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August 17, 2020

VIA ELECTRONIC FILING

Ms. Kimberley A. Campbell
Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

**Re: Duke Energy Progress, LLC's DSM/EE Cost Recovery Rider – Supplemental Testimony and Exhibits
Docket No. E-2, Sub 1252**

Dear Ms. Campbell:

Enclosed for filing is Duke Energy Progress, LLC's Supplemental Testimony of Robert P. Evans and Evans Supplemental Exhibit D for filing in connection with the referenced matter.

Please do not hesitate to contact me if you have any questions or require additional information.

Sincerely,

Kendrick C. Fentress

Kendrick C. Fentress

Enclosures

cc: Parties of Record

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-2, SUB 1252

In the Matter of	)	
Application of Duke Energy Progress, LLC	)	**SUPPLEMENTAL**
for Approval of Demand-Side Management	)	**TESTIMONY OF**
and Energy Efficiency Cost Recovery Rider	)	**ROBERT P. EVANS FOR**
Pursuant to N.C. Gen. Stat. § 62-133.9 and	)	**DUKE ENERGY PROGRESS,**
Commission Rule R8-69	)	**LLC**

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Robert P. Evans. My business address is 410 South Wilmington Street, Raleigh, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Duke Energy Corporation ("Duke Energy") as Senior Manager-Strategy and Collaboration for the Carolinas in the Regulatory Strategy Portfolio Analysis and Regulatory Strategy group.

Q. DID YOU PREVIOUSLY FILE DIRECT TESTIMONY IN SUPPORT OF DUKE ENERGY PROGRESS, LLC'S APPLICATION IN THIS DOCKET?

A. Yes.

Q. WHAT IS THE PURPOSE OF YOUR SUPPLEMENTAL TESTIMONY?

A. The purpose of my supplemental testimony is to provide the Commission with an exhibit that was inadvertently left out of the Company's original filing in this proceeding.

Q. WILL YOU DESCRIBE THIS EXHIBIT?

A. The exhibit, identified as Evans Supplemental Exhibit D, is an EM&V report associated with the 2018 evaluation, measurement, and verification ("EM&V") Report for the Duke Energy Progress, LLC ("Company") Commercial, Industrial, and Governmental Demand Response Automation Program ("CIG DRA"). CIG DRA is a non-residential demand side management ("DSM") program. This report was finalized on May 28, 2019.

Q. WERE ANY OTHER ELEMENTS OF THE COMPANY'S FILING IMPACTED BY THE OMISSION OF THIS EXHIBIT?

A. No. The omission of this exhibit did not impact any other elements of the Company's filing.

Q. DOES THIS CONCLUDE YOUR PRE-FILED SUPPLEMENTAL TESTIMONY?

A. Yes.

2018 EM&V Report for the Duke Energy Progress Commercial, Industrial, and Governmental Demand Response Automation Program

Prepared for:

Duke Energy Progress

Prepared by:

Navigant Consulting, Inc.

May 28, 2019

NAVIGANT

Prepared for:
Duke Energy Progress

Presented by:
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Attached as separate documents:
Appendix A: Event Day Load Profile and Baseline Plots (.pdf document)
Appendix B: Analysis Data Tables & Graphics (.xlsx document)

EXECUTIVE SUMMARY

The Commercial, Industrial, and Governmental (CIG) Demand Response Automation (DRA) program is offered to qualifying customers in the Duke Energy Progress (DEP) service territory. DRA offers participating companies a financial incentive to reduce their electricity consumption when called upon by DEP. This report covers Navigant's evaluation, measurement, and verification (EM&V) activities for program year 2018 (PY2018).

This EM&V report is intended to verify program impacts as per the requirements established by the North Carolina Utilities Commission and the Public Service Commission of South Carolina. The evaluation had two major objectives:

- Verify the demand reduction calculated by DEP's method of baseline estimation as described in the *Demand Response Automation Rider DRA-7 (North Carolina)* and *DRA-8 (South Carolina)* filed by DEP.[1]
- Produce a set of verified program impacts by customer and for the program as a whole using the most accurate baseline method, as determined by Navigant via the testing regime outlined in the evaluation plan.[2] Specifically, per Navigant's scope of work (SOW) and the approved evaluation plan, Navigant was required to complete the following:
    - Estimate verified impacts using the approach determined to be the most accurate predictor of aggregate load through testing on non-event days
    - Estimate average kilowatt (kW) event load shed per meter, by sector, and for the program as a whole
    - Provide a detailed baseline approach and explanation of the kW impact calculations

Program Summary

The DRA program offers participating companies a financial incentive to reduce their electricity consumption for up to 8 hours at a time on select system peak days in either the summer or winter months. In PY2018, DEP called four winter events and three summer events.

[1] North Carolina Rider, DRA-7: https://www.duke-energy.com/_/media/pdfs/rates/gp2ncriderdradep.pdf?la=en
South Carolina Rider, DRA-8: https://www.duke-energy.com/_/media/pdfs/for-your-home/rates/electric-sc/gp1scriderdra.pdf?la=en

[2] In previous years, Navigant used the regression specification and approach determined as part of the PY2010 and PY2011 evaluations to deliver the most accurate estimate of impacts. One of the recommendations of the PY2017 evaluation report was to, in light of the length of time since the initial testing, repeat and update this testing procedure.

In PY2018, 22 customers were registered as participants in DEP's DRA program for summer and/or winter events, representing 49 unique sites and 73 meters.[3] Of the 73 meters registered as participants for at least one event in PY2018:

- 34 meters were at commercial sites
- 4 meters were at governmental sites
- 35 meters were at industrial sites (16 of the 35 meters belonged to a single manufacturing company)

For brevity, the very large industrial participant (with 16 meters) is referred to the VLIP in this report. Many customers do not have a winter commitment in their contract.

Key Findings

DEP called four winter DRA events and three summer DRA events during PY2018, involving 73 unique customer meters that each participated in at least one event.[4] The key impact evaluation findings are as follows:

- **The best models for estimating verified impacts were regression-based with a day-of load adjustment.** Navigant tested a set of regression and customer baseline (CBL) models out of sample[5] using event-like, non-event days as test days. The evaluation team determined that regression-based models performed best for both summer and winter events, as well as for events where DEP provided day-of and day-ahead notification.
- **Verified impacts were less than reported impacts.** The average realization rate for summer demand response (DR) impacts for PY2018 was 97%, with an average of approximately 20.0 MW of DR contributed by the program. This realization rate is similar to the average across prior years (2010 through 2017) of 96%. The average realization rate for winter DR impacts for PY2018 was 93%, with an average of approximately 6.9 MW of DR contributed by the program. This realization rate falls between prior years when DEP called winter events in 2014 and 2015, which had realization rates of 92% and 97%, respectively, or an average of 95%.
- **Participation[6] was inconsistent between events.** The average total event impacts for the summer of PY2018 were highest for the first and second events (21.5 MW and 20.0 MW, respectively) but lower for the third event (18.4 MW). The third summer event had the lowest participation (58 meters). For winter events, the first and second events had the highest impacts (7.2 MW and 7.4 MW, respectively) with the participation of 32 and 39 meters, respectively. The third and fourth winter events had impacts of 6.3 MW and 6.8 MW and participation of 35 and 31 meters, respectively. These impacts suggest that the participation of large customers drives the impacts of winter events.

[3] Two meters for a single customer were reported as single meter, consistent with DEP's reported impacts.

[4] Two meters for a single customer were reported as single meter, consistent with DEP's reported impacts.

[5] Out of sample testing refers to the procedure whereby the accuracy of a model is tested using only observations not included in the model itself—i.e., the period being predicted is not included in the calculation that delivers the parameters that provide the prediction.

[6] Event-specific participation refers to enrolled participants delivering more than 0 kW of DR for a given event. An enrolled customer meter has participated in only two of three events if that meter has contributed more than 0 kW on only two of the three events.

1. PROGRAM DESCRIPTION AND RESEARCH OBJECTIVES

The Commercial, Industrial, and Governmental (CIG) Demand Response Automation (DRA) program is offered to qualifying customers in the Duke Energy Progress (DEP) service territory. DRA offers participating companies a financial incentive to reduce their electricity consumption when called upon by DEP.

DRA offers participating companies a financial incentive to reduce their electricity consumption for up to 8 hours at a time on a few peak days each year. To be eligible, customers must be able to commit at least 75 kW of curtailable load. DEP's program literature specifies that a minimum of three summer events will be called, and the maximum number of curtailment events that could be called is 10. Typical event duration is 6-8 hours. Participants will receive notification of events at least 30 minutes prior to the event.

This report covers Navigant's evaluation, measurement, and verification (EM&V) activities for program year 2018 (PY2018). The primary objective of the evaluation is to estimate reductions in peak demand is, as energy impacts are generally negligible.

1.1 Evaluation Objectives

This EM&V report is intended to verify program impacts as per the requirements established by the North Carolina Utilities Commission and the Public Service Commission of South Carolina. The evaluation had two major objectives:

- Verify the demand reduction calculated by DEP's method of baseline estimation as described in the *Demand Response Automation Rider DRA-7 (North Carolina)* and *DRA-8 (South Carolina)* filed by DEP. [7]
- Produce a set of verified program impacts by customer and for the program as a whole using the most accurate baseline method, as determined by Navigant via the testing regime outlined in its evaluation plan.[8] Specifically, per Navigant's scope of work (SOW) and the approved evaluation plan, Navigant was required to complete the following:
    - Estimate verified impacts using the approach determined to be the most accurate predictor of aggregate load through testing on non-event days
    - Estimate average kilowatt (kW) event load shed per meter, by sector, and for the program as a whole
    - Provide a detailed baseline approach and explanation of the kW impact calculations

1.2 Program Activity Overview

For the summer of PY2018, all participants received day-of notice in advance of one event (June 19) and day-ahead notice in advance of two events (August 8 and 28). A summary of all events is listed in Table

[7] North Carolina Rider, DRA-7: https://www.duke-energy.com/_/media/pdfs/rates/gp2ncriderdradep.pdf?la=en
South Carolina Rider, DRA-8: https://www.duke-energy.com/_/media/pdfs/for-your-home/rates/electric-sc/gp1scriderdra.pdf?la=en

[8] In previous years, Navigant used the regression specification and approach determined as part of the PY2010 and PY2011 evaluations to deliver the most accurate estimate of impacts. One of the recommendations of the PY2017 evaluation report was to, in light of the length of time since the initial testing, repeat and update this testing procedure.

1. For the winter of PY2018, all participants received day-ahead notice in advance of two events (January 15 and 18) and day-of notice in advance of two events (January 2 and 7). One event, January 7, was called on a Sunday.

The notification period determines whether or not a same-day adjustment can be applied when estimating verified impacts. Same-day adjustments generally materially improve the accuracy of verification baselines, but they cannot be applied when notification is day-ahead.

Table 1. DEP DRA PY2018 Event Details

Season	Event Date	Start Time	End Time	Event Duration (Hours)	Advance Notification Window (Hours)	Day-of Notification
Summer	2018-08-28	13:00	19:00	6	23.25	No
Summer	2018-08-08	13:00	19:00	6	23.25	No
Summer	2018-06-19	13:00	19:00	6	3.50	Yes
Winter	2018-01-18	5:30	9:30	4	16.08	No
Winter	2018-01-15	5:00	10:00	5	14.20	No
Winter	2018-01-07	6:00	11:00	5	1.60	Yes
Winter	2018-01-02	7:00	10:00	3	0.87	Yes

Source: DEP DRA Event Details

Eligibility. To qualify for the program, DEP commercial and industrial customers must be able to curtail 75 kW. Importantly, all industrial customers and any commercial customers that use more than 1 million kWh per year must also elect to forego the opportunity to opt out of the rider that funds DEP's DSM (demand-side management) programs while participating in DRA.

