April 28, 2014
REPORT #E14-279

Small to Medium Industrial SEM Energy Savings Validation

Prepared by:
Energy 350
107 SE Washington Street, Suite 145
Portland, OR 97214

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

Table of Contents

List of Figures

List of Tables

This page intentionally left blank

1. Acknowledgements

We would like to acknowledge the contributions of Kim Brown from EnerNOC, Steve Phoutrides and Kathryn Bae from Northwest Energy Efficiency Alliance (NEEA), as well as from each participating Site and their electric utility, NorthWestern Energy (NWE).

2. Executive Summary

To determine whether Strategic Energy Management (SEM) can be effectively delivered within small to medium business facilities and whether energy savings from this effort can be measured, NEEA contracted with EnerNOC to implement a pilot with two cohorts of small (1-999 thousand kWh/yr) to medium (1-100 million kWh/yr) sized industrial facilities in Montana in SEM practices. These cohorts were a collection of non-competitive industrial facilities. They collaborated numerous times throughout the year, and some took tours of each other's facilities. NEEA defines SEM as a management system integrated into the planning and operational practices of a company in order to create reliable, persistent energy savings.

NEEA has defined some key attributes of facilities practicing SEM to include facilities that:

- Have set energy reduction goals.
- Have dedicated resources to energy reduction.
    - Have a dedicated "energy manager" whose primary responsibility is focused on reducing energy use.
    - Have at least one "energy champion" or person who allocates some time to help to reduce energy use.
    - Have supplied training to staff to achieve goals.
    - Have commitment from top management to support the facilities energy reduction goal financially.
- Track energy usage and progress towards energy reduction goals and regularly reports progress toward energy goals to top management.

The first cohort was established in 2011 and the second in early 2013. Each cohort consists of 5 small-to-medium sized facilities located in Montana. As part of their work, EnerNOC encouraged and documented activities and indicators of the presence of SEM in the facilities of the cohort members. In addition, EnerNOC developed savings models and estimated savings for each member.

NEEA selected Energy 350 to evaluate the energy savings resulting from two SEM cohorts at ten facilities in Montana. Energy 350 evaluated EnerNOC's original SEM energy savings analysis, visited all 10 Sites, collected additional data, and performed our own top down analysis to quantify energy savings.

2.1 Cohort 1

Cohort 1 included five industrial participants in Western Montana. This Cohort period was from August 2011 - July 2012. To keep the participants anonymous, we will identify the five facilities that participated in the first Cohort of NEEA's SEM initiative as:

- Site 1
- Site 2

- Site 3
- Site 4
- Site 5

2.2 Cohort 2

Cohort 2 included five industrial participants in Central and Southern Montana. This Cohort period was from August 2012 - July 2013. Similarly, for anonymity, we will identify the five industrial facilities that participated in the second Cohort of NEEA's SEM initiative as:

- Site 6
- Site 7
- Site 8
- Site 9
- Site 10

2.3 Ex-Ante Analysis

EnerNOC employed two energy modeling techniques for each Site. The first approach used a multivariate regression in which EnerNOC identified energy consumption driving variables and correlated with kWh consumption. In the second analytical approach, EnerNOC used a Key Performance Indicator (KPI) approach. Ultimately, EnerNOC used the KPI approach at most of the participating Sites. The KPI approach identifies one KPI or variable that drives energy consumption. The KPI equation is shown below:

$$\text{Monthly kWh} = \text{KPI Coefficient}\left(\frac{\text{kWh}}{\text{Qty}}\right) * \text{Qty per month}$$

The KPI used in the equation varies by facility; it could be a production quantities per month for a facility or millions of gallons of water processed per month through a waste water treatment facility. One key difference between the KPI approach and a linear regression with a single independent variable is that the KPI approach does not include a y intercept. In other words, if a facility uses a base amount of energy, regardless of production, the KPI approach does not account for this base load. Energy 350 used an ex-ante modeling approach that captures additional insight into production levels of various products, weather factors, base load, and company production strategies.

2.4 Ex-Post Analysis

Energy 350 used single variable and multivariable regressions in order to calculate energy savings attributed to the participants SEM participation. Energy 350 validated the baseline of each model by comparing the average percent deviation of the calculated baseline kWh consumption to the actual kWh consumption for that period. In some instances Energy 350 determined that EnerNOC's model was valid, and used the same methodology to calculate energy savings. In other cases, if the resulting R^2 value of the Energy 350 model is less than 0.7, we found that no combination of independent variables had a significant effect on energy use. In these cases, we calculated energy savings from the annualized baseline period energy consumption, and annualized post-cohort energy consumption. In all cases, there were some updates to the EnerNOC model. For example, even if we agreed with the approach, given the later date of the evaluation, we can now update the models with additional performance data, given that we have access to more recent energy, production and weather data.

We generally found the KPI approach to be a simplified approach that allows for a simplified normalization of energy use, but with a decrease in accuracy compared to regression modeling. All of Energy 350's energy savings models used a regression approach, typically, multivariate.

2.5 Summary of Results

Table 1 shows the Ex-Ante and Ex-Post savings. Note that Energy 350 calculated kWh savings both gross and net of NWE funded projects. We calculated realization rates based on net kWh savings.

Table 1 – Energy Savings Summary

Cohort	Site	Ex-Ante Savings (aMW)			Ex-Post Savings (aMW)			Ex-Post Savings as a % of Baseline Energy		Realization Rate
		Gross	NWE Funded	Net	Gross	NWE Funded	Net	Gross	Net	
1	1	0.170	0.005	0.165	0.087	0.029	0.058	1.0%	0.68%	0.35
1	2	0.128	0.000	0.128	0.086	0.018	0.068	5.3%	4.2%	0.53
1	3**	0.007	0.000	0.007	0.000	0.000	0.000	0.1%	0.1%	0.02
1	4*	0.005	0.000	0.005	0.000	0.000	0.000	0.0%	0.0%	0.00
1	5	0.000	0.000	-0.001	0.000	0.001	-0.001	0.0%	-2.7%	N/A
Cohort 1 Total		**0.310**	**0.006**	**0.305**	**0.173**	**0.048**	**0.125**	**1.6%**	**1.2%**	**0.41**
2	6**	-0.230	0.000	-0.230	-0.075	0.000	-0.075	-8.4%	-8.4%	N/A
2	7	0.002	0.000	0.002	0.013	0.002	0.012	1.6%	1.4%	7.40
2	8	0.009	0.001	0.008	0.009	0.001	0.008	1.5%	1.3%	0.97
2	9**	-0.001	0.000	-0.001	-0.003	0.000	-0.003	-3.1%	-3.1%	N/A
2	10	0.004	0.000	0.004	0.099	0.000	0.099	13.3%	13.3%	25.64
Cohort 2 Total		**-0.216**	**0.001**	**-0.217**	**0.043**	**0.003**	**0.040**	**1.4%**	**1.3%**	**-0.19**
Total Both Cohorts		**0.094**	**0.007**	**0.088**	**0.216**	**0.051**	**0.165**	**1.6%**	**1.2%**	**1.89**

Notes: *Site 4 moved to a new facility in November 2012. As such, the Ex-Post energy savings is zero. **Energy 350 calculated SEM kWh savings for Site 3, 6, and 9 according to actual kWh consumption prior to the cohort start date and after the cohort start date.

Table 2 summarizes demographic data of the participating population.

Table 2 – Participant Demographic Data

Cohort	Facility	Year Savings Occurred	Year Savings Validated	Location (Urban/ Rural)	State	Service Territory
1	1	2011-2013	2014	Rural	Montana	NWE
1	2	2011-2013	2014	Rural	Montana	NWE
1	3	2011-2013	2014	Urban	Montana	NWE
1	4	2011-2013	2014	Urban	Montana	NWE
1	5	2011-2013	2014	Urban	Montana	NWE
2	6	2012 - 2013	2014	Urban	Montana	NWE
2	7	2012 - 2013	2014	Urban	Montana	NWE
2	8	2012 - 2013	2014	Urban	Montana	NWE
2	9	2012 - 2013	2014	Urban	Montana	NWE
2	10	2012 - 2013	2014	Rural	Montana	NWE

2.6 Key Conclusions

Through this effort, including our site visits and associated facility staff interviews, we were able to draw the following conclusions:

- Most participating facilities are still practicing many or most aspects of SEM.
- Although the total energy savings were modest, the majority of participants saved energy.
- Many participants have had staff turnover since their SEM engagement, however, aspects of SEM have persisted through the turnover.
- Common obstacles for the participants were lack of human and financial resources; all energy champions had other primary duties and energy management took less than ten percent of their time. This is understandable given the small to medium size of the facilities.
- While the more immediate result of SEM is operational energy savings, it also serves as an effective marketing tool in developing capital projects. In this case, all capital projects were funded by Northwestern Energy and as such, were netted out of the final energy savings. However, most facilities credited their SEM engagement as a significant driving force in identifying and implementing capital projects.

3. Cohort 1 Evaluation

This section provides site by site detail of the ex-ante and ex-post analysis and results of the first cohort. Readers interested in further details regarding the analysis can reference Appendix B – Site Level Analysis Details. Table 3 and Table 4 summarize the ex-ante and ex-post analytical inputs, baseline periods and performance periods.

Table 3 – Cohort 1 Ex-Ante Modeling Summary

Participant	Key Parameters Affecting Energy Use	Baseline Period (Month/Year)	Cohort Period (Month/Year)
Site 1	-Tons of Rock Crushed -Facility Restart	Sep 05 - Feb 09 & Jan 11 - Jun 11	Aug 11 - July 12
Site 2	-Raw Material Processed in Calcining Unit #1 -Raw Material Processed in Calcining Unit #2 -Daily Run Hours Calcining Unit #1 -Daily Run Hours Calcining Unit #2 -Daily Run Hours Hydrator -Daily Run Hours Crusher -Heating Degree Days -Cooling Degree Days	July 10 - July 11	Aug 11 - July 12
Site 3	-KPI - Millions of Gallons of Influent Pumped	Aug 09 - July 11	Aug 11 - July 12
Site 4	-KPI - Line Items Shipped per Month	March 10 - July 11	Aug 11 - July 12
Site 5	-Units produced each month -Cooling Degree Days -Interaction variable	March 11 - Dec 12	Aug 11 - July 12

Table 4 – Cohort 1 Ex-Post Modeling Summary

Participant	Key Parameters Affecting Energy Use	Baseline Period (Month/Year)	Cohort Period (Month/Year)
Site 1	-Tons of Rock Milled -Ounces of Mineral Recovered	Sep 05 – March 09 & Jan 11 – July 11	Aug 11 - July 12
Site 2	-Raw Material Processed in Calcining Unit #1 -Raw Material Processed in Calcining Unit #2 -Daily Run Hours Calcining Unit #1 -Daily Run Hours Calcining Unit #2 -Daily Run Hours Hydrator -Daily Run Hours Crusher -Heating Degree Days -Cooling Degree Days	Feb 10 - July 11	Aug 11 - July 12
Site 3	-Did Not Use Regression Model	Feb 09 - July 11	Aug 11 - July 12
Site 4	-Line Items Shipped -Cooling Degree Days	Jan 09 - July 11	Aug 11 - July 12
Site 5	-Total units produced -Cooling Degree Days -Heating Degree Days -Interaction Variable	March 11 - Dec 12	Aug 11 - July 12

3.1 Site 1

3.1.1 Introduction

Site 1 is a mineral mine that employs approximately 200 people. EnerNOC reported in 2012 that the Site has a 3% annual energy reduction goal. During the cohort period Site 1 implemented the following SEM elements:

- Created energy goals and policy
- Energy team meets every other week and is represented by all departments
- Energy team developed a long-term action plan
- Quantified energy consumption through KPIs
- Prioritized energy usage similar to production goals
- Formalized how organization reviews energy projects to include management review
- Developed employee training and awareness presentations that incorporate energy topics
- Developed energy program logo to set apart from safety program

These elements help Site 1 to identify and implement energy efficiency measures, but are not discrete energy efficiency measures.

3.1.2 Process

The process begins by mining rocks using mining trucks powered by diesel fuel. The trucks then transport the rocks to a Primary Crusher. The primary crusher crushes the rocks using a 400 HP electric motor. A vibration screener screens the rocks, and then a conveyor transports them to the Secondary Crusher. From there, a conveyor transports the smaller rocks to the Primary Grind Circuit. This circuit grinds the smaller rocks to powder using crushing mills driven by 2,000 to 3,000 HP motors. A conveyor then transports the powder to the Mean Leach Circuit for about 40 to 48 hours, then to large tanks, where it's treated with chemicals. Low pressure compressed air agitates the rocks. The tanks also have electric motor driven mixers to agitate the solution. Site 1 then moves the solution through a process which extracts minerals, Site 1 then uses a different process, which introduces electricity to the solution to remove impurities. Lastly, Site 1 uses a furnace to melt and form the final product.

The conveyor belt motor that transports the rocks from process to process is controlled by a VFD to process 320 tons of rock per hour. Although the conveyor belt is set for this rate some rocks sometimes need to be 're-crushed' through a regrind process.

3.1.3 Available Data

EnerNOC provided the following production data to Energy 350:

Table 5 – Available Data

Variable	Interval	Period
Tons of Rock Milled	Monthly	September 2005 - March 2009 & January 2011-December 2012
Ounces Produced		
Mill Availability (%)		

The mine was shut down from February 2009 to January 2011. The facility made a minor change in their rock crushing sequencing during this shut down.

3.1.4 Summary of Results

The savings for this analysis are drastically lower than EnerNOC's original calculations. This is because of three main differences in Energy 350's and EnerNOC's modeling approach.

1. Energy 350 did not use a facility restart variable[1], where EnerNOC used it in January and February of 2011.
2. We found that EnerNOC netted out 88,621 kWh of NWE funded savings, whereas NWE reports a savings of 513,513 kWh in savings during the performance period. Energy 350 reduced the gross savings by 513,513 kWh to net out NWE funded energy savings consistent with NWE reported savings.
3. Due to the timing of the analysis, EnerNOC was forced to annualize seven months of kWh savings for the post cohort period, where Energy 350 was able to compare actual kWh through July of 2013.

Other than these differences, the models are very similar. Table 6 summarizes the comparison of both models and the calculated realization rate.

Table 6 – Site 1 Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
1,446,494	505,304	0.35

[1] *Energy 350 was unsure as to how EnerNOC calculated the facility restart variable constant. EnerNOC used this variable as the facility shut down for two years prior to starting back up in January 2011. Energy 350 did not use this constant as kWh consumption still correlated strongly with production levels during this startup period, despite the lower production output.*

3.2 Site 2

3.2.1 Introduction

Site 2 is a construction material production facility that mines rock and refines it into the final product. The construction industry uses most of facility’s finished product for road paving. During the cohort period Site 2 implemented the following SEM elements:

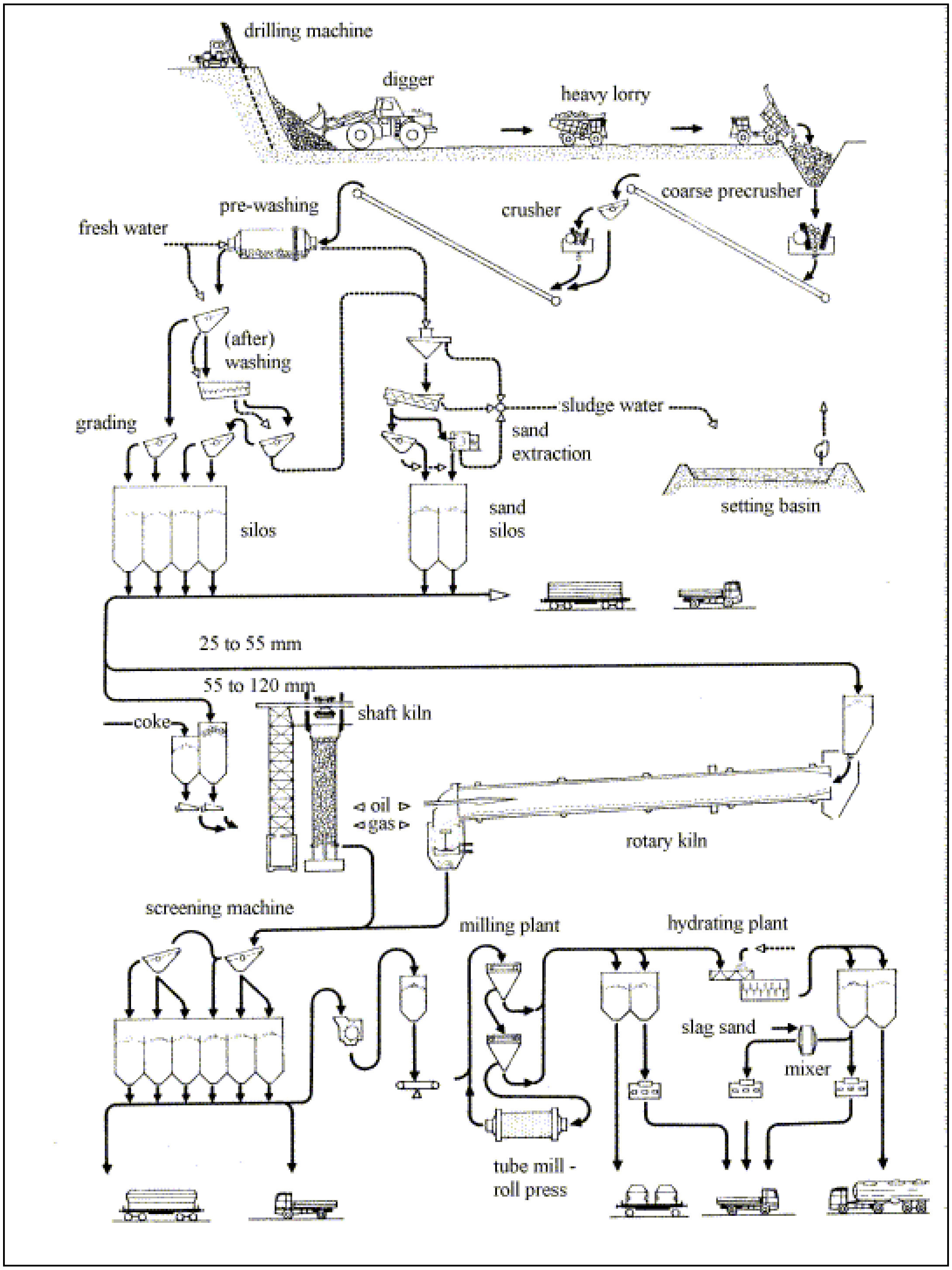
- Developed energy policy and goals
- Management evaluated process for potential energy upgrades
- Management communicated with workforce regarding energy performance
- Monitored, tracked and communicated results of energy KPIs to management on a monthly basis
- Facility had a cultural shift which included a focus on energy consumption as it relates to production
- Created energy team and logo to heighten employee awareness
- Engaged employees to recommend energy projects

These elements help Site 2 to identify and implement energy efficiency measures, but are not discrete energy efficiency measures.

3.2.2 Process

The process begins with Site 2 mining rocks using mining trucks powered by diesel fuel. The trucks then transport the rocks to a Primary Crusher. The primary crusher crushes the rocks using a 300 HP electric motor. A 40 HP secondary crusher then re-crushes the rocks. From there, a conveyor transports the crushed rocks to large kilns for the Calcining process. These kilns use coal and coke as fuel to heat the rocks to 1,800°F. Site 2 then mixes this product with a small amount of water. Electric motor driven blowers then transport the hydrated product to storage. Figure 1 illustrates the process.

Figure 1 – Process Flow Diagram



3.2.3 Available Data

EnerNOC provided the following production data.

Table 7 – Available Data

Variable	Interval	Period
Tons of raw material processed in Calcining Unit #1	Daily	February 1st 2009 – December 31st, 2013
Tons of raw material processed in Calcining Unit #2	Daily	
Run Hours Calcining Unit #1	Daily	
Run Hours Calcining Unit #2	Daily	
Run hours Hydrator	Daily	
Run hours Crusher	Daily	
Heating degree days (base 65°F)	Daily	
Cooling degree days (base 55°F)	Daily	
kWh Consumption	Daily	

3.2.4 Summary of Results

The report provided by EnerNOC is inconsistent with the actual energy model provided. We believe the source of the discrepancy is a result of a version control issue. Since Energy 350 was unable to view EnerNOC's final energy model, it is difficult to determine why the savings differ. Although EnerNOC's report[2] to NEEA states that the two-year net savings were estimated to be 2,247,928 kWh, the cumulative savings graph seem to show a net cumulative savings of approximately1,250,000 kWh, which is extremely close to what Energy 350 calculated. Table 8 summarizes the ex-ante savings, ex-post savings and realization rate.

Table 8 – Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
1,123,964	596,422	0.53

[2] 2013. *Memorandum: NEEA 1st Montana SEM Cohort – Energy Savings Estimation Methodology and Findings.* EnerNOC. Page 10. Figure (Cumulative Energy Reductions – Site 2).

3.3 Site 3

3.3.1 Introduction

Site 3 is a wastewater treatment plant that treats an average flow of 2.92 million gallons per day (MGD) of wastewater. They also process septic waste from septic haulers serving remote locations. According to a report written by EnerNOC in February 3rd, 2012[3] the Site had already reduced their energy consumption by 35% over the past few years, and were planning on integrating energy usage into the plant's new management tool: supervisory control and data acquisition (SCADA) interface. During the cohort period Site 3 implemented the following SEM elements:

- Developed an energy strategy and organizational goals tied to energy
- Gained top management support and commitment to provide resources for projects and energy team meetings
- Began reporting energy performance to City Commission and City Manager
- Quantified benefits and impacts of energy projects through State of Montana CAP software
- Energy team meets regularly and reviews project tracker
- Engaged employees in process of identifying and managing energy projects
- Assesses energy bills and demand charges to identify and investigate deltas of forecasted totals

These elements help Site 3 to identify and implement energy efficiency measures, but are not discrete energy efficiency measures.

3.3.2 Process

The process begins when effluent flows through a series of bar screens and grates to remove large objects. The waste then passes through a grit chamber at a reduced speed to allow for sand, grit, glass, and other particles to settle. After these pre-treatment processes, Site 3 pumps the waste to large water basins where skimmers remove the less dense sludge from the top of the waste, and the tank drains the sludge that is denser than water at the bottom of the tank. Pumps then carry the remaining waste water to a secondary treatment process. Here aerobic digesters treat water contaminants by using microorganisms to breakdown biodegradable material in the absence of oxygen. These digesters use a 125 HP positive displacement blower and recirculation pumps. Site 3 then skims the wastewater after the secondary treatment. Once skimmed, Site 3 pumps the water through a process where UV lights disinfect the effluent before discharging it into the local water supply. A belt press then processes the removed sludge and digests it separately. During summer months, the sludge undergoes less dewatering, and Site 3 can recover it for use in fertilizer. Site 3 recovers Methane from the digester and uses it in the boiler in place of natural gas.

3.3.3 Available Data

Energy 350 obtained the following production data:

[3] 2012. *Western Montana Strategic Energy Management Cohort: Energy Process Assessment of Site 3.* EnerNOC. Page 20.

Table 9- Available Data

Variable	Interval	Period
Influent Millions of Gallons	Monthly	February 2009 – December 2013
Influent BOD	Monthly	
Cooling Degree Days (Base 50°F)	Monthly	
kWh Consumption	Monthly	

EnerNOC also attempted to develop a regression using Biological Oxygen Demand and Total Suspended Solid amounts.

3.3.4 Summary of Results

Energy 350 calculated the SEM energy savings by comparing the average kWh consumption prior to the cohort start date (February 2009-July 2011) to the average kWh consumption after the cohort start date (August 2011-July 2013).

Table 10 – Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
62,552	1,337	0.02

3.4 Site 4

3.4.1 Introduction

Site 4 produces clothing and has an embroidery process. During the cohort period, Site 4 implemented the following SEM elements:

- Created energy goals and policy
- Created new requirement that energy management goals and business goals align
- Energy management is included in all aspects of business planning and operations
- Formed an energy team that meets monthly
- Developed employee awareness campaign
- Monitored, tracked and communicated results of energy consumption to product output to management and all employees on a monthly basis
- Include energy efficiency as part of the manufacturing continuous improvement program
- Monitor, report and re-evaluate five-year energy savings goals at manageable intervals

These elements help Site 4 to identify and implement energy efficiency measures, but are not discrete energy efficiency measures.

3.4.2 Process

Production typically takes 2-3 business days. Trucks deliver the fabric and two electric forklifts distribute it. The fabric is then cut manually or with a small, motorized fabric cutter. The cut fabric then goes through pressing and gluing stages that use electrical heating and compressed air. Employees then use sewing machines to sew the fabric. Compressed air cools the sewing machines. Employees cross patch and glue the sewn material using electric heat and compressed air. The assembled product is leak tested with warm water heated by a domestic hot water heater. All approved product goes through the drying process using multiple small fans or custom drying apparatus. Dried product is then scanned into storage until they are shipped.

