NAVIGANT

150 N Riverside Plaza
Suite 2100
Chicago, IL 60606
www.navigant.com

To: Erin Daughton, ComEd
CC: Milos Stefanovic, ComEd; Jennifer Morris, ICC Staff; Jeff Erickson, Randy Gunn, Rob Neumann, Laura Agapay-Read, Navigant
From: Jennifer Fagan, Itron
Date: October 11, 2019
Re: Net-to-Gross Research Results for the ComEd Data Centers Program CY2018

EXECUTIVE SUMMARY

This memo presents the findings of the CY2018 net-to-gross (NTG) study of the ComEd Data Centers Program. The CY2018 NTG calculations were based on the NTG algorithms specified in the Illinois Technical Reference Manual (TRM) v 7.0 and rely on the self-report approach for estimating free ridership and spillover. Findings are based on in-depth interviews completed for seven projects (out of a population of 32 projects) that represented 47% of program savings.

Within the co-location category, NTG ratios for new construction and retrofit projects are 0.44 and 0.78 respectively. For non-co-location retrofit projects, the researched NTG ratio is 0.03, however it is based on a single small project. For this reason, we do not recommend using it to compute program-verified savings for CY2020 projects. *Instead, the EM&V team recommends that this value be combined with the PY8 and PY9 kWh NTG ratio value for non-co-locations to compute program-verified savings for CY2020 projects going forward. The combined PY8/PY9/CY2018 NTG ratio value for non-colocations is 0.67.* We are recommending this combined PY8/PY9/CY2018 value because it blends the CY2018 value from a single project with the most recent findings from PY8/PY9 based on a larger and statistically robust sample size.

These results will inform Navigant's September 2019 recommendations to the Illinois Stakeholders Advisory Group (SAG) of NTG values to be used for this program in CY2020.

Table 1. NTG Research Results for Data Centers CY2018

Overall Program	Savings Type	Free Ridership	Participant Spillover	NTG Ratio
Co-location				
New Construction	kWh	0.56	0.00	0.44
New Construction	kW	0.66	0.00	0.34
Retrofit	kWh	0.22	0.00	0.78
Retrofit	kW	0.18	0.00	0.82
Non-Co-location*				
Retrofit	kWh	0.33	0.00	0.67
Retrofit	kW	0.33	0.00	0.67

* The researched value for non-co-location projects free ridership is 0.97. However, because this value is based on only one small project, the evaluation team does not recommend it. Instead, we recommend the combined PY8, PY9 and CY2018NTG ratio value of 0.67 for CY2020 non-co-location projects going forward.
Source: Evaluation team analysis

A key factor contributing to high free ridership was that all but one of the evaluated projects (six out of seven projects) were for co-location data centers, and the four largest projects within this subgroup were new construction. In general, co-location data centers, particularly newly constructed ones, are already highly motivated to be as energy efficient as possible. Co-location data centers are driven by market

forces to drive down their operating costs per-unit (also referred to as Power Utilization Effectiveness or PUE) as low as possible.

In addition, the one non-co-location project had already made the decision to convert from a server closet to a co-location when they learned about the availability of an incentive through the Data Centers Program. The financial benefits of the project were already substantial without the incentive due to savings on heating, cooling, and fire suppression equipment and a generator that did not need to be replaced. The decisionmaker described the rebate as “icing on the cake”.

Free Ridership and Spillover Survey Disposition

In-depth telephone interviews were conducted with key decisionmakers for each sampled project. A total of seven interviews (six co-location data centers, one non co-location data center) were completed. The survey interview guides followed the standard NTG question structure, but the in-depth format allowed for more flexibility for follow up probing and consistency checking.

Table 2. Free Ridership Decision Maker Survey Disposition

Measure	Population	Sample	Target Completes	Actual Completes	Analyzed Completes	Share of Program Savings Represented by Analyzed Completes
Co-locations	22	7	7	6	6	>46.9%
Non Co-locations	11	1	1	1	1	<0.001%
Overall Program	32	9	8	7	7	47%

Source: Evaluation team analysis

Table 3. Participant Spillover Survey Disposition

Measure	Population	Sample	Target Completes	Actual Completes	Made Additional Efficiency Improvements	Qualified for Spillover
Co-locations	22	7	7	6	0	0
Non Co-locations	11	1	1	1	0	0
Overall Program	32	9	8	7	0	0

