ATTACHMENT 2

2016 Evaluation Report for the Duke Energy Ohio PowerShare® Program

Prepared for:

Duke Energy

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EXECUTIVE SUMMARY

This document presents Navigant's evaluation for the Duke Energy Ohio (DEO) PowerShare Program for Program Year 2016. PowerShare is a demand response (DR) program offered to commercial and industrial customers that is part of the portfolio of demand side management and energy efficiency (DSM/EE) programs offered by Duke Energy. PowerShare offers participating companies and agencies a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

The DEO program offers customers two options to choose between: CallOption and QuoteOption.

- **CallOption:** In exchange for a monthly availability bill credit and event performance credits[1], participants reduce and maintain a predetermined load level during Emergency Curtailment events.
- **QuoteOption:** Customers nominate amounts of curtailable load based on upon price and timing offers from Duke Energy. Customers receive bill credits for actual load curtailed during the event.

No QuoteOption events were called during the period covered by this evaluation.

Participants enrolled in CallOption must further select one of three seasonal participation periods[2]:

1. **Summer Only** – A maximum of 10 emergency events may occur from June 1 to September 30. Events may only be called on non-holiday weekdays from 12 noon to 8 pm and events may be a maximum of 6 hours in length.
2. **Extended Summer** – No limit is placed on the number of emergency events that may occur from June 1 to October 31, 2016 plus May of 2017. Events may be called on any day during those months and an event may last no more than 10 hours.
3. **Annual** – No limit is placed on the number of events, and events may occur any day through the year (June 1, 2016 to May 31, 2017). Events may last no more than 10 hours.

CallOption participants may choose between one of two compliance options: that of having curtailment evaluated based on a "Firm" demand level ("down to") or a "Fixed" demand reduction ("down by"). CallOption participants must further choose between one of two energy options: "Capacity Only" (may also participate in PJM energy markets) and "Emergency Full" (Duke acts as the participant's sole curtailment service provider).

In the period of analysis, DEO PowerShare participants were subject to only test events. Participants are only required to respond to a single test event per season, and the vast majority of participants elected to participate in the first test event on September 1, 2016.

[1] Event performance energy credits are provided only to participants that select the "Emergency Full" energy option. See body of report for more details.
[2] Participation periods shown are specific to a given calendar period, as specified in the program literature.

Evaluation Objectives

The research objectives of this evaluation are as follows:

1. Validate the detailed DR baseline approach and calculations, as well as the monthly and seasonal capability calculations performed by Duke Energy.

2. Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric Energy Profiler Online™ (EPO) methods used to calculate the energy (kWh) and demand (kW) impacts that are used to determine settlement payments.

To complete the first objective, Navigant conducted a detailed audit of the SAS code used by Duke Energy to determine participant baselines and monthly and seasonal capability. To complete the second objective, Navigant replicated the EPO energy and demand calculations used by Duke Energy to determine settlement payments.

Key Findings

This section presents Navigant's key evaluation findings for the two principal evaluation objectives:

Duke Energy Baseline SAS Code Audit

Code performing correctly. Navigant performed a detailed audit of the SAS code used by Duke Energy to calculate settlement baselines, as well as monthly and seasonal capabilities, and found that the code was performing correctly. Navigant's approach to reviewing the SAS code was to document the flow of the datasets with high-level annotations along with making notes of the datasets utilized in each SAS script. These notes provide Duke Energy with a basis for improving the flow of the code and help identify datasets that can be deleted after each step to improve data management.

Opportunities for improved functionality. Navigant identified several opportunities to improve the functionality of the SAS code along with organizational suggestions that may reduce the potential for errors. Additionally, there is unnecessary code that has been used to explore alternative baseline calculations that can be removed from the code. Navigant's detailed recommendations provide actionable revisions to the SAS code that will simplify and consolidate the analysis. Follow-up discussions with Duke Energy indicate the unnecessary code, which is represented as comments, is being reviewed and either eliminated or simplified.

Verification and Validation of Settlement Energy and Demand Calculations

Settlement calculations verified as correct. EPO is used by Duke Energy to determine the energy (kWh) and capacity (kW) values that are the basis for calculating monthly settlement amounts. Navigant replicated the calculations for all of the participants in the period from June through September of 2016. A comparison of Navigant's replicated calculations with the output of EPO revealed no deviations beyond what could be expected as a result of rounding error, meaning that Duke Energy's estimates are accurate per the settlement algorithms defined by the program literature. A summary of the validation results may be found in Table 1 below.