The embroidery process takes 1 business day. The facility receives manufactured line items by truck and distributes them using two battery-charged forklifts. The items are distributed to the embroidery station, which embroider Site 4 product logos on line items. They then are scanned, stored, and shipped.

Most of the equipment that treats, sews, heats, and cools the fabric remains on throughout the day as the equipment requires it.

3.4.3 Available Data

EnerNOC provided us with the following production data:

Table 11- Available Data

Variable	Interval	Period
Packages	Monthly	January 2008 - December 2010
Product		January 2009 - November 2011
Logo Items		January 2011 - December 2011
Line Items Shipped		January 2008 - December 2010
Received Goods		January 2011 - June 2011
Cooling Degree Days (base 60°F)		January 2009 - September 2011
Heating Degree Days (base 60°F)		January 2009 - September 2011

Site 4 provided ample production data, however the periods for the data do not line up, making it difficult to use each variable for the baseline regression model.

3.4.4 Summary of Results

Energy 350 calculated slight negative energy savings, or in other words a slight increase in energy consumption using the estimated baseline. However, during our evaluation, we found that Site 4 moved to a new facility. Since the energy savings resulting from SEM are operational and do not stay with the facility when the occupant moves, we feel that the energy savings are lost as a result of Site 4 moving. While it is possible that the lessons learned through SEM have some transfer to the new facility, as a new construction, it is impossible to quantify and attribute savings at the new facility as a result of the SEM engagement. As such, the ex-post energy savings and realization rate are 0.

Table 12 – Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
43,352	0	N/A

3.5 Site 5

3.5.1 Introduction

Site 5 manufactures a range of products. During the cohort period, Site 5 implemented the following SEM elements:

- Formed corporate Strategic Energy Management program to support the overall business goals, including improving production, quality, environmental stewardship, and safety practices.
- Updated corporate project decision model to include energy as a matric
- Top management meets monthly to communicate energy results with all employees
- Created an energy team that meets regularly
- Utilized Outdoor Industry Association, Eco Index, to benchmark and measure the sustainability of their products

These elements help Site 5 to identify and implement energy efficiency measures, but are not discrete energy efficiency measures.

3.5.2 Process

The facility produces plastic manufactured products. The plastic production process takes 1 business day. The facility receives small base-material beads, color, and product scrap. Site 5 mixes material and color with a small mixer 2 to 3 times a week. The mixer operates on a timer at 20 minutes per batch. Site 5 uses a vacuum to pull the material into the injection molding machine. The injection molding machine requires an air compressor and dedicated chiller. The injection molding machine must turn on at least 30 minutes prior to production to warm up. The products coming out of the injection molding machine go into a water bath for cooling and final inspection. The Site also receives finished plastic products that it scans, stores, and ships.

The process for these products sometimes requires use of a pattern tacker and/or die cutter. These use electrical energy and compressed air to cut patterns out.

The facility also fabricates sewn products. Products from this process typically take 1-2 business days. The facility receives fabric from trucks and distributes products using forklifts. The fabric is cut using cutting equipment, and sewn using sewing machines. Production staff then manually stuff the fabrication material into the sewn fabric. The 'Green Machine' produces the stuffing. This machine turns the flat batting. Staff then sew the product shut, scan it, and store it for shipment.

3.5.3 Available Data

EnerNOC provided us with the following production data:

Table 13- Available Data

Variable	Resolution	Period
Sewn Product 1	Monthly	March 2011 – January 2012
Sewn Product Stuffed	Monthly	March 2011 – January 2012
Sewn Product 2	Monthly	March 2011 – January 2012
Machine Cell	Monthly	March 2011 – January 2012
Packaging Cell	Monthly	March 2011 – January 2012
Total Produced	Monthly	March 2011 - December 2012

3.5.4 Summary of Results

Similar to EnerNOC, Energy 350 calculated slight negative energy savings, or in other words a slight increase in energy consumption using the estimated baseline. Energy 350's model estimates that the Site essentially broke even in terms of gross energy savings, calculating annual gross kWh savings of 130 kWh/yr. NEEA does not claim annual kWh savings that have been incentivized by NWE. Taking the NWE incentivized measures into account, Energy 350 reduced the SEM claimed savings by 8,154 kWh. The negative savings in the model are mainly due to the reduction in savings due to the NWE incentivized projects.

Table 14 – Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
-7,271	-8,089	N/A

4. Cohort 2 Analysis

This section provides Site-by-Site detail of the ex-ante and ex-post analysis and results of the second cohort. Readers interested in further details regarding the analysis can reference Appendix B – Site Level Analytical Details. Table 15 and

Table 16 summarizes the ex-post and ex-ante analytical inputs, baseline periods and cohort periods.

Table 15 – Cohort 2 Ex-Ante Modeling Summary

Facility	Key Parameters Affecting Energy Use	Baseline Period	Cohort Period
6	KPI - Millions of Gallons Pumped	August 2011 - July 2012	August 2012 - May 2013
7	Milled Grain Production (Cwt)	July 2012 - January 2013	January 2013 - July 2013
8	Milled Grain Production (Cwt)	July 2012 - January 2013	January 2013 - July 2014
9	CDD (Base 60)	August 2011 - September 2012	August 2012 - June 2013
10	-Adjusted Quantity (production) -Employee Count	September 2011 - June 2011	August 2012 - May 2013

Table 16 – Cohort 2 Ex-Post Modeling Summary

Facility	Key Parameters Affecting Energy Use	Baseline Period	Cohort Period
6	Did Not Use Regression Model	January 2011 - July 2012	August 2012 - May 2013
7	-Milled Grain Production (Cwt)	July 2012 - January 2013	January 2013 - July 2013
8	-Milled Grain Production (Cwt)	July 2012 - January 2013	January 2013 - July 2014
9	Did Not Use Regression Model	January 2008 - July 2012	August 2012 - June 2013
10	-Average Temperature -Line 1 Production -Line 2 Production -Line 3 Production -Line 5 Production -Waste -Regrind	January 2011 - July 2012	August 2012 - May 2013

4.1 Site 6

4.1.1 Introduction

Site 6 was originally built in 1945 with the capacity to treat 15 million gallons per day (MGD). In the early 1970s, the facility underwent an upgrade to handle 26 MGD on average with a maximum of 40 MGD. During the cohort period Site 6 implemented the following SEM elements:

- Developed long term Energy Strategy
- Involved key department city managers in the energy team
- Adopted SEM concepts and methods
- Developed a long term plan to communicate energy priorities and success

There were no utility incentivized energy savings claimed for this site.

4.1.2 Process

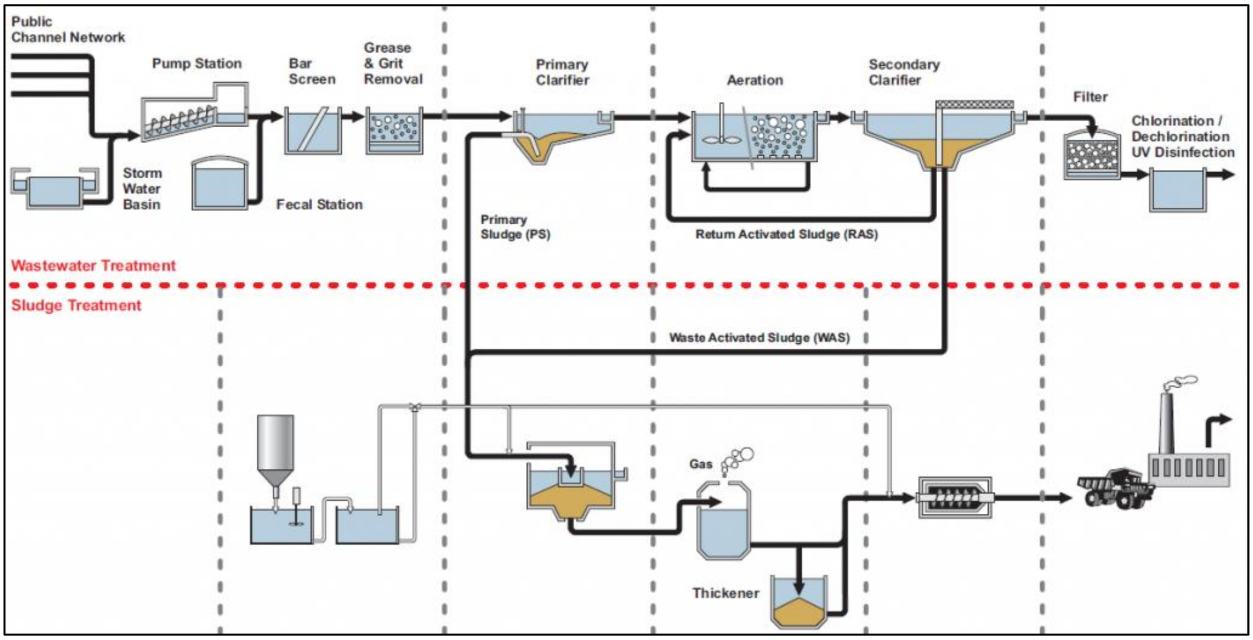
The plant is capable of processing 33,000 lbs/day of biochemical oxygen demand (BOD5) and 42,000 lbs/day of total suspended solids (TSS). The current process has primary and secondary activated sludge treatment.

The activated sludge treatment process includes:

- Screening
- Grit removal Primary and Secondary Clarification
- Disinfection
- Dissolved air flotation of waste activated sludge
- Gravity thickening of primary sludge
- Anaerobic digestion followed by centrifuge dewatering

The basic process is shown in Figure 2.

Figure 2 - Sample Wastewater Treatment Process



4.1.3 Available Data

Monthly electrical data for this facility is available from 1999 until May 2013. The influent in millions of gallons is also available from 1999, but several data gaps exist in this data set. Dissolved oxygen (DO) content is available for the year of 2000 only. Additionally, National Oceanographic and Atmospheric Administration (NOAA) weather data can provide precipitation and temperature data that would allow us to calculate CDD and HDD data. Data was only available in monthly intervals.

4.1.4 Summary of Results

Energy 350 calculated an increase in facility energy use over the in-cohort period. The energy model developed by Energy 350 was statistically insignificant and did not accurately model the facility energy use based on the investigated variables. The calculated savings are based on the difference between the annualized baseline period and annualized actual energy consumption during and post cohort. Table 17 summarizes the ex-ante and ex-post energy savings.

Table 17- Site 6 Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
-2,011,044	-660,060	N/A

4.2 Site 7

4.2.1 Introduction

The company that owns Sites 7 and 8 has 10 milling plants in the US. The two located in Montana (Sites 7 & 8) both participated in the second Cohort of the SEM Program. During the cohort period, Site 7 implemented the following SEM elements:

- Management commitment to engage in SEM
- Identified goals, objectives, and targets for 2013 and 2014
- A quarter of the staff are on the energy team
- Monthly meetings of the energy team
- Energy tool tracking implemented and shared
- Management has clear insight on production impacts with energy consumption
- Energy awareness culture developed
- Projects have energy consumption in the decision making process
- Weekly compressed air leakage detectors

NWE incentivized the installation of a VFD on an air compressor system at this facility. The project was implemented post-cohort on October 18, 2013. The savings-to-date during the analysis period are 15,611 kWh.

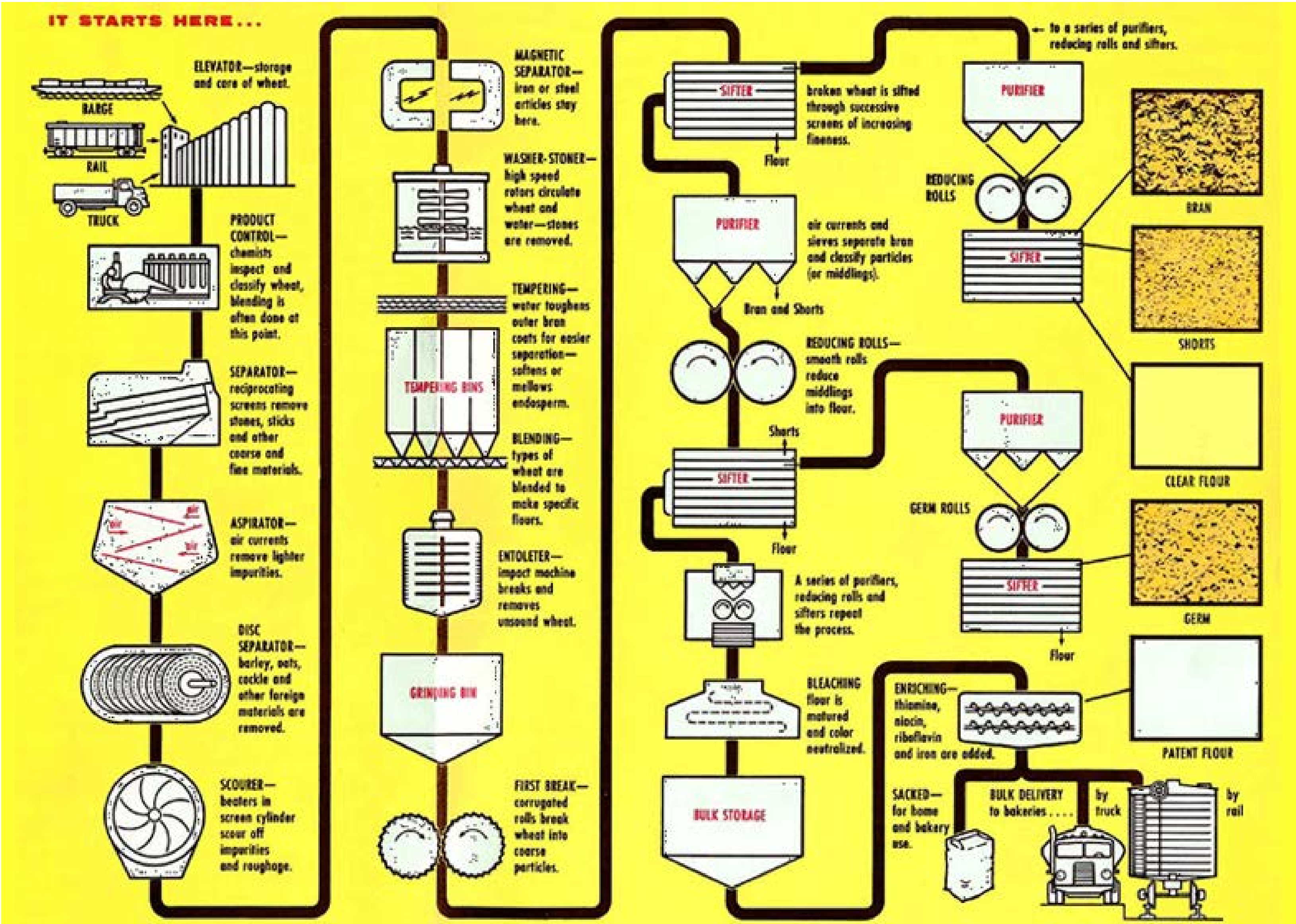
4.2.2 Process

The Site 7 produces approximately 1,200,000 Cwt of grains annually, of varying varieties. Cwt is an industry unit of measurement meaning hundredweight, which is equal to 100 pounds. The grain milling process involves several stages, the basics as outlined by the North American Miller's Association (NAMA) are:

- Grain Delivery and Inspection
- Grain Storage – must be stored at specific temperature and humidity
- Cleaning:
  - Magnetic Separator: removes ferrous material
  - Separator: removes sticks, debris, anything too big or small to be grain
  - Aspirator: air vacuum removes lighter debris
  - De-stoner: removes heavy debris
  - Disc Separator: rejects any awkward shapes that may not be grain
  - Impact Entoleter: breaks apart unsound kernels or insect eggs
- Tempering: specific moisture and temp controls to toughen bran and mellow endosperm
- Grinding: Various sized rollers break down the kernels to different grain byproducts
- Sifters: pneumatically delivered to the shaking boxes that separate byproducts
- Bleaching and Enrichment

Figure 3 outlines this process. Site 7 upgraded this facility to a pneumatic conveying system that moves the milled grain with air rather than conveyer belts and buckets. Pneumatic conveying is more sterile, although more energy intensive. Site 7 also has individual packaging capabilities that they produce upon client's request.

Figure 3 - Grain Milling Process



4.2.3 Available Data

The facility had not trended data prior to their participation in the SEM cohort. During the in-cohort period, facility staff recorded daily Cwt of flour produced as well as daily kWh consumed. We also obtained NOAA data for the area to incorporate daily dry bulb and wet bulb temperatures, as well as relative humidity.

4.2.4 Summary of Results

Energy 350 agrees with the modeling approach developed by EnerNOC for Site 7. The changes Energy 350 made to the reported savings are a result of redefining the measurement periods. Table 18 summarizes the differences between Energy 350's model and EnerNOC's model.

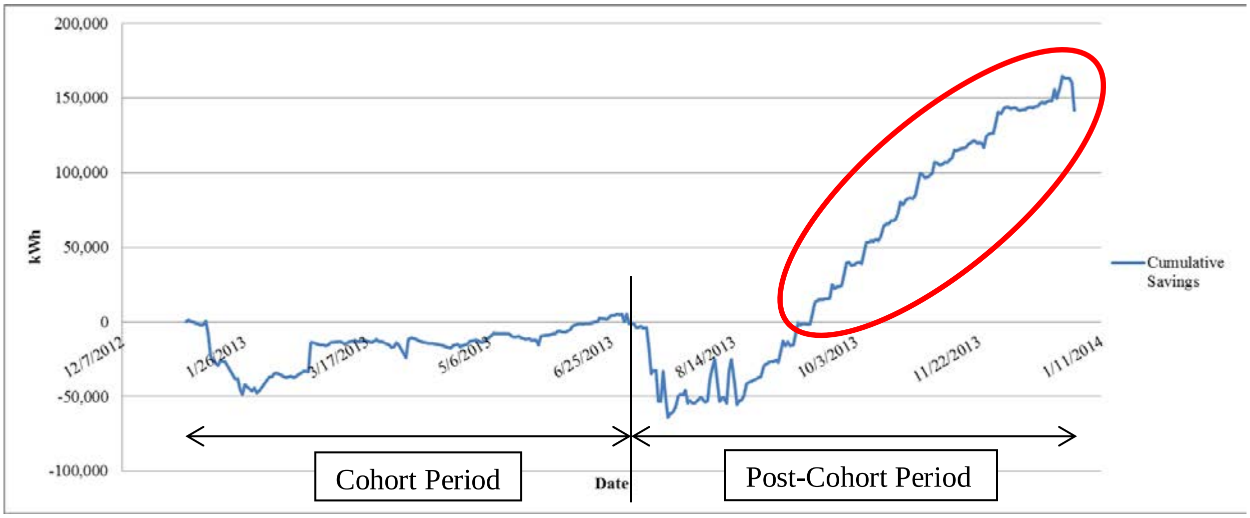
Table 18- Site 7 Realization Summary

Period	Ex-Ante Date Range	Ex-Ante Energy Savings (kWh)	Ex-Post Date Range	Ex-Post Energy Savings (kWh)
Baseline	July 2012 - January 2013	-660	July 2012 - January 2013	0
In-Cohort	August 2012 - June 2013	9,419	January 2013 - July 2013	4,794
Post-Cohort	N/A	0	June 2013 - December 2013	112,955
NWE Incentivized Savings		0		15,611
Annualized Energy Savings		13,807		102,138
Realization Rate				**7.40**

The facility did not realize savings from participating in the SEM program until after the cohort ended.

Figure 4 shows the late occurrence of savings.

Figure 4 - Site 7 Cumulative Energy Savings



4.3 Site 8

4.3.1 Introduction

Site 8 is a grain milling plant that distributes bulk orders of product. This site is slightly larger than Site 7 in weight of milled grain produced. Site 8 also has been progressive in implementing and tracking energy consumption as a result of participation in the SEM program. They have upgraded lighting and put lights on a separate meter, and they have also commissioned the installation of a real-time power monitoring control system. This system will help track energy consumption, and provide real-time allowing facility personnel to make more informed observations. During the cohort period, Site 8 implemented the following SEM elements:

- Management commitment to make energy efficiency a priority
- First facility/corporate Energy Management Strategy
- Set energy goals, objectives, and targets for 2013 and 2014
- Energy as a consideration in new projects
- Regular meeting of Energy Team
- Plant manager is actively engaged in new efficient technology (e.g. LED installation)
- Weekly leak detection during shut down time

The two EEMs that NWE incentivized are an LED lighting upgrade and a VFD for a 30 HP compressor. NWE claimed a total of 10,963 kWh/yr savings, but only the energy tool for Site 8 only reflects the lighting savings.

4.3.2 Process

Site 8 has the same process overview as Site 7. Site 8 has lower energy intensity than Site 7. This is a result of the mechanical conveying system used at Site 8. This facility is looking to upgrade to a more energy intensive, but more sterile, pneumatic conveying system. Additionally, Site 8 does not package any product, but fills rail cars for distribution.

4.3.3 Available Data

The facility had not trended data prior to their participation in the SEM cohort. During the in-cohort period, Site 8 tracked daily Cwt of milled grain produced as well as daily kWh consumed. NOAA data for the area is also available to obtain daily dry bulb and wet bulb temperatures, as well as relative humidity.

4.3.4 Summary of Results

Energy 350 agrees with the model developed by EnerNOC for Site 8 for use in predicting energy consumption. The changes Energy 350 made to the reported savings are very little, a difference of 2,232 kWh. The resulting realization rate is 0.97. Table 19 summarizes the ex-ante and ex-post savings and associated realization rate.

Table 19 - Site 8 Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
71,970	69,738	.97

4.4 Site 9

4.4.1 Introduction

Site 9 is an industrial manufacturer of lifting tools and equipment for various smooth materials. This facility also has the capability to create custom tools for any job the client needs. Site 9 takes pride in developing state-of-the-art products through implementation of advanced manufacturing and machining equipment. The product line includes over 100 unique components, as well as any requested custom component. The primary product is the hand vacuum cup. During the cohort period Site 9 implemented the following SEM elements:

- Management commitment to energy efficiency (Energy sponsor is President. Energy champion is Quality Director)
- Developed first facility energy policy
- Energy is considered in project management
- Employees educated on energy efficiency
- Built consumption considerations into SOP
- Tracking and monitoring of energy consumption
- Developed KPI

The site is in the process of having volunteers from the staff perform energy audits in 12 sectors of the facility. The audit will produce equipment listing and specification for each sector, and annual energy consumption. The energy champion will compile the sector audits into a report, which categorizes each sector's energy consumption, and report a list of the top ten highest priority energy projects. There are currently no incentivized EEMs that this facility implemented.

4.4.2 Process

This unique process does not have a process flow diagram, as each product line has specific requirements.

4.4.3 Available Data

Monthly production data for lifting tools, equipment, energy consumption, number of employees, and weather is available from the data set proved by EnerNOC. Production and weather data are available from October 2010 to June 2013. Employee data available is from January 2001 to December 2012.

4.4.4 Summary of Results

Energy 350 calculated an increase in facility energy use over the cohort period. Similar to the methodology used to calculate energy savings for Site 6, the model developed to calculate the energy savings at this site is also a direct comparison of baseline energy to post-cohort actual energy. This model is validated from the relatively constant energy consumption, yielding statistically insignificant models from the selected variables. Table 20 summarizes the annualized realization between the two methods.

Table 20- Site 9 Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
-9,439	-25,468	N/A

4.5 Site 10

4.5.1 Introduction

Site 10 is an advanced pasta manufacturer that focuses on high-quality product for its clients. The 62,500 square foot plant has an annual capacity to produce 70,000,000 pounds of product. Their production line can make over 50 different types of dry pasta. Recently they added a 30,000 square foot storage warehouse, claiming to be the state of the art circa 2001. Site 10 touts the plant is the most sanitary and technically advanced pasta facility in North America. During the cohort period, Site 10 implemented the following SEM elements:

- Management commitment to energy efficiency
- Development of first facility Energy Policy
- Energy efficiency aspects included in all aspects of business planning and operation
- Aligned energy consumption to production metrics
- Used energy efficiency targets to drive performance improvements
- Conducted technical energy assessments to establish goals and track progress

There were no incentivized EEMs implemented at this facility during the cohort participation.

4.5.2 Process

Site 10 currently operates four product lines that produce short and long pastas. The site has a direct line from a local flour mill that delivers semolina. The facility has recently installed a scale to weigh the semolina, ensuring the mill delivers the appropriate amount. The scale has decreased the flow of the dry semolina, slightly slowing production. Site 10 then mixes dry semolina with water, and then pumps it to each product line and molds it into the desired product shape. The product is cooked and dried slowly in strict process-controlled environments that ensure the quality of the product. Employees then inspect the dried material for clumps, which will be reground and mixed with the water semolina mixture. Product that passes inspection is packaged and then shipped. The plant has made improvements in the temperature and humidity control system in the plant that has automated controls remotely monitored that has increased stability in the production quality. There are 4 main production lines used at the facility, all using hard amber durum. The facility incorporates custom-designed equipment for efficient production to exacting specifications.