Source: Evaluation team analysis

Free Ridership and Spillover Protocols

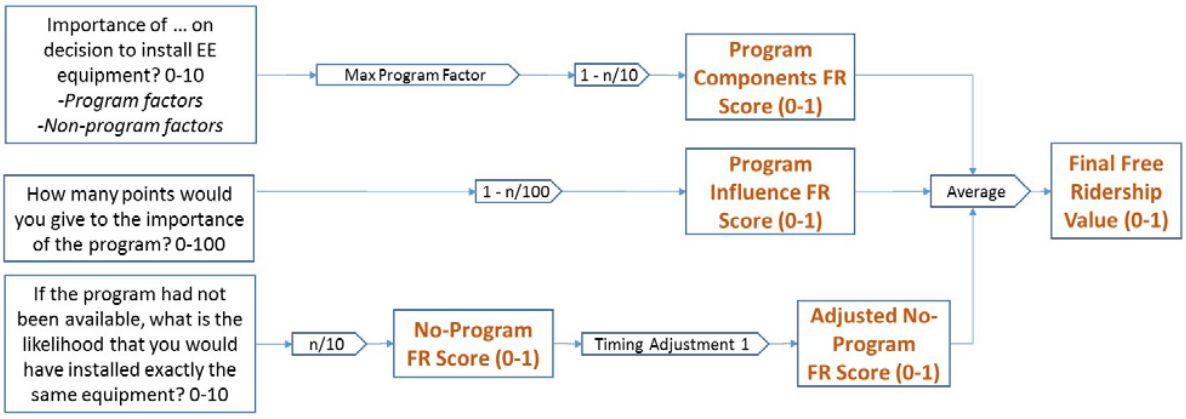
The evaluation team applied the relevant free ridership and spillover protocols from the TRM. The NTG protocols in version 7 of the TRM were developed by the Illinois NTG Working Group in their deliberations during the summer and fall of 2018. For free ridership, the protocols provide two options for combining three sub-scores. These two options use different specifications to account for the impact that the program had on project timing (referred to as “deferred free ridership). Evaluators are to calculate free ridership using both options and to select one option for purposes of calculating the net energy savings for comparing to the legislated goal.

The evaluation team’s preferred algorithm specification is Core Free Ridership Algorithm 1, shown graphically below (Figure 1). The majority of NTG findings discussed below are based on this version. The second option, Core Free Ridership Algorithm 2 (Figure 2), has also been analyzed, and those

findings are presented as a sensitivity case later in this memo. The rationale for selecting Algorithm 1 over Algorithm 2 is that Algorithm 1 provides for equal weighting of each of the three sub-scores, which represent different ways of determining program influence. In contrast, Algorithm 2 applies a 50% weight to the program's effect on the timing of the project, which we believe is too high. Such a high weighting essentially discounts the effect of the other factors that drive program influence, which in our view is inappropriate.

Figure 1. Core Free Ridership Algorithm 1

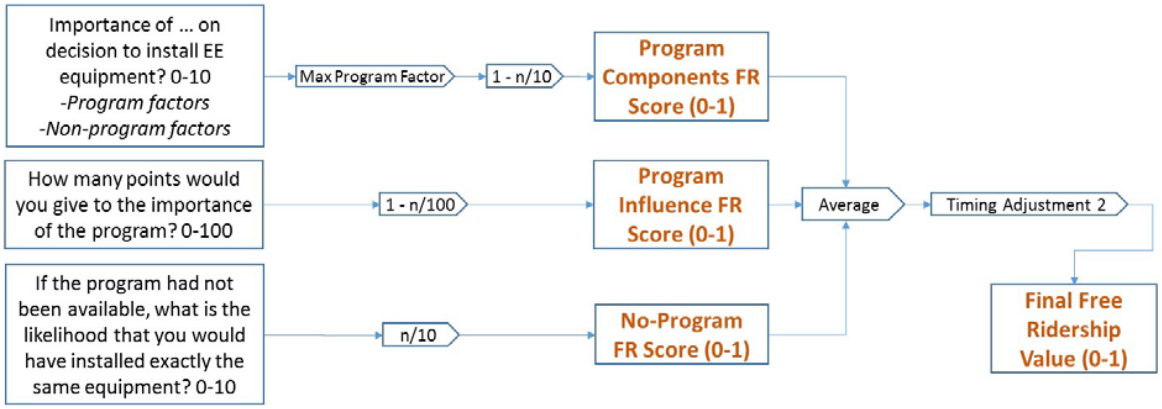
(Program Components FR Score + Program Influence FR Score + (No-Program FR Score * Timing Adjustment 1)) / 3