Incentives. The program provides three types of participant incentives:

- **A one-time participation incentive of $50 per demonstrated kW.** Intended to enhance customer acquisition and to support customer investment related to program participation, including the purchase and installation of switchgear upgrades or emission controls for backup generators.
- **A monthly availability credit of $3.25 per contracted kW.** Intended to provide steady payment streams and ensure readiness.
- **An event performance credit of $6 per curtailed kW.** Intended to increase resource reliability by emphasizing event compliance.

DEP selected this three-part incentive structure to benefit customers responding to more events and to ensure that DEP pays for performance but limits its costs when few events are called. As a pay-for-play program, it ensures that customers will receive more incentives when the need for peak reduction is high.

Performance and Compliance. DEP provides customers with information about complying with program requirements based on curtailment levels during predefined seasonal periods. Participants are also provided information about the method for estimating the baseline to determine curtailment impacts.

1.3 Reported Program Participation and Savings

In PY2018, 22 customers were registered as participants in DEP's DRA program in summer and/or winter events, representing 49 unique sites and 73 meters.[9] Not all meters participated in all events.[10] Many customers do not have a winter commitment in their contract, which is reflected in the total number of participating meters in winter compared with summer. Of the 73 meters that were registered as participants for at least one event in PY2018, 34 were at commercial sites, four at governmental sites, and 35 at industrial sites. Of the 35 meters at industrial sites,16 belonged to a single manufacturing company. For brevity, the very large industrial participant (with 16 meters) is referred to as the VLIP in this report.

Table 2 and Table 3 summarize participation by season, including the number of customers, meters, and sites by customer type and the average demand reduction reported by DEP over the three summer and four winter events.

Table 2. Summary of Customer Meter Counts – Summer Contracts

Sector	Customer Type	Number of Customers	Number of Sites	Number of Meters	Avg. Reported Summer Reduction per Meter (kW)
Commercial	Grocery	4	23	25	248
Commercial	Hospital/Medical	1	1	1	1,064
Commercial	Office	3	3	3	304
Commercial	Warehouse/ Distribution	1	1	1	531
Governmental	Government Institution	2	2	2	1,752
Governmental	Water Treatment	2	2	2	624
Industrial	Manufacturing	8	15	35	269
	Total Program	**21**	**47**	**69**	**N/A[11]**

Source: DEP DRA program database

[9] Two meters for a single customer were reported as single meter, consistent with DEP's reported impacts.

[10] Participating meters are added, removed, suspended from the program or removed from suspension over the course of the year. Likewise, some meters were contracted only for summer months, and others only for winter.

[11] An average by meter is not provided here to avoid undue confusion in comparison with aggregated impacts. Average impacts per participating meter across multiple events ignore impacts of events in which the meter did not participate. Reporting an average per meter value here could appear to inflate program-level impacts inappropriately.

Table 3. Summary of Customer Meter Counts – Winter Contracts

Sector	Customer Type	Number of Customers	Number of Sites	Number of Meters	Avg. Reported Winter Reduction per Meter (kW)
Commercial	Grocery	4	24	26	169
Commercial	Hospital/Medical	1	1	3	98
Commercial	Office	3	3	3	165
Commercial	Warehouse/ Distribution	0	0	0	0
Governmental	Government Institution	0	0	0	0
Governmental	Water Treatment	2	2	2	713
Industrial	Manufacturing	4	4	7	211
	Total Program	**14**	**34**	**41**	**N/A**[12]

Source: DEP DRA program database

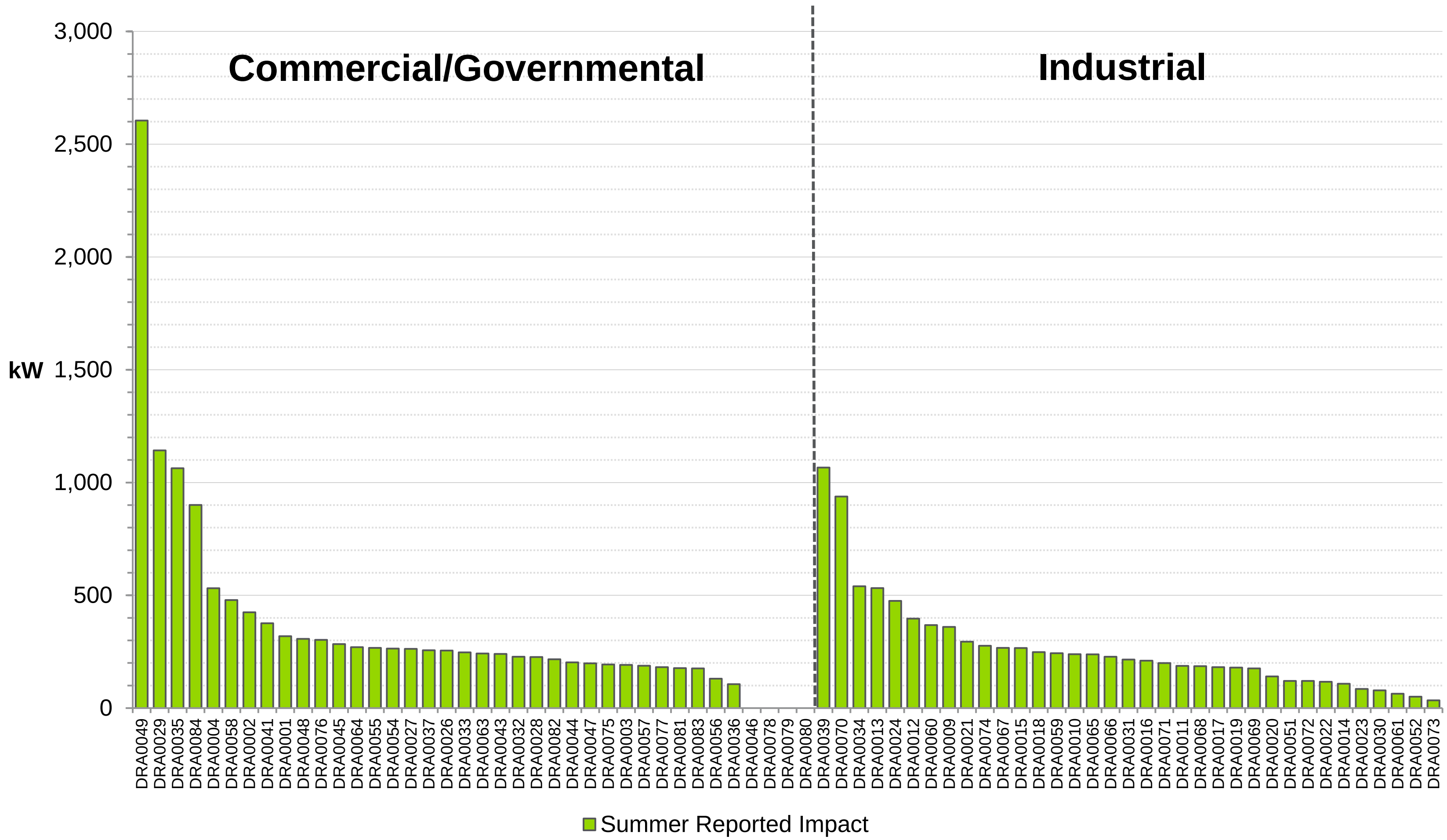
The average reported impacts shown above are the average of the impacts for event/participant pairs where DEP reported a non-zero impact (referred to as participation in this report). DEP reported an average total impact of approximately 20.5 MW, per summer event and 7.4 MW per winter event.

PY2018 average reported[13] event curtailments at individual meters for summer and winter are shown in Figure 1 and Figure 2. Curtailments ranged from negligible to nearly 2,800 kW during the summer and nearly 1,400 kW during the winter. In these charts, meters are segregated by sector: commercial/governmental and industrial. Note that winter participation is disproportionately from the commercial sector, and it is more concentrated—the participant with the highest reported summer impact contributed approximately 11% of the program total, whereas the participant with the highest reported impact in the winter contributed approximately 17% of the program total.

[12] An average by meter is not provided here to avoid undue confusion in comparison with aggregated impacts. Average impacts per participating meter across multiple events ignore impacts of events in which the meter did not participate. Reporting an average per meter value here could appear to inflate program-level impacts inappropriately.

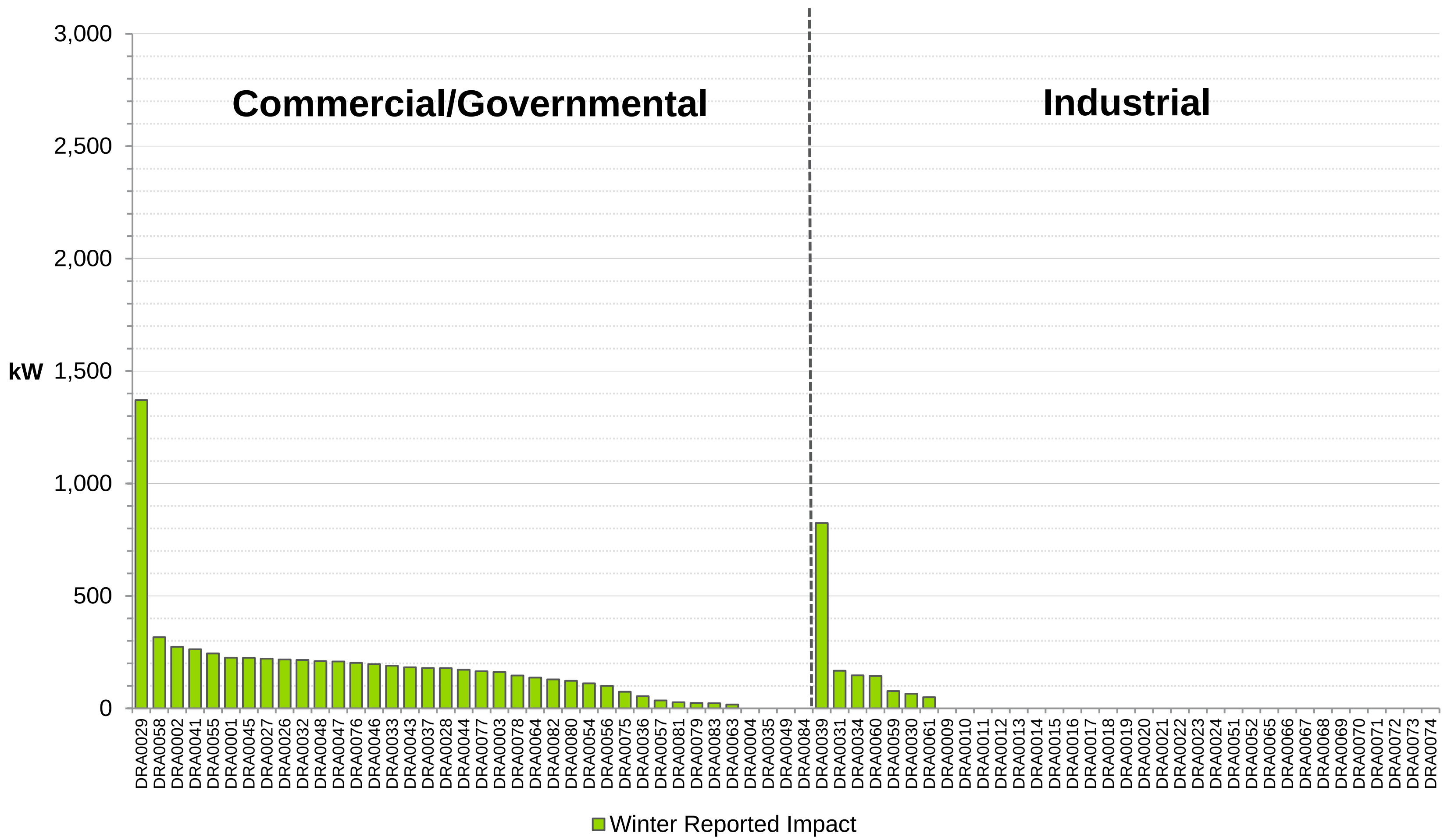
[13] Note that per the convention of this report, reported impacts refer to the settlement impacts estimated using the DEP baseline algorithm.