No event data was provided for QuoteOption participants during the period of analysis.

Table 1. Verification of EPO Calculations

Program Option	Credit Type	Customers	# of Unique Account Numbers	# of EPO Results Replicated[a]	Average % Absolute Error[b]
CallOption	Energy	39	40	41	0.00%
CallOption	Capacity	39	40	160	0.00%

a. *The number of calculations reproduced by Navigant for this analysis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and four test curtailment events. CallOption participants are required only to participate in one test event per season.*

b. *The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.*

Source: EPO Settlement Data and Navigant analysis

1. INTRODUCTION

This document presents Navigant's evaluation for the Duke Energy Ohio (DEO) PowerShare Program for Program Year 2016. The PowerShare Program is a demand response program offered to commercial and industrial customers that is part of the portfolio of demand side management and energy efficiency (DSM/EE) programs offered by Duke Energy. PowerShare offers participating customers a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

1.1 Program Overview

The customer contracts for DEO's PowerShare Program commence on the first day of the month and the initial contract term varies between four months (CallOption – Summer Only) to one year (all other options).

The DEO program offers customers two options to choose between: CallOption and QuoteOption.

- **CallOption:** In exchange for a monthly availability bill credit and event performance credits[3], participants reduce and maintain a predetermined load level during Emergency Curtailment events.
- **QuoteOption:** Customers nominate amounts of curtailable load based on upon price and timing offers from Duke Energy. Customers receive bill credits for actual load curtailed during the event.

There were no QuoteOption events during the period covered by this evaluation.

Participants enrolled in CallOption must further select one of three seasonal participation periods[4]:

1. **Summer Only** – A maximum of 10 emergency events may occur from June 1 to September 30. Events may only be called on non-holiday weekdays from 12 noon to 8 pm and events may be a maximum of 6 hours in length.
2. **Extended Summer** – No limit is placed on the number of emergency events that may occur from June 1 to October 31, 2016 plus May of 2017. Events may be called between 10:00am and 10:00pm on any day during those months and an event may last no more than 10 hours.
3. **Annual** – No limit is placed on the number of events, and events may occur any day through the year (June 1, 2016 to May 31, 2017). Events may last no more than 10 hours.

In the period of analysis, DEO PowerShare participants were subject to only test events. Participants are only required to respond to a single test event per season, and the vast majority of participants elected to participate in the first test event on September 1, 2016.

Duke Energy contracts with Schneider Electric to calculate monthly customer settlements for the PowerShare Program. Schneider Electric is a specialized firm providing services in energy management

[3] Event performance energy credits are provided only to participants that select the "Emergency Full" energy option. See body of report for more details.
[4] Participation periods shown are specific to a given calendar period, as specified in the program literature

and automation. The PowerShare settlements are calculated with the use of Schneider Electric's Energy Profiler Online (EPO), a third-party hosted software application designed to assist utilities with energy data analysis. EPO uses participant interval data, Duke Energy-generated participant baselines and a set of program option-specific calculations to determine the event energy (kWh) and monthly capacity (kW) values that determine participant settlement payments.

1.2 Evaluation Objectives

The research objectives of this evaluation are as follows:

1. Validate the detailed DR baseline approach and calculations, as well as the seasonal and monthly capability calculations performed by Duke Energy.

2. Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric Energy Profiler Online™ (EPO) methods used to calculate the energy (kWh) and demand (kW) impacts that are used to determine settlement payments.

To complete the first objective, Navigant conducted a detailed audit of the SAS code used by Duke Energy to determine participant baselines and monthly capability. To complete the second objective, Navigant replicated the EPO energy and demand calculations used by Duke Energy to determine settlement payments.

1.2.1 Validate Detailed DR Baseline Approach and Capability Calculations

To complete the first objective, Navigant conducted a detailed audit of the SAS code used by Duke Energy to determine participant baselines, monthly, and seasonal capabilities.

As established in a series of conversations with Duke Energy in August of 2016, Navigant was tasked with conducting a detailed review of the SAS code used by Duke Energy to determine participant baselines (sometimes referred to as "pro forma") and the manner in which these were used to determine monthly capability.

