

# Continuous Energy Improvement Program

## 2018 Impact Evaluation Report

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# 01

## Introduction

# Program Summary

## What is the Continuous Energy Improvement (CEI) Program?

The CEI Program provides training for commercial and industrial customers on how to view energy consumption at their facilities in a holistic manner, and identify no cost/low cost opportunities to reduce energy use.

Specifically, the CEI program includes:

- Coaching assistance, tools, and templates to support customer employees to meet facility and corporate cost savings targets
- Custom statistical models for each customer to measure and manage energy intensity
- An Energy Coach and technical resources to help customers identify and implement energy saving opportunities
- A structured support group of local companies that share best practices and provide team support, encouragement, and accountability

These practices can reduce energy use at an individual site anywhere from three to five percent with little or no financial investment from the customer.

## AEP Ohio CEI website

<https://www.aepohio.com/save/business/programs/continuousenergyimprovement.aspx>

# Adjustments to the Program

## Facility size adjustments.

- Original CEI program designed in January of 2013 supported AEP Ohio's largest industrial customers (>10 GWh annually)
- AEP Ohio expanded the program in May of 2013 to support customers using >3 GWh annually and is still the threshold for 2018

## Facility type adjustments.

- In 2015 AEP Ohio expanded the CEI program to large customers beyond the industrial sector
- 2018 participants include offices, schools, and other large commercial businesses as well as industrial facilities

## Program structure adjustments.

- The 2018 evaluation includes “alumni” customers who participated in past years of the CEI program
- These alumni facilities requested continued CEI support in 2018 and generated program savings
- Navigant treated all savings claimed from the alumni group as incremental savings to avoid double counting with prior years

# Cohort Description

The CEI program consists of “cohorts” or groups of program participants who began the program in roughly the same calendar year. These customers often attend group training sessions together and form a peer group for discussing CEI related savings activities.

The 2018 evaluation consisted of cohorts 9-12, which were split into two major groups:

1. Customers in their first year of participation in the CEI Program (cohorts 11 and 12)
2. Alumni customers who participated in prior program years but continued to receive training and other program support in 2018 (cohorts 9 and 10) [footnote 1]

Footnote 1: Alumni customers could include any facilities who were a part of cohorts 1 through 8 in past program years. Savings claimed by the program for cohorts 9 and 10 in 2018 are incremental changes to 2017 claimed savings to avoid double counting.

# Evaluation Objectives

The 2018 evaluation objectives include:

- 01 Review a sample of site-level energy models and verify the claimed *ex ante* savings
- 02 Compare the *ex post* savings to the program's near- and long-term goals
- 03 Identify whether AEP Ohio was successful in meeting its goals for the CEI program





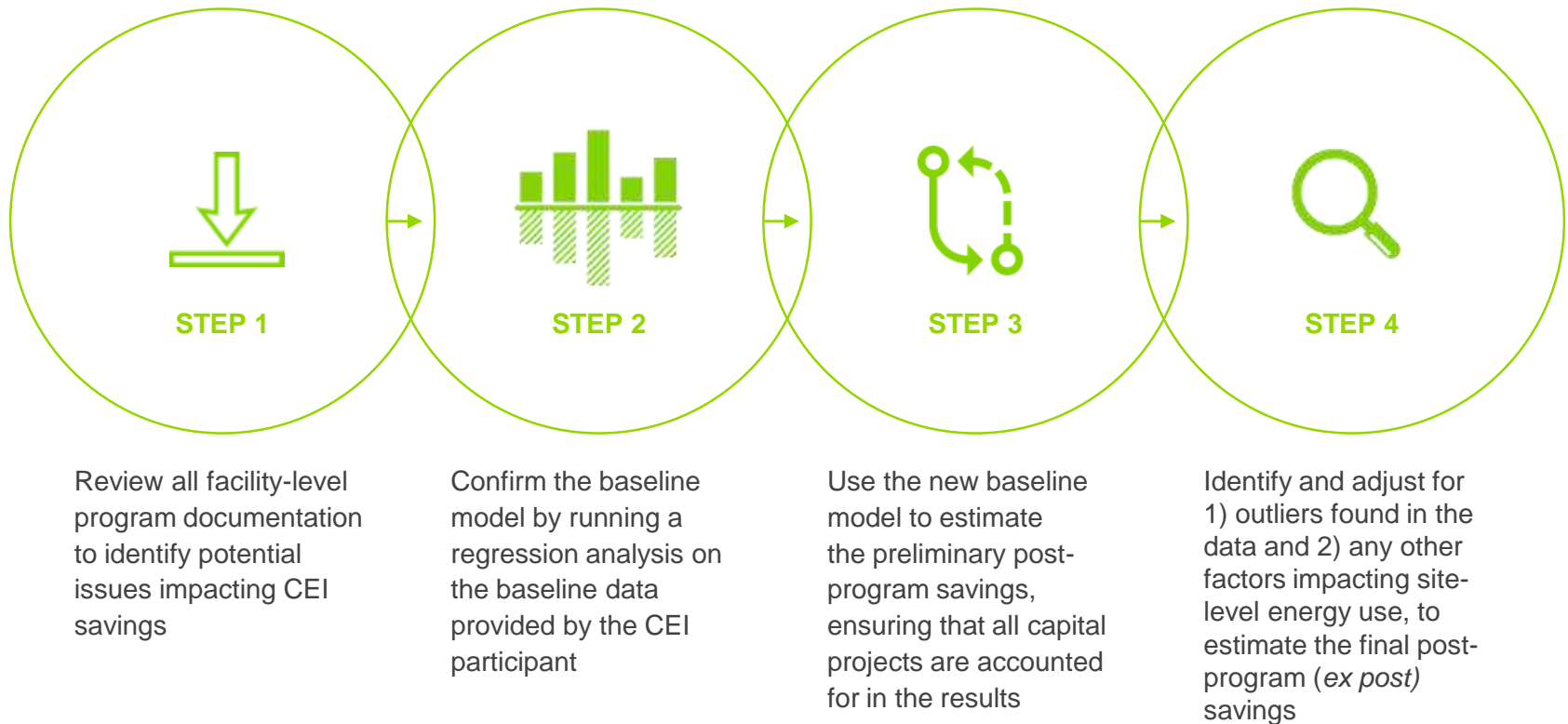
02

Methodology



# Evaluation Methodology

AEP Ohio provided Navigant with the energy and demand models as well as the CEI reports for all sites participating in cohorts 11 and 12 of the CEI Program. Navigant reviewed the models and used the data to recreate the pre- (baseline) and post-program implementation savings estimates. This process generally followed these steps:



# Evaluation Methodology

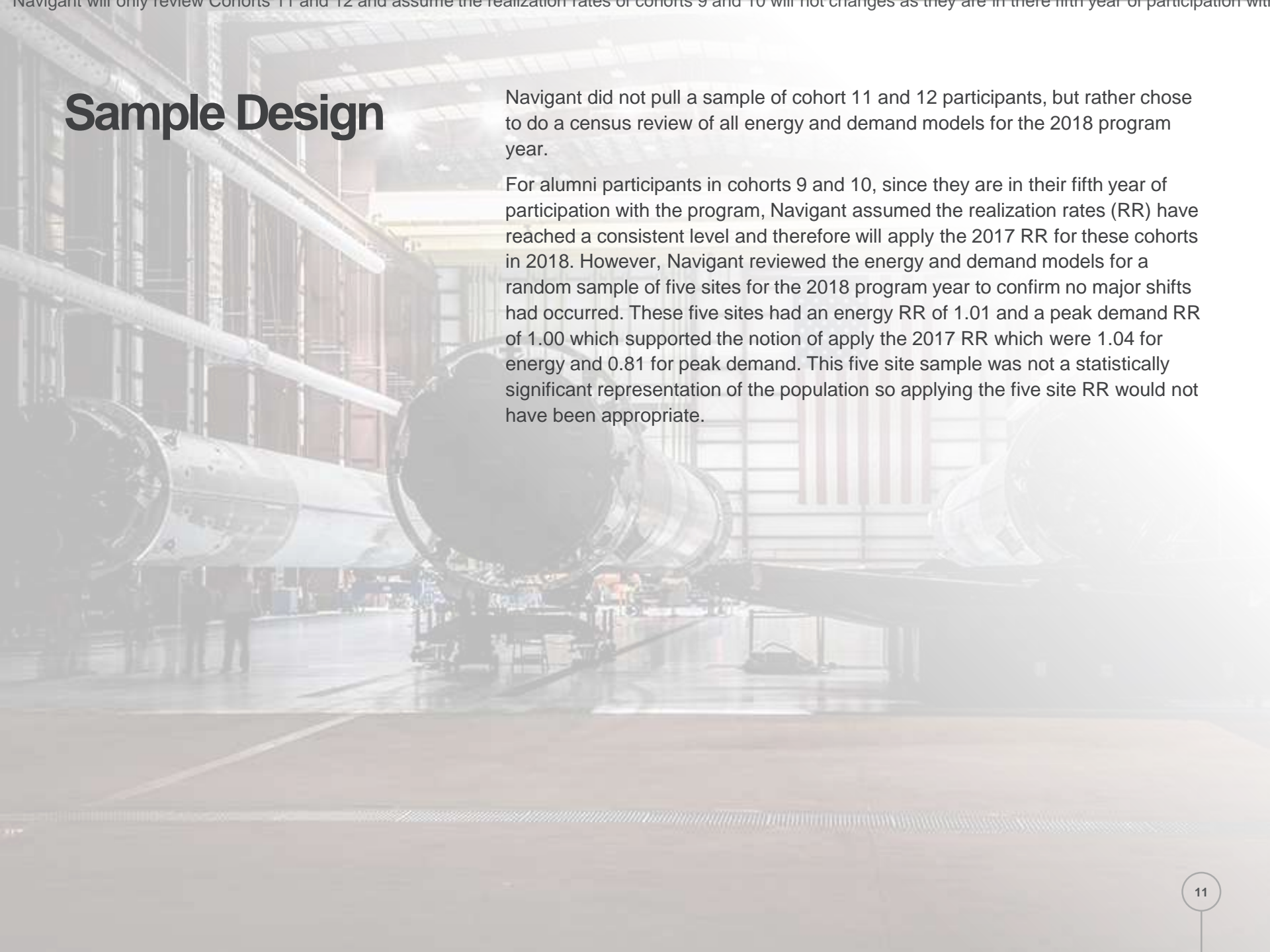
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Navigant also identified any impacts of other site related activities that may have impacted energy consumption, and reflected the impacts in the *ex post* models. These impacts could include:

- Changes in hours of operation
- Changes in number of employees
- Changes in production
- Capital measures installed at the site through other AEP Ohio energy efficiency programs

Once the site related activities were removed from the model, Navigant identified outliers and other impactful energy activities by searching the energy models for data points that were either greater than 110% of the baseline average, or below 90% of the baseline average. The team then reviewed each of these data points to understand what caused them, what impact they had on the energy model, and whether to zero out savings. The CEI analysis tool provides detailed descriptions for each outlier found and how the team adjusted savings. The following table provides an example of the outlier check from Site A.