Figure 1. Average Reported Load Reductions (kW) by Meter – Summer



Source: DEP DRA program database

Figure 2. Average Reported Load Reductions (kW) by Meter – Winter



Source: DEP DRA program database

2. EVALUATION METHODS

This section describes the methods and data used by the evaluation team to conduct the PY2018 impact evaluation of the CIG DRA program. Estimating impacts of DR events involves first estimating a counterfactual baseline of what a customer's load would have been during the hours of the curtailment event had the event not been called. Actual measured loads are then subtracted from this baseline to estimate load reductions.[14] The baseline estimation methods used by DEP and by the evaluation team are discussed below.

The evaluation team used the following data in its analysis:

- Quarter-hourly interval data for 73 DRA program participating meters from November 1, 2017 through February 28, 2018 (Winter) and from May 1, 2018 through October 31, 2018 (Summer)
- Hourly observations of temperature data from National Oceanic and Atmospheric Administration (NOAA) weather stations
- Event logs supplied by DEP indicating the date, the start and end time of each event, and the time at which participants were notified of an imminent event

Using this data, the evaluation team conducted three principal sets of analyses:

1. **Replicate DEP-Reported Impacts**, which estimated baselines using the three qualifying non-excluded days immediately prior to an event.
2. **Test Alternative Baselines**, including both customer baselines (CBLs) and regression models. For each season, Navigant selected the approach that most accurately estimated demand on event-like non-event days
3. **Verify Program Impacts** using the best baseline for each season identified. Day-of load adjustments were applied for events when participants were notified on the date of the event.

Evaluations of DSM/energy efficiency programs commonly estimate a net-to-gross (NTG) ratio based on the evaluated percentage of demand reductions that may be ascribed either to free ridership (which reduces the NTG ratio) or program spillover (which increases the NTG ratio). Free ridership is typically defined as the percentage of demand reductions that would have occurred anyway, absent the presence of the program. Participant spillover is typically defined as incremental demand reductions undertaken by a program's participants though not directly incented or promoted by the program administrator.

In the case of DR programs such as DRA, there is no reason to expect that a customer would curtail loads during the event periods (the timing of which would be unknown to the customer absent participation in the program) without being enrolled in the program. Furthermore, because demand reductions are estimated relative to an estimated baseline that captures expected participant behavior absent an event, the analysis inherently accounts for free ridership and participant spillover; that is, absent the DRA program, none of the observed demand reductions would have taken place. Based on

[14] When regression techniques are applied, this subtraction often takes place implicitly within the model, through the inclusion of a battery of dummy variables that are hour of sample-specific.

the above considerations, the evaluation team considers the NTG ratio for the impact analysis of the DRA program to be 1.0.

2.1 Replicating the DEP Savings Calculations

DEP estimated load reductions using a baseline calculation method developed internally and described in the *Demand Response Automation Rider DRA-7 (North Carolina)* and *DRA-8 (South Carolina)* filed by DEP. The evaluation team replicated DEP's algorithm to confirm the results reported by DEP.

The DEP algorithm[15] generates a baseline for calculating program impacts on event days based on the three non-excluded (holidays, weekends, and curtailment days) and qualifying days immediately prior to an event day. A day is deemed as qualifying if average demand during curtailment event hours on that day is at least 50% of the average of the three non-excluded days. If one of the first three non-excluded days prior to the event is deemed to be non-qualifying, the next prior non-excluded day is used. If there are not three qualifying days out of the 10 non-excluded days prior to the event, the algorithm reverts to using the three most immediate non-excluded days prior to the event.

The average demand over the three selected days during the hours corresponding to those in which the event was called is the baseline used to calculate impacts and participant incentive payments. The reported impact is calculated as the difference between the average baseline over the event period and the average actual demand over that period, excluding the first 15 minutes of the event.[16]

2.2 Testing Alternative Baselines

Navigant tested 60 alternative baselines and selected the approach the evaluation team used to verify DR impacts using the following steps:

1. **Identify test days.** Navigant selected non-event, non-holiday weekdays that were as similar as possible to the actual event days to be test days. The evaluation team selected four winter test days and three summer test days, equivalent to the number of events called in each season. Test days were selected based on weather and to be consistent across participants.

   The evaluation team first calculated average daily temperatures across all customers, weighted by each customer's average contracted curtailment in each season. Winter test days were selected as the four coldest, eligible, non-event, non-holiday weekdays, and the summer test days were selected as the three warmest, eligible, non-event, non-holiday weekdays.
2. **Estimate baselines.** Navigant predicted each participant's demand during the seasonal typical event hours (1 p.m.-9 p.m. in summer, 5 a.m.-10 a.m. and 5 p.m.-11 p.m. in winter) on test days using all approaches tested.
3. **Quantify accuracy and select approaches.** Navigant calculated the root mean square error (RMSE) for each approach's predicted demand relative to actual demand during the event window for all customers. These errors were aggregated by approach type, and the most

[15] The details of the DEP algorithm are described in more detail in Appendix A of the PY2010 report.

Navigant Consulting, on behalf of Progress Energy, *2010 EM&V Report for the Progress Energy Carolinas Commercial, Industrial and Governmental Demand Response Automation (DRA) Program*, December 2011

[16] Note, however, that the baseline is calculated using all event quarter-hours.

accurate approach in aggregate (lowest RMSE) was selected to verify impacts. Because the most accurate approach was one that uses a day-of load adjustment, Navigant also determined the most accurate approach that does not use a day-of load adjustment for each season. This approach was employed for events where day-ahead notification occurred.

The types of baselines tested by Navigant fall into two broad categories: CBLs and regression-based baselines. Note that each approach described represents two different baselines: one with a symmetric additive day-of load adjustment and one with no day-of load adjustment (i.e., assuming day-ahead notification).

The load adjustment was calculated as the average difference between the baseline and the actual demand during the 3 hours of demand observed 1 hour prior to customer notification of the event. For testing the adjustments, Navigant used assumed notification time of 1 hour for winter events and 3 hours for summer events.

2.2.1.1 CBLs

The two most basic types of CBL are the following:

- **X-of-Y day CBLs.** In this case, the baseline is delivered by the average event window demand on the X days in which that demand was highest within a Y day window.
- **X-of-Y days of the same day of week CBLs.** In this case, the baseline delivered by the average event window demand on the X number of prior days with the highest event window demand from within the Y number of days that fall on the same day of the week as the event.

Only non-event days may qualify for inclusion in the baseline. A day may qualify for inclusion in the baseline if and only if it is a non-holiday, non-event weekday (i.e., the same rules applied for the method used by DEP for settlement).

Qualifying non-event days are eligible for inclusion in the look-back window (the period of Y days) in the baseline only if the participant’s average demand during the event period on that day is 50% or more of the average demand across all Y days. This is the same rule applied to the settlement baseline used by DEP.

Days that fail to meet the eligibility criterion (i.e., days where the average demand during the event window is less than half of the average demand in that window across the Y days of the look-back period) are replaced by the next most proximate previous qualifying and eligible day. If there are not three qualifying days out of the 10 non-excluded days prior to the event, the algorithm reverts to using the three most immediate non-excluded days prior to the event, as in the case of the existing DEP settlement baseline approach.

Navigant tested the 23 CBLs listed in Table 4. These cover a wide range of different look-back periods and include both types of CBL identified above.

Table 4. CBLs Tested

CBL Number	CBL
1	2 of 2
2	2 of 3
3	3 of 3[17]
4	2 of 4
5	3 of 4
6	4 of 4
7	3 of 5
8	4 of 5
9	5 of 5
10	3 of 6
11	4 of 6
12	5 of 6
13	6 of 6
14	4 of 7
15	5 of 7
16	6 of 7
17	7 of 7
18	2 of 2 of same day of week
19	2 of 3 of same day of week
20	3 of 3 of same day of week
21	2 of 4 of same day of week
22	3 of 4 of same day of week
23	4 of 4 of same day of week

Source: DEP DRA Program Evaluation Plan

2.2.1.2 Regression-Based Baselines

All regression specifications Navigant tested were variants of a core model that accounts for a base set of demand patterns, presented in Equation 1. The base, or core, model specification is the regression model used in previous years to verify DR impacts.

Equation 1. Core Regression Specification

$$y_t = \sum_{i=1}^{96} \beta_{1,t} qhour_{t,i} + \sum_{i=1}^{96} \beta_{2,i} qhour_{t,i} [CDQH_t / HDQH_t] + \sum_{d=1}^{D} \gamma_d C_{t,d} + errors$$

Where:

y_t = The average demand (kW) observed at the given meter in the quarter-hour of sample *t*.

[17] This is the CBL used by Duke Energy for settlement purposes.

$qhour_{t,i}$ = A set of 96 dummy variables, one for each quarter-hour of the day. The given dummy takes a value of 1 when the quarter-hour of the observation is the i-th quarter-hour of that day. For example, if quarter-hour *t* is between midnight and 12:15 a.m., $qhour_{t,i=1}$ is equal to 1 and 0 otherwise, or if quarter-hour *t* is between 1:00 p.m. and 1:15 p.m. then $qhour_{t,i=53}$ is equal to 1 and 0 otherwise.

$CDQH_t$ / $HDQH_t$ = The cooling degree quarter-hours (for summer) or heating degree quarter-hours (for winter) in quarter-hour of sample *t*.

$C_{t,d}$ = A set of *D* dummy variables identifying each quarter-hour in which a curtailment event took place.

Navigant also tested specifications that include the following additional variables.

$EMA6dqh_t$ = An exponential moving average of $CDQH_t$ (summer) or $HDQH_t$ (winter) observed in the 6-hour period leading up to, and including, hour *t*. This variable is represented as ema6hr_dqh65 in Table 5.