As specified by Duke Energy, this review focused on two key issues:

a. Identifying technical flaws in the code (e.g., code that fails to do what the author intends it to do, or else does more than it is intended to do).

b. Ensuring that the in-line commenting is sufficiently clear and complete that the code is useable by a competent SAS programmer with experience and understanding of demand response programs.

Navigant did not execute the code, however the Navigant analyst performed a detailed assessment of output extracts from each section of the code, and coordinated closely with the Duke Energy SAS code author throughout the review process.

1.2.2 Verify Energy and Demand Calculations Used for Settlement

To complete the second objective, Navigant replicated the energy and demand calculations used by Duke Energy to determine settlement payments and compared these with the energy and demand values reported in the program's operational tracking database for the calculation of settlement payments.

The energy and demand calculations used by Duke Energy to determine settlement payments are generated by the Energy Profiler Online (EPO) tool, a Schneider Electric software product. Schneider Electric's EPO outputs a settlement report for each participant settlement (monthly capacity and event energy settlements). Each report contains the data (including the Duke Energy baseline and the participant actuals) used and the arithmetic applied to calculate the settlement payment.

To fulfill this task, Duke Energy directed Navigant to replicate the settlement arithmetic for the population of Schneider Electric reports for all PowerShare participants from June through September of 2016. The purpose of this replication was effectively to audit the process and ensure that all algorithms were applied as specified in the program literature.

1.3 Program Rules

This sub-section provides some additional detail regarding the program rules, specifically, those rules that define how much DR participants are required to provide, and a summary of the participant credits. This information is a summary of the DEO PowerShare Program brochure to which interested readers should refer for additional detail.[5]

As noted above, there are two PowerShare program options in DEO territory, but no QuoteOption events were called during the period covered by this evaluation.

The CallOption has, itself, a high degree of optionality for participants. Participants enrolled in CallOption must select:

- A compliance plan ("Fixed" or "Firm");
- A participation period ("Summer Only", "Extended Summer", or "Annual"), and;
- An energy option ("Capacity Only" or "Emergency Full").

Details of each of these options are discussed in the text immediately below, and in Table 2, which follows.

Compliance Plan. Participants in the CallOption must select one of two compliance plans:

- Fixed. A "Fixed" compliance plan is a "down by" requirement (i.e., when called participants must reduce demand by X kW).
- Firm. A "Firm" compliance plan is a "down to" requirement (i.e., when called participants must reduce demand to X kW).

Participation Period. The participation period selected determines the contract term, potential periods of interruption and the payment schedule. Details of these differences are presented in Table 2, below.

Energy Option. CallOption participants may choose either the:

[5] Duke Energy Ohio, *PowerShare Ohio 2016 - 2017* (Program Brochure), Accessed November 2016 https://www.duke-energy.com/business/products/powershare

- "Capacity Only" option, in which case they may participate in the PJM energy markets but do not receive any energy payments from Duke Energy; or,
- "Emergency Full" option which precludes the participant from participating in other curtailment programs.

All PowerShare options, compliance plans, participation periods and energy options require participants to commit to curtailing a minimum of 100kW per event.

CallOption curtailment may only be called as required by PJM capacity constraints.

Table 2, below, presents some additional detail regarding the program rules for the three PowerShare options in DEO territory with enrolled participants.

Table 2: Detailed PowerShare Option Rules

	CallOption – Summer Only	CallOption – Extended Summer	CallOption – Annual	QuoteOption
Eligibility	Available to customers served on rate schedules DS, DP, and TS.	Available to customers served on rate schedules DS, DP, and TS.	Available to customers served on rate schedules DS, DP, and TS.	Available to customers served on rate schedules DS, DP, and TS.
Notice	30 Minutes	30 Minutes	30 Minutes	The morning of the event.
Curtailment Frequency and Timing	Curtailment may occur between noon and 8pm for up to 6 hours on non-holiday weekdays from June through September, 2016. No more than 10 emergency events may be called during the summer.	Curtailment may occur between 10am and 10pm for up to 10 hours on any day from June through October, 2016, and May 2017. There is no limit on the number of events that may be called.	Curtailment may occur between 10am and 10pm for up to 10 hours on any day from June through October, 2016, and May 2017. Curtailment may also occur between 6am and 9pm on any day from November through April. There is no limit on the number of events that may be called.	Curtailment may occur at any time for up to 10 hours on any day from June 2016 through May 2017. There is no limit on the number of events that may be called.
Energy Payment	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.	Emergency Full option participants receive credit at a rate equivalent to 85% of the real-time LMP observed during the event.	Energy credits for voluntary curtailment are based on current market prices.
Capacity Payment	$36 per kW/year	$48 per kW/year	$54 per kW/year	
Penalty	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.	Failure to reduce to Firm Demand levels incurs a penalty of the Real-Time cost of energy (LMP + 10%). All penalties charged by PJM and include potential for removal from the program.