| Week Start | Week End  | Predicted Electricity [kWh] | Electricity Saved (Predicted – Actual) [kWh] | Cumulative Sum of Electricity Saved [kWh] | All Indirect Hours refined | Outlier Check |
|------------|-----------|-----------------------------|--|---|----------------------------|---------------|
| 2/2/2018   | 2/8/2018  | 417,453                     | 88,307                                       | 600,734                                   | 2,584                      | Pass          |
| 2/9/2018   | 2/15/2018 | 381,177                     | 29,678                                       | 630,412                                   | 1,945                      | Pass          |
| 2/16/2018  | 2/22/2018 | 374,246                     | 45,514                                       | 675,927                                   | 1,823                      | Pass          |
| 2/23/2018  | 3/1/2018  | 553                         | 0  | 675,927                                   | 329                        | Fail          |
| 3/2/2018   | 3/8/2018  | 350,848                     | 26,823                                       | 702,749                                   | 1,786                      | Pass          |
| 3/9/2018   | 3/15/2018 | 368,463                     | 44,968                                       | 747,718                                   | 1,965                      | Pass          |
| 3/16/2018  | 3/22/2018 | 372,908                     | 40,233                                       | 787,950                                   | 1,980                      | Pass          |



# Sample Design

Navigant will only review Cohorts 11 and 12 and assume the realization rates of cohorts 9 and 10 will not change as they are in their fifth year of participation with the program. Navigant did not pull a sample of cohort 11 and 12 participants, but rather chose to do a census review of all energy and demand models for the 2018 program year.

For alumni participants in cohorts 9 and 10, since they are in their fifth year of participation with the program, Navigant assumed the realization rates (RR) have reached a consistent level and therefore will apply the 2017 RR for these cohorts in 2018. However, Navigant reviewed the energy and demand models for a random sample of five sites for the 2018 program year to confirm no major shifts had occurred. These five sites had an energy RR of 1.01 and a peak demand RR of 1.00 which supported the notion of apply the 2017 RR which were 1.04 for energy and 0.81 for peak demand. This five site sample was not a statistically significant representation of the population so applying the five site RR would not have been appropriate.

# Data Collection Activities

## DATA COLLECTION TYPE

### Review Provided Site Modes

Targeted Population  
**Census of sites in cohorts  
11 and 12**

Sample Frame  
**Tracking Database**

Sample Size  
**Census**

Timing  
**Feb-19**

# 1

### In-Depth Telephone Interview

Targeted Population  
**Implementation Contractor  
and Program Manager**

Sample Frame  
**Contact from  
Implementation Contractor**

Sample Size  
**2**

Timing  
**March-19**

# 2

### Site Surveys

Targeted Populations  
**Sample of sites with  
problematic energy models**

Sample Frame  
**Tracking Database**

Sample Size  
**8**

Timing  
**March-19**

# 3



# 03

## Evaluation Findings



# Savings Results – Program Level

The 2018 evaluation of AEP Ohio's CEI program shows the program is operating with realization rates at 1.06 for energy savings (MWh) and 0.91 for coincident peak demand reduction (kW). The program's *ex post* energy savings achieved 78% of the energy goal set forth in the 2016 Action Plan, but over 250% of the demand goal as shown in the table below.

|                      | Program Goals*<br>(a) | Ex Ante Incremental Savings<br>(b) | Ex Post Incremental Savings**<br>(c) | Realization Rate<br>(c / b) | % to Goal<br>(c / a) |
|----------------------|-----------------------|------------------------------------|--------------------------------------|-----------------------------|----------------------|
| Energy Savings (MWh) | 23,157                | 16,997                             | 18,019                               | 1.06                        | 78%                  |
| Demand Savings (kW)  | 474                   | 1,337                              | 1,216                                | 0.91                        | 257%                 |

\* AEP Ohio Volume 1: 2017 TO 2019 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, June 15, 2016

\*\* Evaluation analysis of AEP Ohio tracking data from 2018

# Savings Results – Cohort Level

Navigant used the realization rates from the 2017 evaluation for alumni cohorts 9 and 10. For cohorts 11 and 12, Navigant evaluated a census of facility energy models to calculate the energy (MWh) and demand (kW) realization rates as shown in the table.

| Cohort | Number of Sites | <i>Ex Ante</i> Incremental Savings (MWh)* (a) | <i>Ex Post</i> Incremental Savings (MWh) (b) | Realization Rate (MWh)** (b / a) | <i>Ex Ante</i> Demand Savings (kW) (c) | <i>Ex Post</i> Demand Savings (kW) (d) | Realization Rate (kW) (d / c) | Effective Useful Life (EUL)*** (e) | <i>Ex Post</i> Lifetime Savings (b * e) |
|--------|-----------------|---|--|----------------------------------|--|--|-------------------------------|------------------------------------|---|
| 9      | 9               | 8,496   | 8,836  | 1.04                             | 678                                    | 556                                    | 0.82                          | 5                                  | 44,179                                  |
| 10     | 8               | 3,153   | 3,279  | 1.04                             | 25                                     | 20                                     | 0.82                          | 5                                  | 16,396                                  |
| 11     | 16              | 3,562   | 4,089  | 1.15                             | 727                                    | 733                                    | 1.01                          | 5                                  | 20,446                                  |
| 12     | 6               | 1,787   | 1,815  | 1.02                             | -92                                    | -92                                    | 1.00                          | 5                                  | 9,076                                   |

\* Values for cohorts 9 and 10 taken from AEP Ohio's claimed savings tracking data file AEPCEL\_YE2018

