Analysis

Table 8-4 provides the ex ante and ex post demand savings for all the projects in the sample.

Table 8-4. CY2018 Demand Savings by Project

| Sampled Application ID | Sample Strata | Ex-Ante Gross Demand Reduction (kW) | Verified Gross Realization Rate | Verified Gross Demand Reduction (kW) | NTG* | Verified Net Demand Reduction (kW) |
|------------------------|---------------|-------------------------------------|---------------------------------|--------------------------------------|------|------------------------------------|
| CUST-37530 | 1 | 594 | 1.06 | 628 | 0.70 | 440 |
| CUST-37533 | 1 | 410 | 1.03 | 424 | 0.70 | 297 |
| CUST-40298 | 1 | - | | | 0.70 | - |
| CUST-50042 | 1 | 122 | 0.94 | 115 | 0.70 | 80 |
| CUST-39531 | 2 | 220 | 0.65 | 144 | 0.70 | 101 |
| CUST-37500 | 2 | - | | 115 | 0.70 | 81 |
| CUST-37196 | 2 | 148 | 1.03 | 152 | 0.70 | 106 |
| CUST-38865 | 2 | 109 | 0.27 | 30 | 0.70 | 21 |
| CUST-38127 | 2 | - | | 48 | 0.70 | 34 |
| CUST-39252 | 2 | - | | 29 | 0.70 | 20 |
| CUST-50037 | 2 | 33 | 1.43 | 47 | 0.70 | 33 |
| CUST-50134 | 2 | 55 | 1.72 | 95 | 0.70 | 67 |
| CUST-36447 | 3 | - | | 54 | 0.70 | 38 |
| CUST-40069 | 3 | 40 | 0.44 | 18 | 0.70 | 13 |
| CUST-50148 | 3 | 26 | 0.74 | 20 | 0.70 | 14 |
| CUST-40027 | 3 | - | | 14 | 0.70 | 10 |
| CUST-50047 | 3 | 17 | 1.05 | 18 | 0.70 | 13 |
| CUST-39251 | 3 | - | | | 0.70 | - |
| CUST-38693 | 3 | - | | 3 | 0.70 | 2 |
| CUST-50125 | 3 | 3 | 0.92 | 3 | 0.70 | 2 |
| Total | | 1,778 | NA | - | 0.70 | 1,370 |

* 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: Navigant Team Analysis

The evaluation team has provided ComEd with site-specific M&V reports for each verified project. These site-specific impact evaluation reports summarize the ex ante savings in the end of year summary submitted, as well as the ex post M&V plan, data collected at the site, and all the calculations and parameters used to estimate savings. Table 8-3 and Table 8-4 above summarize the results for each project. The evaluation team uncovered some issues in six of the 20 projects, which resulted in energy realization rates with a discrepancy of greater than 15% from a realization rate of 1.0. Some key observations from these site-specific evaluation results are discussed below for each project that saw large differences in savings.

- Project 50042: Ex ante analysis derated the original calculated savings from the eQuest model by 25% to account for the interactive effects between various measures. Based on the billing analysis performed by the evaluation team the interactive factor reduced the savings by closer to 50% of the total savings. Ex post energy savings were estimated using the billing analysis for this project.

- Project 36447: Ex post savings for this lighting project increased by around 20% because of the adjustment made to the hours of operation based on the customer interview.
- Project 40069: Allowable Lighting Power Density for office space was changed from 1.55 to 0.82 based on the International Energy Conservation Code 2015 (IECC 2015). The ex post savings for this project decreased by more than 50% for this project based on that change.
- Project 50148: Ex post savings for this lighting project decreased by around 60% of the ex ante savings. The main reason is due to an electric heating penalty in the ex post calculations. This was not claimed in the ex ante calculations as the heating fuel was recorded as gas, but the evaluation team determined that the actual heating system uses electricity.
- Project 40027: Ex ante savings were estimated based on the trend data for a summer month (June). The evaluation team included data for winter months (February and March) in the post-retrofit period. Because of the low load on the chiller during the winter months, the average annual load on the chiller dropped from 68% (ex ante estimate based on June) to 46% and that change decreased savings by 35%.
- Project 39251: Ex post savings for this project were reduced as the measures were not installed as expected. The new evaporators did not have Variable Frequency Drives (VFDs) and the refrigeration units did not have floating head pressure controls as assumed in the ex ante analysis. The new units do have VFDs on the condenser fan, which are modulated to maintain the head pressure. The savings for the condenser fan VFD are considered in the ex post calculations and it resulted in energy gross realization rate of 20% for this project.

9. TOTAL RESOURCE COST DETAIL

Table 9-1 below, shows the Total Resource Cost (TRC) table. 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, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation 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) |
|--------------|-----------------------------|----------|----------|-----------------------|------------------------------|---|-------------------------------|-----------------------------|--------------------------------|-----------------|----------------|--------------------|----------------------------|---|-----------------------------|---------------------------|------------------------------|
| Custom | Waste Water Treatment | Measures | 7 | 13.0 | 8,566,451 | 1,585 | - | N/A | N/A | 0.58 | 0.70 | N/A | 4,968,542 | 1,110 | - | N/A | N/A |
| Custom | Motors/Fans/Pumps | Measures | 6 | 20.0 | 2,680,542 | 52 | - | N/A | N/A | 0.58 | 0.70 | N/A | 1,554,715 | 36 | - | N/A | N/A |
| Custom | HVAC | Measures | 15 | 13.0 | 3,429,587 | 357 | 4,162 | N/A | N/A | 0.58 | 0.70 | N/A | 1,989,160 | 250 | 2,414 | N/A | N/A |
| Custom | Compressed Air | Measures | 3 | 13.0 | 1,856,378 | 271 | - | N/A | N/A | 0.58 | 0.70 | N/A | 1,076,699 | 190 | - | N/A | N/A |
| Custom | Lighting | Measures | 51 | 15.0 | 6,171,887 | 852 | - | N/A | N/A | 0.58 | 0.70 | N/A | 3,579,694 | 596 | - | N/A | N/A |
| Custom | Other | Measures | 11 | 13.0 | 1,855,243 | 273 | - | N/A | N/A | 0.58 | 0.70 | N/A | 1,076,041 | 191 | - | N/A | N/A |
| Custom | Commercial Refrigeration | Measures | 23 | 13.0 | 819,919 | 79 | - | N/A | N/A | 0.58 | 0.70 | N/A | 475,553 | 56 | - | N/A | N/A |
| Custom | Process Heating | Measures | 1 | 13.0 | 294,433 | 137 | - | N/A | N/A | 0.58 | 0.70 | N/A | 170,771 | 96 | - | N/A | N/A |
| Custom | Free Cooling HX/Economizers | Measures | 1 | 16.0 | 177,647 | 30 | - | N/A | N/A | 0.58 | 0.70 | N/A | 103,035 | 21 | - | N/A | N/A |
| Custom | Process Cooling | Measures | 5 | 23.00 | 498,714 | 113 | - | N/A | N/A | 0.58 | 0.70 | N/A | 289,254 | 79 | - | N/A | N/A |