Source: Illinois TRM, version 7.0

Figure 2: Core Free Ridership Algorithm 2

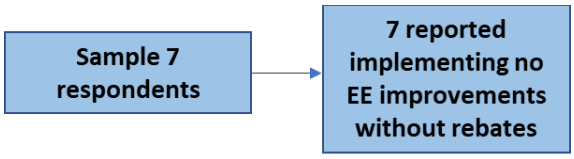
((Program Components FR Score + Program Influence FR Score + No-Program FR Score) / 3) * Timing Adjustment 2



Source: Illinois TRM, version 7.0

The Core Participant Spillover protocol specified in the TRM is the method that the evaluation team used to qualify non-rebated energy efficiency improvements to be spillover. This protocol is generally applicable to most commercial, industrial, and public sector programs. However, none of the surveyed projects reported improvements that qualified as spillover. Figure 3 below illustrates the resulting lack of projects with qualified spillover.

Figure 3: Qualified Spillover



Source: Evaluation team analysis

DETAILED NET TO GROSS RESULTS

Free Ridership Consistency Check Analysis

None of the interviews completed were excluded from the analysis because of inconsistencies or non-response. However, there was one type of adjustment made as reported below in Table 4. As a result of the evaluation team's quality control review, one of the seven projects was found to have scoring for the Program Components score that was inconsistent with the remainder of their interview findings related to program influence. Some of the explanation for their scoring of specific program-related factors was unrelated to the actual project decision making. For example, the ComEd account representative was scored a nine out of ten in importance, and the explanation was, "she is nice". In the remainder of the interview, the customer repeatedly said the project already made economic sense without the program incentive and they would have completed it on their own if the program had not been available. For this reason, the Program Components score was dropped from the calculation of the NTG ratio.

Table 4. Free Ridership Consistency Check Disposition

Project-Level Response Disposition	All projects
Projects covered by interviews	7
Excluded: Non-response	0
Excluded: Triggered and Failed Consistency Check	0
Total of Excluded Responses	0
Analyzed Sample	7
Evaluated to Require no Exclusion	6
Evaluated to Exclude NP Score	0
Evaluated to Exclude PC Score	1

NP = No Program; PC = Program Components
Source: Evaluation team analysis

Free Ridership Component Scores

Table 5 below summarizes the average sub-scores and associated free ridership for each segment analyzed.

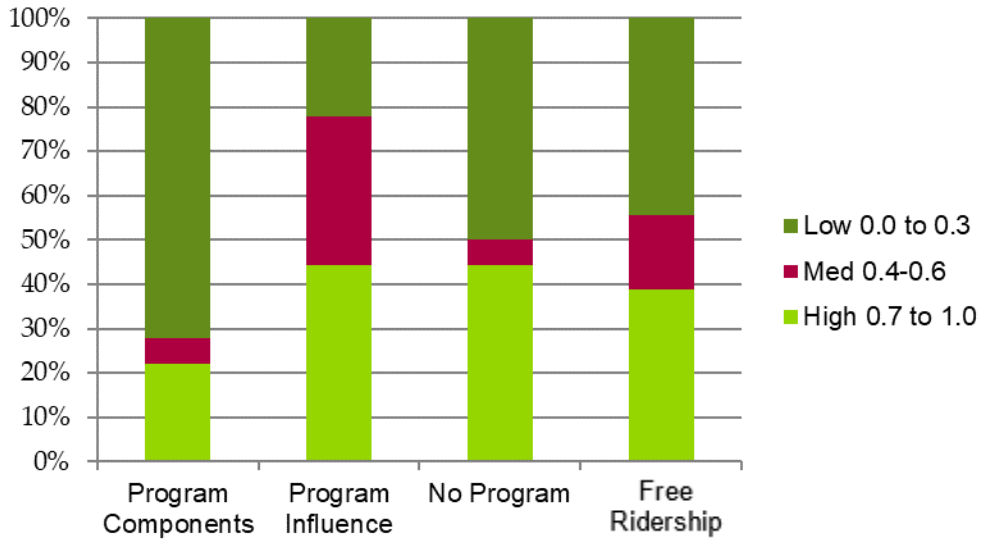
Table 5. Free Ridership Sub-Scores

Savings Type	Program Influence Score	Program Component Score	No Program Score	Free Ridership
Co-location				
New Construction	0.65	0.47	0.58	0.56
Retrofit	0.42	0.13	0.11	0.22
Non-Co-location				
Retrofit	0.95	1.0	1.0	0.97