Source: Duke Energy

2. EVALUATION METHODS

This section of the PowerShare evaluation outlines the methods employed by the evaluation team to complete the evaluation.

This section is divided into two sub-sections:

- **Duke Energy Baseline SAS Code Audit.** This sub-section describes Navigant's approach to auditing the SAS code developed by Duke Energy to estimate participant baselines and calculate capabilities.
- **Replication of EPO Calculations.** This sub-section describes the approach and data used to replicate the EPO calculations that deliver the energy and demand used by Duke Energy to determine settlement payments.

2.1 Duke Energy Baseline SAS Code Audit

Navigant's approach to reviewing the SAS code was to document the flow of the datasets with high-level annotations along with making notes of the datasets utilized in each SAS script. The notes taken on the datasets utilized in each script were provided to Duke Energy in an Excel workbook. These technical notes are intended to provide Duke Energy with a basis for improving the flow of the code and to help identify datasets that can be deleted after each step to improve data management. The high-level annotations are included in Navigant's documentation of the SAS code process flow, which may be found in Appendix A of this report.

2.2 Replication of EPO Calculations

This sub-section describes the approach and data used by Navigant to replicate the EPO calculations for energy and demand used by Duke Energy to determine settlement payments.

It is divided in two parts:

- **Input Data** - This section lists the key data and documents used as inputs for this analysis.
- **Description of EPO calculations** - This section provides the algebraic descriptions of the calculations replicated by Navigant.

2.2.1 Input Data

Navigant used the following key input data and documents to replicate the EPO settlement calculations:

1. EPO settlement results data
2. DEO PowerShare participants' interval consumption data
3. DEO PowerShare Program brochure[6]

[6] The DEO PowerShare Program brochure can be found at https://www.duke-energy.com/business/products/powershare

4. The Schneider Electric summary of data required to complete settlement algorithms, provided to Navigant by Duke Energy.
5. PowerShare program guidelines, provided to Navigant by Duke Energy.

2.2.2 Description of EPO Calculations

This section summarizes Navigant's replication of the EPO calculations that estimate the energy and demand values used by Duke Energy to determine settlement. There are several key terms that are worth formally defining in order to clarify their use in equations that follow. These terms are:

- **Proforma Demand**: Demand level specified in CallOption participants' agreement
- **Firm Demand Compliance Option**: CallOption participants may choose one of two compliance options. For the Firm demand option, participants agree to reduce load **by** a certain kW level when called.
- **Fixed Demand Compliance Option**: CallOption participants may choose one of two compliance options. For the Fixed demand option, participants agree to reduce load **to** a certain kW level when called.

Navigant applied the equations in this section to the interval consumption data resulting in the relevant energy or capacity credits. Navigant then compared the calculated credits to the EPO settlement data and verified that the results were essentially identical for each calculation.[7]

Event Energy Credits (Applies to "Emergency Full" CallOption Participants)

$$LR = \sum_{h} [MAX(0, MIN(1000, P_h - A_h))]$$

Where:

LR = Load reduction,
P_h = Proforma demand in hour h,
A_h = Actual demand in hour h

Monthly Capacity Credits (Applies to CallOption Participants)

The calculation of monthly capacity differs by compliance option.

Firm Demand Compliance Option

$$NEOL = MAX(0, A_i - F)$$

$$EOL = MAX(0, P - F)$$

Where:

NEOL = Non-event option load, used for months in which no event occurred,

[7] Some small insignificant differences in individual calculations were found due to rounding effects.