\*\* Realization rates for cohorts 9 and 10 are from the 2016 evaluation

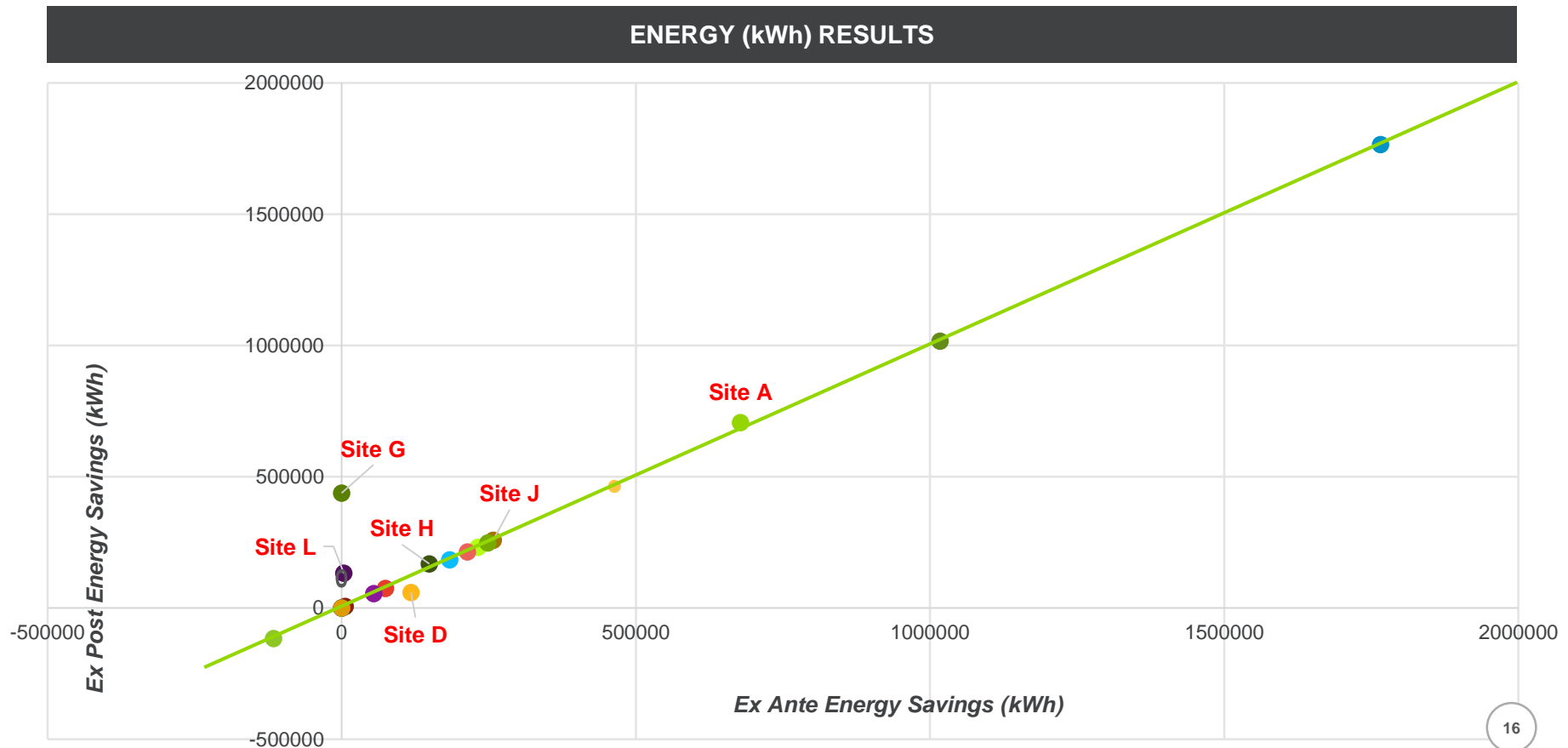
\*\*\* Effective Useful Life (EUL) is from the prior 2016 evaluations and not updated during the 2018 evaluation effort. Navigant did not have enough data to calculate persistent savings in 2018.



# Savings Results – Site Summary

The figure below is a graphical representation of the site level ex ante versus ex post energy savings. The diagonal line represents the goal of a realization rate of one. Points above and to the left of the  $RR=1$  line represent sites with energy realization rates above one, while those points below and to the right are sites with realization rates less than one.

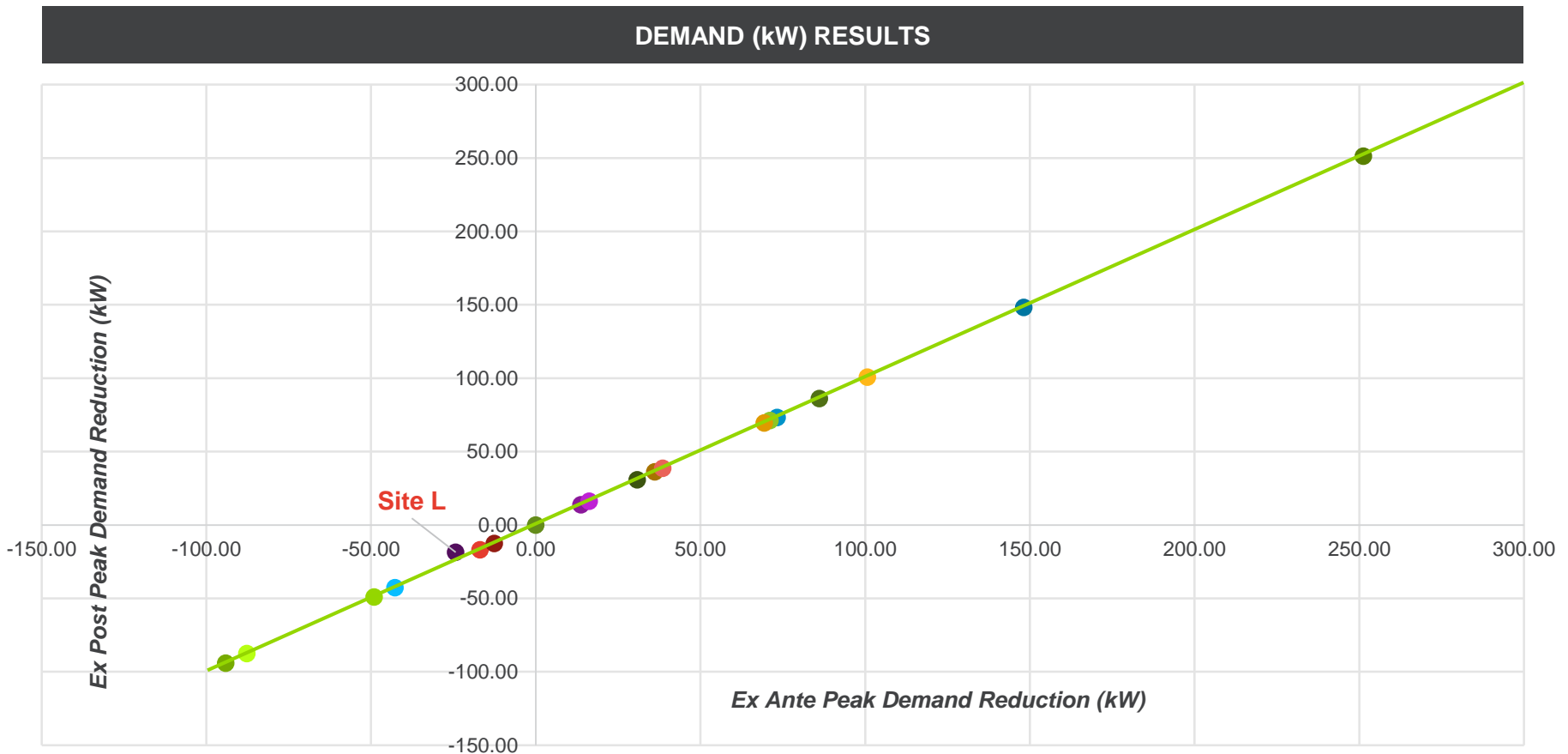
The majority of the sites reviewed in the 2018 evaluation have a realization rate of 1.00. Sites with higher or lower realization rates are discussed in the site-level details later in the report.