Source: Evaluation team analysis

A breakdown of the NTG ratio by the three sub-scores is shown graphically in Figure 4. These are shown for the program as a whole. The Program Components score reflects the importance of various program and program-related elements in the customer's decision and timing of the decision in selecting specific program measures. The Program Influence score reflects the relative degree of influence the program had on the customer's decision to install the specified measures versus non-program factors. The No Program score captures the likelihood of various actions the customer might have taken at this time and in the future if the program had not been available. Here, for all three sub-scores, a low score indicates low free ridership.

Figure 4: Free Ridership Level by Sub-Scores



Source: Evaluation team analysis

Note that the concentration of low values is significantly higher for the Program Components score than for either the Program Influence Score or the No Program score. As a result, Program Components score values tend to be lower than those for the other two scores. A key reason for this is that the Program Components score is based on the maximum importance rating provided to any given program element.

Sensitivity Case - Weighted NTG Results Based on Core Free Ridership Algorithm 2

The evaluation team also performed a sensitivity analysis based on Core Free Ridership Algorithm 2. NTG results are slightly higher than Algorithm 1 results due to the greater weight given to the acceleration (i.e. timing) effect of the program. Algorithm 2 varies from Algorithm 1 in the way it treats the effect of timing in the calculation of the free ridership value. Algorithm 1 adjusts for timing only on the No-Program score, then averages the three sub-scores. Algorithm 2 determines the No-Program Score without a timing adjustment, averages the three sub-scores, then applies a timing adjustment factor to the three sub-score average, based on the formula below:

> **Timing Adjustment Factor for Algorithm 2 (Free Ridership Score)** as equal to:
> 1 - ((Number of Months Expedited - 6)/42) *((10 - Likelihood of Implementing within One Year)/10)

While not intuitive, this formula is designed to apply a linear adjustment factor to self-reported deferral (i.e., program induced acceleration) periods ranging from six months to 48 months. Thus, under this formula, a value of six months or less receives zero credit, and a value of 48 months or greater of accelerated adoption receives 100% credit. Both timing adjustment factors have the effect of only ever decreasing free ridership.

NTG Algorithm 2 –CY2018 Weighted NTG Results

Table 6 below summarizes the NTG research results for the free ridership Algorithm 2 across the various segments examined.

Table 6. NTG Research Results for CY2018 ComEd Data Centers Program – Free Ridership Algorithm 2

Overall Program	Savings Type	Free Ridership	Participant Spillover	NTG Ratio
Colocation				
New Construction	kWh	0.54	0.00	0.46
New Construction	kW	0.68	0.00	0.32
Retrofit	kWh	0.09	0.00	0.91
Retrofit	kW	0.04	0.00	0.96
Non-Colocation				
Retrofit	kWh	0.97	0.00	0.03
Retrofit	kW	0.97	0.00	0.03

Source: Evaluation team analysis

The CY2018 program-level kWh NTG ratio by sampling stratum for Algorithm 2, along with precision estimates, is shown below in Table 7. The overall program kWh NTG ratio for CY2018 is 0.44, which is slightly higher than the Algorithm 1 value of 0.41. This timing “bump” is due to several decisionmakers reporting that the program accelerated the installation of their installed project compared to if there had been no program and incentive.

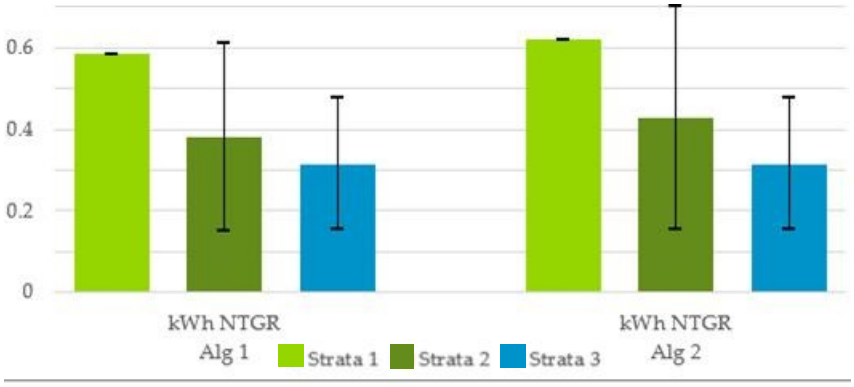
Table 7: Algorithm 2 CY2018 kWh NTG Ratio and Relative Precision at 90% Confidence Level