$EMA24dqh_t$ = Identical to $EMA6dqh_t$, except for 24, instead of 6 hours. This variable is represented as ema24hr_dqh65 in Table 5.

hbu_t = Heat index buildup observed in quarter-hour of sample *t*. This is a 72-hour geometrically decaying average of the NOAA-defined heat index.[18] It is calculated in the following manner:

$$cbu_t = \sum_{h=1}^{72} 0.96^h \cdot heatindex_{t-h} \Big/ 1{,}000 \; .$$

Note in this case that the *t* subscript denotes hourly intervals. NOAA's heat index is calculated in the following manner:

$$heatindex_t = -42.379 + 2.049 \cdot drybulb_t + 10.1433 \cdot hum_t - 0.2248 \cdot drybulb_t \cdot hum_t - 0.0068 \cdot drybulb_t^2 - 0.0548 \cdot hum_t^2 + 0.0012 \cdot drybulb_t^2 \cdot hum_t + 0.0009 \cdot drybulb_t \cdot hum_t^2 - 0.000002 \cdot drybulb_t^2 \cdot hum_t^2$$

Where $drybulb_t$ is the dry bulb temperature (in °F), hum_t is relative humidity (in percent) observed at quarter-hour *t,* and ws_t is the wind speed in miles per hour observed at quarter-hour *t.* Note that although some of NOAA's coefficients have been rounded for concision above, the complete unrounded values were used in the analysis. This variable is represented as norm_hbu in Table 5.

[18] National Oceanic and Atmospheric Administration, National Weather Service – Weather Prediction Center, *The Heat Index Equation*, accessed February 2018. http://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml

In total, Navigant tested seven different regression specifications (with and without adjustment): the core model and six models consisting of the core model with additional variables as listed in Table 5.

Table 5. Additional Variables Included in Regression Specifications Tested

Model	Var1	Var2	Var3
1	ema6hr_dqh65		
2	ema24hr_dqh65		
3	norm_hbu		
4	norm_hbu	ema6hr_dqh65	
5	norm_hbu	ema24hr_dqh65	
6	norm_hbu	ema6hr_dqh65	ema24hr_dqh65

Source: Navigant Analysis

2.3 Verified Program Impacts

The evaluation team estimated verified impacts using the approach that most accurately predicted test day demand in each season, subject to the notification period. For each event, Navigant used the best model with or without day-of load adjustment depending on when notification occurred. The team calculated the verified impacts as the difference between actual average demand over the timespan of the event (excluding the first 15 minutes[19]) and the estimated average baseline demand.[20]

[19] This exclusion is applied to ensure that the period evaluated for impacts is consistent for verified and reported impacts (the settlement algorithm used for reported impacts excludes the first 15 minutes of the event from the impact calculation).

[20] Note that this subtraction is implicit in the model specification above. More specifically, the results of this subtraction are captured by the estimated values of the γ_d parameters.

3. PROGRAM IMPACTS

This section describes the findings from the evaluation team's analysis of load reduction impacts for the DRA program for PY2018. These findings are broadly grouped into the following categories:

Approved Baseline Methodology

- **Finding 1:** Initially, Navigant's replicated settlement baselines differed materially from those reported by DEP due to a software issue that incorrectly included New Year's Day in the baseline estimations. After the vendor corrected this issue and DEP program staff provided updated data, the evaluation team successfully replicated the DEP settlement baseline and reported impacts for every meter/event pair.

Testing of Alternative Baselines

- **Finding 2:** Navigant found that regression-derived baselines with day-of load adjustment were the most accurate approaches for estimating impacts for both summer and winter events. Similarly, the evaluation team found regression-derived baselines to be the most accurate approaches for estimating impacts for events where notification was provided day-ahead and no day-of load adjustment was possible.

Verified Impacts

- **Finding 3:** For summer events, the evaluation team verified that participants achieved an average total of 20.0 MW of demand reduction during summer events, approximately 97% of that reported and 106% of that contracted. The verified versus reported realization rate is similar to the average across prior years (2010 through 2017) of 96%. The verified versus contracted realization rate is higher than the historical average (2010 through 2017) of 99%, as well as the highest rate achieved in 2017 of 104%.
- **Finding 4:** For winter events, the evaluation team verified that participants as a whole achieved an average of 6.9 MW of demand reduction during winter events, approximately 93% of that reported and 78% of that contracted. The verified versus reported realization rate falls between prior years 2014 and 2015, which had realization rates of 92% and 97%, respectively, or an average of 95%. The verified versus contracted realization rate is higher than the historical average (2014 and 2015) of 69% and is similar to the highest rate achieved in 2014 of 77%.
- **Finding 5:** Total program impacts for the summer season increased in PY2018 compared to PY2017 and were similar to the highest impacts over the life of the program in PY2015. For winter events, program impacts were between those found in PY2014 and PY2015.

The remainder of this section is divided into three subsections:

- **Section 3.1: Replicating DEP-Reported Impacts.** Replication of the DEP settlement algorithm.
- **Section 3.2: Testing Alternative Baselines.** Selection of the best approaches to calculate impacts.
- **Section 3.3: Verifying Impacts.** Impacts estimated using the regression baseline method described above.

3.1 Replicating DEP-Reported Impacts

As noted above, part of the task assigned to the evaluation team was to replicate the DEP algorithm to confirm the validity of the results reported by DEP. Navigant's replicated settlement baselines differed materially from those reported by DEP in two instances:

- **Summer.** For one customer (DRA0067), the service base had a defective meter that did not get replaced prior to initiation of the August 8, 2018 event. To address this issue, DEP applied this participant's June 19 event data as an estimation for August 8 event performance.
- **Winter.** The DRA Energy Manager software used by DEP for settlement calculation incorrectly included New Year's Day (2018-01-01) as an eligible baseline day for the 2018-01-02 event because the vendor's new administrator had not manually entered 2018 holidays. This issue has been corrected by the vendor, and steps are being taken to introduce automation that will avoid such an error from occurring in the future. DEP program staff are also augmenting internal DRA processes to include an audit of baseline day selections following events.

Following receipt of updated data for the DEP settlement baseline, Navigant resolved all differences in settlement impacts reported by DEP and replicated by the evaluation team.

3.2 Testing Alternative Baselines

Table 6 lists the test days used for testing each alternative baseline. The evaluation team selected the number of test dates in each season to be equal to the number of events called. These dates were selected from non-event, non-weekend, and non-holiday dates in each season and include the four coldest eligible days in the winter and the three hottest eligible days in the summer. As described in Section 2.2, Navigant calculated a weighted average temperature for ranking test days based on the average contracted curtailment and daily temperature experienced for each customer.

Table 6. Selected Non-Event Days for Testing Alternative Baselines

Season	Date	Weighted Average Temperature (°F)
Winter	2017-12-29	9.1
Winter	2018-01-03	5.7
Winter	2018-01-05	1.4
Winter	2018-01-08	6.5
Summer	2018-08-02	74.8
Summer	2018-09-17	76.4
Summer	2018-10-11	75.3

Sources: DEP DRA program database and Navigant analysis

Table 7 summarizes the best tested approaches for the summer and winter seasons. For each season, the evaluation team determined the best model with and without a day-of load adjustment. For detailed descriptions of each model, refer to Section 2.2 and Table 5.

Table 7. Best Baseline Approach by Season and Day-of Load Adjustment

Season	Day-of Load Adjustment	Type	Best Approach
Summer	Yes	Regression	Model 5
Summer	No	Regression	Model 6
Winter	Yes	Regression	Model 4
Winter	No	Regression	Model 5

Sources: DEP DRA program database and Navigant analysis

Figure 3 and Figure 4 summarize the results of Navigant's testing of alternative baselines for the summer and winter seasons, respectively. In general, the models that include a day-of adjustment performed better than those without, and regression models performed better than CBLs. The best models overall were regression-based with day-of adjustment, while the worst performing models were CBLs without day-of load adjustment.

For summer events, the most accurate approach with a day-of load adjustment was Model 5, which consists of the following:

- Core regression model (Equation 1)
- Heat buildup variable
- Exponential moving average (24 hours) of cooling degree quarter-hours

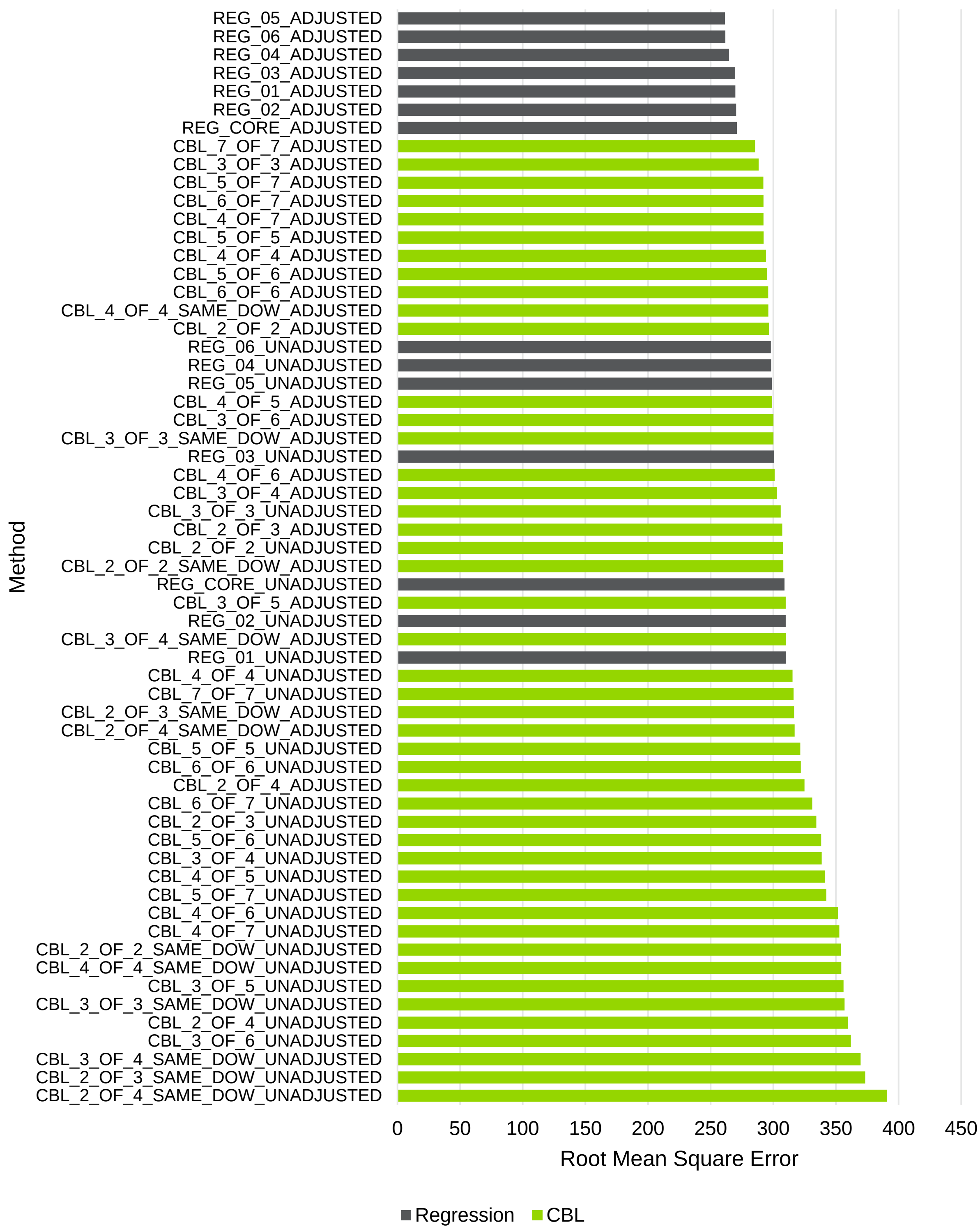
The best summer model without a day-of load adjustment was Model 6, which adds an exponential moving average variable (6 hours) to Model 5. Note that Models 5 and 6, without day-of load adjustment, showed similar accuracy in testing.