EOL = Event option load, used for months in which an event occurred,
A_i = Average demand for month i during the exposure period,
F = Firm demand,
P = Average proforma demand during curtailment period

Fixed Demand Compliance Option

$$NEOL = MAX(0, MIN(A_i, FDR))$$

$$EOL = MIN(P, FDR)$$

Where:

NEOL = Non-event option load, used for months in which no event occurred,
EOL = Event option load, used for months in which an event occurred,
A_i = Average demand for month i during the exposure period,
FDR = Fixed demand reduction,
P = Average proforma demand during curtailment period

Event Energy Credits (Applies to QuoteOption Participants)

$$LR = \sum_h [MAX(0, P_h - A_h)]$$

Where:

LR = Load reduction,
P = Proforma demand in hour h,
A_h = Actual demand in hour h

3. EVALUATION FINDINGS AND RESULTS

This section describes the findings and results of Navigant's evaluation. It is divided into two sections:

- **Duke Energy Baseline SAS Code Audit.** This section describes Navigant's findings and recommendations based on our audit of the Duke Energy baseline SAS code.
- **PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations.** This section describes Navigant's findings based on our analysis of the program tracking database[8] and the replication of the EPO calculations that deliver the energy and demand impacts used by Duke Energy to determine settlement payments.

3.1 Duke Energy Baseline SAS Code Audit

Navigant has identified several opportunities to improve the functionality of the SAS code along with making the code more readable for other support staff. The following list of findings and suggestions are intended to improve functionality and consistency:

Methodology and Baseline Calculations

- Navigant has found that Duke Energy is correctly conducting settlement baseline calculations in the daily baseline calculation code in accordance with the intended approach.
- During the review of calculations for seasonal capabilities (separate from daily baseline calculations), Navigant found that the forecast includes the holidays of July 4th and Labor Day, and that those holidays are treated as regular weekdays. Although the impact of treating two holidays as weekdays rather than weekends would be very minimal, Navigant suggests that Duke Energy consider treating those holidays as weekends in the code.
- Weekday and weekend datasets for calculating DR capabilities are created using the "today()" function. This would cause an error in weekend calculations if the code is run on a weekend since there is a dependency of "today" being a weekday. Navigant understands that Duke Energy calculates the weekend capabilities on Fridays so there are likely no errors, however we recommend that Duke Energy consider updating the capability codes to account for day type in case the estimates are ever calculated on a weekend.

SAS Code Functionality

- The 'main' SAS script for each jurisdiction should be simplified to improve readability and consistency.
    - Recommendation: Move all analysis into sub-routines and update the 'main' scripts to only do the following:
        - Define global macro variables
        - Import external data

[8] The "program tracking database" refers to the documentation provided by Duke Energy outlining the reported capacity and energy values used by Duke for settlement payment.

        - Call sub-routine SAS scripts
- Comments and descriptions should be added to the beginning of each file and section of code to provide simplified documentation of what the code accomplishes.
    - Recommendation: Add at least a one-sentence description at the beginning of each SAS script file and at the beginning of each section of code.
- After each SAS script is run, temporary datasets and macro variables that are not used in subsequent scripts should be deleted to avoid any misuse of data from preceding analysis.
    - Recommendation: Include the "PROC DATASETS" procedure at the end of each script to delete datasets and macro variables that are no longer needed.
- Delete any code that is not being used in the analysis to improve readability and prevent errors.
    - Recommendation: Delete all unnecessary code that has been commented out of each script.

3.2 PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations

This section describes Navigant's findings based on our analysis of the program tracking database and the replication of the EPO calculations that deliver the energy and demand impacts used by Duke Energy to determine settlement payments.

Navigant replicated the EPO calculations for all of the participants in the period from June through September of 2016. A comparison of Navigant's replicated calculations with the output of the EPO revealed no deviations beyond what could be expected as a result of rounding error, meaning that Duke Energy's estimates are accurate. A summary of the validation results, by option and credit type may be found in Table 3, below. There were no QuoteOption events during this evaluation cycle.

Table 3. Verification of EPO Calculations

Program Option	Credit Type	Customers	# of Unique Account Numbers	# of EPO Results Replicated[a]	Average % Absolute Error[b]
CallOption	Energy	39	40	41	0.00%
CallOption	Capacity	39	40	160	0.00%

a. *The number of calculations reproduced by Navigant for this analyisis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and four test curtailment events. CallOption participants are required only to participate in one test event per season.*

b. *The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.*

Source: EPO Settlement Data and Navigant analysis

Navigant calculated verified values according the EPO algorithms described above using Duke Energy's participant baselines and participant interval data. Only CallOption test events (as opposed to

Emergency events) were called in the period of analysis. Since participants are required to participate only in a single test event during the DR season, most only participated in the first event. This resulted in most energy impacts being observed in that event. The total energy impacts per event for the summer of 2016 by PowerShare option are summarized in Table 4, below.