# Savings Results – Site Summary

This figure represents coincident peak demand savings, where again the diagonal line represents a realization rate of one.

Nearly all of the sites reviewed in the 2018 evaluation have a demand realization rate of 1.00. See the site-level detail slides later in the report for information on sites with higher or lower demand realization rates.



# Savings Results – Site Level

The site-level results provide a cumulative sum of savings displayed in the chart below, along with an explanation of each CEI activity the facility undertook.

**Site A** – Good example of CEI savings where the site realizes an increase in energy savings each time it introduces an CEI activity. There is an outlier in the post period energy model that underestimated energy use, accounting for the realization rate of 1.04.

## Realization Rates for Site A:

Energy (MWh) – 1.04

Demand (kW) – 1.00

## Ex Ante and Ex Post Results for Site A:

### Energy (MWh)

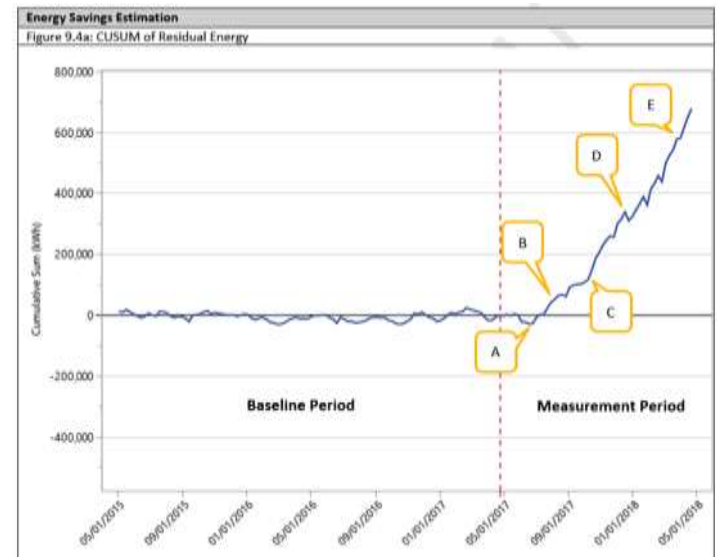
Ex Ante – 678

Ex Post – 706

### Demand (kW)

Ex Ante – (49)

Ex Post – (49)



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item | Description  | Date Implemented |
|------|--|------------------|
| A    | Compressed air leak repair program implemented             | Jul 2017         |
| B    | Major compressed air leaks repaired on Week 1 & 2 machines | Sep 2017         |
| C    | Consolidated production into two shifts rather than three  | Sep/Oct 2017     |
| D    | Shut down procedures implemented                           | Jan 2018         |
| E    | Installed engineered nozzles                               | April 2018       |