For Winter events, the most accurate model with a day-of load adjustment was Model 4, which consists of the following:

- Core regression model (Equation 1)
- Heat buildup variable
- Exponential moving average (6 hours) of heating degree quarter-hours

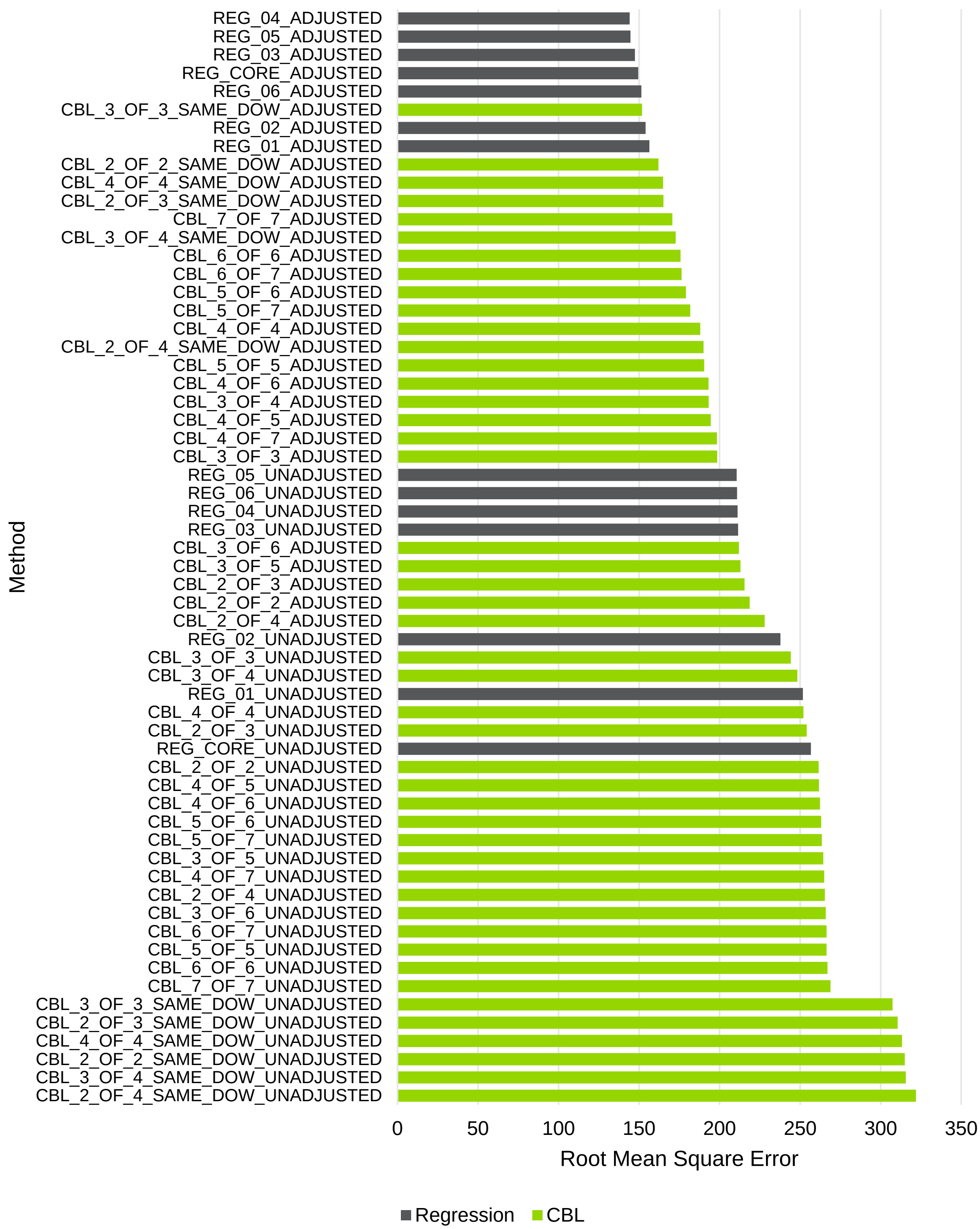
The best winter model without a day-of load adjustment was Model 5.

Figure 3. RMSE for all Tested Baseline Approaches – Summer



Sources: DEP DRA program database and Navigant analysis

Figure 4. RMSE for all Tested Baseline Approaches – Winter



Sources: DEP DRA program database and Navigant analysis

3.3 Verifying Impacts

All verified impacts discussed below are based on the best performing models for each season, listed in Table 7. For events when customers received day-of notification, listed in Table 1, Navigant used the best performing model with day-of load adjustment. Likewise, for events when customers received day-ahead notification, the evaluation team used the best performing model without a day-of load adjustment.

3.3.1 Summer Events

DEP called three summer events in 2018 involving 69 unique customer meters. Verified load reductions and verification rates for summer and winter events are shown in Table 8. The EM&V analysis found average load reductions[21] of approximately 20.0 MW per summer event, or approximately 324 kW per meter.[22] These reductions are slightly less than the 20.5 MW reduction reported by DEP in its DRA program database (Table 8).[23]

Table 8. Verified Load Reductions and EM&V Verification Rate – Summer

Load Reduction Category	Event kW Reduction			Avg. Total Reduction Over Summer Events
	2018-06-19	2018-08-08	2018-08-28	
Reported (DEP Database)	21,078	20,649	19,734	20,487
Contracted (DEP Database)	18,425	19,838	18,248	18,837
Verified Commercial/Government	13,621	12,464	12,762	12,949
Verified VLIP	3,549	2,662	1,233	2,481
Verified Other Industrial	4,372	4,886	4,354	4,537
Verified – Total	**21,541**	**20,011**	**18,350**	**19,968**
Verified Realization Rate (Verified Reductions/Reported Reductions)	**102%**	**97%**	**93%**	**97%**

Sources: DEP DRA program database and Navigant analysis, values subject to rounding

For summer 2018, the EM&V team verified that the 34 commercial/governmental meters realized an average total of 12,949 kW of load reductions, accounting for approximately 65% of the total kW reduction. The 16 industrial meters belonging to the VLIP realized an average total of 2,481 kW of load reductions, which accounts for approximately 12% of the total kW reduction. The balance of load

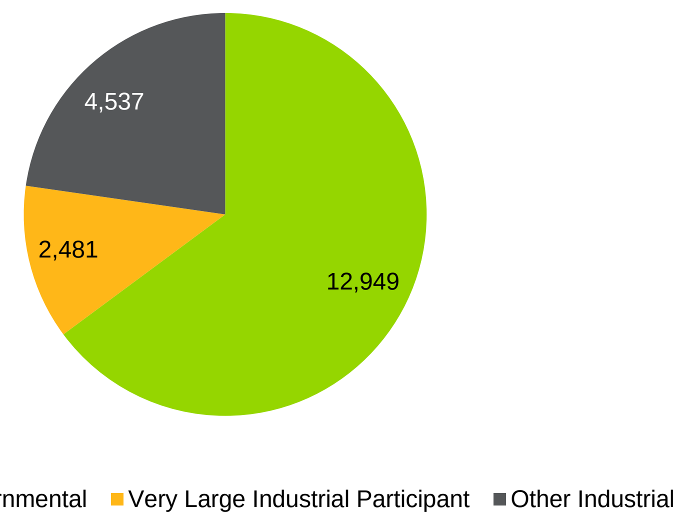
[21] Note that the average load reduction per event is the average of only non-zero load reductions achieved. For example, if two meters contributed 100 kW each and a third meter did not achieve any DR (i.e., actuals were above baseline), the average verified impact for this event would be reported as 100 kW.

[22] Average impact per meter is calculated as the average across events of the average across participating meters by event. This value will not correspond to the average impact across events (20.0 MW) divided by the total number of meters that participated at some point in the summer (69), since not all meters participated in all events.

[23] As noted previously, reported impacts are those impacts calculated by DEP using the DRA baseline algorithm. Verified impacts are net values, implicitly assuming an NTG ratio of 1.0. See Section 2 for further discussion.

reductions—4,537 kW, or 23% of the total—was made up by meters located at industrial sites not belonging to the VLIP. This distribution is shown in Figure 5.

Figure 5. Share of Total Verified kW Reduction – Summer



Sources: DEP DRA program database and Navigant analysis

The following discussion provides a summary of load impact findings based on a linear-regression baseline method identified by the evaluation team as the most accurate for predicting customer loads (described in Section 3.2). The team estimated load reductions for individual participants for each event. Average verified program savings were then calculated as the average across each of the three summer events across all 69 participant meters.

DEP had reported summer program impacts to be approximately 109% of the aggregate contracted load reductions, or 20.5 MW reported versus 18.8 MW contracted. The EM&V analysis verified 97% of these reported reductions (or 106% of the contracted reductions).

The average contracted, DEP-reported, and verified load curtailment for each participant meter is shown in Table 9. This table includes a count of the number of events for which each meter contributed non-zero DR impacts. The average contracted, reported, and verified impacts shown in Table 9 are the averages only of events for which the given participant was contracted and in which that participant participated. This means that the sum of the average impacts in this table will not match the average of the total impacts reported in Table 8, which are the average of the total impacts across all participants for each event.

Table 9. Average Contracted, Reported, and Verified Loads by Meter – Summer

Commercial/Governmental					Industrial					
Participant Site	Contracted kW	DEP Reported kW	Verified kW	No. of Events Participated	Participant Site	Contracted kW	DEP Reported kW	Verified kW	No. of Events Participated	VLIP
DRA0001	320	319	309	3	DRA0009	450	360	323	1	1
DRA0002	383	425	408	3	DRA0010	75	239	178	2	1
DRA0003	150	191	202	3	DRA0011	75	187	139	2	1
DRA0004	490	531	561	3	DRA0012	300	397	311	2	1
DRA0026	209	255	257	3	DRA0013	75	532	367	3	1
DRA0027	220	262	260	3	DRA0014	75	108	86	3	1
DRA0028	183	227	229	3	DRA0015	150	266	188	2	1
DRA0029	900	1,143	1,272	3	DRA0016	200	210	187	3	1
DRA0032	200	228	225	3	DRA0017	200	182	154	3	1
DRA0033	204	247	248	3	DRA0018	180	248	218	3	1
DRA0035	1,660	1,064	1,153	2	DRA0019	100	180	188	3	1
DRA0036	75	106	84	3	DRA0020	75	140	120	3	1
DRA0037	203	257	250	1	DRA0021	200	294	189	3	1
DRA0041	415	376	372	3	DRA0022	75	117	73	3	1
DRA0043	240	240	242	3	DRA0023	75	85	48	3	1
DRA0044	163	203	200	3	DRA0024	300	475	301	2	1
DRA0045	209	284	281	3	DRA0030	75	79	57	2	0
DRA0046				0	DRA0031	225	215	233	2	0
DRA0047	177	199	202	3	DRA0034	800	540	687	2	0
DRA0048	295	307	303	3	DRA0039	1,050	1,066	1,090	3	0
DRA0049	2,500	2,605	2,714	3	DRA0051	135	121	67	3	0
DRA0054	275	264	268	3	DRA0052	75	50	48	3	0
DRA0055	275	267	259	3	DRA0059	209	243	264	3	0
DRA0056	135	131	131	3	DRA0060	413	368	383	3	0
DRA0057	198	188	190	3	DRA0061	75	64	60	3	0
DRA0058	500	479	504	3	DRA0065	130	238	256	3	0
DRA0063	250	242	248	2	DRA0066	200	228	222	3	0
DRA0064	209	270	264	3	DRA0067	190	267	243	3	0
DRA0075	250	194	198	3	DRA0068	140	186	179	3	0
DRA0076	310	302	308	3	DRA0069	150	176	169	3	0
DRA0077	185	182	182	2	DRA0070	761	938	871	2	0
DRA0078				0	DRA0071	180	199	185	2	0
DRA0079				0	DRA0072	125	121	131	3	0
DRA0080				0	DRA0073	105	34	69	2	0
DRA0081	285	177	205	1	DRA0074	225	276	72	1	0
DRA0082	215	216	213	3						
DRA0083	275	176	190	3						
DRA0084	900	900	847	3						