4.5.3 Available Data

Several important factors in predicting energy consumption are available from the data provided by EnerNOC: production, energy consumption, and weather data. The total pounds of dry pasta produced are recorded monthly dating back to January 2006. Monthly energy consumption data is available from April 2006 – May 2013. Weather data for Site 8 monthly CDD and HDD are available from NOAA.

4.5.4 Summary of Results

Energy 350 calculated a decrease in facility energy use over the cohort period. Energy 350's model more accurately estimated the anticipated energy consumption of Site 10, resulting in large savings. Site 10 has implemented many of the SEM program strategies. The realization rate is the largest of the Cohort 2 participants. Table 21 summarizes the annualized realization between the two models.

Table 21- Site 10 Realization Summary

Ex-Ante Net (kWh)	Ex-Post Net (kWh)	Realization Rate
33,853	867,997	25.64

5. Participant Adoption of SEM

Energy 350 developed a questionnaire for each SEM participant, in order to determine whether facilities are actively practicing SEM following the engagement. Table 22 summarizes the results of the survey. As this section will show, all facilities are practicing at least some aspects that define SEM. Most facilities credit NEEA's engagement with their current SEM practices.

Table 22 – SEM Survey Summary

Site	Has the facility established energy reduction goals?	Is there a dedicated Energy Manger or Energy Champion?	Has staff received training to achieve energy goals?	Does upper management provide financial support to help achieve energy goals?	Is progress toward energy goals tracked?	**SEM Status**	Notes
1	No	Yes	Yes	Yes	Yes	**Not practicing**	They do not have current goals, but are very energy aware as a result of the SEM Program.
2	Yes	Yes	Yes	Yes	Yes	**Practicing**	Site 2 has benefited greatly from the SEM program and continues to practice SEM fundamentals.
3	Yes	Yes	Yes	Yes	Yes	**Practicing**	Site 3 stated that SEM helped to validate that they were practicing the proper energy management practices.
4	No	Yes	Yes	Yes	Yes	**Not practicing**	Even though Site 4 does not have any current energy goals in place, they still track energy consumption per line item shipped.
5	No	Yes	Yes	Yes	Yes	**Not practicing**	Even though Site 5 does not have an energy goal in place for 2014, they still track energy consumption per unit produced.
6	No	No	Yes	Yes	No	**Not practicing**	Site 6 is being upgraded to a different process
7	Yes	Yes	Yes	Yes	Yes	**Practicing**	Energy goal has been reduced, but energy efficiency still a focus

Site	Has the facility established energy reduction goals?	Is there a dedicated Energy Manger or Energy Champion?	Has staff received training to achieve energy goals?	Does upper management provide financial support to help achieve energy goals?	Is progress toward energy goals tracked?	**SEM Status**	Notes
8	Yes	Yes	Yes	Yes	Yes	**Practicing**	This facility is used as an example of efficiency in milling
9	No	Yes	No	Yes	Yes	**Not practicing**	The site is slow to implement SEM elements, but they are working on it.
10	Yes	Yes	Yes	Yes	Yes	**Practicing**	This facility is very proactive and realizing great savings

Cohort 1

Site 1 **-** Although there are no current energy reduction goals, this facility is more aware of energy efficiency as a result of the SEM program. Energy projects are predominantly limited by stringent ROIs, as the useful life of the mine is only 2-3 years. Attention is paid to energy projects, however, and multiple VFDs and other energy saving equipment has been installed under the guidance and recommendations of Jason Campbell of NWE.

Site 2 **–** This facility has surpassed their 10% energy metric reduction goal as a result of implementing different elements of the SEM program. Staff training, upper management support, and general energy awareness have greatly impacted the operations, and many incentivized projects are a direct result of the SEM program. Corporate has praised this Site for their energy efficiency.

Site 3 – The city owned and operated plant has been proactive in energy efficiency since 2008; their interest in energy efficiency brought them to the SEM program rather than being a result of the program. The implanted SEM elements have helped them compare themselves to other facilities and keep energy efficiency at the forefront.

Site 4 – Between moving facilities and ramping up production, Site 4 has had little resources to dedicate toward energy efficiency. The major impacts of the SEM program are lost in the transition to the new facility, but the cultural change is long lasting. Major behavioral changes have been realized throughout the facility, and special attention was given to the new building's energy.

Site 5 – This facility achieved the 5% energy reduction goal established for 2011 – 2012. There is no current energy reduction goal, but the facility still has energy efficiency as a priority. An environmental team manages all forms of company performance pertaining to consumption. The SEM program initiated several energy projects, and although they are not currently practicing all elements, the lessons learned have changed their behavior and outlook.

Cohort 2

Site 6 – Site 6 is seeking energy star ratings, and has a history of energy efficiency. The SEM program taught many energy efficiency practices, but the application toward the WWTP specifically was lacking. This is mainly a result of the planned upgrade toward the WWTP, which will move it from an activated sludge process to a nutrient demand based process. This facility may not be practicing the SEM elements, but the lessons have been applied to other facilities managed by the city.

Site 7 – Site 7 has set a high goal of 10% energy reduction over three years, which is now believed to be unattainable. Many of the SEM elements were applied after the cohort period ended, with a major project being a new air compressor with a VFD. Upper management encourages the plant to become more efficient, and has funded and supported energy projects.

Site 8 – Site 8 is frequently used as an exemplary energy efficient flour mill to others in the industry. The SEM program has initiated multiple energy projects on this Site, and has influenced the mindset of the industry toward energy efficiency. Lighting has been a major focus, but behavioral changes and other energy projects have also contributed energy savings.

Site 9 – Although this facility has been determined as "not practicing," the SEM elements have not been completely neglected. The lack of human and financial resources has been a major obstacle, but there has been recent progress in the development of energy audits to be performed throughout the Site. Not much has been implemented from the SEM program to date, but there are projects in the pipeline.

Site 10 – Many of the SEM elements have been implemented in this facility; numerous projects such as circulation pumps, pneumatic conveyors, lighting, air compressors and others have been completed at this site. There is good support for energy projects, and the energy team is very proactive. The whole company is encouraged to participate in energy efficiency. This facility has taken complete advantage of the SEM program.

6. Conclusion

Energy 350 has developed regression models and employed a top-down analysis approach to estimate energy savings as a result of participation in NEEA's SEM program. With the advantage of more time over which to accrue performance data and increased data collection and analysis, we were able to develop improved ex-post models to calculate validated energy savings. We did not use key performance indicator models in our ex-post models which present overly simplified models of complex processes and which obscure important information such as base load (y-intercept can't be estimated using KPI). b. All ex-post models in conducting the savings validation were regression models, most of which use multiple independent variables.

For ease of reference, Table 23 below summarizes the energy savings presented in the executive summary.

Table 23 – Energy Savings Summary

Cohort	Site	Ex-Ante Savings (aMW)			Ex-Post Savings (aMW)			Ex-Post Savings as a % of Baseline Energy		Realization Rate
		Gross	NWE Funded	Net	Gross	NWE Funded	Net	Gross	Net	
1	1	0.170	0.005	0.165	0.087	0.029	0.058	1.0%	0.68%	0.35
1	2	0.128	0.000	0.128	0.086	0.018	0.068	5.3%	4.2%	0.53
1	3**	0.007	0.000	0.007	0.000	0.000	0.000	0.1%	0.1%	0.02
1	4*	0.005	0.000	0.005	0.000	0.000	0.000	0.0%	0.0%	0.00
1	5	0.000	0.000	-0.001	0.000	0.001	-0.001	0.0%	-2.7%	N/A
Cohort 1 Total		**0.310**	**0.006**	**0.305**	**0.173**	**0.048**	**0.125**	**1.6%**	**1.2%**	**0.41**
2	6**	-0.230	0.000	-0.230	-0.075	0.000	-0.075	-8.4%	-8.4%	N/A
2	7	0.002	0.000	0.002	0.013	0.002	0.012	1.6%	1.4%	7.40
2	8	0.009	0.001	0.008	0.009	0.001	0.008	1.5%	1.3%	0.97
2	9**	-0.001	0.000	-0.001	-0.003	0.000	-0.003	-3.1%	-3.1%	N/A
2	10	0.004	0.000	0.004	0.099	0.000	0.099	13.3%	13.3%	25.64
Cohort 2 Total		**-0.216**	**0.001**	**-0.217**	**0.043**	**0.003**	**0.040**	**1.4%**	**1.3%**	**-0.19**
Total Both Cohorts		**0.094**	**0.007**	**0.088**	**0.216**	**0.051**	**0.165**	**1.6%**	**1.2%**	**1.89**

Notes: *Site 4 moved to a new facility in November 2012. As such, the Ex-Post energy savings is zero. **Energy 350 calculated SEM kWh savings for Site 3, 6, and 9 according to actual kWh consumption prior to the cohort start date and after the cohort start date.

The total energy savings is fairly modest, largely driven by a large increase in energy use at Site 6 that overshadows the other sites' energy savings. The major increase in energy is a result of the facility not implementing SEM elements due to the scheduled decommissioning. Most of the participants implemented the SEM elements and realized energy savings. Furthermore, the quantification of energy savings also nets out NWE incentivized projects, although many of the projects were a direct result of the

SEM training. Given this, we consider the net savings to be a conservative estimate of the energy savings influenced by NEEA's engagement.

Through this effort, including our site visits and associated facility staff interviews, we were able to draw the following conclusions:

- Most participating facilities are still practicing many or most aspects of SEM.
- Although the total energy savings were modest, the majority of participants saved energy.
- Many participants have had staff turnover since their SEM engagement, however, aspects of SEM have persisted through the turnover.
- Common obstacles for the participants were lack of human and financial resources; all energy champions had other primary duties and energy management took less than ten percent of their time. This is understandable given the small to medium size of the facilities.
- While the more immediate result of SEM is operational energy savings, it also serves as an effective marketing tool in developing capital projects. In this case, all capital projects were funded by Northwestern Energy and as such, were netted out of the final energy savings. However, most facilities credited their SEM engagement as a significant driving force in identifying and implementing capital projects.

Appendix A – SEM Questionnaire Responses

Site 1 SEM Survey

1. Has the facility established energy reduction goals? If so what are they and are they being met?

Corporate set a 2% reduction goal in 2012, however never really followed up on it. They did not implement any additional goals, but did mention that the SEM forced them to keep energy awareness in the back of their minds.

2. Is there a dedicated Energy Manger or Energy Champion? Is energy management that person's full time job?

There is an acting Energy Manager, but it is not his full time job. He will send reports to the Department of Revenue for Montana each year summarizing energy savings projects. He also sends applications to NWE to receive incentives for energy savings projects.

3. Has staff received training to achieve energy goals? What kind of training?

They have incorporated energy awareness and behavior training into their safety meetings. Most of this is behavioral awareness, however they did address how to search for compressed air leaks and be mindful of them.

4. Does upper management provide financial support to help achieve energy goals?

Yes and no. The useful life of the mine is most always defined as 2-3 years based on the currently identified resources. It has been this way since the mine opened. This makes it extremely difficult for corporate to invest in an energy savings measure with a payback longer than the useful life of the mine. They also have a limited amount of capital. At the same time, they will invest in energy savings projects with quick paybacks, such as installing wipers to replace the compressed air system at the carbon circuit.

5. Is progress toward energy goals tracked? Is it reported to top management?

The Energy Manager has to report on consumption of fuels that contribute to greenhouse gas emissions. This includes kWh consumption, Natural Gas consumption, Diesel, Blasting Agents, and Propane.

6. Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?

No specific examples, however they now always consider energy costs and savings when considering a project or retrofit. They have installed VFDs on conveyor belt motors, compressors, etc. They mentioned that John Campbell of NWE was extremely helpful and gave them a lot of great ideas to consider for lighting and compressed air projects.

Site 2 SEM Survey

1. Has the facility established energy reduction goals? If so what are they and are they being met?

Inspired by the SEM program, the facility set a 10% energy reduction goal for 2012. This is based off of $kWh/Tons of product. At the end of 2012, they were able to report an 11.5% energy reduction goal. This can be attributed to measures suggested and an improvement in energy savings awareness and behavior.

Currently they are in a 'maintain, don't gain' mentality, as they are in the process of obtaining additional contracts and upping production for 2014. They also mentioned that the cheaper they get the more contracts corporate sends them. In a way the plants are competing against each other for the cheapest production costs.

2. Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?

No. The site representative has assumed that role as part of his day to day operation, but he is not dedicated to being an energy manager. The plant is small, and he deals with process engineering, product quality, environmental standards, as well as being the lead 'energy manager.'

3. Has staff received training to achieve energy goals? What kind of training?

Yes. Prior to the SEM program employees had a habit of leaving equipment on or running idle. Through trainings put on by management, employees learned when they were able to turn equipment on and off. As part of a funded energy project by NWE, a controls system was also installed to automatically shut equipment down when not in use.

The site also gave employees a comprehensive compressed air training. This training helped employees to be more aware of compressed air leaks, to listen for them, and what signs to look for. Lastly, they put on a training on VFD control as a function of process requirements. Fans with VFDs are toggled by operators to satisfy the process without sacrificing product quality.

4. Does upper management provide financial support to help achieve energy goals?

After initial energy projects were suggested through the SEM cohort, upper management was very proactive in funding all of the measures. They also funded a lighting upgrade of the plant without energy incentives from NWE. They had a celebratory lunch and took the staff out to dinner for achieving their energy reduction goal in 2012.

5. Is progress toward energy goals tracked? Is it reported to top management?

The plant submits a Monthly Business Review to corporate every month. This summarizes their kWh consumption versus production. Progress on this rate is reported monthly.

6. Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?

The SEM program had two major impacts on this site. The first was its effect on the behavior and awareness of employees. Prior to the cohort, most of the technicians and employees did not consider the energy consumption of equipment and processes. Equipment and lights were left on. The SEM program spurred a behavior change on site, and a couple of the technicians mentioned that they were very appreciative of it.

The second impact was the amount of measures that it identified for the plant. While many of these measures were funded by NWE and cannot be claimed from the SEM program, the cohort was the initial spark for the measures. The site implemented every measure that was suggested based on SEM walkthroughs and audits.

Site 3 SEM Survey

1. Has the facility established energy reduction goals? If so what are they and are they being met?

Yes. Prior to and during the cohort period they were aiming for a 10% reduction in annual consumption. This reduction was achieved as a result of large projects that were implemented between 2008-2010 and incentivized by Northwestern Energy.

Currently they are working to maintain their energy consumption levels, while seeking additional energy savings opportunities.

2. Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?

The site contact has taken the role of Energy Manager. He stressed that it is only one of his many roles on site.

3. Has staff received training to achieve energy goals? What kind of training?

Staff has met with Northwestern Energy, especially while implementing energy savings projects. The site has worked closely with John Campbell (formerly of NWE) extensively to identify energy savings opportunities. Plant supervisors make sure that all employees are aware and able to learn about energy savings projects that they are looking into or implementing. They also attend NWE seminars throughout the year.

4. Does upper management provide financial support to help achieve energy goals?

The city is very proactive in funding energy savings projects, especially when NWE provides incentives for these measures. They are willing to invest. They recently installed a heat pump system that runs off of filtered waste at a water treatment facility. Most of this project was funded by NWE. The city paid for the rest.

5. Is progress toward energy goals tracked? Is it reported to top management?

The city uses a central energy tracking system. This system monitors kWh consumption, costs, and process information. The Facilities Director assembles this data for the city commissioner annually, and helps to facilitate energy savings projects around the city.

6. Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?

They stressed to us that the main component that they benefited from was comparing their practices to other facilities. This helped to validate that the processes and behavior they had in place. They did not benefit much from the SEM program. They learned about energy measures here and there. One example in particular that was mentioned was they learned about the energy wasted associated with compressed air leaks. They also learned about the energy savings when switching from pneumatic controls to a DDC system.

Site 4 SEM Survey

1. Has the facility established energy reduction goals? If so what are they and are they being met?

During the Cohort they initiated a 2% kWh/line item shipped reduction goal. Since the move the energy team has not met and they have not established any other goals.

2. Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?

There isn't a dedicated Energy Manager, but the facility has put together an energy team. This team met during the cohort and a year after the cohort. The move to the new facility along with a high increase in demand for product kept them from meeting in the past year. They plan to start up energy meetings again as operations are beginning to settle down.

3. Has staff received training to achieve energy goals? What kind of training?

Most of the training for the energy team was through the Cohort. One member attends webinars online through NEEA and NWE as well. They also put on a compressed air leak challenge in which they rewarded employees for spotting compressed air leaks.

Another energy team member also started sending monthly energy topics e-mails, with cover energy topics and way to conserve and recycle resources.

4. Does upper management provide financial support to help achieve energy goals?

Yes. They invested in quite a bit of energy efficiency project to upgrade the new facility. The new facility has energy efficient lighting, two rotary wheel heat exchangers, a solar PV array, a solar hot water heater, and heats part of the warehouse using exhausted heat from the compressed air system.

5. Is progress toward energy goals tracked? Is it reported to top management?

Yes. They report kWh consumption/ line item shipped monthly. Sometimes the owner of the company will poll the energy team to get energy numbers to report to the state or other organizations during meetings.

6. Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?

Employees are much more aware of 'Vampire Appliances' such as computers etc. The behavior around the facility has changed as well. Employees are much more energy aware of their actions. The energy team has even extended this to help employees reduce energy consumption at their houses. They also report energy savings to field guides for the company, as well as give them tips to 'go green' and reduce their energy consumption.

The energy team started a program where if an employee suggests a good energy efficiency or conservation idea, they are rewarded with company merchandise.

Site 5 SEM Survey

1. Has the facility established energy reduction goals? If so what are they and are they being met?

During the cohort they set a 5% reduction from 2011-2012 for their Energy/Unit. They did not establish a 2013 goal. Even though they did not set a goal they still saw a reduction in 2013.

2. Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?

The site contact is considered to be the Energy Manager. His main role is a customer service representative. He also mentioned that the company just recently was awarded a B Corporation certification. He manages the environmental team. This team assesses the company's performance associated with energy, recycling, water consumption, waste, etc.

3. Has staff received training to achieve energy goals? What kind of training?

Their energy team is currently putting together lunch and learns to cover basic energy reduction strategies. Most of these are behavioral such as turning the lights off when you leave a room. They are currently putting together a compressed air training to go over efficient compressor use and energy costs associated with compressors.

4. Does upper management provide financial support to help achieve energy goals?

Yes. They are currently budgeting for a lighting upgrade to replace Metal Halide fixtures in the warehouse. They also are considering a 2015 plan to install solar panels on the roof. They mentioned that they would like some guidance so they are able to look into the proper channels at NWE to apply for incentives or grants.

5. Is progress toward energy goals tracked? Is it reported to top management?

Yes. The contact provided Energy 350 with a spreadsheet that tracks monthly energy consumption as well as energy cost/unit produced. It is important to note that this calculation also takes into account natural gas usage, which we are not considering as part of this model.

6. Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?

As a result of the SEM program they were more aware of certain measures. In February of 2013 they installed occupancy sensors for lighting in certain areas. They also installed a timer for the forklift chargers to charge the forklifts during off-peak hours to save on their demand charges. They also installed energy star servers and computers in 2012.

Site 6 SEM Survey

1. *Has the facility established energy reduction goals? If so what are they and are they being met?*

There are no set energy reduction goals, but there are goals to reduce energy consumption. The facility will be revamped to a higher capacity WWTP that also will use a different treatment process.

2. *Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?*

The site contact is the designated Energy Champion. He spends <10% of his time on energy management. Another city environmental engineer is also involved in energy management and spends little time on the topic.

3. *Has staff received training to achieve energy goals? What kind of training?*

Staff receives energy training in the form of learning the operation of new higher efficiency equipment as it is replaced; there is no formal training completed by all personnel. Energy is always a consideration, but usually not a driving factor in project implementation.

4. *Does upper management provide financial support to help achieve energy goals?*

Upper management will provide financial support to energy projects that meet the same financial metrics as any new project. There are no special allotments for energy projects.

5. *Is progress toward energy goals tracked? Is it reported to top management?*

Energy consumption and the metrics specified in the Energy Tool provided by EnerNOC have been tracked, but the results are rarely analyzed and there are no generated reports.

6. *Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?*

It has helped push energy conservation emphasis toward management. It really identified energy as a motivator for projects. It brought to light city goals, and really focused public works on energy.

Site 7 SEM Survey

1. *Has the facility established energy reduction goals? If so what are they and are they being met?*

The site has set an energy reduction goal of 10% over 3 years. They have since deemed this goal unattainable.

2. *Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?*

The energy team consists of three employees. They spend about 5% of their time on energy management.

3. *Has staff received training to achieve energy goals? What kind of training?*

There has been no formal training, but the facility personnel have been informed of the new mission statement that emphasizes energy efficiency.

4. *Does upper management provide financial support to help achieve energy goals?*

Yes, they have funded requested projects.

5. *Is progress toward energy goals tracked? Is it reported to top management?*

Data is collected using the energy tool provided to them, but this is not reported to the CEO, just the plant manager.

6. *Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?*

As a result of the SEM training, a new air compressor with a VFD, as well lighting upgrades have been implemented. The site now takes energy efficiency into consideration when installing new equipment.

Site 8 SEM Survey

1. *Has the facility established energy reduction goals? If so what are they and are they being met?*

Yes, goal of 5% reduction. The facility is on track to meet this target, lighting is the main focus. A lighting survey was performed by Dave Houser from ENCAT. LED lighting is not incentivized.

2. *Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?*

The site contact is the energy champion, spending 5% of their time or less on energy projects.

3. *Has staff received training to achieve energy goals? What kind of training?*

The Montana SEM training was the only training through Kim Brown.

4. *Does upper management provide financial support to help achieve energy goals?*

Yes, absolutely.

5. *Is progress toward energy goals tracked? Is it reported to top management?*

Yes, through a custom spreadsheet. The lighting is also on a separate meter. The reports are delivered to the Director of Operations.

6. *Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?*

Lighting upgrade, air compressors may be upgraded.

Site 9 SEM Survey

1. *Has the facility established energy reduction goals? If so what are they and are they being met?*

The realistic goal is to have a positive impact. Last quarter the energy team met, and an organization strategy is in development. There are no specific goals because the targets may not be met.

2. *Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?*

The quality control engineer is tasked with this role, but he on spends about 5% on energy efficiency.

3. *Has staff received training to achieve energy goals? What kind of training?*

The energy team puts on SEM training seminars.

4. *Does upper management provide financial support to help achieve energy goals?*

CEO is on the energy team, mostly just created procedures, no capital projects.

5. *Is progress toward energy goals tracked? Is it reported to top management?*

The site uses an energy spreadsheet to track progress. The sheet is shown to everyone during company meetings.

6. *Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?*

Energy audit team developed and plan of attack to audit all areas.

Site 10 SEM Survey

1. *Has the facility established energy reduction goals? If so what are they and are they being met?*

Yes, 5% reduction in kWh as goal. They currently have met 13.6% reduction in kWh/lbs of production.

2. *Is there a dedicated Energy Manger or Energy Champion (include contact info)? Is energy management that person's full time job?*

The CFO is the energy champion, and he spends 4 hours a month on energy efficiency. He is supported by a team comprised of QC, maintenance manager, and production foreman. Together they spend maybe 20 hours per week on energy efficiency.

3. *Has staff received training to achieve energy goals? What kind of training?*

Yes, the team attended the SEM workshops in Billings and on-site training from NWE. The production manager attended some training. Energy efficiency is a topic at the company meetings, there is a suggestion box.

4. *Does upper management provide financial support to help achieve energy goals?*

Yes, the CFO is on the energy team. The CFO outlined capital purchases with a focus on energy efficiency (pumps, lights, etc.)

5. *Is progress toward energy goals tracked? Is it reported to top management?*

Progress is tracked, and there is an energy consumption report. Additional reports or flyers posted for employees. CEO gets a report from management meetings.

6. *Are there any specific examples of how involvement in the SEM program has impacted the facility's energy use?*

The site installed a new hot water circulation pump, a PLC for oven efficiency like staging dryers, and LEDs in the warehouse and silos. They also have gone through pneumatic conveying, reduced compressed air psi and identified air leaks.

Appendix B – Site Level Analysis Details

This Appendix is intended for readers interested in a higher level of detail regarding analytical details. Table 1 summarizes the ex-ante and ex-post analytical details.