# Savings Results – Site Level

**Site J** – Good example of CEI. Facility saw immediate savings after introducing each CEI activity.

## Realization Rates for Site J:

Energy (kWh) – 1.00  
Demand (kW) – 1.00

## Ex Ante and Ex Post Results for Site J:

### Energy (MWh)

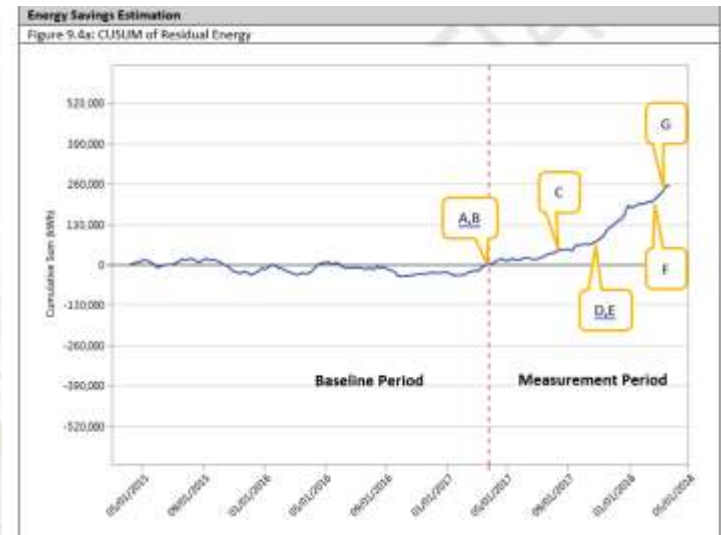
Ex Ante – 258

Ex Post – 258

### Demand (kW)

Ex Ante – 36

Ex Post – 36



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item | Description  | Date Implemented |
|------|--|------------------|
| A    | Worked on cooler door operation: encouraged employees to close them when done, repaired photoeyes and hinges that were preventing doors from closing appropriately | Apr-Jul 2017     |
| B    | Improved shutdown practices: turn off HTST when not running product for a significant amount of time-especially unit 4   | Apr 2017         |
| C    | Continued installation of occupancy sensors  | Aug 2017         |
| D    | Modified compressed air distribution system for one of four blow molders   | Dec 2017         |
| E    | Removed compressed air pressure reducing valve piping constriction   | Dec 2017         |
| F    | Ultrasonic air leak detection and repair   | Feb 2018         |
| G    | Steam and ammonia insulation repairs   | Mar 2018         |

# Savings Results – Site Level

**Site D** – Navigant removed the final week of savings in the *ex post* calculations as it does not align with previous weeks, and represents a large jump in savings. There is currently no other data to support this trend and no CEI activities to explain the behavior.

When Navigant recreated the baseline regression model, the variables did not align with the *ex ante* model. Navigant adjusted the savings model to the new coefficients. See the table Model Coefficient Check below.

## Realization Rates

### for Site D:

Energy (kWh) – 0.50

Demand (kW) – 1.00

### Ex Ante and Ex Post Results for Site D:

#### Energy (MWh)

Ex Ante – 118

Ex Post – 59

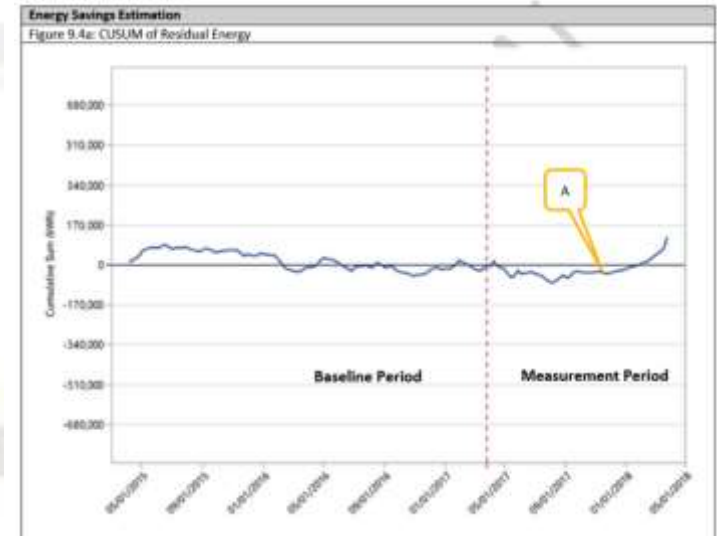
#### Demand (kW)

Ex Ante – 101

Ex Post – 101

## Model Coefficient Check

| Parameter                         | Model coefficients | Navigant coefficient check | Units          |
|-----------------------------------|--------------------|----------------------------|----------------|
| Intercept                         | 224,769.807        | 225,151.160                | kWh            |
| CDD-50                            | 151.077            | 155.421                    | kWh/degree-day |
| Holiday - New Year's Day Observed | -37,993.333        | -25,233.210                | kWh            |
| Bottles                           | 0.016              | 0.016                      | kWh/bottle     |
| Drums                             | 0.011              | 0.010                      | kWh/drum       |
| Bottle Line Shutdown              | -26,174.429        | -25,845.690                | kWh            |
| Holiday Week Observed (G 4 L T C) | -13,479.990        | -13,221.954                | kWh            |



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item Description   | Date Implemented |
|--|------------------|
| A Reviewed preventative maintenance procedures and reinstituted a compressed air leak repair program | Dec 2017         |

# Savings Results – Site Level

**Site G** – The site experienced poor production scheduling resulting in a short-term negative impact on the CEI energy model. Navigant removed these data points in the *ex post* model because they were unrelated to CEI activities.

Navigant staff contacted the site and confirmed that the production issue was due to low customer orders. This is independent of the CEI program and not likely to impact future savings.

## Realization Rates for Site G:

Energy (kWh) – N/A\*

Demand (kW) – 1.00

## Ex Ante and Ex Post Results for Site G:

### Energy (MWh)

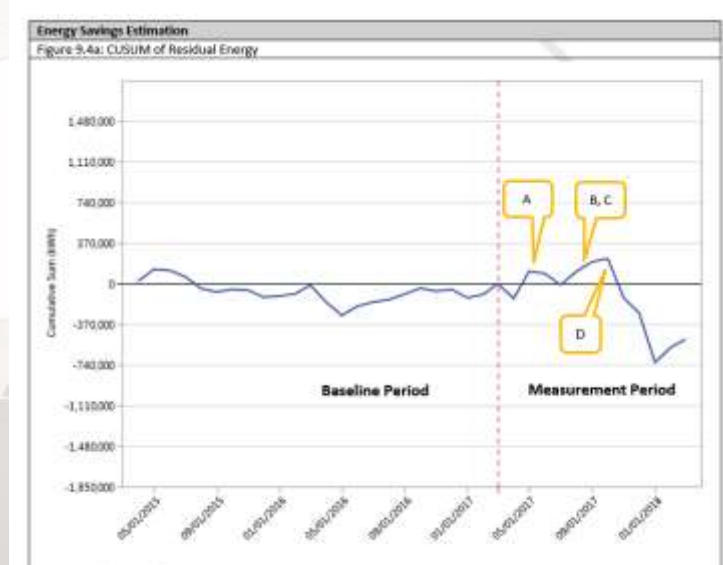
*Ex Ante* – 0

*Ex Post* – 438

### Demand (kW)

*Ex Ante* – 251

*Ex Post* – 251



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item | Description  | Date Implemented |
|------|--|------------------|
| A    | Optimize refiner operations  | Jul 2017         |
| B    | Reduce main header pressure by 2psig   | Aug 2017         |
| C    | Compressed air leak survey   | Aug 2017         |
| D    | Period of poor production scheduling<br>(low throughputs, high idle time, low reliability) | Oct 2017         |

\* *Ex ante* savings was zero but the removal of the poor production data resulted in positive *ex post* savings.