Table 4: Summary of 2016 Event Impacts (Total Program MWh per Event)

Program Name	September 1st	September 13th	September 21st	September 30th	Total
Total Energy Curtailed (MWh)	61	2	6	0	69
# of Participants	37	3	1	0	41

Source: EPO Settlement Data and Navigant analysis

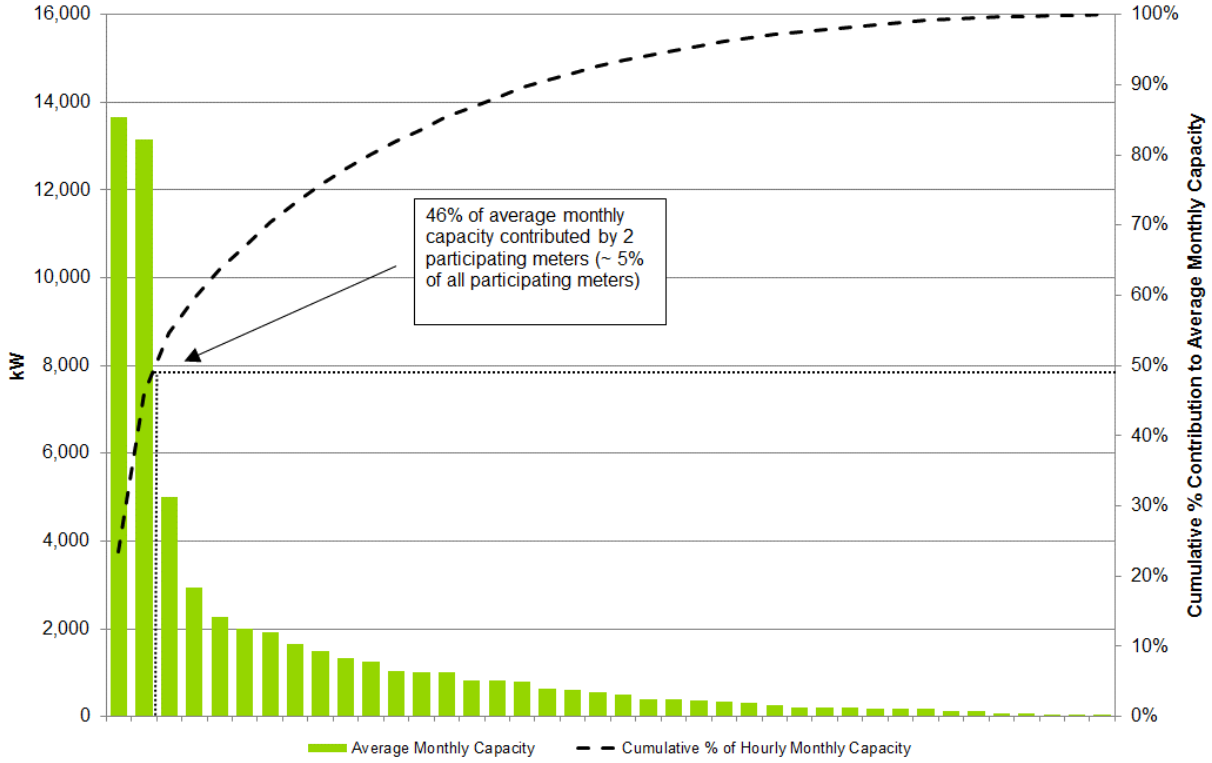
The PowerShare Program paid out capacity credits to participants for an average monthly capacity of approximately 58 MW during the summer of 2016. This value is calculated according the EPO algorithms described above using Duke Energy's participant baselines and participant interval data. As is the case for delivered energy, the vast majority of this was delivered by customers enrolled in the Mandatory Curtailment option. The total DR capacity per month for the summer of 2016 for PowerShare CallOption participants is summarized in Table 5, below.

Table 5: Total Monthly Capacity for 2016 (MW)

Program Name	June	July	August	September	Average
CallOption	54	56	62	61	58.3

Average monthly capacity is driven by a small percentage of meters. Figure 1 shows that the top two meters in terms of average monthly capacity account for 46% of total average monthly capacity.