Table 1 – Analytical Detail Summary

Cohort	Facility	Ex-Ante Independent Variables	Ex-Post Independent Variables	Ex-Ante Baseline Period	Ex-Post Baseline Period
1	1	Tons of rock crushed per month Ounces of mineral per month Facility restart variable	Tons of rock crushed per month Tons of rock crushed per month^2 Ounces of mineral per month Ounces of mineral per month^2	September 2005 - February 2009 & January 2011 - June 2011	January 2006 - March 2009 & January 2011 - June 2011
1	2	Raw material processed in Calcining Unit #1 Raw material processed in Calcining Unit #2 Daily run Hours - Calcining Unit #1 Daily run hours - Calcining Unit #2 Daily run hours - Hydrator Daily run hours - Crusher Heating Degree Days - (Base 65°F) Cooling Degree Days (Base 55°F)	Raw material processed in Calcining Unit #1 Raw material processed in Calcining Unit #2 Daily run Hours - Calcining Unit #1 Daily run hours - Calcining Unit #2 Daily run hours - Hydrator Daily run hours - Crusher Heating Degree Days - (Base 65°F) Cooling Degree Days (Base 55°F)	February 1, 2010 - July 31, 2011	February 1, 2010 - July 31, 2011
1	3	Influent millions of gallons per month	Influent millions of gallons per month Influent BOD Cooling Degree Days (Base 50°F)	August 2009 - July 2011	February 2009 - July 2011

1	4	Line items shipped per month	Line items shipped per month Cooling Degree Days (Base 65°F)	March 2010 - July 2011	January 2009 - July 2011
1	5	Units produced per month Cooling degree days (CDD base 65°F) Interaction variable between CDD and in-cohort months	Units produced per month Cooling degree days (CDD base 65°F) Interaction variable between CDD and in-cohort months	March 2011 - December 2012	March 2011 - December 2013
2	6	KPI - millions of gallons pumped	N/A	Aug 11 - July 12	January 2011 - July 2012
2	7	Milled grain production (CWT) indicator variables	Milled grain production (CWT), indicator variables	July 12 - Jan 13	July 2012 - July 2013
2	8	Milled grain production (CWT) indicator variables	Milled grain production (CWT), indicator variables	July 12 - Jan 13	July 2012 - July 2014
2	9	Adjusted Quantity production employee count	N/A	Sep 11 - Jun 12	January 2008 - July 2012
2	10	CDD (Base 60^{o}F)	Line 1 Production (lbs) Line 2 Production (lbs) Line 3 Production (lbs) Line 5 Production (lbs) Waste (lbs) Regrind (lbs) Avg Monthly Temp (°F)	Aug 11 - Sep 12	January 2011 - July 2012

1. Site 1 Analysis Details

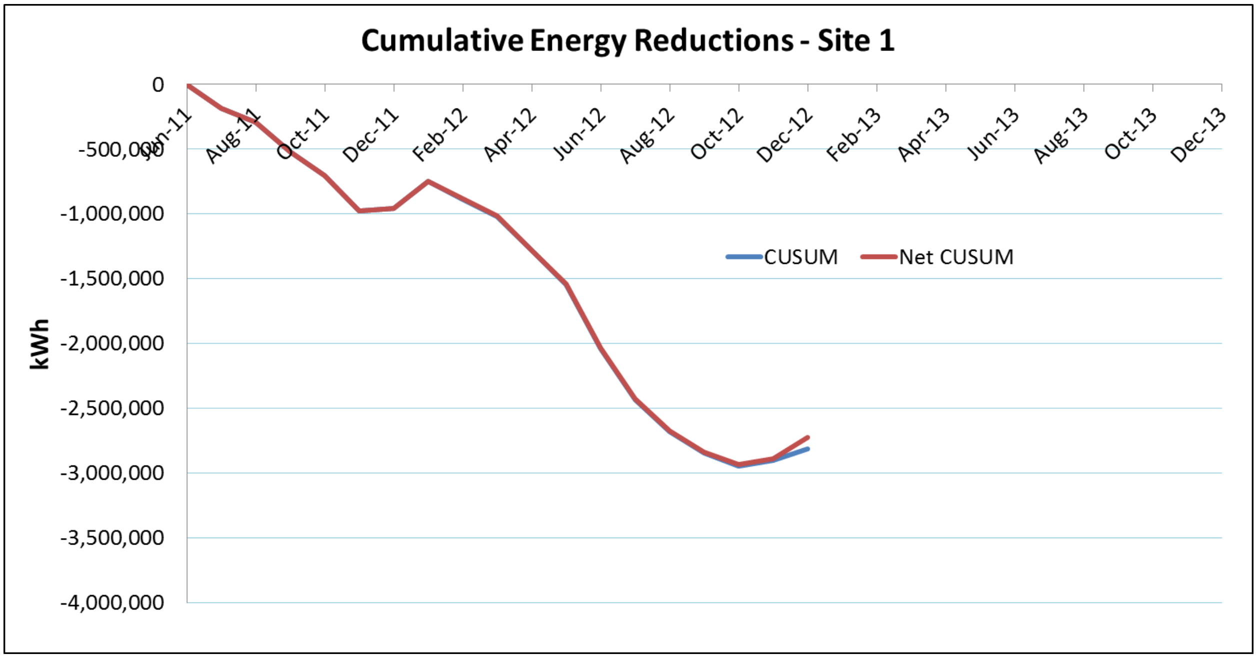
1.1 EnerNOC Methodology

The cumulative estimated net savings calculated by EnerNOC can be found in Table 2 and Figure 1

Table 2- Site 1 Estimated Net Savings

			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	Aug 2011 - July 2012	12	2,178,870	2,178,870
Post-Cohort	Aug 2012 - Dec 2012	5	297,549	714,117
			Average kWh Savings/year	1,446,494

Figure 1 – Cumulative Energy Savings



Notes: CUSUM are the cumulative energy savings, Net CUSUM are the cumulative energy savings after deducting the savings attributed to NWE incentivized projects. EnerNOC calculated energy savings as negative values. ***(EnerNOC-2013)***

EnerNOC used the following variables:

- Tons of Rock Crushed
- Ounces of mineral processed
- Facility Restart variable

EnerNOC conducted their analysis with monthly data intervals using two baseline periods, one from September 2005 – February 2009, and January 2011 – June 2011. The Facility Restart variable was fixed to be -1,224,084 kWh, reducing baseline energy consumption in January and February. Energy 350 is unsure as to how this restart variable was calculated. With these three variables EnerNoc used a linear multivariate regression shown below:

$$Monthly\ kWh = 3{,}409{,}511.2 + 13.31 * Ton\ Rock\ Crushed * 19.05 * Oz\ (Au) - 1{,}224{,}084.4 * Restart$$

The restart variable was defined as being “1” or “0”. This variable was fixed in January and February of 2011 when the operation was brought back on-line.

1.1.1 NWE Incentivized Measures

Site 1 implemented energy savings measures during the Cohort that were incentivized by Northwest Energy (NWE). NWE provided the energy savings estimates and incentives summarized in Table 3.

Table 3- NWE Incentivized Measures

Measure Type	NWE Application Date	NWE Annual kWh Claimed Savings	E+ Program Incentive Amount	Notes
Business Partners - Process tank efficient compressed air proposal	On-line (on-hold)			Project on hold awaiting information & customer decision to move forward
Large Customer USB - Install new high efficiency HVAC unit in secondary crusher and control rooms	30-Nov-11	10,857	$13,013	During Cohort
Large Customer USB - Install VFD on pit water 'white tank' 125 HP feed pump.	30-Nov-11	27,900	$15,084	During Cohort
Large Customer USB - Replace 6 1000 watt mercury vapor lights in old shop with 6 150 watt led fixtures	30-Nov-11	49,056	$6,369	During Cohort
Large Customer USB - 33 high efficiency 4 tube fluorescent lights to replace old 4-tube fixtures.	30-Nov-11	14,454	$4,886	During Cohort
Large Customer USB - Install 24 70 Watt RAB high efficiency lighting fixtures in mill and crusher buildings to replace 24 98-Watt fluorescent fixtures.	30-Nov-11	5,886	$4,020	During Cohort
Large Customer USB - Replace decommissioned surge tank with new, energy efficient tank and water distribution system has been installed	29-Nov-12	397,182	$91,000	Post Cohort
Large Customer USB - Replaced 180 T-8 fixtures with T-5 fixtures.	29-Nov-12	35,145	$38,056	Post Cohort
Total		540,480	$172,429	

Site 1 implemented five energy measures that were incentivized by NWE during the cohort:

1. Install new high efficiency HVAC unit in secondary crusher and controls room
2. Install VFD on pit water 'white tank' 125 Hp feed pump
3. Replace (6) 1000W Mercury Vapor lights with (6) 150W LED fixtures
4. Install (33) high efficiency four tube fixtures to replace inefficient four tube fixtures
5. Install (24) 70W RAB high efficiency fixtures to replace (24) 98W fixtures

Together, NWE estimates that these measures save 108,153 kWh annually. EnerNOC's model deducted 1,000 kWh per month from November 2011 – December 2012 from SEM claimed savings to account for this. We are unsure as to how they calculated this reduction.

Site 1 implemented two additional energy measures that were incentivized by NWE in November 2012 after the cohort period:

1. Replace decommissioned surge tank with new, energy efficient tank and water distribution system
2. Replace (180) T-8 fixtures with T-5 fixtures

Together, NWE estimates that these measures save 432,327 kWh annually. EnerNOC reduced the claimed savings an additional 75,621 kWh in the month of December 2012 to account for these projects. Energy 350 is unsure as to how they calculated this reduction. In total, EnerNOC reduced the cumulative energy savings by 88,621 kWh.

1.2 Energy 350 Methodology

1.2.1 Baseline

Energy 350 established the same baseline period to be from September 2005 to February 2009 and January 2011 to June 2011. Site 1 shut down operation from April 2009 to December 2011, which explains the lack of production data during this time period.

1.2.2 Variables Used

Energy 350 used the following variables in the energy savings calculations:

Table 4 – Variables used for Site 1 Energy Model

Variable	Interval	Period
Tons of Rock Milled	Monthly	September 2005 - March 2009 & January 2011 - December 2013
Ounces of mineral Produced		
Tons of Rock Milled^2		
Ounces of mineral Produced^2		

EnerNOC's selection of production variables was valid. With limited run hour data on the heavy equipment, it was difficult to use other variables. Energy 350 did not believe that using a forced facility restart variable was a valid approach. Instead of using a facility restart variable, Energy 350 used a second order polynomial multivariate regression. This approach proved to have a stronger correlation than a linear multivariate regression (with no facility restart variable):

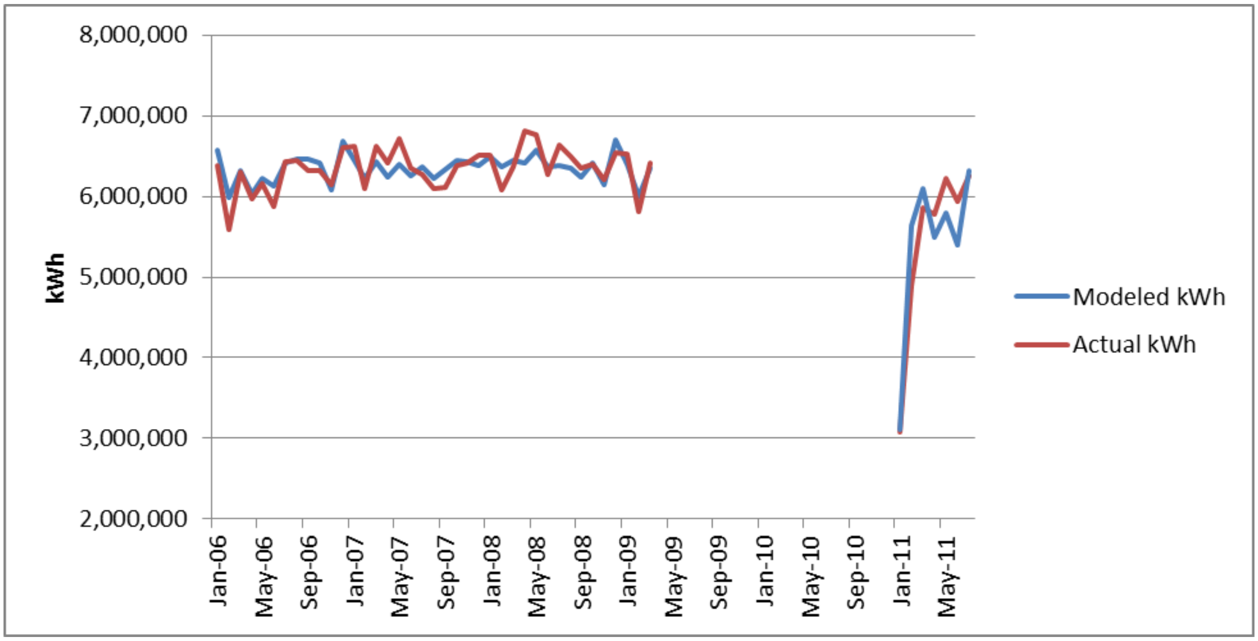
$$Monthly\ kWh = 372{,}221 + 39.11 * TM - 6.06 * TM^2 + 38.03 * Oz - 0.0013 * Oz^2$$

Where ***TM*** is tons of rock milled, and ***Oz*** is ounces of mineral produced.

1.2.3 Model Validation

Energy 350 analyzed the percent deviation between the actual kWh consumption and modeled kWh consumption during the baseline period to determine the validity of the model. This model had an average monthly deviation of 6% with an adjusted R^2 value of 0.92.

Figure 2 – Actual kWh versus Modeled Baseline kWh



1.2.4 NWE Incentivized Projects

Energy 350 used energy savings estimates provided by NWE to reduce the claimed SEM savings. These annual energy savings measures can be found in Table 3. Energy 350 converted the annual savings to monthly savings, and reduced the savings in accordance with the application date provided in Table 3. Energy 350 assumed that the savings persisted throughout the in-cohort and post cohort period. This approach reduced the gross SEM kWh savings by 513,513 kWh over the two year analysis, resulting in annualized reductions of 256,757 kWh/yr. The monthly kWh savings adjustments can be found in

Table 5.

Table 5 – NWE Incentivized Project Monthly Reductions

Date	NWE Incentivized Projects
Aug-11	
Sep-11	
Oct-11	
Nov-11	9,013
Dec-11	9,013
Jan-12	9,013
Feb-12	9,013
Mar-12	9,013
Apr-12	9,013
May-12	9,013
Jun-12	9,013
Jul-12	9,013
Aug-12	9,013
Sep-12	9,013
Oct-12	9,013
Nov-12	45,040
Dec-12	45,040
Jan-13	45,040
Feb-13	45,040
Mar-13	45,040
Apr-13	45,040
May-13	45,040
Jun-13	45,040
Jul-13	45,040
Two Year Total	513,513
Annualized	256,757

1.2.5 Validated Results

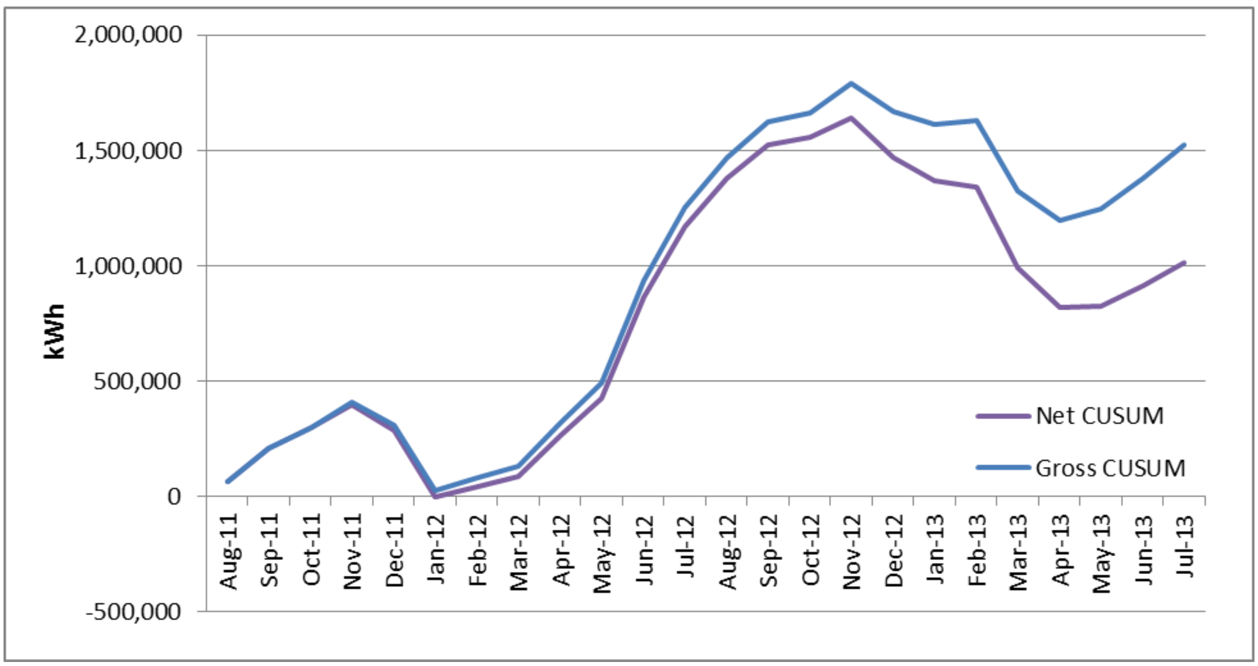
The total in-cohort and post cohort savings can be found in Table 6. Energy 350 calculated the total SEM net savings to be 505,304 kWh/yr.

Table 6 – Site 1 SEM Energy Savings

Period	Gross Savings (kWh)	NWE Reductions (kWh)	Net Savings (kWh)
In-Cohort	1,250,122	81,115	1,169,008
Post-Cohort	273,999	432,398	-158,400
Average kWh Savings/year	762,060	256,757	505,304

Figure 3 summarizes the cumulative savings that Energy 350 calculated for Site 1's SEM participation. The 'Net CUSUM' reflects the energy savings with the NWE incentivized project reduction.

Figure 3 – Site 1 Gross and Net Cumulative Savings



2. Site 2 Analysis Details

2.1 EnerNOC Methodology

The cumulative estimated net savings calculated by EnerNOC can be found in Table 7 and

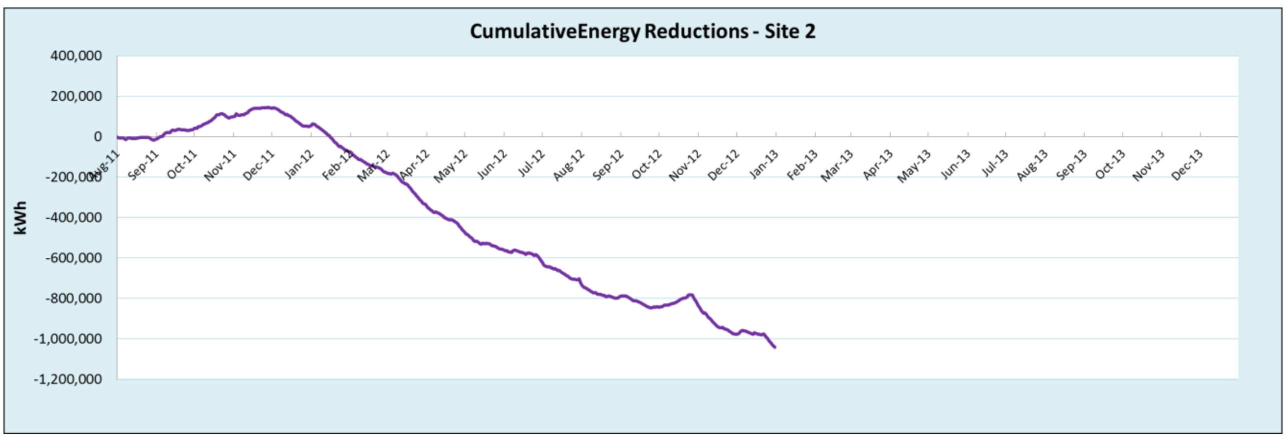
			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	Aug 2011 - July 2012	12	876,343	876,343
Post-Cohort	Aug 2012 - Dec 2012	5	1,257,286	1,371,585
Average kWh Savings/year				1,123,964

Figure 4.

Table 7- Site 2 Estimated Net Savings

			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	Aug 2011 - July 2012	12	876,343	876,343
Post-Cohort	Aug 2012 - Dec 2012	5	1,257,286	1,371,585
Average kWh Savings/year				1,123,964

Figure 4 – Site 2 Cumulative Energy Savings



Notes: CUSUM are the cumulative energy savings, Net CUSUM are the cumulative energy savings after deducting the savings attributed to NWE incentivized projects.

EnerNOC was able to create a valid regression equation with the following variables:

$$Daily\ kWh = 12{,}932.4 + 24.23 * QL_1 + 23.87 * QL_2 + 284.16 * RH_1 + 293.85 * RH_2 + 133.86 * RH_H + 267.62 * RH_c + 77.6 * HDD + 182.76 * CDD$$

Where QL_1 is quantity of raw material processed in Calcining Unit #1, QL_2 is quantity of raw material processed in Calcining Unit #2, RH_1 is run hours of Calcining Unit #1, RH_2 is run hours of Calcining Unit #2, RH_H is run hours of the Hydrator, RH_C is the run hours of the Crusher, ***HDD*** is daily heating degree days, and ***CDD*** is daily cooling degree days.

The baseline period for the regression was defined as from February 1st, 2010 to July 31st, 2011. It is important to note that Energy 350 did not receive the final energy model that EnerNOC references in their Memo to NEEA from July 31st, 2013. Energy 350 has a version of the daily model, which Energy 350 used to validate the regression equation. That model only calculates savings through December 31st, 2012. In the memo from July 2012, the savings are calculated through June 2013.

2.1.1 NWE Incentivized Measures

Site 2 implemented energy savings measures during the Cohort that were incentivized by NWE. NWE provided measures that Site 2 implemented or were planning on implementing in Table 8.

Table 8- NWE Incentivized Measures

NWE Customer Name	E+ Program and Type	NWE Application Date	NWE Annual kWh claimed savings (prescriptive, custom, other)	E+ Program Incentive Amount	Notes
Site 2	Commercial Lighting Rebate - Interior lighting retrofit	On-line November 2012	9,360		During Cohort
Site 2	Business Partners - Efficient compressed air system project in progress	On-line April 2013	907,447		Post Cohort

In the energy model, EnerNOC reduces the kWh savings by 780 kWh on November 1st 2012 to account for the lighting retrofit. This was only accounted for on one day. It is unclear as to how this number was calculated, and why the savings did not persist. The compressed air project was not considered in EnerNOC's model.

2.2 Energy 350 Methodology

2.2.1 Baseline

Energy 350 agreed with EnerNOC's original daily multivariate regression approach. Energy 350 used the same baseline period, from February 1st, 2010 to July 31st, 2011.

2.2.2 Variables Used

Energy 350 used the following variables in the energy savings calculations:

Table 9 – Variables used for Site 1 Energy Model

Variable	Interval	Period
Tons of raw material processed in Calcining Unit #1	Daily	February 1st, 2010 – December 31st, 2013
Tons of raw material processed in Calcining Unit #2	Daily	
Run Hours Calcining Unit #1	Daily	
Run Hours Calcining Unit #2	Daily	
Run hours Hydrator	Daily	
Run hours Crusher	Daily	
Heating degree days (base 65°F)	Daily	
Cooling degree days (base 55°F)	Daily	
kWh Consumption	Daily	January 1st, 2010 – December 31st, 2012
kWh Consumption	Monthly	January 2013 - December 2013

EnerNOC's selection of production variables was valid. Energy 350 employed the same variables and baseline period as EnerNOC:

$$Daily\ kWh = 12{,}932.4 + 24.23 * QL_1 + 23.87 * QL_2 + 284.16 * RH_1 + 293.85 * RH_2 + 133.86 * RH_H + 267.62 * RH_c + 77.6 * HDD + 182.76 * CDD$$

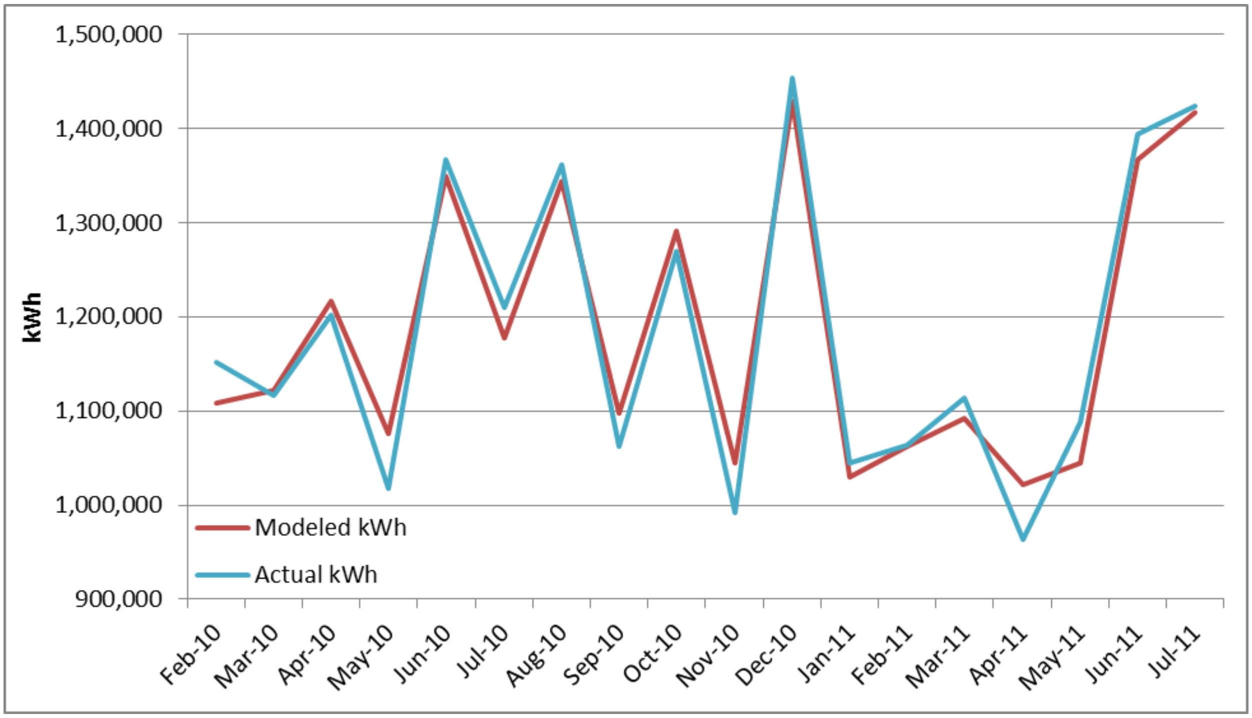
Where QL_1 is quantity of raw material processed in Calcining Unit #1, QL_2 is quantity of raw material processed in Calcining Unit #2, RH_1 is run hours of Calcining Unit #1, RH_2 is run hours of Calcining Unit #2, RH_H is run hours of the Hydrator, RH_C is the run hours of the Crusher, ***HDD*** is daily heating degree days, and ***CDD*** is daily cooling degree days.