Sources: DEP DRA program database and Navigant analysis

Verification rates at the portfolio level are driven by findings for individual meters. Four of the 69 participating meters in 2018[24] account for a little less than one-third of all summer reductions and thus

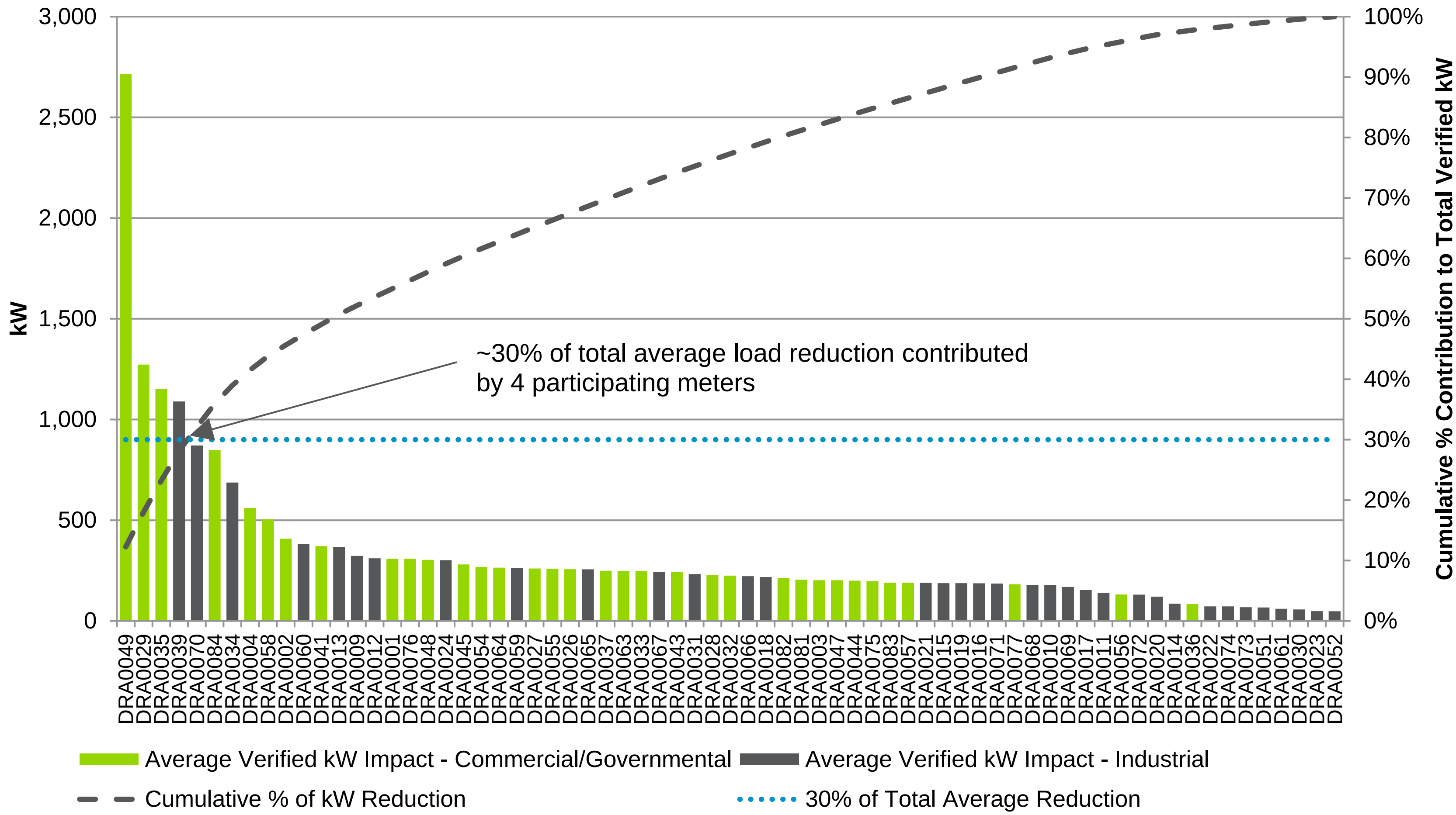
[24] The three meters that are driving overall results include three commercial/governmental sites and one industrial site.

drive overall summer findings. Figure 6 ranks the meters by the verified kW reduction in descending order, illustrating the decrease in load reductions between the largest and smallest contributors in the program.

These results can be re-examined by plotting the reported and verified demand reductions and verified realization rate (average verified kW across three events divided by average reported kW across three events) once they have been sorted by verified realization rate (see Figure 7). In this figure, the gray diamonds represent commercial/governmental realization rates, the gray diamonds represent the VLIP's realization rates, and the white diamonds represent the non-VLIP industrial realization rates.

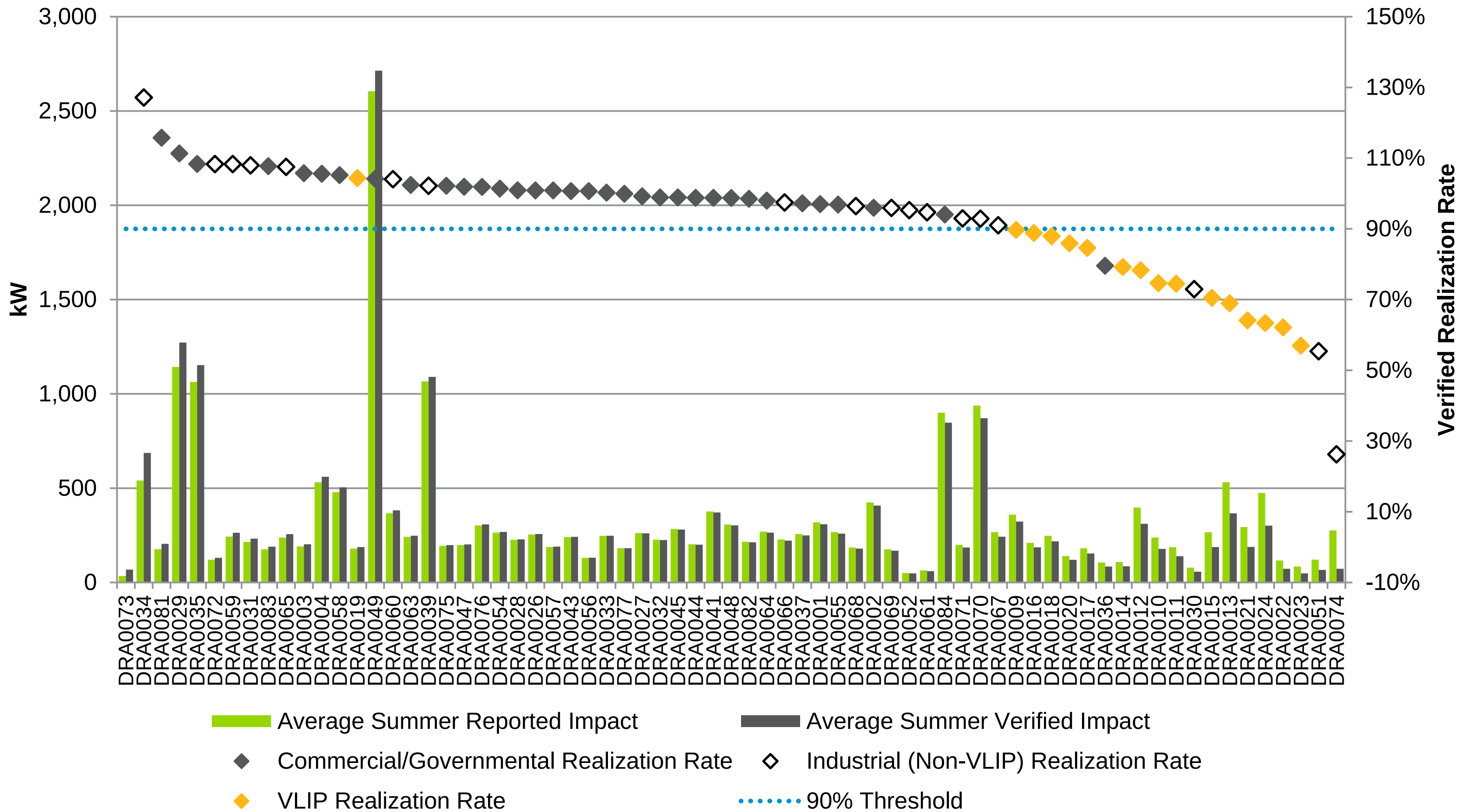
As seen in Figure 7, the average verified summer realization rate for all but four of the commercial and governmental meter sites is at or above 90%. In contrast, the average verified summer realization rate of the majority of the VLIP meters is below 90%.