# Savings Results – Site Level

**Site H** – The model shows unusually high pump flow in the post period (in some cases more than 25% higher) than in the baseline period. Navigant removed these variables in the *ex post* results.

## Realization Rates for Site H:

Energy (kWh) – 1.13  
Demand (kW) – 1.00

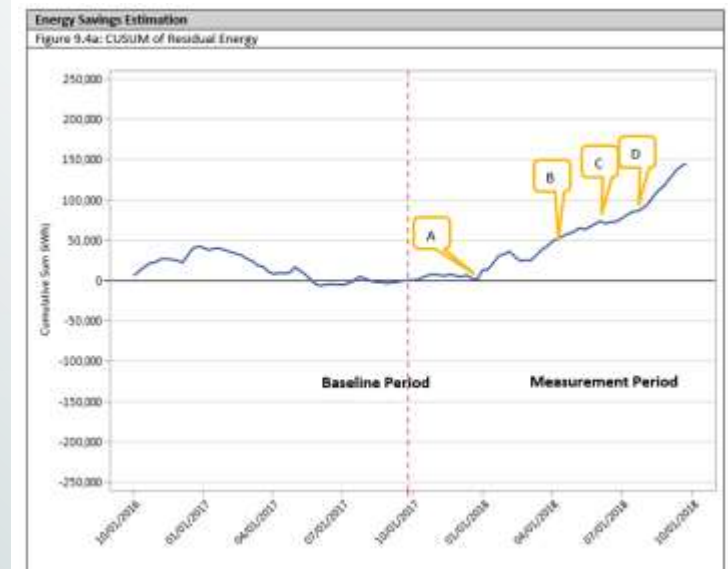
## Ex Ante and Ex Post Results for Site H:

### Energy (MWh)

*Ex Ante* – 149  
*Ex Post* – 168

### Demand (kW)

*Ex Ante* – 31  
*Ex Post* – 31



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item | Description  | Date Implemented |
|------|--|------------------|
| A    | Begin operating with one aeration blower rather than two   | Jan 2018         |
| B    | Reverted to two-blower operation due to aeration inefficiency related to solids settling (maintenance concern) | May 2018         |
| C    | Removed 100 tons of grit from the aeration basins to improve flow  | Jun 2018         |
| D    | Resumed single-blower operation  | Jul 2018         |



# Savings Results – Site Level

**Site L** – Navigant added a model variable to estimate the impact of weeks where the facility required additional days of production, not captured in the baseline operation data. Navigant removed data from July in both the energy and demand models to account for these production changes.

Navigant contacted the site and confirmed that the irregular operation was due to production needs and not influenced by the CEI program.

## Realization Rates for Site L:

Energy (kWh) – 38.62  
Demand (kW) – 0.76

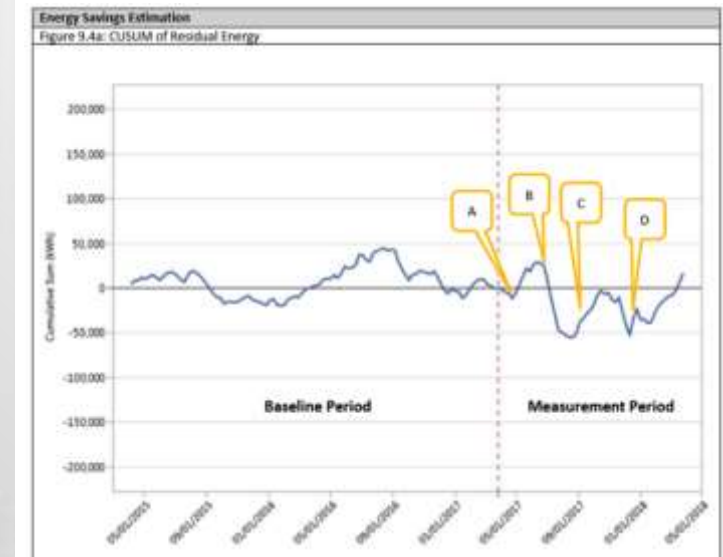
## Ex Ante and Ex Post Results for Site L:

### Energy (MWh)

Ex Ante – 3.44  
Ex Post – 132.9

### Demand (kW)

Ex Ante – (24.28)  
Ex Post – (18.55)



### PROGRAM INTERVENTION POINTS

The intervention points shown above represent operational changes that had an impact on energy intensity.

| Item | Description  | Date Implemented |
|------|--|------------------|
| A    | Removal of presses no longer used revealed numerous compressed air leaks that were repaired                              | Jun 2017         |
| B    | Production occurred on Saturdays, despite sufficient capacity to meet production demands with only one weekday operation | Jul 2017         |
| C    | Removed 60 HP fan and duct work from scrap collection system   | Sep 2017         |
| D    | Production occurred on Saturdays, despite sufficient capacity to meet production demands with only one weekday operation | Nov 2017         |

# Savings Results – Site Level

**Site 4 (cohort 10)** – Navigant found that the post-condition model had two weeks of data removed due to metering issues. The model explained the removal of these points adequately, but did not re-annualize savings to a full 52 weeks. Navigant adjusted by annualizing savings.