Energy 350 was unable to obtain daily kWh consumption from Site 2 for 2013. To calculate savings, Energy 350 totaled the daily kWh consumption by month and compared against the monthly 2013 Site 2 electricity bill. Without the most recent model, Energy 350 was unable to verify the savings that EnerNOC calculated in 2013.

2.2.3 Model Validation

As stated in the introduction, Energy 350 analyzed the percent deviation between the actual kWh consumption and modeled kWh consumption during the baseline period to determine the validity of the model. This model had an average monthly deviation of 2.4% with an adjusted R^2 value of 0.95.

Figure 5 – Actual kWh versus Modeled Baseline kWh



2.2.4 NWE Incentivized Projects

Energy 350 used energy savings estimates provided by NWE to reduce the claimed SEM savings. These annual energy savings measures can be found in Table 8. Energy 350 converted the annual savings to monthly savings, and reduced the savings in accordance with the application date provided in Table 8. Energy 350 assumed that the savings persisted throughout the in-cohort and post cohort period. This approach reduced the gross SEM kWh savings by 309,512 kWh over the two year analysis, resulting in an annualized reduction of 154,751 kWh/yr. The monthly kWh savings adjustments can be found in

Table 10.

Table 10 – NWE Incentivized Project Monthly Reductions

Date	NWE Incentivized Projects
Aug-11	
Sep-11	
Oct-11	
Nov-11	
Dec-11	
Jan-12	
Feb-12	
Mar-12	
Apr-12	
May-12	
Jun-12	
Jul-12	
Aug-12	
Sep-12	
Oct-12	
Nov-12	780
Dec-12	780
Jan-13	780
Feb-13	780
Mar-13	780
Apr-13	76,401
May-13	76,401
Jun-13	76,401
Jul-13	76,401
Two Year Total	309,502
Annualized	154,751

2.2.5 Results

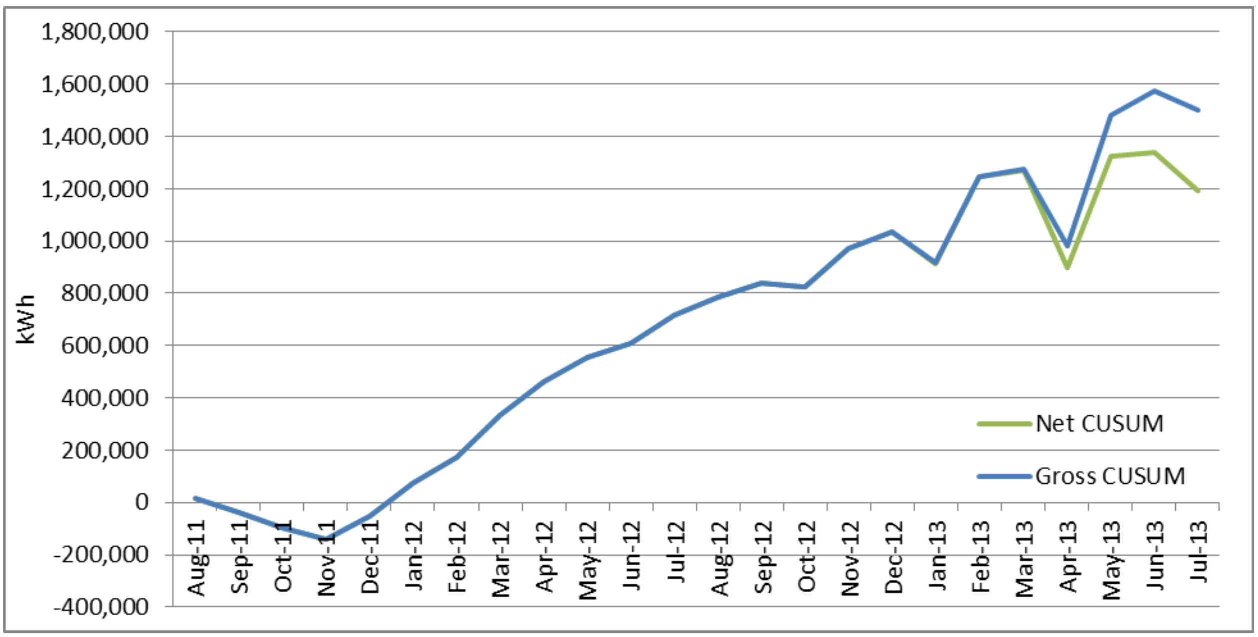
The total in-cohort and post cohort savings can be found in Table 11. Energy 350 calculated the SEM net savings to be 596,422 kWh/yr.

Table 11 – Site 2 SEM Energy Savings

Period	Gross Savings (kWh)	NWE Reductions (kWh)	Net Savings (kWh)
In-Cohort	716,512	0	716,512
Post-Cohort	785,835	309,502	476,332
Average kWh Savings/year	751,173	154,751	596,422

Figure 6 summarizes the cumulative savings that Energy 350 calculated for Site 2's SEM participation. The 'Net CUSUM' reflects the energy savings with the NWE incentivized project reduction.

Figure 6 – Site 2 Gross and Net Cumulative Savings



3. Site 3 Analysis Details

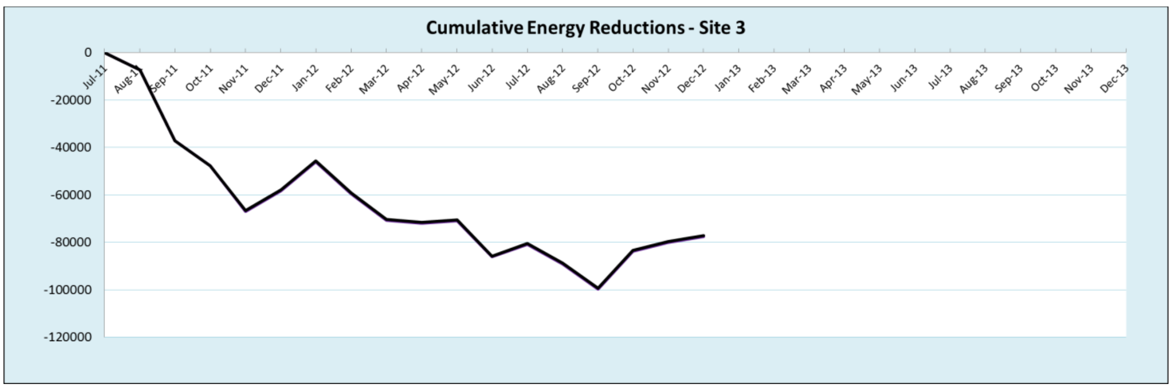
3.1 EnerNOC Methodology

The cumulative estimated net savings calculated by EnerNOC are shown in Table 12 and

Table 12- Site 3 Estimated Net Savings

			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	Aug 2011 - July 2012	12	94,097	94,097
Post-Cohort	Aug 2012 - May 2013	10	25,839	31,007
			Average kWh Savings/year	62,552

Figure 7 – Site 3 Cumulative Energy Savings



Notes: Site 3 implemented one energy efficient project in November of 2011. EnerNOC did not take this into consideration in their energy model.

Due to the fact that EnerNOC was unable to develop a strong relationship between the data that was given to them and kWh consumption, they utilized a KPI approach.

$$Monthly\ kWh = 1{,}983.37 * Million\ Gallons\ per\ Month$$

'Million Gallons per Month' represents the millions of gallons of wastewater that were processed per month.

3.1.1 NWE Incentivized Measures

Site 3 implemented energy savings measures during the Cohort that were incentivized by NWE. NWE provided the energy savings estimates and incentives in Table 13.

Table 13- NWE Incentivized Measures

Measure Type	NWE Application Date	NWE Annual kWh claimed savings (prescriptive, custom, other)	E+ Program Incentive Amount	Notes
Business Partners - 10 kW distilled water still	On-line November 2011	384		During Cohort

The memo from EnerNOC states that Site 3 did not implement any energy savings measures that were incentivized by NWE. NWE's documentation shows that one measure was implemented and incentivized during the cohort. EnerNOC did take this into account in their energy model, despite what was stated on the memo. One could argue that the claimed savings according to NWE are negligible however, compared to the annual kWh consumption of the WWTP.

3.2 Energy 350 Methodology

3.2.1 Baseline

Site 3 provided Energy 350 with data from August 2009 to December 2013. Energy 350 defined the baseline period to be from August 2009 to July 2011.

3.2.2 Model Validation

Energy 350 calculated the savings by averaging the actual annual kWh consumption prior to the cohort start date (February 2009 – July 2011), and averaging the actual annual kWh consumption after the cohort start date (August 2011-July 2013). The SEM savings were calculated by taking the difference between the two values. These values can be found below:

Table 14 – Pre Cohort versus Post Cohort Average Actual kWh Consumption

Pre Cohort Average Actual kWh Consumption	Post Cohort Average Actual kWh Consumption
2,330,880 kWh	2,329,207 kWh

3.2.3 NWE Incentivized Projects

Energy 350 used energy savings estimates provided by NWE to reduce the claimed SEM savings. These annual energy savings measures can be found in Table 13. Energy 350 converted the annual savings to monthly savings, and reduced the savings in accordance with the application date provided in Table 13. Energy 350 assumed that the savings persisted throughout the in-cohort and post cohort period. This approach reduced the gross SEM kWh savings by 336 kWh/yr. The monthly kWh savings adjustments can be found in

Table 15.

Table 15 – NWE Incentivized Project Monthly Reductions

Date	NWE Incentivized Projects
Aug-11	
Sep-11	
Oct-11	
Nov-11	32
Dec-11	32
Jan-12	32
Feb-12	32
Mar-12	32
Apr-12	32
May-12	32
Jun-12	32
Jul-12	32
Aug-12	32
Sep-12	32
Oct-12	32
Nov-12	32
Dec-12	32
Jan-13	32
Feb-13	32
Mar-13	32
Apr-13	32
May-13	32
Jun-13	32
Jul-13	32
Two Year Total	672
Annualized	336

3.2.4 Results

The total in-cohort and post cohort savings can be found in Table 16. Energy 350 calculated the annualized SEM kWh savings to be 1,337 kWh/yr.

Table 16 – Site 3 SEM Energy Savings

Period	Gross Savings (kWh)	NWE Reductions (kWh)	Net Savings (kWh)
Average kWh Savings/year	1,673	336	1,337

4. Site 4 Analysis Detail

4.1 EnerNOC Methodology

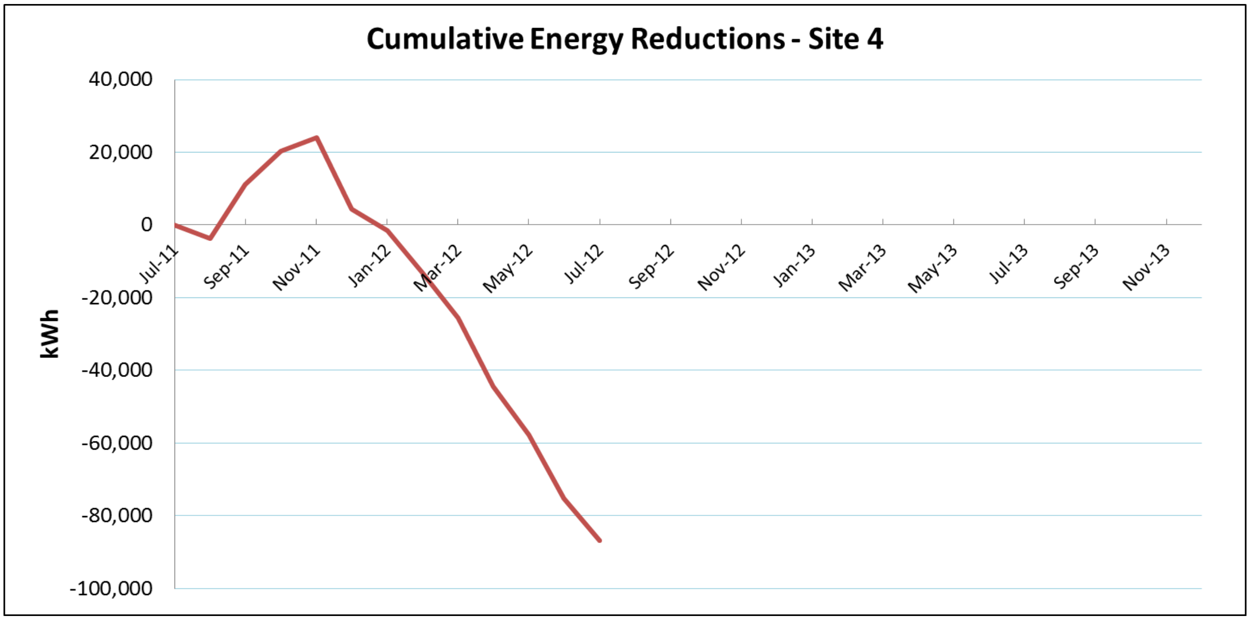
The cumulative estimated net savings calculated by EnerNOC are shown in Table 17 and Figure 8

Table 17- Site 4 Estimated Net Savings

			Estimated Net Savings (kWh)	
Period	Dates	Months	Period	Annualized
In-Cohort	August 2011 - July 2012	12	-86,703	-86,703
Post-Cohort	N/A	0	0	0
			Total kWh Savings	-86,703

Site 4 moved to a new facility in November of 2012, and therefore EnerNOC did not calculate savings for the Post-Cohort period. The savings are not persistent as the participant moved to a new site.

Figure 8 – Site 4 Cumulative Energy Savings



EnerNOC attempted to use the following variables:

- Packages
- Product
- Logo items
- Line items shipped
- Received goods
- Cooling Degree Days (CDD) (base 60°F)
- Heating Degree Days (HDD) (base 60°F)
- Season (indicator of high production period during spring months)

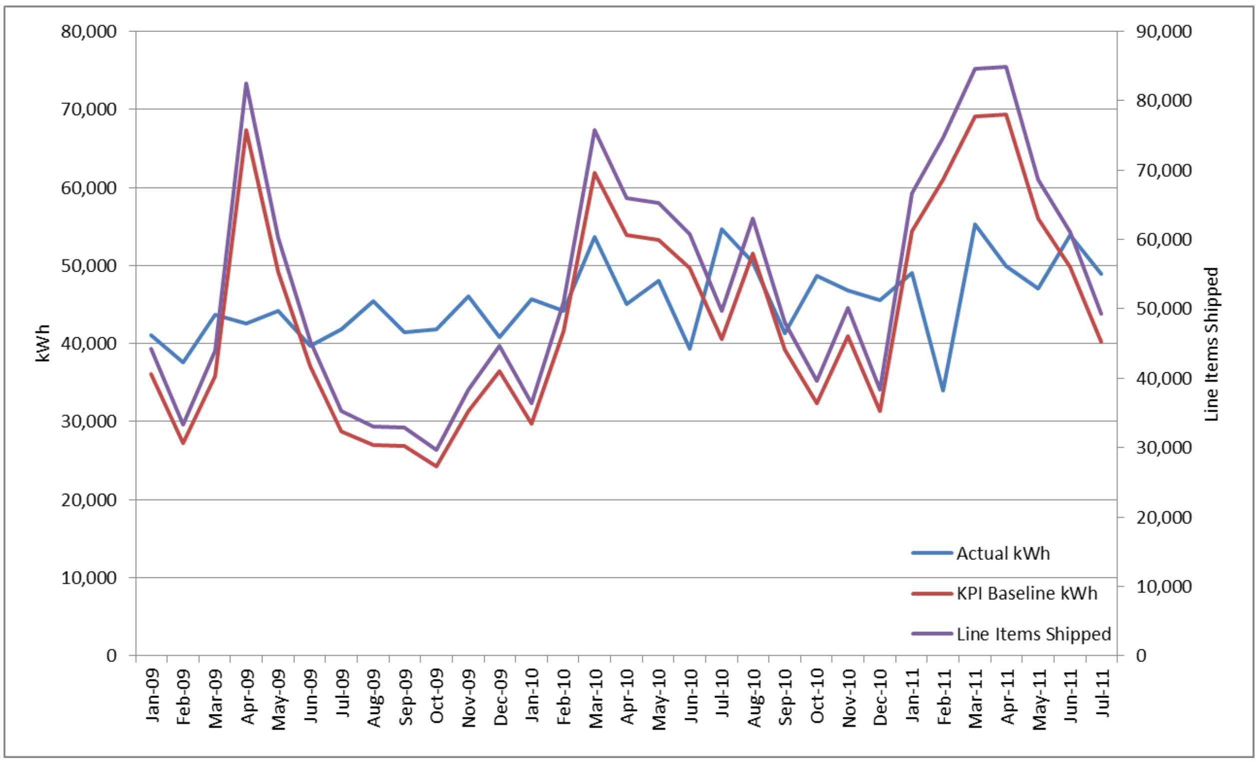
EnerNOC was not able to find a strong correlation between these variables and kWh. Because of this they used a Key Performance Indicator (KPI) approach, and selected 'Line items shipped per month' as their

KPI. EnerNOC considered the baseline period to be from March 2010 to July 2011. The KPI coefficient was calculated by averaging the monthly kWh/Line Item during the baseline period:

$$Monthly\ kWh = 0.817 * Line\ Items\ Shipped$$

This approach does not provide an accurate baseline to calculate energy savings. This is especially the case when the output variable is relatively constant, and the input variable varies. Energy 350 reproduced EnerNOC's KPI strategy and plotted the results versus actual kWh consumption. It is apparent that this baseline is not adequate to calculate energy savings as it follows the 'Line Items Shipped' profile, with no relation to kWh consumption, as expected.

Figure 9 – Site 4 KPI Baseline versus Actual Baseline



4.1.1 NWE Incentivized Measures

Site 4 implemented measures during the Cohort that were incentivized by NWE. NWE provided the measures in Table 18.

Table 18- NWE Incentivized Measures

E+ Program and Type	NWE Application Date	NWE Annual kWh claimed savings (prescriptive, custom, other)	E+ Program Incentive Amount	Notes
Commercial Lighting Rebate - Interior lighting retrofit	On-line November 2012	NA	NA	
Renewable Energy - 44.4 kW solar PV system (new building)	On-line September 2012	NA	NA	

Both of these measures were implemented during the Cohort period; however NWE provided no claimed savings values for these measures. This is irrelevant as Site 4 implemented these measures at their new facility and not at the facility where they went through the SEM program. EnerNOC did not take these measures into account in their model.

4.2 Energy 350 Methodology

4.2.1 Baseline

Site 4 provided Energy 350 with data from January 2009 to December 2013. Energy 350 defined the baseline period to be from January 2009 to July 2011.

4.2.2 Variables Used

Energy 350 used the following variables in the energy savings calculations:

Table 19 – Variables used for Site 4 Energy Model

Variable	Interval	Period
Line Items Shipped	Monthly	January 2009 – December 2013
Cooling Degree Days (Base 60°F)	Monthly	
kWh Consumption	Monthly	

Energy 350 employed a multivariate regression to calculate the baseline kWh consumption.

$$Monthly\ kWh = 37{,}638.9 + 0.1296 * LIS + 10.84 * CDD$$

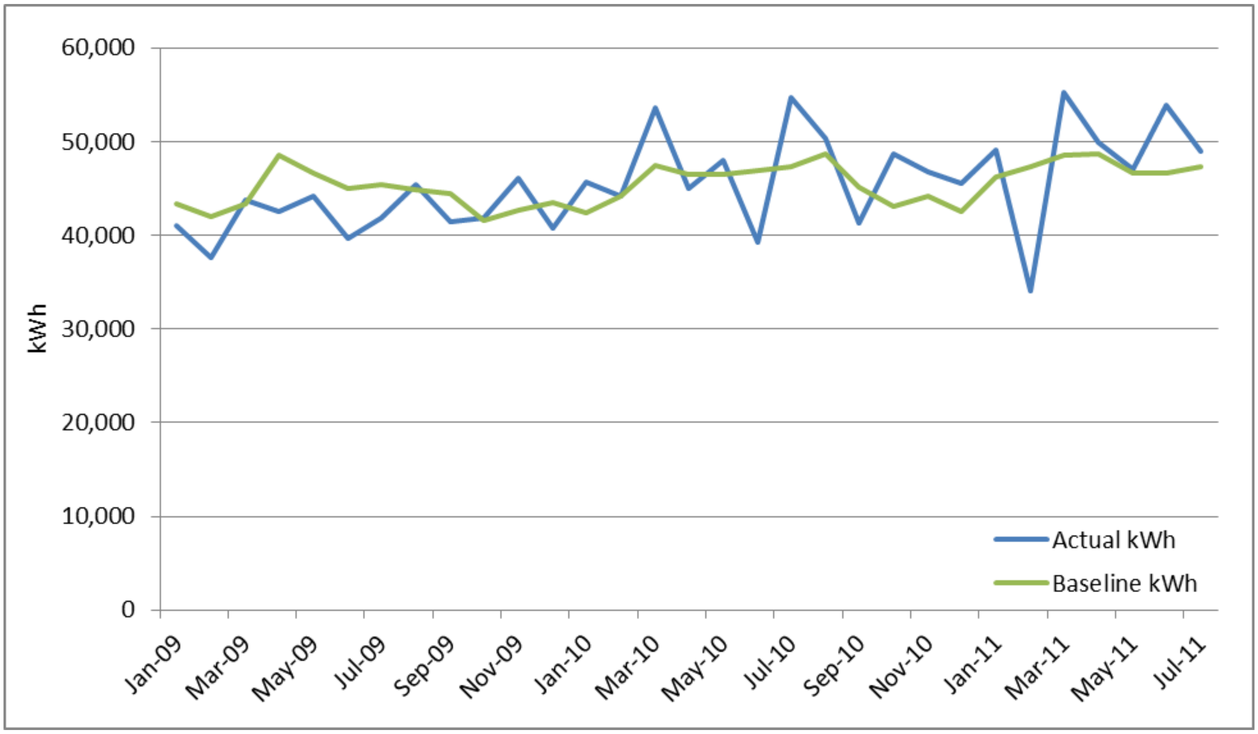
Where ***LIS*** is Line Items Shipped per Month and ***CDD*** is monthly cooling degree days.

4.2.3 Model Validation

As stated in the introduction, Energy 350 analyzed the percent deviation between the actual kWh consumption and modeled kWh consumption during the baseline period to determine the validity of the model. This model had an average monthly deviation of 8.2% with a R^2 value of 0.42. The R^2 value can be attributed to the small variances in the kWh throughout the baseline period.

The facility's main kWh process load is used to produce clothing. Site 4 was not willing to share production data with Energy 350 due to proprietary reasons. While 'Line Items Shipped' is a good indicator of how much product is shipped, the value also includes product that is not produced at the main facility. 'Line Items Shipped' was the best process indicator that was available to Energy 350 over the baseline, in-cohort, and post-cohort periods.