Sampling Strata	Relative Precision ± %	Low	Mean	High
1	0%	0.62	0.62	0.62
2	64%	0.16	0.43	0.70
3	51%	0.15	0.32	0.48
Data Centers CY2018 Alg 2	**28%**	**0.32**	**0.44**	**0.56**

Source: Evaluation team analysis

Figure 5 below compares the evaluated NTG ratios for Algorithms 1 and 2 for each sampling stratum. For CY2018 when compared to Algorithm 1, the mean energy NTG ratio values are 0.62 (Algorithm 2) versus 0.58 (Algorithm 1) for stratum 1 (large sized projects), 0.43 (Algorithm 2) vs. 0.38 (Algorithm 1) for stratum 2 (medium sized projects), and 0.32 (Algorithm 2) vs. 0.32 (Algorithm 1) for stratum 3 (small sized projects). The higher results for stratum 1 and stratum 2 projects drive the increase in the average program NTG ratio for Algorithm 2 relative to Algorithm 1.

Figure 5: Comparison of CY2018 Evaluated NTG Ratio by NTG Algorithm and Stratum



Source: Evaluation team analysis

Spillover Estimation

As previously stated, none of the evaluated projects reported any non-rebated energy efficiency improvements that were sufficiently influenced by the program, thus the spillover savings is zero and the rate of spillover incorporated into the NTG ratios is zero.

Combining Free Ridership and Spillover to Create Program NTG Ratio

Estimates of free ridership and spillover were added together and the resulting value was subtracted from unity (1.0) to yield the NTG ratio for each program segment and the program overall, as reported in Table 8.

Table 8. Free Ridership and Participant Spillover for the Data Centers Program

Program Segment	Metric	Free Ridership	Participant Spillover	NTG
Colocation				
New Construction	kWh	0.56	0.00	0.44
New Construction	kW	0.66	0.00	0.34
Retrofit	kWh	0.22	0.00	0.78
Retrofit	kW	0.18	0.00	0.82
Non-Colocation				
Retrofit	kWh	0.33	0.00	0.67
Retrofit	kW	0.33	0.00	0.67

Source: Evaluation team analysis

Procedures to Reduce Free Ridership

Screening out Free Riders

One way to assess the rate of free ridership likely on a given project is to critically examine the key reasons behind the project **before** the incentive is approved. For example:

- Has the project already been included in the customer's capital or operating budget? Has the equipment already been ordered or installed?
- Is the measure one that the company or other comparable companies in the same industry or segment routinely installs as a standard practice? Is the measure installed in other locations, without co-funding by incentives? Is the measure potentially industry standard practice?
- Is the project being done, in part, to comply with regulatory mandates (such as environmental regulations)?
- Are the project economics already compelling without incentives? Is the rebate large enough to make a difference in whether the project is implemented?
- Is the company in a market segment that is ahead of the curve on energy efficiency technology installations? Is it part of a national chain that already has a corporate policy to install the proposed technology?
- Does the proposed measure have substantial non-energy impacts? Is it largely being considered for non-energy reasons (such as improved quality or increased production)?
- Is the project payback quite short even without the incentive?

By conducting a brief interview regarding these issues before the incentive is approved, ComEd can better assess the likely degree of free ridership and may be able to then decide if the project should be excluded or substantially re-scoped to a higher efficiency level. In particular, co-location new construction projects, and other data center projects suspected of high free ridership would be prime candidates for this screening interview.

Cronbach's Alpha Results

Cronbach's Alpha is a measure of internal consistency or reliability. It is used to assess how closely related a set of items are as a group. In this memo, Cronbach's Alpha is used to assess how closely related the items going into the NTG score are to each other. In general, the higher the measured Cronbach's Alpha value, the more consistent and reliable are the results. However, given the small number of items (i.e., the three sub-scores) being considered in this application of Cronbach's Alpha, a high alpha value is not expected. Realistically, Alpha values ranging from 0.4 to 0.6 are considered an acceptable measure of reliability for this analysis given the small number of items being analyzed.