Figure 6. Cumulative Percentage of Total Verified kW Reduction – Summer



Sources: DEP DRA program database and Navigant analysis

Figure 7. Reported and Verified DR Impact and Verified Realization Rate – Summer

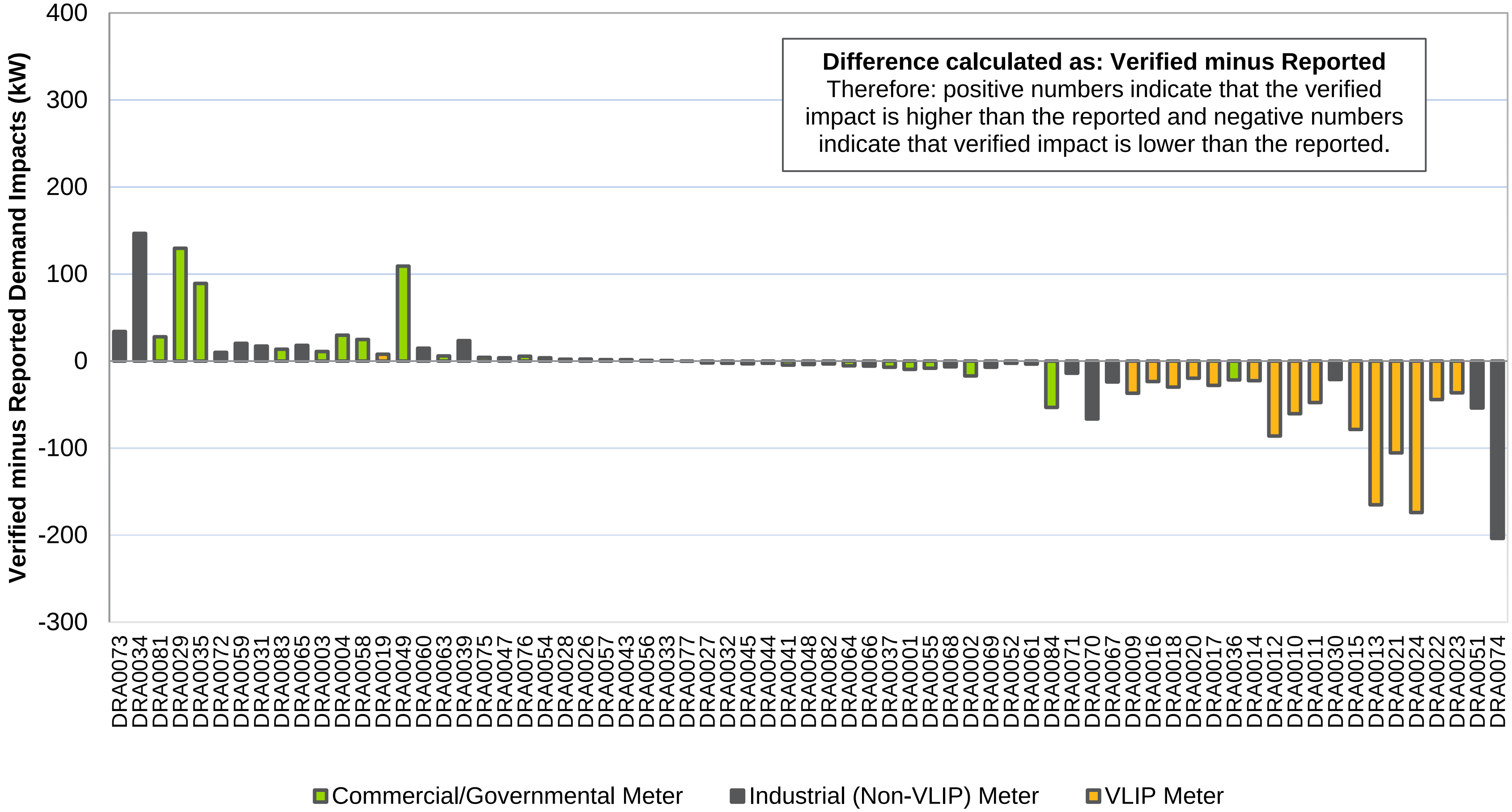


Sources: DEP DRA program database and Navigant analysis

Recall that the verified realization rate is the (regression-estimated) verified impact divided by the (DEP algorithm calculated) reported impact. The regression approach estimates a baseline using average seasonal relationships, whereas the DEP approach relies entirely on the three most recent non-excluded qualifying days to calculate a baseline.

To better understand the results implied by the realization rates presented above, it is important to also observe the magnitude of the difference (in kW instead of as a percentage) between the DEP-reported impacts and the verified impacts. For this reason, the evaluation team presents the average difference (across the seasonal events) between the verified summer impact and the reported summer impact for each meter in Figure 8. For example, the evaluation team found that DEP's reported impacts for meter DRA0034 were approximately 150 kW less than those verified by Navigant, and DEP's reported impacts for meter DRA0074 were about 200 kW higher than those verified by Navigant. To aid understanding, meters have been sorted in this figure by realization rate in the same manner as in Figure 7.

Figure 8. Differences in Impact Estimates: Regression vs. DEP Settlement Method – Summer



Sources: DEP DRA program database and Navigant analysis

3.3.2 Winter Events

DEP called four winter events in 2018 involving 41 unique customer meters. Table 10 shows verified load reductions. The EM&V analysis found average load reductions[25] of approximately 6.9 MW per winter event, or approximately 203 kW per meter.[26] These reductions are slightly less than the 7.4 MW reductions reported by DEP in its DRA program database.[27]

Table 10. Verified Load Reductions and EM&V Verification Rate – Winter

Load Reduction Category	Event kW Reduction				Avg. Total Reduction Over Winter Events
	2018-01-02	2018-01-07	2018-01-15	2018-01-18	
Reported (DEP Database)	6,983	8,248	7,698	6,739	7,417
Contracted (DEP Database)	8,175	10,036	8,892	8,404	8,877
Verified Commercial/ Government	6,026	6,724	5,223	5,595	5,892
Verified VLIP	0	0	0	0	0
Verified Other Industrial	1,128	631	1,123	1,156	1,010
Verified – Total	**7,154**	**7,355**	**6,346**	**6,751**	**6,901**
Verified Realization Rate (Verified Reductions/Reported Reductions)	**102%**	**89%**	**82%**	**100%**	**93%**

Sources: DEP DRA program database and Navigant analysis, values subject to rounding

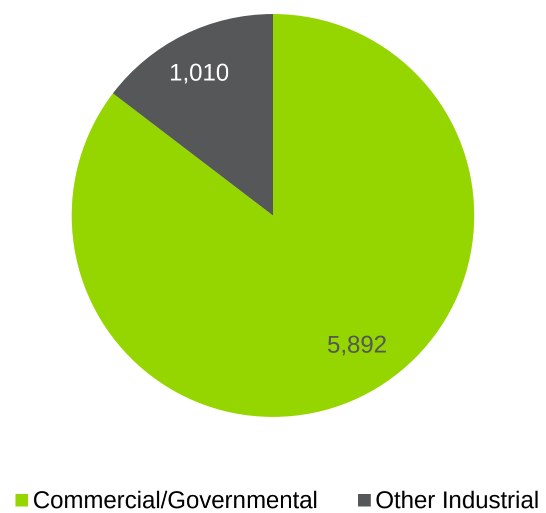
For winter 2018, the EM&V team verified that the commercial/governmental meters realized an average total of 5,892 kW of load reductions, accounting for approximately 85% of the total kW reduction. The balance of load reductions—1,010 kW or 15% of the total—was made up by meters located at industrial sites. This distribution is shown in Figure 9.

[25] Note that the average load reduction per event is the average across meters of only non-zero load reductions achieved. For example, if two meters contributed 100 kW each and a third meter did not achieve any DR (i.e., actuals were above baseline), the average verified impact for this event would be reported as 100 kW.

[26] Average impact per meter is calculated as the average across events of the average across participating meters by event. This value will not correspond to the average impact across events (6.9 MW) divided by the total number of meters that participated at some point in the winter (41) since not all meters participated in all events.

[27] Reported impacts are those impacts calculated by DEP using the DRA baseline algorithm. Verified impacts are based on a regression baseline. Both sets of impacts are net values, implicitly assuming an NTG ratio of 1.0. See Section 2 for further discussion.

Figure 9. Share of Total Verified kW Reduction – Winter



Sources: DEP DRA program database and Navigant analysis

The following discussion provides a summary of load impact findings based on a linear-regression baseline method identified by the evaluation team as the most accurate for predicting customer loads (described in Section 3.2). The team estimated load reductions for individual participants for each event. Average verified program savings were then calculated as the average across each of the four winter events across all 41 participant meters.

DEP had reported winter program impacts to be approximately 84% of the aggregate contracted load reductions, or 7.4 MW reported versus 8.9 MW contracted. The EM&V analysis verified 93% of these reported reductions (or 78% of the contracted reductions).

The average contracted, DEP-reported, and verified load curtailment for each participant meter is shown in Table 11. This table includes a count of the number of events for which each meter contributed non-zero DR impacts. The average contracted, reported, and verified impacts shown in Table 9 are the averages only of events for which the given participant was contracted and in which that participant participated. This means that the sum of the average impacts in this table will not match the average of the total impacts reported in Table 10, which are the average of the total impacts across all participants for each event.

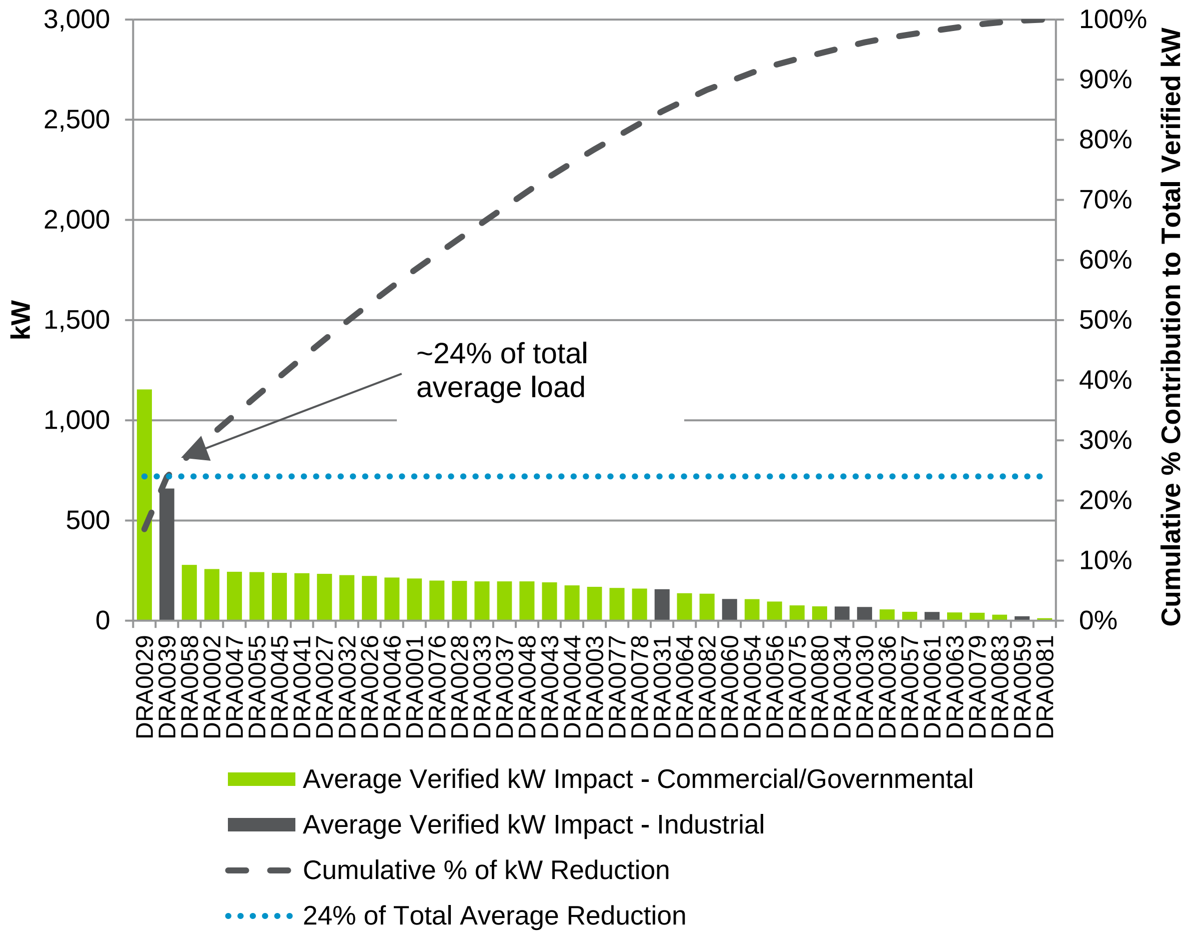
Table 11. Average Contracted, Reported, and Verified Loads by Meter – Winter