Figure 10 – Actual kWh versus Modeled Baseline kWh



4.2.4 NWE Incentivized Projects

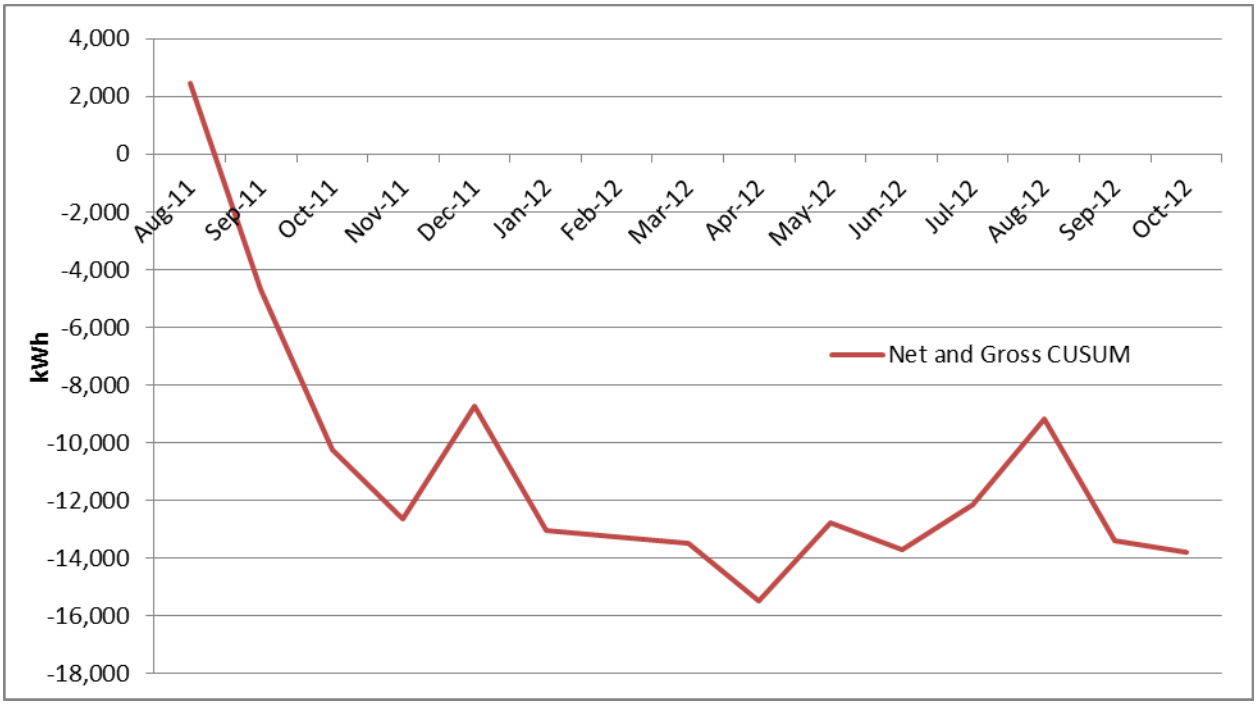
Site 4 implemented a number of energy efficiency projects at their new facility (Moved in November 2012). These are not relevant to the SEM energy model, as the claimed savings can only be associated with the original site associated with the SEM Cohort.

4.2.5 Results

Upon scheduling and conducting the site visit, Energy 350 discovered that the facility has moved. As such, Energy 350 considers the SEM savings for this site to be zero. However, Energy 350 still produced a model to determine if there were savings prior to the facility moving. There were not.

Figure 11 summarizes the cumulative savings that Energy 350 calculated for Site 4’s SEM participation. The ‘Net CUSUM’ reflects the energy savings with the NWE incentivized project reduction.

Figure 11 – Site 4 Gross and Net Cumulative Savings



5. Site 5 Analysis Details

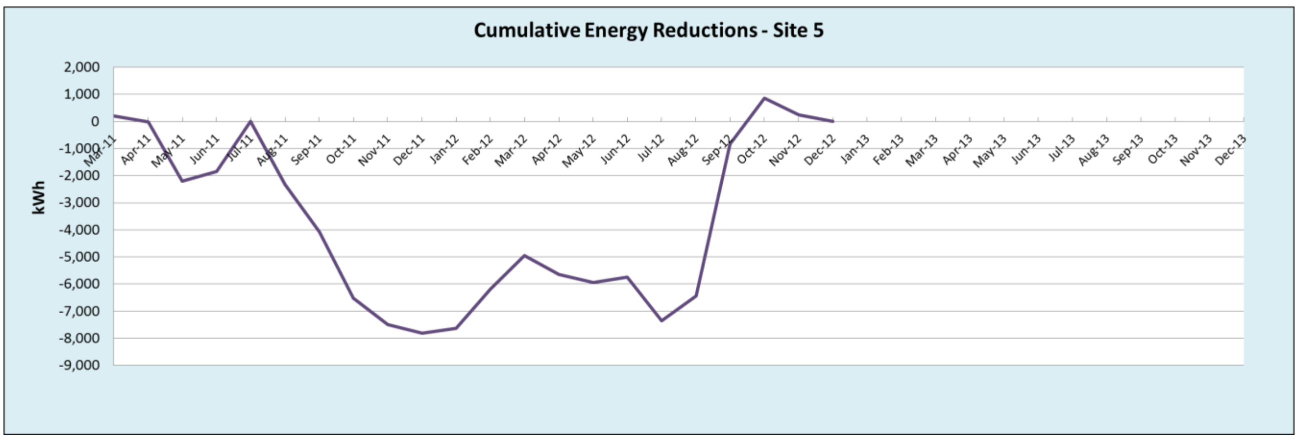
5.1 EnerNOC Methodology

The cumulative estimated net savings calculated by EnerNOC are shown in Table 20 and Figure 12.

Table 20- Site 5 Estimated Net Savings

			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	August 2011 - July 2012	12	1,896	1,896
Post-Cohort	Aug 2012 - May 2013	10	-13,698	-16,438
Total Estimated Two-Year Annualized Savings				-7,271

Figure 12 – Site 5 Cumulative Energy Savings



EnerNOC used the following variables:

- Units produced per month
- CDD (base 65°F)
- Interaction variable between CDD and in-cohort months

The baseline was considered to be from March 2011 to December 2012. This baseline period encompasses the cohort period. EnerNOC used this baseline because they only had production and kWh data starting five months prior to the start of the cohort (March 2011 – July 2011).

Using the variables listed above with the 6 month baseline, EnerNOC established a linear regression to calculate energy savings during the cohort:

$$Monthly\ kWh = 16{,}581.8 + 0.1 * Units\ Produced + 20.7 * CDD65 - 6.6 * Prog$$

Prog represents the interaction variable. This is a product of a standard indicator variable. This variable equaled "1" from August 2011 and on in the model.

5.1.1 NWE Incentivized Measures

Site 5 implemented one energy savings measure that was incentivized by NWE. This is shown in Table 21.

Table 21- NWE Incentivized Measure

Measure Type	NWE Application Date	NWE Annual kWh claimed savings (prescriptive, custom, other)	E+ Program Incentive Amount	Notes
Commercial Electric Existing - (8) Energy Star Computers & (2) Energy Star Servers	On-line November 2011	84,946 824		Data provided by Justin Hoyt (KEMA - NWE's sub contractor) 1. Energy Star Server 42,473 kWh/unit x 2 =84,946 2. Energy Star Computer 103 kWh/unit x 8 = 824

EnerNOC did not mention this measure in their Memo, however did take NWE incentivized measures into account by reducing the savings by 7,148 kWh for November 2011. These savings were not persistent in the model though, meaning that for the in-cohort period savings, the total in-cohort cumulative savings were reduced by 7,148 kWh. Energy 350 does not believe that these savings estimates are valid, and was unable to obtain information on the servers that were replaced.

5.2 Energy 350 Methodology

5.2.1 Baseline

Site 5 was only able to provide Energy 350 with production data from March 2011 to December 2013. Energy 350 defined the baseline period to be from March 2011 to December 2013.

5.2.2 Variables Used

Energy 350 used the following variables in the energy savings calculations:

Table 22 – Variables used for Site 5 Energy Model

Variable	Interval	Period
Cooling Degree Days (Base 65°F)	Monthly	March 2011 - December 2013
kWh Consumption	Monthly	March 2011 - December 2013
Total Produced	Monthly	March 2011 - December 2013
Interaction Variable (1 or 0)	Monthly	March 2011 - December 2013

Energy 350 employed a multivariate regression to calculate the baseline kWh consumption.

$$Monthly\ kWh = 15{,}285.1 + 0.1 * Prod + 16.3 * CDD + 1946.0 * Interaction$$

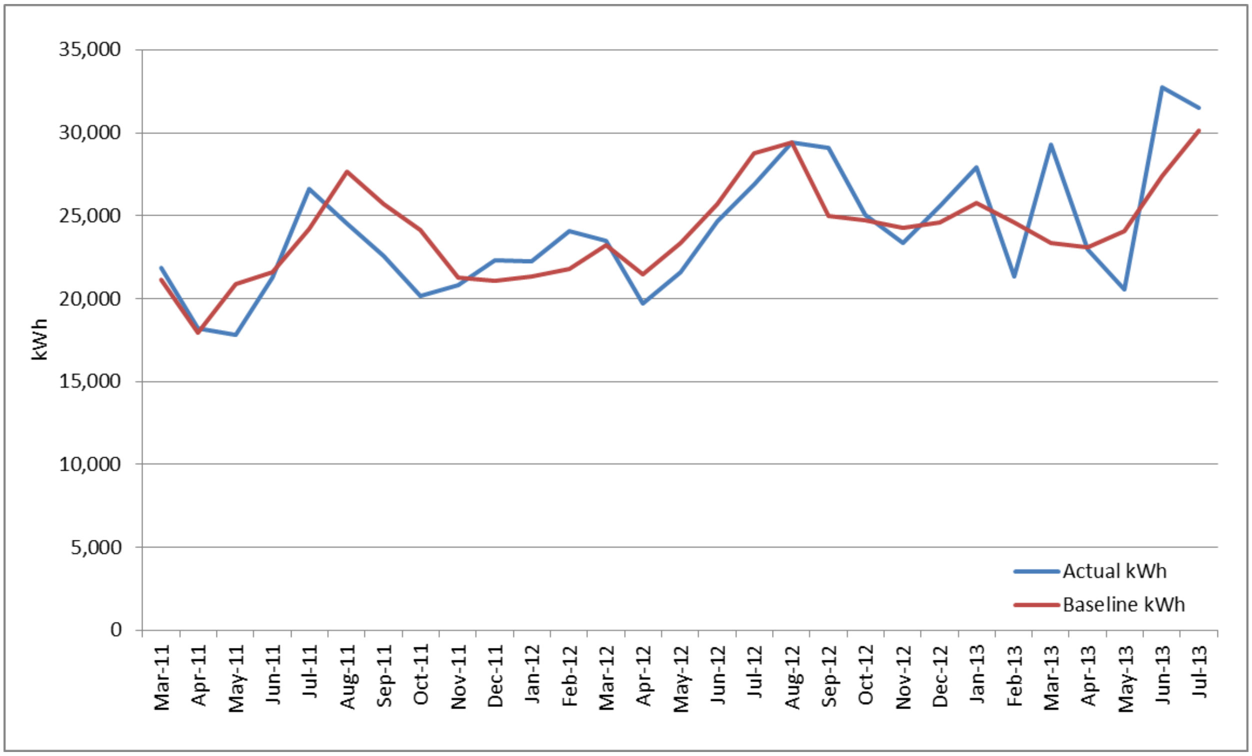
Where ***Prod*** is total items produced per month, ***CDD*** is monthly cooling degree days, and ***Interaction*** is the Interaction variable (0 or 1) that indicates whether or not the month took place before the cohort started or afterwards.

5.2.3 Model Validation

As stated in the introduction, Energy 350 analyzed the percent deviation between the actual kWh consumption and modeled kWh consumption during the baseline period to determine the validity of the model. This model had an average monthly deviation of 9.1% with a R^2 value of 0.52.

Energy 350 confirmed that the process load on the facility is relatively small compared to the HVAC load on the equipment. Most of the products are made with sewing machines, or by manual labor. The largest piece of equipment on site is the high efficiency injection molding machine used to make the manufactured products.

Figure 13 – Actual kWh versus Modeled Baseline kWh



5.2.4 NWE Incentivized Projects

Site 5 installed two Energy Star servers and eight Energy Star computers. NWE claimed that together these units save 85,770 kWh annually. Energy 350 concluded that these values were unreasonably high after considering the power draw on the existing servers and analyzing Site 5's current annual energy consumption. Energy 350 estimated that these units save 9,319 kWh annually. According to the implementation date of the NWE incentivized measures; Energy 350 reduced the gross SEM savings by 8,154 kWh/yr.

Table 23 – Site 5 NWE Incentivized Projects

Date	NWE Incentivized Projects
Aug-11	
Sep-11	
Oct-11	
Nov-11	777
Dec-11	777
Jan-12	777
Feb-12	777
Mar-12	777
Apr-12	777
May-12	777
Jun-12	777
Jul-12	777
Aug-12	777
Sep-12	777
Oct-12	777
Nov-12	777
Dec-12	777
Jan-13	777
Feb-13	777
Mar-13	777
Apr-13	777
May-13	777
Jun-13	777
Jul-13	777
Two Year Total	16,308
Annualized	8,154

5.2.5 Results

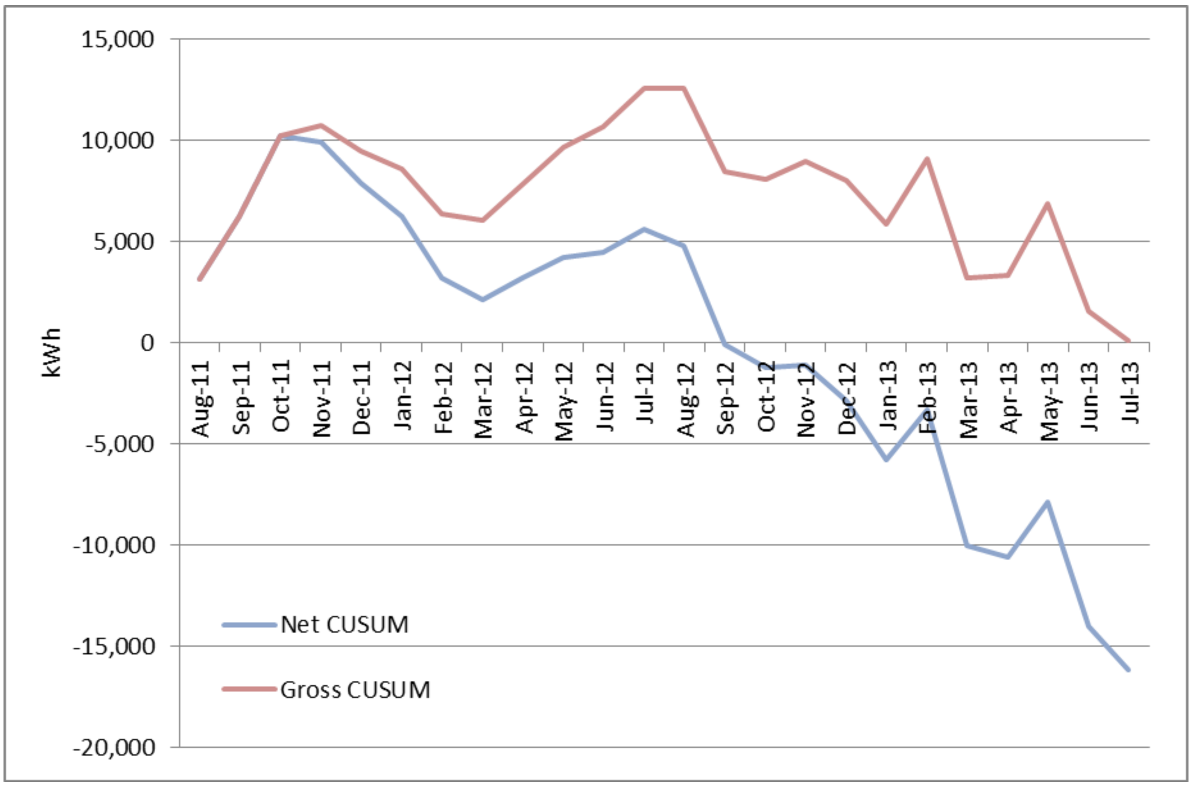
The total in-cohort and post cohort savings can be found in Table 24. Energy 350 calculated the total SEM net savings to be -16,177 kWh and on average -8,089 kWh/yr.

Table 24 – Site 5 SEM Energy Savings

Period	Gross Savings (kWh)	NWE Reductions (kWh)	Net Savings (kWh)
In-Cohort	12,581	6,989	5,592
Post-Cohort	-12,451	9,319	-21,769
Total	65	8,154	-8,089

Figure 14 summarizes the cumulative savings that Energy 350 calculated for Site 5's SEM participation. The 'Net CUSUM' reflects the energy savings with the NWE incentivized project reduction.

Figure 14 – Site 5 Gross and Net Cumulative Savings



6. Site 6 Analysis Details

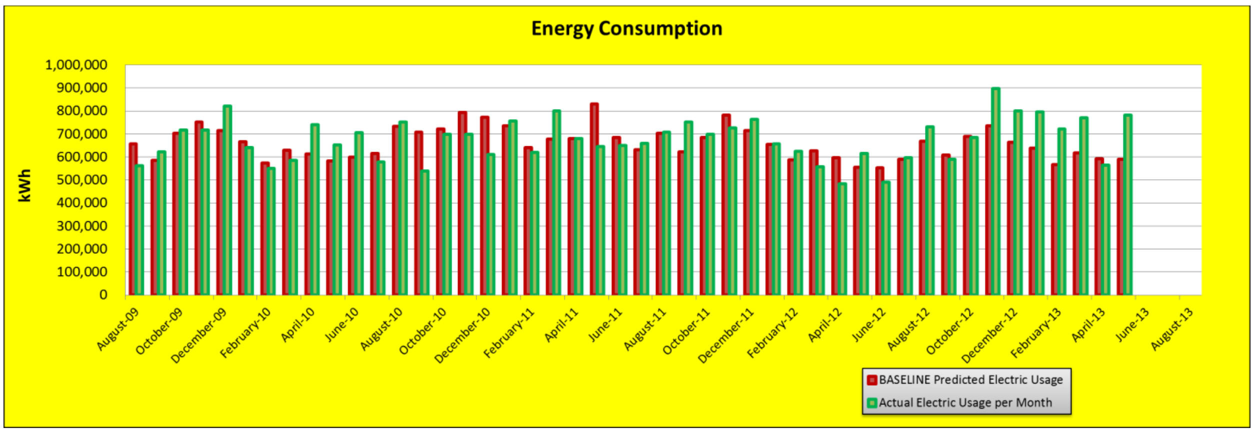
6.1 EnerNOC Analysis

The baseline period used in this analysis was from August 2009 to August 2012. A key performance indicator (KPI) was used to model the baseline energy consumption. This key performance indicator used was based on the millions of gallons processed and was adjusted to reflect a trended increase in energy consumption over the baseline period, as well as seasonal indices. This equation is given as:

$$Monthly\ kWh\ =\ [Trend\ \ +\ Seasonal\ Index]\left(\frac{kWh}{MG}\right)x\ Monthly\ Treatment\ Volume\ (MG)$$

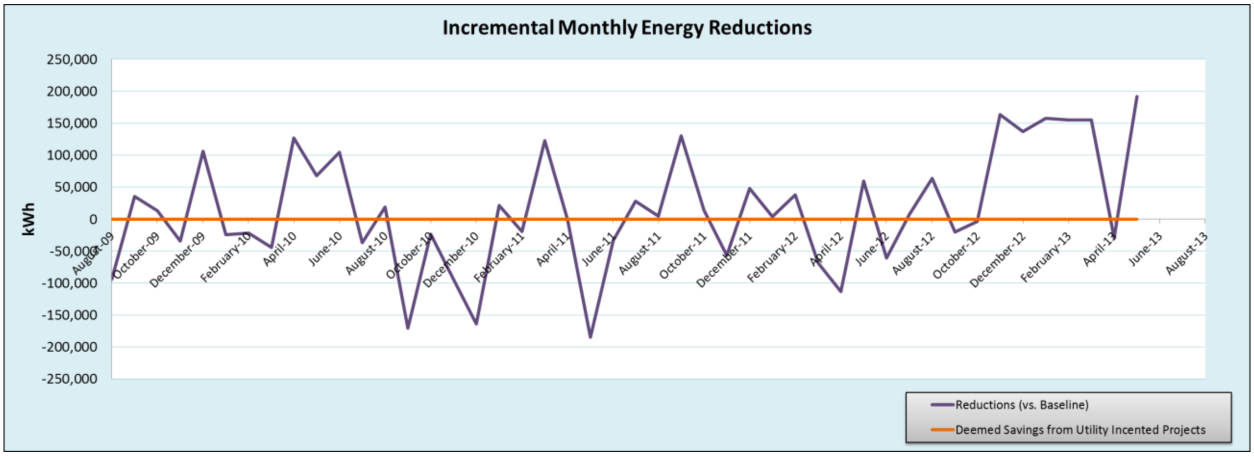
This linear equation uses a trend that has the date as an input, indicating over time the kWh/MG rate will increase. Furthermore, the seasonal index accounts for the average deviation for each month in the baseline from the trended value. This means it takes the average deviation from the trended baseline for each month and uses the average difference to correct the monthly rate. Finally, the actual MG of processed wastewater is multiplied by the adjusted slope to result in the baseline energy consumption. Figure 15 shows the baseline vs actual energy consumption.

Figure 15 – Site 6 Baseline and Actual Energy Consumption



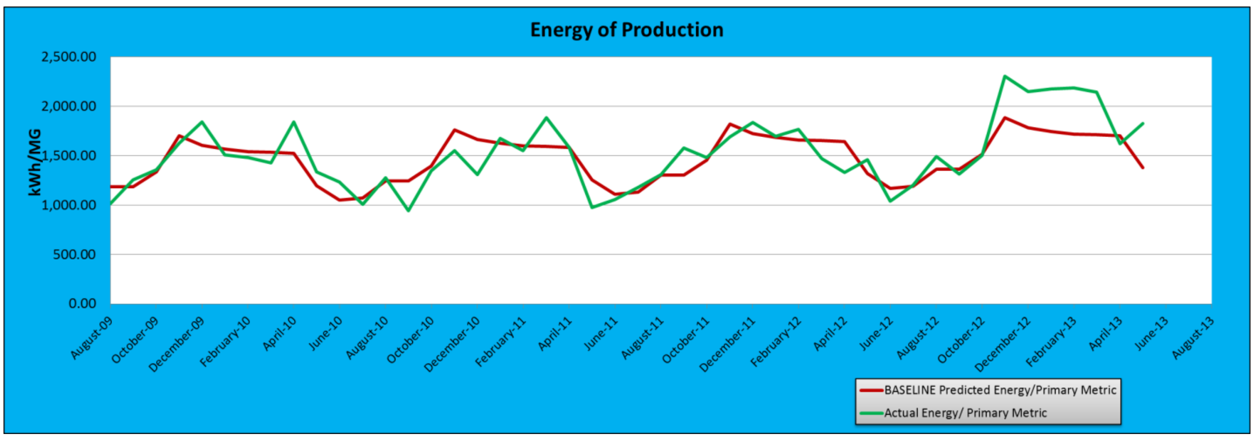
It can be seen from this figure that the actual energy consumption fluctuates from about 480,000 kWh/month to about 900,000 kWh/month. The month-to-month fluctuation is also fairly high with an average fluctuation during the baseline period of 90,054 kWh. The average difference between the baseline and the actual energy consumption during the baseline period is about 60,000 kWh/month (10% of the average value). These variations can be seen in Figure 16.

Figure 16 – Site 6 Monthly Energy Savings



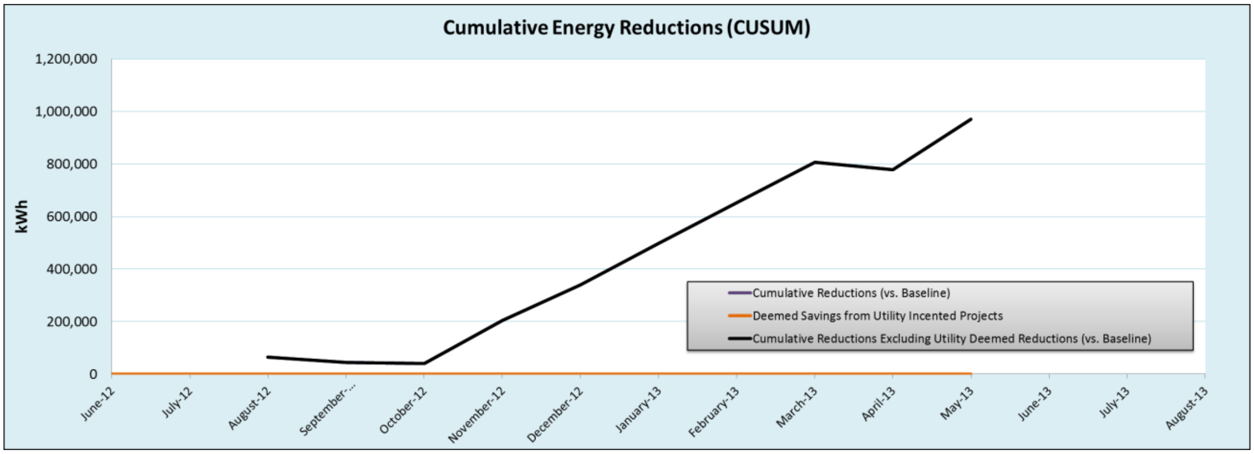
The calculated energy consumption for the baseline period as well as the in-cohort period is based primarily on the KPI millions of gallons per day treated by the facility. Figure 17 shows the baseline energy of production and the actual energy production.