Figure 1. Average Monthly Capacity by Participant[9]



Source: EPO Settlement Data and Navigant analysis

[9] The bar chart shows each participant's average capacity only across the months in which they participated in events.

4. CONCLUSIONS AND RECOMMENDATIONS

This section presents Navigant's key evaluation findings for the two principal evaluation objectives:

- **Duke Energy Baseline SAS Code Audit.** This sub-section presents the key findings of Navigant's audit of the Duke Energy SAS code used to estimate baseline and capability calculations.
- **Verification and Validation of Settlement Energy and Demand Calculations.** This sub-section presents the key findings of Navigant's efforts to replicate the calculation of the participant-level kWh and kW impacts used to determine settlement payments.

4.1 Duke Energy Baseline SAS Code Audit

Navigant's detailed review of Duke Energy's SAS code determined that the settlement baseline and monthly and seasonal capabilities are being calculated correctly per Duke Energy's definitions. Navigant provided a series of recommendations to Duke Energy that are meant to enhance the functionality of the code, and reduce potential for errors. Navigant recommends the following:

Methodology and Baseline Calculation Recommendations

- Update the DR capability code to take into account the day type for each day in the capability period.

SAS Code Functional Recommendations

- Move all analysis into sub-routines and update the 'main' scripts to simplify the flow of analysis
- Add at least a one sentence description at the beginning of each SAS script file and at the beginning of each section of code.
- Include the "PROC DATASETS" procedure at the end of each script to delete datasets and macro variables that are no longer needed.
- Delete all unnecessary code that has been commented out of each script.

4.2 Verification and Validation of Settlement Energy and Demand Calculations

Navigant found no major discrepancies when replicating Duke Energy's settlement calculations per the algorithms defined in Section 2.2. This finding confirms that Duke Energy's procedure for calculating impacts is functioning in accordance with the program definitions.

APPENDIX A: DUKE BASELINE SAS PROCESS FLOW

The following outline provides a functional description of what the SAS code is performing. These notes are intended as documentation that can be referenced without a deep understanding of the nuances of SAS code.

Duke Energy Code:

- Set date ranges for analysis
- Import line losses
- Import load data
- Import participation data
- Consolidate IS and PS datasets
- Flag weekend days and holidays in load data
- Flag event days in load data
- Seasonal classifications of load
    - Summer: 6, 7, 8, 9
    - Winter: 12, 1, 2
    - Other: 3, 4, 5, 10, 11
- Data quality checks
    - Remove non-participants from data
    - Assess missing data by account
    - Identify accounts with insufficient data for forecast
    - Analyze accounts with some missing data (partial days missing vs. whole days)
    - Identify intervals with 0 load
    - Generate PDF report of data quality metrics
- Forecast capability
    - Weekday forecast
        - Select data for pro forma forecast (excludes weekends, event days, and holidays)
            - Prior 480 intervals (5 days) in PJM and then top 4 days from that range (15-minute intervals)
        - Calculate average load by hour and account
        - Generate a list of the next 35 days from today's date for forecast dates
        - Merge KW values with the forecast date list
    - Weekend forecast
        - Select weekend days for forecast
            - Prior 288 intervals (3 days) in PJM and then top 2 days from that range (15-minute intervals)
        - Calculate the average KW by hour and account
        - Generate a list of the next 35 days from today's date for forecast dates
        - Join average KW values to forecast dates when the day is Saturday or Sunday
    - Select the weekdays from the weekday forecast series and join to the weekend forecast
    - Produce 'slinger' (*.LSE) file using the forecast
    - Create hourly forecast dataset to estimate and report capability
    - Join account IDs to hourly forecast data for weekdays
    - Calculate seasonal capability based on compliance plan
        - Remove accounts with insufficient data
    - Output summarized capability for parent accounts

        - Takes into account Parent-Child account relationships to report at the Parent Account level
    - Summarize capability by program, state, and hour
    - Adjust capability for line losses
    - Count the number of participants by program and state
    - Repeat preceding steps, but using weekend forecast
    - Code is included to compare new and existing forecasts
    - Calculate generator capability with line loss adjustments to the Firm Fixed KW value
    - Summarize generators by state with participant counts and KW
    - Generate PDF reports with participant counts, KW capability, and data deficiency summaries for weekdays and weekends