Commercial/Governmental					Industrial					
Participant Site	Contracted kW	DEP Reported kW	Verified kW	No. of Events Participated	Participant Site	Contracted kW	DEP Reported kW	Verified kW	No. of Events Participated	VLIP
DRA0001	286	225	210	4	DRA0009				0	1
DRA0002	286	274	258	4	DRA0010				0	1
DRA0003	200	162	169	4	DRA0011				0	1
DRA0004				0	DRA0012				0	1
DRA0026	193	217	223	4	DRA0013				0	1
DRA0027	198	221	234	4	DRA0014				0	1
DRA0028	157	179	199	4	DRA0015				0	1
DRA0029	700	1,371	1,154	4	DRA0016				0	1
DRA0032	193	216	227	4	DRA0017				0	1
DRA0033	182	190	196	4	DRA0018				0	1
DRA0035				0	DRA0019				0	1
DRA0036	75	54	56	4	DRA0020				0	1
DRA0037	195	179	196	1	DRA0021				0	1
DRA0041	298	263	237	4	DRA0022				0	1
DRA0043	217	182	191	4	DRA0023				0	1
DRA0044	143	172	176	4	DRA0024				0	1
DRA0045	138	225	239	4	DRA0030	75	65	69	4	0
DRA0046	180	196	215	3	DRA0031	225	167	157	4	0
DRA0047	166	209	244	4	DRA0034	750	147	71	4	0
DRA0048	365	210	196	4	DRA0039	750	824	660	4	0
DRA0049				0	DRA0051				0	0
DRA0054	200	111	108	4	DRA0052				0	0
DRA0055	275	244	243	4	DRA0059	157	77	22	3	0
DRA0056	135	100	95	4	DRA0060	309	144	108	1	0
DRA0057	150	35	44	2	DRA0061	75	50	43	1	0
DRA0058	500	316	278	3	DRA0065				0	0
DRA0063	200	17	41	2	DRA0066				0	0
DRA0064	158	137	137	3	DRA0067				0	0
DRA0075	325	74	76	3	DRA0068				0	0
DRA0076	285	202	200	4	DRA0069				0	0
DRA0077	135	165	163	4	DRA0070				0	0
DRA0078	300	146	160	1	DRA0071				0	0
DRA0079	125	24	39	2	DRA0072				0	0
DRA0080	300	123	71	4	DRA0073				0	0
DRA0081	240	27	12	4	DRA0074				0	0
DRA0082	255	129	135	3						
DRA0083	285	23	30	1						
DRA0084				0						

Sources: DEP DRA program database and Navigant analysis

Verification rates at the portfolio level are driven by findings for individual meters. Two of the 41 participating meters in 2018 account for approximately 24% of all winter reductions and drive overall findings. Figure 10 ranks the meters by the verified kW reduction in descending order, illustrating the decrease in load reductions between the largest and smallest contributors in the program.

Figure 10. Cumulative Percentage of Total Verified kW Reduction – Winter



Sources: DEP DRA program database and Navigant analysis

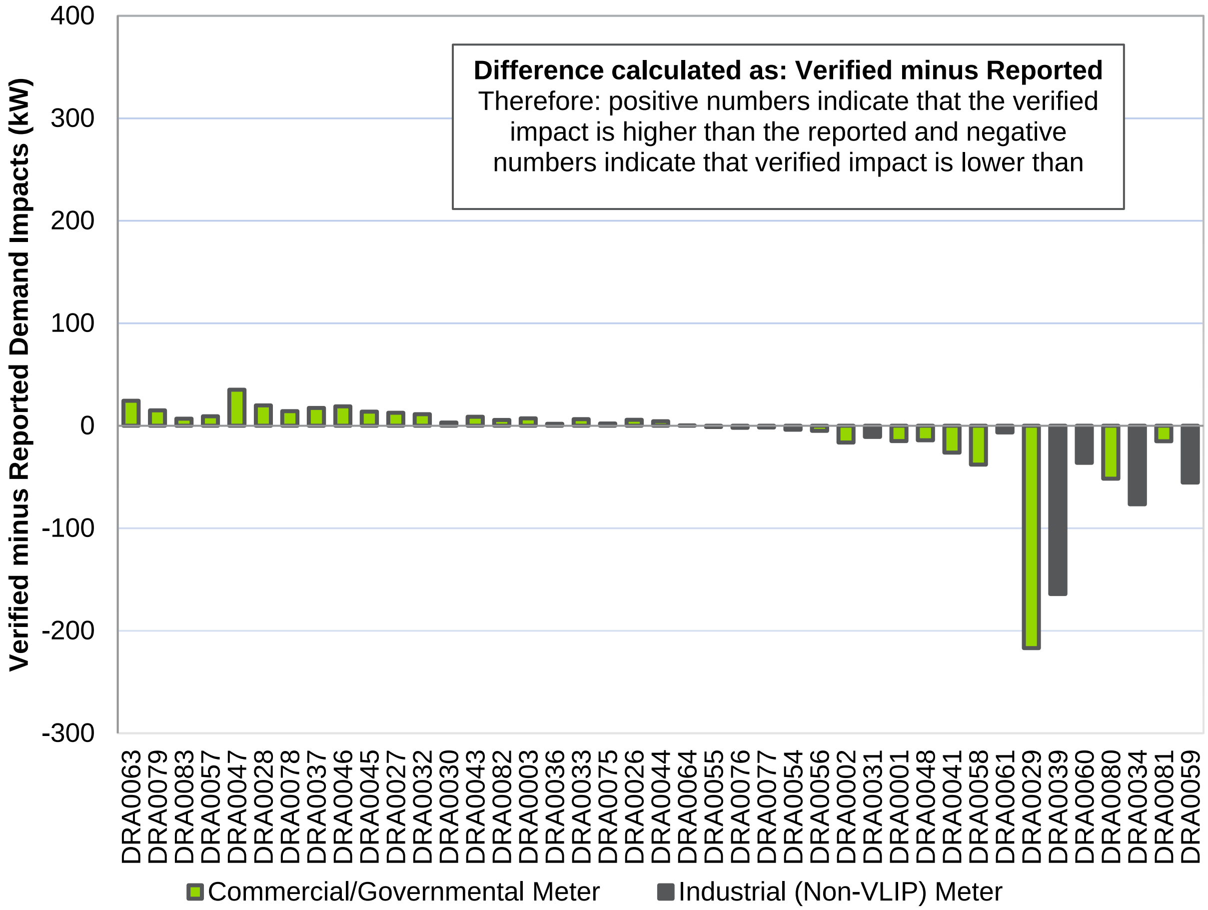
These results can be re-examined by plotting the reported and verified demand reductions and verified realization rate (average verified kW across three events divided by average reported kW across three events) once they have been sorted by verified realization rate (see Figure 11). In this figure, the gray diamonds represent commercial/governmental realization rates and the white diamonds represent the non-VLIP industrial realization rates. As seen in Figure 11, the average verified winter realization rate for all but nine sites is at or above 90%.

Figure 11. Reported and Verified DR Impact and Verified Realization Rate – Winter

Sources: DEP DRA program database and Navigant analysis

Similar to summer events, Figure 12 presents the average difference (across the seasonal events) between the verified and reported winter impact for each meter. The evaluation team found that DEP's reported impacts for meter DRA 0029 and DRA 0039 were about 200 kW and 160 kW higher than those verified by Navigant. To aid understanding, meters have been sorted in this figure by realization rate in the same manner as in Figure 11.

Figure 12. Differences in Impact Estimates: Regression vs. DEP Settlement Method – Winter



Sources: DEP DRA program database and Navigant analysis

4. SUMMARY FORM

Commercial, Industrial, and Governmental Demand Response Automation Program

Completed EMV Fact Sheet

Description of Program

DEP's CIG DRA program is a demand response (DR) program where customers are incentivized by DEP to curtail their loads during events as requested by DEP.

Participants must have the capability to curtail at least 75 kW of load when called upon by DEP. Most events last for 3-6 hours, and participants are guaranteed at least 30 minutes of notice before an event starts, but they are often notified the day before.

DEP called four winter and three summer events in 2018. The program included 22 customers, spanning 49 site locations and 73 electric meters that participated in at least one event during the year.

Date:	May 28, 2019
Region:	Duke Energy Progress
Evaluation Period	January 1, 2018 through December 31, 2018
Annual MWh Savings	N/A
Net-to-Gross Ratio	1.0

Evaluation Methods

The evaluation team estimated impacts from the DR events by replicating DEP's settlement baseline, testing a menu of 60 alternative baselines, and applying the most accurate baseline approach to estimate verified impacts for each season.

Impact Evaluation Details

- The program achieved a verified average of 20.0 MW per summer event and 6.9 MW per winter event. These reductions are 2.0% and 6.8% less than the 20.5 MW and 7.4 MW reductions reported by DEP for summer and winter, respectively.
- The average impact was approximately 324 kW per meter for summer events and 203 kW per meter for winter events. For summer events, impacts were as low as 48 kW and as high as 2,714 kW for individual meters. For winter events, impacts were as low as 12 kW and as high as 1,154 kW for individual meters.
- The evaluation team found the verified impacts to be at least 90% of DEP's reported impacts for most participants in both winter and summer events.
- The net-to-gross ratio is estimated to be 1.0 for this program. This is because the regression approach accounts for the counterfactual baseline, and it is highly unlikely that any participants would curtail their load in the absence of the program during the same time that events are being called by DEP (since only participants are notified of events).

5. CONCLUSIONS

The key impact evaluation conclusions are as follows:

- **The best models for estimating verified impacts were regression-based with a day-of load adjustment.** Navigant tested a set of regression and CBL models out of sample using event-like, non-event days as test days. The evaluation team determined that regression-based models performed best for both summer and winter events, as well as for events where DEP provided day-of and day-ahead notification.
- **Verified impacts were less than reported impacts.** The average realization rate for summer DR impacts for PY2018 was 97%, with an average of approximately 20.0 MW of DR contributed by the program. This realization rate is similar to the average across prior years (2010 through 2017) of 96%. The average realization rate for winter DR impacts for PY2018 was 93%, with an average of approximately 6.9 MW of DR contributed by the program. This realization rate falls between prior years DEP called winter events in 2014 and 2015, which had realization rates of 92% and 97%, respectively, or an average of 95%.
- **Participation[28] was inconsistent between events.** The average total event impacts for the summer of PY2018 were highest for the first and second events (21.5 MW and 20.6 MW, respectively) but lower for the third event (18.4 MW). The third summer event had the lowest participation (58 meters). For winter events, the first and second events had the highest impacts (7.2 MW and 7.4 MW, respectively) and had participation of 32 and 39 meters respectively. The third and fourth winter events had impacts of 6.3 MW and 6.8 MW and participation of 35 and 31 meters, respectively. These impacts suggest that the participation of large customers drives the impacts of winter events.
- **Total program impact increased in PY2018 compared to PY2017 and approached PY2015 levels for summer events.** The average summer event impact increased from 19.2 MW in PY2017 to 20.0 MW in PY2018, which is similar to the 20.1 MW achieved in 2015. The average winter event impact was 6.9 MW in PY2018, which is between the average of 6.2 MW achieved in 2014, but lower than the average of 8.1 MW achieved in 2015.

[28] Event-specific participation refers to enrolled participants delivering more than 0 kW of DR for a given event. An enrolled customer meter has participated in only two of three events if that meter has contributed more than 0 kW on only two of the three events.

<u>CERTIFICATE OF SERVICE</u>

I certify that a copy of Duke Energy Progress, LLC's Supplemental Testimony of Robert P. Evans and Evans Supplemental Exhibit D, in Docket No. E-2, Sub 1252, has been served by electronic mail, hand delivery, or by depositing a copy in the United States Mail, 1st Class Postage Prepaid, properly addressed to parties of record.

This the 17th day of August, 2020.

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