Figure 17 – Site 6 Baseline and Actual Energy of Production



The differences in the baseline and actual values here are taken through to the energy production calculation. When the energy savings for each month are cumulatively added, the result is an increase of 2,011,044 kWh/annually. The cumulative sum of the savings is given in Figure 18.

Figure 18 – Site 6 Cumulative Energy Savings



The cohort period lasted 10 months; the annualized energy savings are shown in Table 25- Site 6 Ex-Ante Savings SummaryTable 25 (taken from EnerNOC's Modeled Savings Memo).

Table 25- Site 6 Ex-Ante Savings Summary

Measurement Period			Estimated Net Savings (kWh)	
Period	Dates	Months	Period	Annualized
In-Cohort	Aug 2012 - May 2013	10	-1,675,870	-2,011,044

Ultimately, this model showed a net increase in average energy consumption during the cohort period of approximately 100,000 kWh/month compared to the calculated baseline. This deviation can be traced to the differences in actual and baseline energy production value, the results of which are shown in Figure 11. The differences in this value are rippled through to the baseline energy calculations, resulting in an overall ineffective model of the facility. The extreme variation in the kWh/MG value is indicative that the process energy consumption is not solely dependent on the amount of water that is treated.

Figure 10 demonstrates the variation in calculated energy compared to actual energy. This graph shows there is little trend regarding whether the baseline is consistently above or below the actual energy consumption. Furthermore, during the cohort participation, there was a noticeable increase in the energy consumed compared to the previous years and MG processed.

6.2 Energy 350 Methodology

6.2.1 Baseline

Monthly data was available for all the parameters for 20 months prior to the cohort (January 2011 – July 2012). The baseline period extended the length of the available data prior to the cohort.

6.2.2 Model Validation

The steady power consumption could not yield a statistically valid regression model; instead, a comparison of annualized baseline energy consumption is compared to the annualized post-cohort energy consumption. The difference between the two annualized energy consumptions with NWE incentivized projects accounted for is the reported energy savings.

6.2.3 Results

With a valid model, the energy savings as a result of the SEM program are calculated using the difference in actual and predicted energy. The Site 6 resulted in a net *increase* in annual energy consumption of 660,060 kWh. Table 26 summarizes the energy analysis.

Table 26- Site 6 Ex-Post Energy Savings Analysis

Annualized Baseline Energy (kWh)	Annualized Post-Cohort Energy (kWh)	Energy Savings (kWh)
7,886,318	8,546,378	-660,060

7. Site 7 Analysis Details

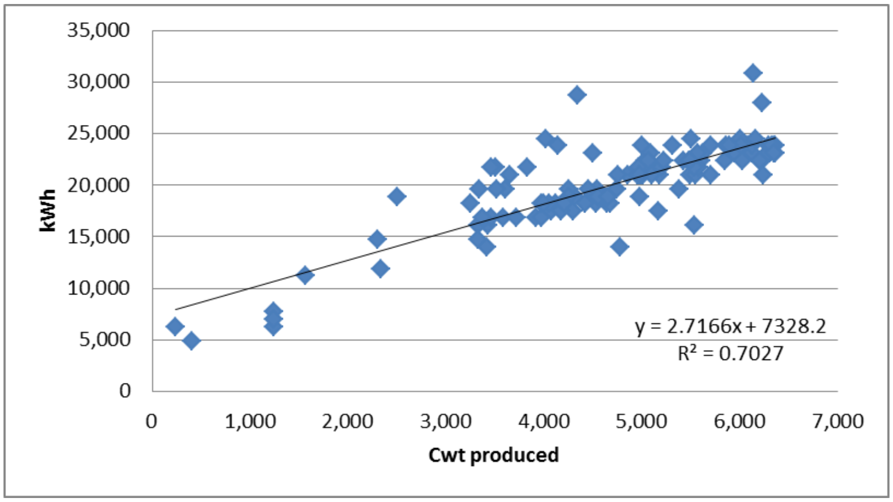
7.1 EnerNOC Analysis

Because there was no data available prior to the SEM program, the baseline period had to be during the in-cohort period. The baseline totaled 119 days, lasting from July 23, 2012 to January 5, 2013. This regression model was developed during this period using Cwt produced as the KPI. The resulting model equation is:

$$Daily\ kWh = 7328.19 + (2.717 * Cwt/day)$$

The regression is shown in Figure 19.

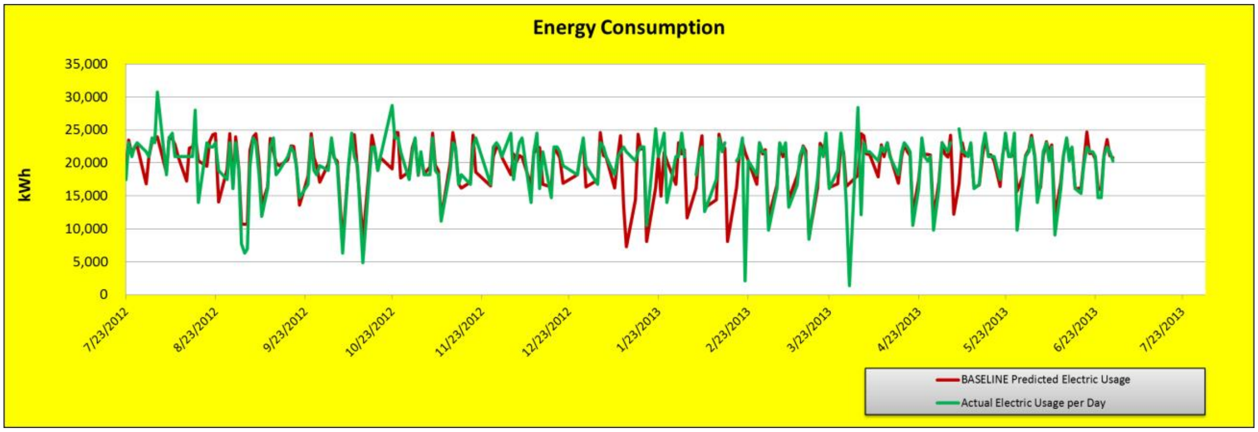
Figure 19- Site 7 Cwt Regression



The regression has a good correlation that results in the baseline and actual energy consumption shown in

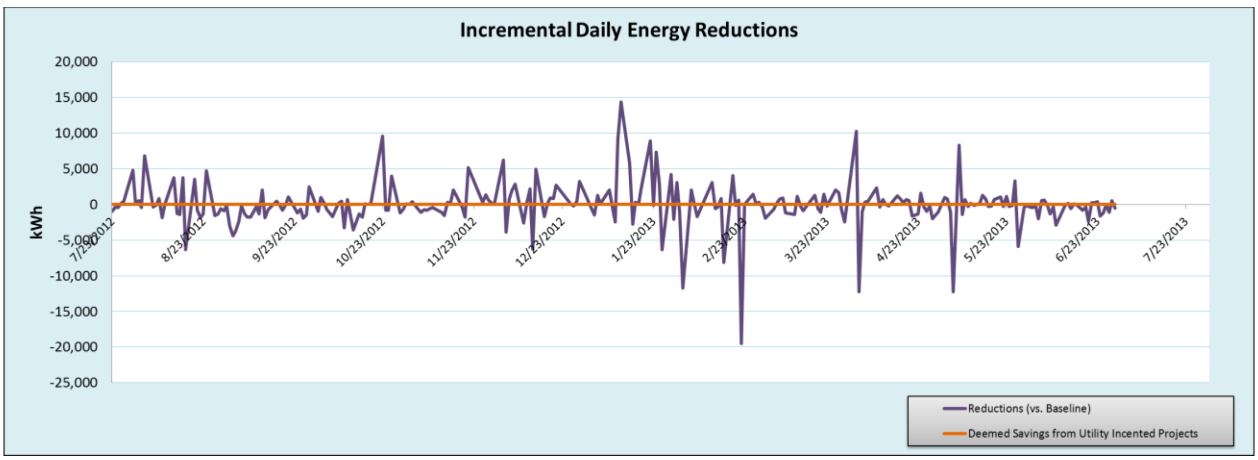
Figure 20.

Figure 20- Site 7 Daily Energy Consumption



This figure shows the baseline following the actual energy consumption pretty closely, except during the periods of low to no production (predominantly during January). Figure 21 shows the daily energy reductions.

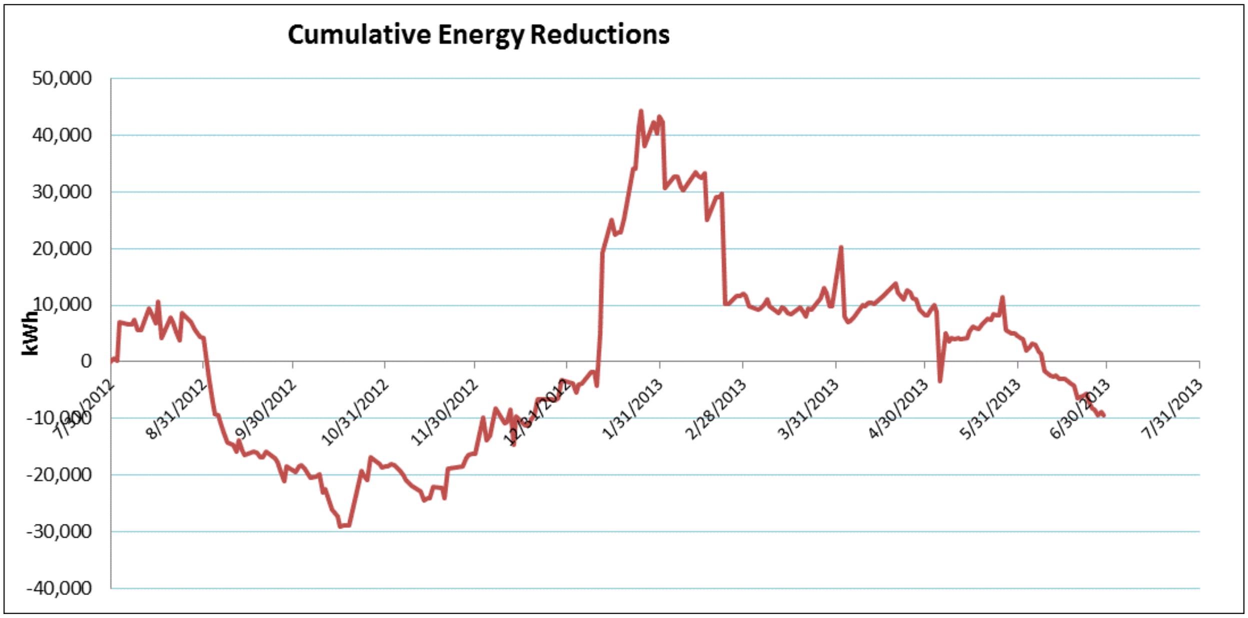
Figure 21- Site 7 Daily Energy Reductions



The graph shows how close (or distant) the baseline and actual energy are. The largest deviation is during the month of January and a little into February. This deviation of energy is actually pretty large when compared to the actual daily energy.

Ultimately, the facility had cumulative energy savings, or a decrease in actual energy consumption compared to the modeled values, by the end of the cohort. The annualized savings result in 13,807 kWh/yr. These savings are shown in Figure 22.

Figure 22- Site 7 Cumulative Energy Savings



This graph depicts energy savings during the baseline period, and then a drastic increase predominantly during January. The ending energy savings during the in-cohort period is 9,419 kWh over 249 days of data. Table 27 summarizes the energy savings.

Table 27- Site 7 Ex-Ante Savings Summary

Measurement Period			Estimated Net Savings (kWh)	
Period	Dates	Days	Period	Annualized
In-Cohort	Aug 1, 2012 - June 29, 2013	249	9,419	13,807

The correlation between Cwt of milled grain produced to energy consumption is strong, as the weight produced is the primary metric for energy consumption. Daily data is also very useful and provides many data points on which to base the regression model. The days where data was inadequate or not recorded were omitted from the regression as necessary. For this analysis, a key performance indicator is a relatively good fit; however, there are a few identified issues.

The cumulative savings depicted in Figure 22 show there is a net energy savings during the baseline period. Savings during the baseline period should not be considered because the baseline should be as close to the actual energy consumption as possible. There is also a large increase in energy production during January, the cause of which is unknown. The KPI also aggregates the various byproducts of the milling process, despite the different stages of the process in which they are produced.

The current regression model does a good job of estimating the energy consumption based on production weight. A more accurate model may be developed with extended trend data, and consideration of other parameters that could affect energy consumption.

7.2 Energy 350 Methodology

7.2.1 Baseline

The baseline period for Site 7 was difficult to determine because there is no historical data prior to the cohort. As a result, the baseline period is July 2012 – January 2013. During this period, daily data was collected and verbal confirmation from facility personnel indicated there were no operational changes that occurred during the first part of the SEM program. The Energy 350 baseline is the same as the EnerNOC baseline, except Energy 350 does not calculate savings during this period.

7.2.2 Variables Used

The only variable found that directly impacts energy consumption at the facility is the milled grain produced, recorded in hundred-weight (Cwt).

Table 28- Variables Used for Site 7 Energy Model

Variable	Interval	Period
Milled grain production (Cwt)	Daily	July 2012 – December 2013

Additional parameters were considered and used to create a new regression; however the factors did not add value to the model.

7.2.3 Model Validation

EnerNOC's model was validated through independent data collection and regression analysis. The only changes to the model were ensuring no energy savings were being calculated during the baseline period, and extending the data collection to the end of 2013. This redefinition of a baseline changes the periods that savings are recorded; in-cohort savings are now from January 2013 – June 2013, and post-cohort savings are from July 2013 – December 2013. EnerNOC's model was validated, but the savings periods have been redefined.

7.2.4 NWE Incentivized Savings

The reported annual energy savings from NWE for this site are a result of a compressor VFD upgrade. An annual savings yielded a daily savings of 208.14 kWh/day. The installation date of this project is October 18, 2013. The incentivized savings considered during the post-cohort measurement period are 15,611 kWh.

7.2.5 Results

The extension of the data collection period resulted in an increase in annualized energy savings. The in-cohort period is six months, and the post-cohort period is six months. The annualized energy savings are therefore the sum of the energy savings of both periods. Table 30 summarizes the annualized energy savings.

Table 29- Site 7 Ex-Post Energy Savings Analysis

Period	Actual Energy	Modeled Energy	NWE Incentivized Savings	Energy Savings
In-Cohort	2,748,950	2,753,744	0	4,794
Post-Cohort	3,136,375	3,249,330	15,611	97,344
Total	**5,885,325**	**6,003,074**	**15,611**	**102,138**

8. Site 8 Analysis Details

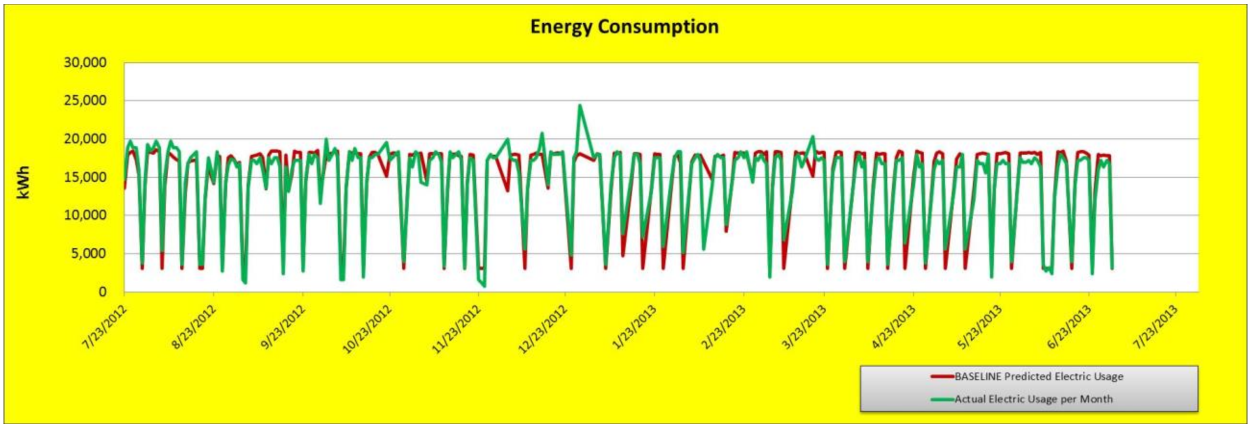
8.1 EnerNOC Analysis

Similar to Site 7, Site 8 started recording daily energy consumption and milled grain production in Cwt for the baseline during the cohort. Site 8's baseline period lasted from July 23, 2012 to January 6, 2013 totaling 150 days with no data gaps. The regression model was developed during this period with Cwt as the performance indicator. The resulting equation used to estimate energy consumption is:

$$Daily\ kWh = 3418.216 + 2.699 * Cwt/day$$

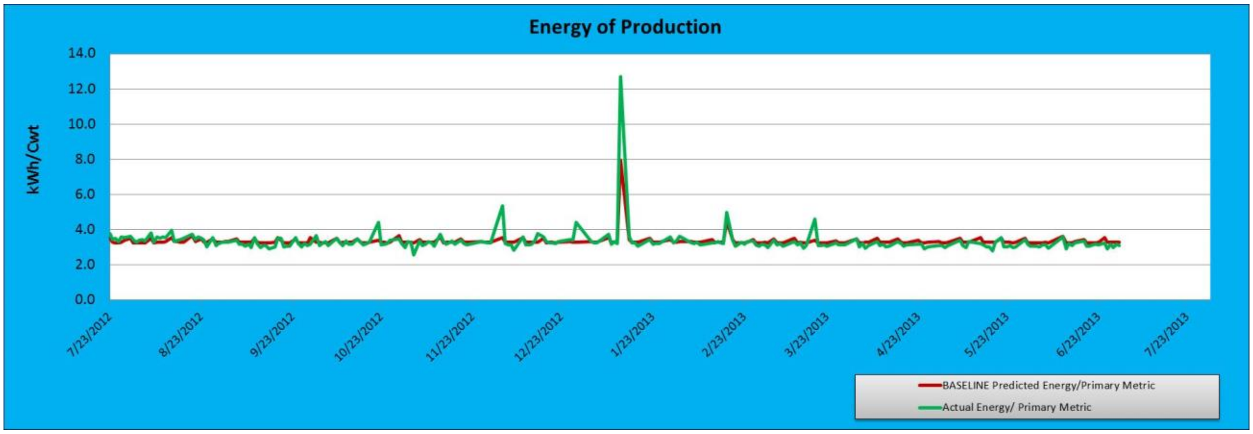
Using this equation, the annual baseline and actual energy consumption is shown in Figure 23.

Figure 23- Site 8 Daily Energy Consumption



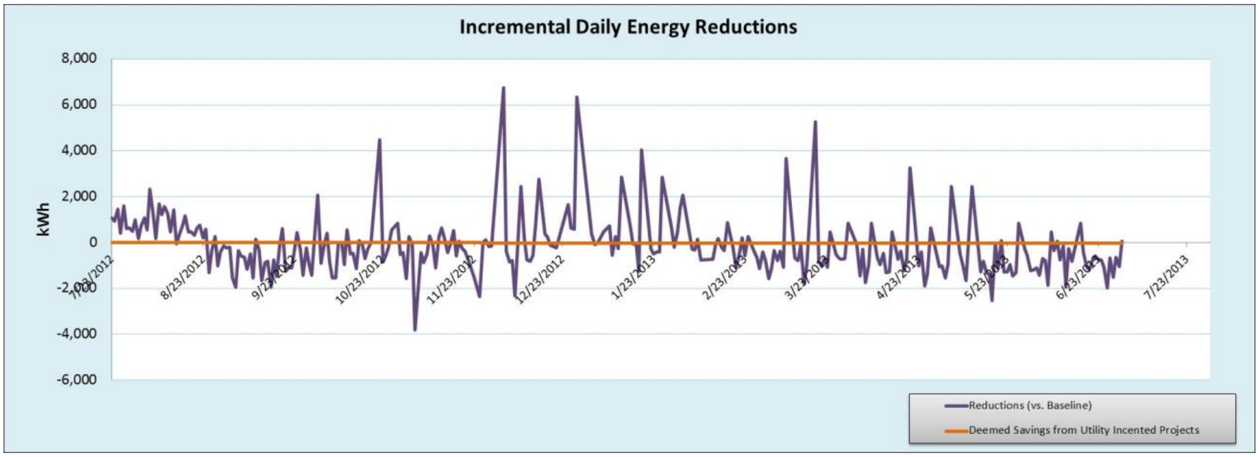
The actual and baseline daily energy consumption follow the same pattern with little deviation or anomalies. The comparison of the baseline KPI and actual KPI is shown in Figure 24.

Figure 24- Site 8 Daily KPI



This facility's KPI hovers around 3.7 most of the time, with some spikes occurring during times of low production. The baseline closely follows the actual performance indicator during the in-cohort period. The daily fluctuation of energy consumption is low compared to the facility's total energy consumption, as seen in Figure 25.

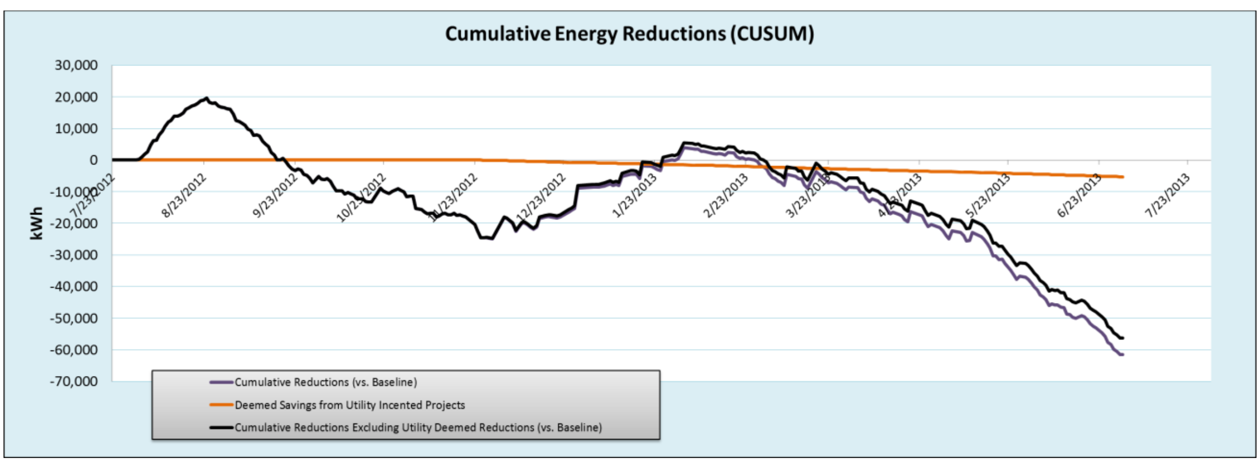
Figure 25- Site 8 Daily Energy Savings



The overestimations of energy consumption are most frequent in the heating season, but are small in magnitude compared to Site 7. Overall, the daily incremental energy reductions are close to the actual energy, especially during the baseline period.

The resultant net energy savings is a calculated to be -56,169 during the cohort. These savings take the incentivized savings of LED lighting project (which total 5,307 kWh during the cohort), but do not add the VFD savings to this. Figure 26 depicts the cumulative savings.

Figure 26- Site 8 Cumulative Energy Savings



This figure shows the savings during the baseline period as adding to the overall savings. The cumulative in-cohort and annualized savings are summarized in Table 30.

Table 30- Site 8 Ex-Ante Savings Summary

Measurement Period			Estimated Net Savings (kWh)	
Period	Dates	Days	Period	Annualized
In-Cohort	Aug 1, 2012 - June 29, 2013	285	56,196	71,970

Similar to Site 7, the KPI of Cwt produced is a good parameter to estimate energy consumption; this regression model has an even stronger correlation. There was data for all days, which helped strengthen the regression. There was little deviation from the actual energy consumed, further validating the model.

The concerns we have are with the baseline period being during the measurement period, and with the incentivized savings not matching those claimed by NWE. The savings that were accumulated during the baseline period are a result of inaccuracy in the model (baseline values should match actual values, or at least be as close as possible). Any deviation should not be considered in cumulative net savings.