## Realization Rates for Site D:

Energy (kWh) – 1.05  
Demand (kW) – 1.00

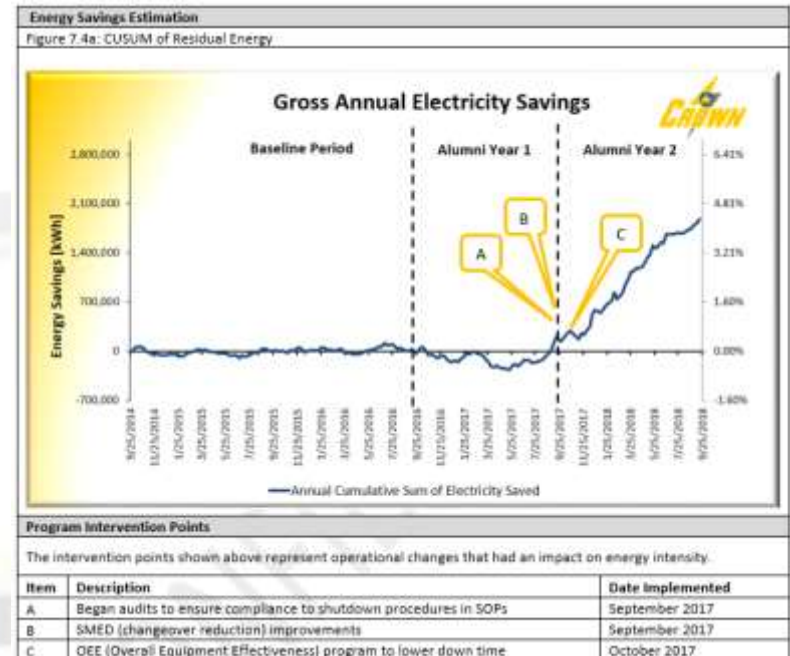
## Ex Ante and Ex Post Results for Site D:

### Energy (MWh)

Ex Ante – 1,630  
Ex Post – 1,704

### Demand (kW)

Ex Ante – 100  
Ex Post – 100



# Cost-Effectiveness Review

This section addresses the cost-effectiveness of the 2018 CEI Program. Cost-effectiveness is assessed using the Total Resource Cost (TRC) test.

## COST-EFFECTIVENESS MODEL INPUTS

| Item  | Value              |
|---|--------------------|
| <b>Average Measure Life</b>                 | <b>5</b>           |
| <b>Participants</b>                         | <b>37</b>          |
| <b>Ex Post Annual Energy Savings (kWh)</b>  | <b>18,019,404</b>  |
| <b>Ex Post Coincident Peak Savings (kW)</b> | <b>1,216</b>       |
| <b>Third Party Implementation Costs</b>     | <b>\$1,225,432</b> |
| <b>Utility Administration Costs</b>         | <b>\$264,319</b>   |
| <b>Utility Incremental Incentive Costs</b>  | <b>\$361,969</b>   |
| <b>Incremental Measure Costs</b>            | <b>\$0</b>         |

Based on these inputs, the TRC ratio is 2.0 and the program passes the TRC test for the program in its entirety.

## COST-EFFECTIVENESS RESULTS

| Benefit-Cost Ratio–Test Results | Ratio      |
|---------------------------------|------------|
| <b>Total Resource Cost</b>      | <b>2.0</b> |
| <b>Participant Cost Test</b>    | <b>N/A</b> |
| <b>Ratepayer Impact Measure</b> | <b>0.5</b> |
| <b>Utility Cost Test</b>        | <b>2.0</b> |

Participant Cost Test is not analyzed as the implementation contractor did not supply data for the participant contribution to the incremental measure costs

Additional benefits related to the reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC.



# 04

## Recommendations

# Recommendations

Navigant was pleased to see that the program had implemented previous recommendations, which resulted in an improved realization rate.

Implementation improvements include:

- The implementer and the CEI participants identified the majority of outlying data points and accounted for them in the baseline and *ex ante* energy models. Navigant found issues with outlying data points for two facilities in the 2018 evaluation. The prior evaluation had six such sites with outlying data points.
- The demand models properly accounted for adjustments made to the energy models by removing data points found to be atypical.



# Recommendations

AEP Ohio's CEI program missed their energy (kWh) goals, only achieving 78% of the goal set forth in the 2016 Action Plan.

Recommendations on how the CEI program should work to increase *ex ante* savings in future program years is provided in the 2018 Business Sector Process Report.

# Recommendations

Navigant identified two sites [Site G and Site L] with production issues impacting CEI savings, but were not factored out of the ex ante energy model. These two sites had the largest impact on the 2018 program level realization rates.

Navigant recommends the implementer investigate potential solutions for quantifying the impacts of major production changes, to account for these outliers, using a statistically significant model variable. If such a variable cannot be found to sufficiently account for the production changes, the implementer could attempt to collect specific onsite information to calculate the impacts directly.



# Recommendations

Navigant identified two sites [Site A and Site H] with above 1.0 realization rates for energy savings [1.04 and 1.13 respectively]. These high realization rates are due to outliers in the post-period model which underestimated energy consumption.

All data points in the post period should be carefully examined to ensure they are within 110% and 90% of the baseline average. If the implementer finds any datapoints outside of these bounds, they should review the impacts to ensure the outlier is not causing the model to under- or overestimate savings.

# Recommendations

Navigant identified one site [Site D] with an energy realization rate of 0.5 due to jumps in energy use not resulting from CEI activities.

The implementer should review the model to ensure that sudden changes in energy consumption, relative to total claimed savings, can be linked to CEI activities. If the sudden changes cannot be explained by CEI activities, the implementer should remove the data points from the model.