We used the Standardized Cronbach's Alpha calculation as specified below:

$$\alpha = \frac{N \cdot \bar{r}}{1 + (N - 1) \cdot \bar{r}}$$

Where:

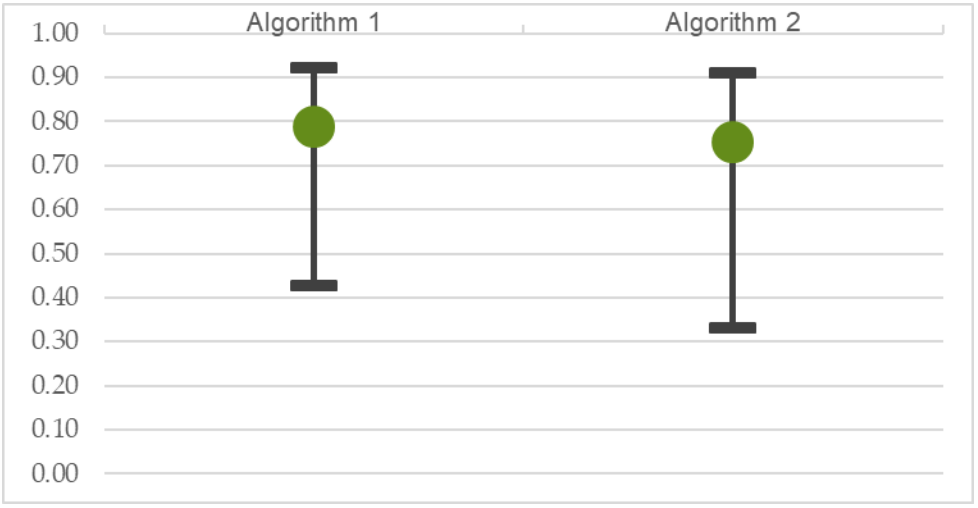
N = the number of items
$\bar{r}$ = the average correlation

We calculated the Cronbach Alpha for the two algorithm variations discussed previously.

Figure 6 below presents the Cronbach's Alpha and the 90% confidence intervals for the two NTG ratio algorithm variations for the CY2018 Data Centers Program. Overall, Cronbach's Alpha values for CY2018 were quite high, 0.79 (Algorithm 1) and 0.75 (Algorithm 2).

Note that the confidence intervals around Cronbach's Alpha are expected to be quite large due to the relatively small sample size. In CY2018, the Cronbach's Alpha results and confidence intervals for the two algorithm variants are nearly identical. Most likely this is because the formula leads to higher values when the inter-item correlations are higher (as was the case in CY2018).

Figure 6: CY2018 Data Centers Program Cronbach's Alpha and 90% Confidence Intervals for the Two Algorithm Variations (N=7)



Source: Evaluation team analysis

APPENDIX: DATA CENTERS PROGRAM NTG HISTORY

	Data Centers
EPY7	**Data Centers NTG: 0.48** **Free-Ridership 0.52** **Participants Spillover: Negligible** **Nonparticipants Spillover: Negligible** **See EPY7 Custom Program**
EPY8	**Recommendation (based upon PY6 research):** **Data Center NTG kWh: 0.60** **Data Center NTG kW: 0.57** **Data Center Free Ridership kWh: 0.40** **Data Center Free Ridership kW:0.43** **Data Center Spillover: Negligible** NTGR results were based on self-reported data from surveys of a census of PY6 projects. For PY6, the net program impacts were quantified solely on the estimated level of Free-Ridership. Information regarding participant spillover was also collected, but ultimately did not support a finding of any spillover – spillover was very small.
EPY9	**Data Center NTG: 0.68** **Data Center Free Ridership: 0.36** **Data Center Spillover: Negligible** **NTG Research Source:** Free-Ridership: PY7 Participant and vendor self-report data Spillover: PY7 Participant and vendor self-report data
CY2019	**Data Center NTG kWh and kW: 0.68** **Data Center Free Ridership kWh and kW: 0.32** **Data Center Spillover: Negligible** **NTG Research Source:** Free-Ridership: PY7 Participant and vendor self-report data Spillover: PY7 Participant and vendor self-report data The evaluation team performed telephone surveys in PY8, but the analysis will be performed and combined with PY9 findings.

Source:
http://ilsagfiles.org/SAG_files/NTG/2019_NTG_Meetings/Corrected_NTG_Values/ComEd_NTG_History_and_CY2019_Recommendations_Aerator_and_Showerhead_Correction_2019-04-12.pdf