8.2 Energy 350 Methodology

8.2.1 Baseline

The baseline period for Site 8 is similar to Site 7 because there is no historical data prior to the cohort. As a result, the baseline period is July 2012 – January 2013. During this period, daily data was collected and verbal confirmation from facility personnel indicated there were no operational changes that occurred during the first part of the SEM program. The Energy 350 baseline is the same as the EnerNOC baseline, except Energy 350 does not calculate savings during this period.

8.2.2 Variables Used

The only variable found that directly impacts energy consumption at the facility is the milled grain produced, recorded in hundred-weight (Cwt).

Table 31- Variables Used for Site 8 Energy Model

Variable	Interval	Period
Milled grain production (Cwt)	Daily	July 2012 – December 2013

Additional parameters were considered and used to create a new regression; however the factors did not add value to the model.

8.2.3 Model Validation

EnerNOC's model was validated through independent data collection and regression analysis. The only changes to the model were ensuring no energy savings were being calculated during the baseline period, and extending the data collection to the end of 2013. This redefinition of a baseline changes the periods that savings are recorded; in-cohort savings are now from January 2013 – June 2013, and post-cohort savings are from July 2013 – December 2013. EnerNOC's model was validated, but the savings periods have been redefined.

8.2.4 NWE Incentivized Projects

This is the only site in Cohort 2 with a NWE incentivized project. The reported savings from an LED lighting upgrade are 31 kWh/day, resulting in 10,889 kWh in savings by December 31, 2013. The project was completed on November 26, 2012.

8.2.5 Results

The extension of the data collection period resulted in a slight decrease in annualized energy savings compared to EnerNOC's model. The in-cohort period is six months, and the post-cohort period is six months. The annualized energy savings are therefore the sum of the energy savings of both periods. Table 32 summarizes the annualized energy savings for Site 8.

Table 32- Site 8 Ex-Post Energy Savings Analysis

Period	Actual Energy	Modeled Energy	Energy Savings
In-Cohort	2,167,866	2,203,633	35,767
Post-Cohort	2,687,625	2,721,596	33,971
Total	**4,855,491**	**4,925,229**	**69,738**

9. Site 9 Analysis Details

9.1 EnerNOC Analysis

The energy tool model provided by EnerNOC is inconsistent with the 2nd Cohort Findings memo. There are two data entry tabs, one that includes energy consumption and production data dating from October 2012 to June 2013 but does not include employee count, and one that has data from September 2011 to December 2012 including employee count. The energy model equation reported in the findings memo is:

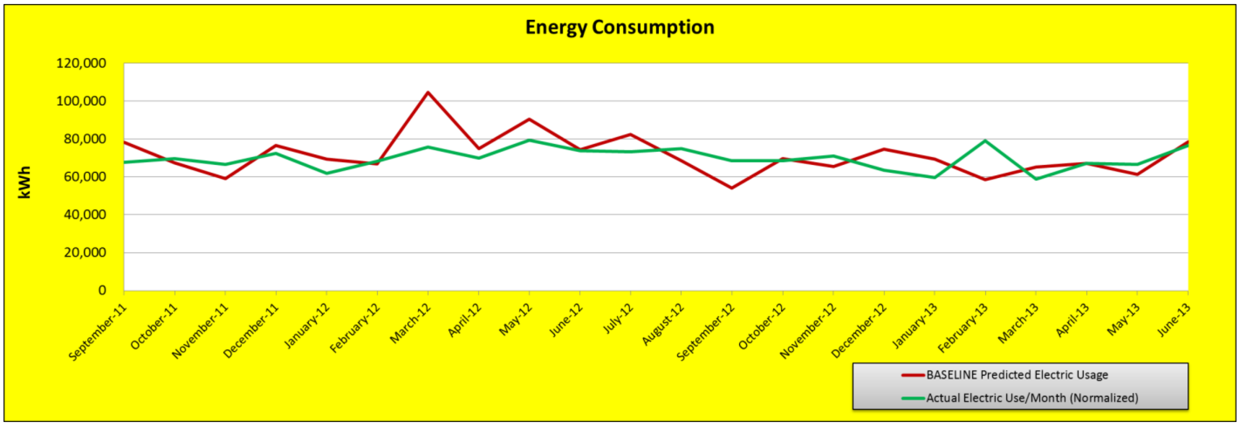
$$Monthly\ kWh = (88.03 * Adjusted\ Qty/month) + (460.47 * Employees/month)$$

The adjusted quantity per month is found using:

$$Adjusted\ Qty = (\#\ lifting\ tools/166.1) + Equipment$$

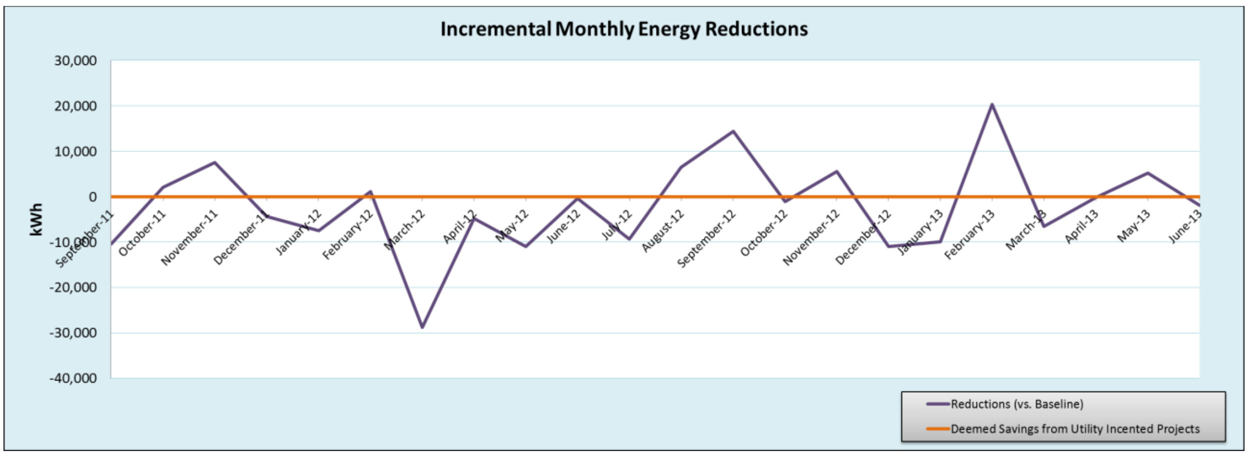
Graphs from the energy tool are actually calculated using a KPI of kWh per unit produced. This value was 329.1 kWh/unit. With the baseline period of September 2011 to June 2012, the baseline predicted energy consumed compared to the actual energy consumption is shown in Figure 27.

Figure 27- Site 9 Monthly Energy Consumption



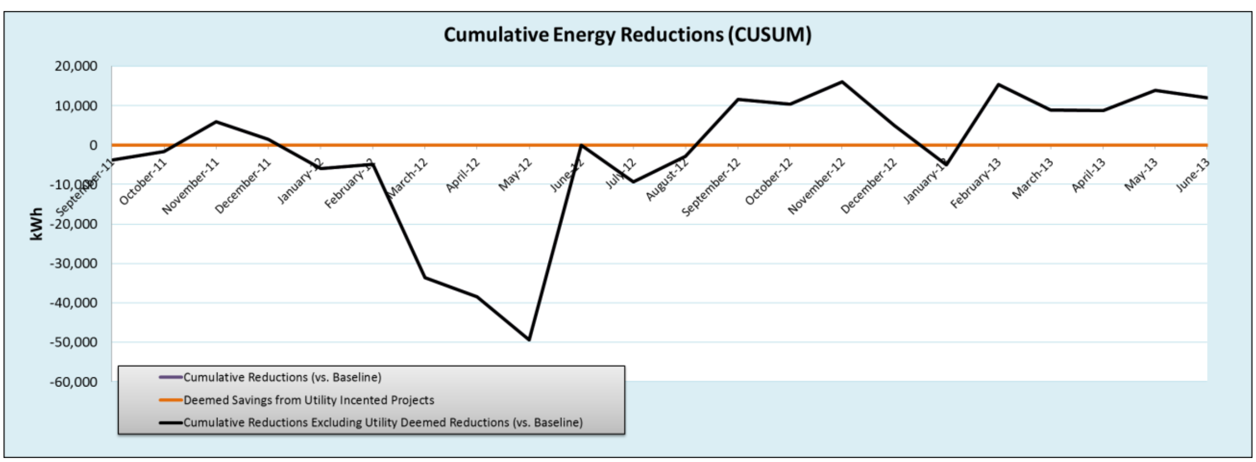
The incremental monthly reductions can be seen in Figure 28. The fluctuation of up to 30,000 kWh is a significant portion of the facility's energy use.

Figure 28 - Site 9 Monthly Energy Savings



The cumulative savings are shown in Figure 29.

Figure 29- Site 9 Cumulative Energy Savings



The cumulative savings were calculated starting after the end of the baseline period June 2012. The cumulative savings ended with at an increase in energy consumption of 11,941 kWh during the cohort period. The findings memo reported an in-cohort production increase of 8,652 kWh. Table 33 summarizes the memo results and energy tool results.

Table 33- Site 9 Energy Savings Summary

Measurement Period			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
Memo	Aug 2012 - June 2012	11	-8,656	-9,439
In-Cohort	Aug 2012 - June 2013	11	-11,941	-13,026

This facility has undergone several analyses to try and accurately predict the energy consumption; two of the models' findings were available. One of the models used production and employee data with fewer data points, and one used only production data with more data points. With the two different versions of the model, the more accurate is the one that considers the employee count as well as the production. Those two parameters form a closer correlation for energy consumption, but they still result in a net increase in energy consumption compared to the predicted value. This regression uses good indicators and has a good correlation. The two parameter model is the preferred model if a more accurate model cannot be developed.

9.2 Energy 350 Methodology

9.2.1 Baseline

Monthly data is available from January 2008 to December 2013. The baseline period ranges from January 2008 to July 2012. This three and a half year baseline period provides good insight to the average energy consumption of the facility.

9.2.2 Model Validation

The relatively constant annual energy consumption led to the statistical insignificance of a regression model based on selected parameters. The method of calculating energy savings is therefore a comparison of the annualized baseline energy consumption to the annualized post-cohort energy consumption.

9.2.4 Results

The analysis resulted in an annualized net increase of 25,468 kWh in facility energy consumption. The facility is not surprised with a net increase in energy consumption as their recent equipment products have been larger and more intricate than previously. Furthermore, the facility has done little to implement aspects of the SEM program, but good progress for implementation is being made. The facility claims a lack of human and financial resources as the main barrier to implementation.

Table 34: Ex-Post Energy Savings Analysis

Annualized Baseline Energy Consumption	Annualized Post-Cohort Energy Consumption	Energy Savings
815,306	840,773	-25,468

10. Site 10 Analysis Details

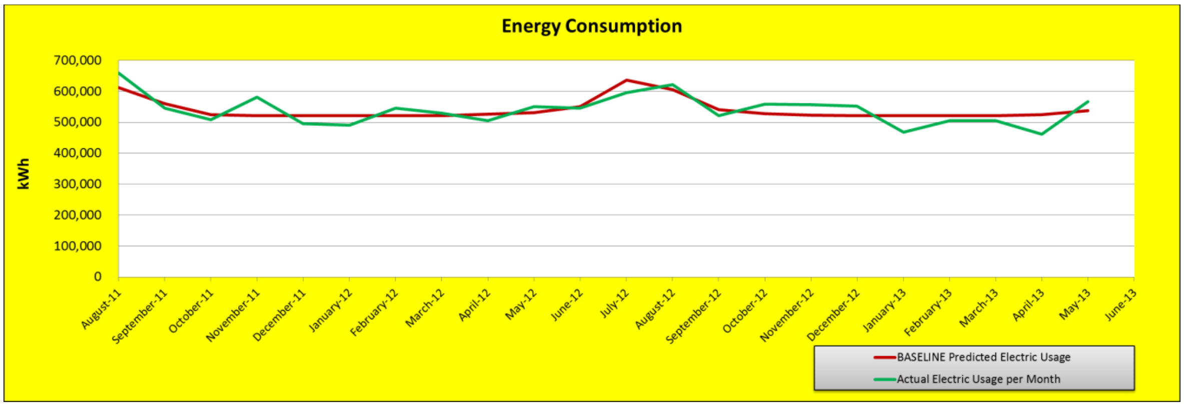
10.1 EnerNOC Analysis

The KPI that was selected for this facility was CDD with a base of 60°F. Pounds of production were initially tested, but results yielded that the parameter was statistically insignificant. The baseline period was from August 2011 to September 2012. The statistical model developed to estimate the energy consumption is:

$$Monthly\ kWh = 521{,}840.72 + (265.81 * CDD)$$

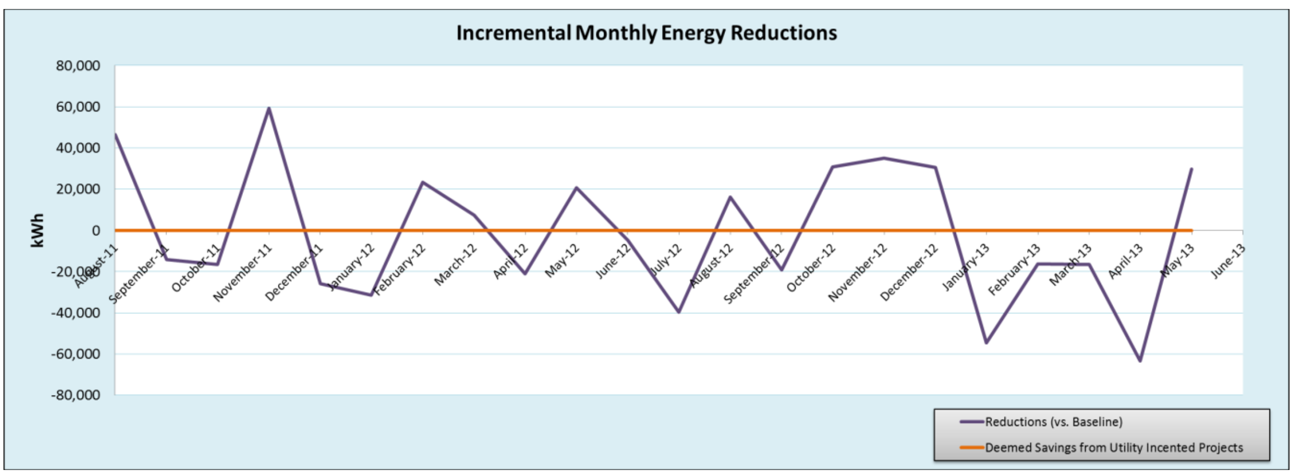
This model results in predicted baseline and actual energy consumption shown in Figure 30.

Figure 30- Site 10 Energy Consumption



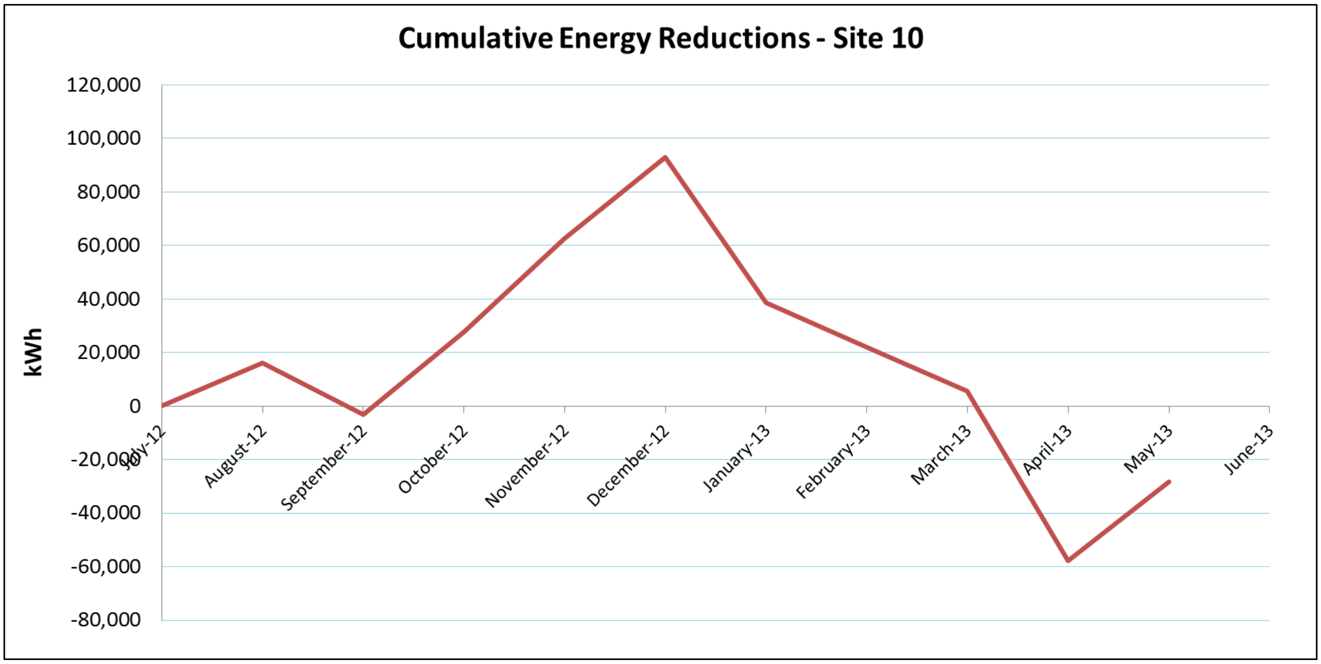
The actual and baseline predicted energy consumption correlate well, but the actual consumption has much more variation on monthly basis. The monthly energy reductions shown in Figure 31 show the fluctuations better.

Figure 31 – Site 10 Monthly Energy Savings



Monthly fluctuations can reach as high as 60,000 kWh, or approximately 10% of the average monthly consumption. These monthly reductions aggregated are shown in Figure 32.

Figure 32- Site 10 Energy Savings



Cumulative energy savings are aggregated starting July 2012 because the facility joined the cohort one month later. The savings for the facility are summarized in Table 35.

Table 35 - Site 10 Savings Summary

Measurement Period			Estimated Net Savings (kWh)	
Period	**Dates**	**Months**	**Period**	**Annualized**
In-Cohort	Aug 2012 - May 2013	10	28,211	33,853

The regression model developed for this facility is accurate when comparing the predicted and actual energy consumption. There is a baseline period of 14 months, although more data is available. The determination of the production being statistically insignificant is a crucial analysis that demands further scrutiny. Using CDD as a primary indicator gets the predicted energy consumption pretty close to the actual energy consumption, but discounting production entirely is inaccurate. The end savings do not seem unreasonable, but the KPI does not account for changes in production. The lowest monthly energy consumption possible from the developed model is 521,840 kWh, although the actual shows it as low as 461,091 kWh/yr. The regression is strongest in the summer months (months with higher CDD) and weaker in winter months.

10.2 Energy 350 Analysis

10.2.1 Baseline

Data is available from January 2011 – December 2013. The data is measured monthly and ranges from January 2011 – July 2012. This baseline is uses all available historical data for the facility.

10.2.2 Variables Used

This polynomial regression uses seven parameters to estimate energy consumption, as seen in Table 36.

Table 36- Variables Used for Site 10 Energy Model

Variable	Interval	Period
Average Temperature	Monthly	January 2011 – December 2013
Line 1 Production	Monthly	
Line 2 Production	Monthly	
Line 3 Production	Monthly	
Line 5 Production	Monthly	
Waste	Monthly	
Regrind	Monthly	
kWh Consumption	Monthly	

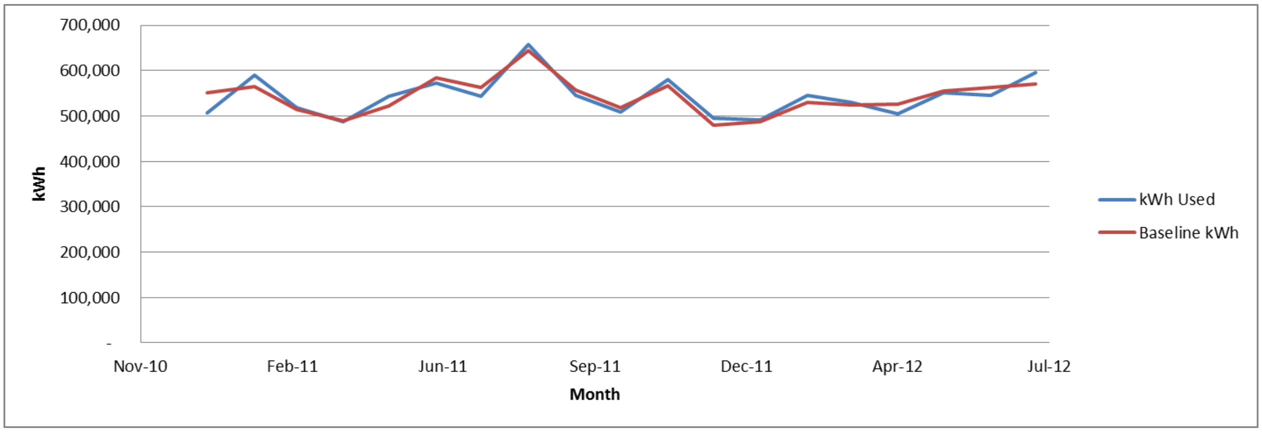
Each parameter uniquely affects energy consumption at Site 10. The different lines of production produce different types of food, requiring different kWh/lbs produced. The waste is not capture in production numbers, but represents additional energy consumed. The regrind is also an additional energy consumer, and is rolled into the production data. The average temperature is an indicator of humidity and temperature control in the facility.

10.2.3 Model Validation

The detailed production data resulted in a highly correlative model with an R^2 of 0.82 and an average percent difference of 2.71%. This baseline model is the best model because of the individual components of energy per unit of production is more accurately captured.

Figure 33 shows the baseline actual and modeled monthly energy consumption.

Figure 33 – Site 10 Baseline Actual vs. Modeled Monthly Energy Consumption



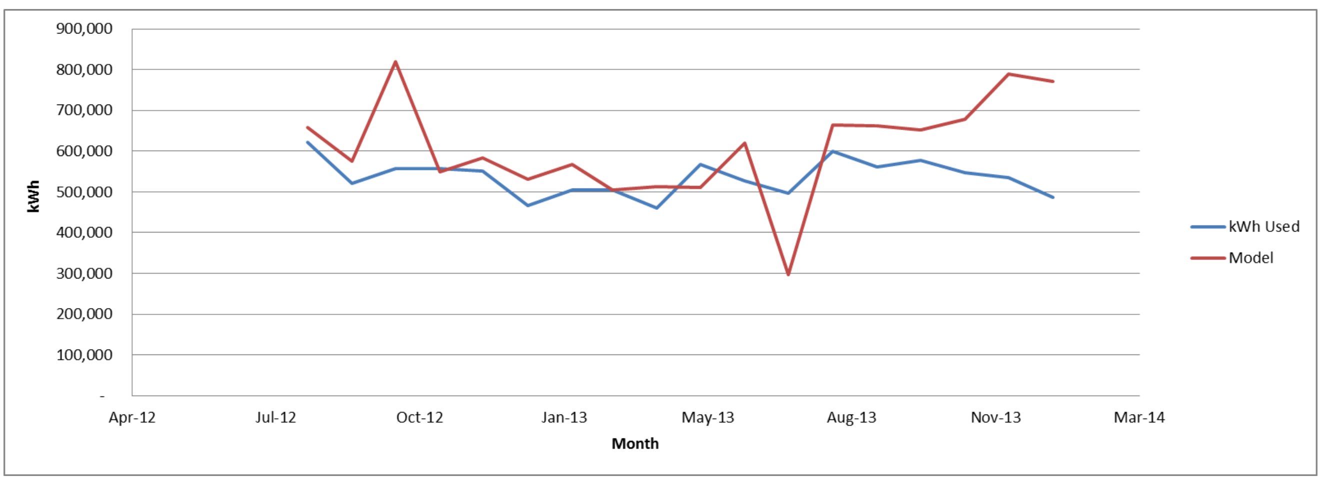
10.2.4 Results

The regression model analysis resulted in an annualized energy savings of 867,997 kWh. Site 10 has been proactive in implementing energy efficiency into their standard operating procedure, and has a multi-disciplinary energy team that meets regularly. The impacts of the SEM program are clearly demonstrated from this facility's annual energy consumption. Table 37 summarizes savings and Figure 34 shows the modeled and actual energy consumption.

Table 37- Site 10 Energy Savings

Actual Energy	Modeled Energy	Energy Savings
6,433,103	7,301,100	867,997

Figure 34- Site 10 Actual vs. Modeled Energy Consumption



There are two outliers in this data set that were investigated: the modeled energy consumption for October 2012 and July 2013. Line production values were significantly different than the average, resulting in high variance between actual and modeled values. These two fluctuations have complimentary fluctuations, and were kept in the model.