An Evaluation of the 2004-2005 Savings By Design Program

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Volume 2 of 2

Appendix

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and the following California Investor Owned Utilities:

Pacific Gas and Electric

San Diego Gas and Electric

Southern California Edison

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Net Savings Assessment

For a new construction program, freeridership mostly comes into play at the measure level. When a project receives an incentive for a measure that would have been installed without an incentive, this constitutes freeridership in its classic form. Conversely, if a baseline or minimally code compliant measure would have been installed in the absence of program influence, there is no freeridership associated with that measure. However, freeridership is not always an all or nothing proposition, partial freeridership indicates that the program influence was responsible for the installation of the measure to some degree, but not completely. The first goal of the methodology explained below is to determine the degree of freeridership for each individual measure.

For complicated projects that were incented for numerous measures, the levels of freeridership often vary widely across the measures. For instance, a project could be a complete free-rider on one set of measures, have partial freeridership on another and have no freeridership on others. Since most SBD projects have multiple measures and frequently have interactive effects, simple multiplication of measure net-to-gross ratios to site parametric results do not yield accurate site level net savings. Instead, the freeridership of the Saving By Design Program was estimated via a “bottom-up approach”, by making measure adjustments to the as-built simulation model in order to create a “net savings model”. The goal of net savings model is to contain only those measure that were influenced by the program, and to reflect the degree of influence. That is, all measure determined to be freeriders “set back” toward baseline values such that a comparison with baseline model outputs show only net savings effects.

The individual measure freeridership was estimated through participant decision-maker surveys and reviewing associated program file documentation. All available information was used to best determine what the customer would have done in the absence of the program.

The net savings scoring questions are provided below along with their associated scoring. These questions were asked for each incented measure documented in the tracking database (systems approach) or identified in the project file (whole building approach). The cumulative score for each measure was compared to the maximum value of 6 to determine the degree of freeridership. The scoring methodology is presented in more detail within the Scoring Methodology section below. It is important to note that the final measure score relies on multiple responses in the score determination. Furthermore, several key responses are followed by an open ended question requesting an explanation for the response. If there is any inconsistency between answers regarding a particular measure, the trained surveyor brings this to the attention of the respondent, to either explain away the apparent inconsistency or revise the responses to better reflect the reality of the measure decision.

Finally, the results of each interview were reviewed by the evaluation project manager, along with the project file, to confirm the outcome. The final score was modified, if necessary, to reflect additional information identified in the review. The complete interview document is available for review in these appendices.

Freeridership Scoring Questions

Q.22 How influential was the Savings By Design, including the incentives, design assistance, design analysis and interactions with SBD representatives and consultants in the implementation of [measure name]?

READ LIST

1 = Very Influential	**1 point**
2 = Somewhat Influential	**0.5**
3 = Slightly or minimally Influential	**0.25**
4 = Not at all Influential (ask why)	**0**

Q22_4:
Why?____

Q.23. How did Savings By Design influence the implementation of ***<<the measure>>*** (choose all that apply) (**maximum of 2 points**)

DO NOT PROMPT

1 = SBD had no influence on this measure	**0**
2 = SBD representative first suggested/introduced measure	**2**
3 = SBD performed simulations and/or design analysis	**2**
4 = SBD incentive made this measure an "easier sell"	**1**
5 = SBD incentive helped measure meet investment criteria	**2**
6 = Prior SBD projects have had success with this measure	**1**
7 = DK, Not Certain, Can't Remember	**0**
50 = Other	**individually assessed**

Q23_Other:
Explain:____

Q.24. If you had no interaction with Savings By Design regarding this project, do you think ***<<the measure>>***…

READ LIST

1 = Definitely would not have been installed (ask Why)	**3**
2 = Probably would not have been installed (ask Why)	**2**
3 = Probably would have been installed (ask Why)	**1**
4 = Would have been installed exactly the same (ask Why)	**0**
5 = Would have been installed with less efficient equipment and/or materials	**2**
98 = DK, Not certain	**1**

Q25_Why? (Ask for each Measure that gets a 1,2 3, or 5 for Q24)

Q26_ Why? (Ask for each Measure that gets a 4 for Q24)

DO NOT PROMPT

1 = As a result of what was learned through previous SBD program participation **2**
2 = As a result of what was learned in past utility efficiency programs **0**
3 = Because it is our standard practice **0**
4 = Because we have had positive prior experience with the same measure **0**
5 = Because we would have funded design analysis through the project budget **0**
0
6 = Measure already met financial criteria without the program incentive **0**
7 = Other **(individually assessed)**

Scoring Methodology

The scoring methodology to determine net savings is based on the answers to questions Q22 through Q24. The score for each measure ranges from 6, which represents a measure that was completely incentive influenced, to 0, for a measure that would have been installed without the program.

Energy efficiency measures can be classified into two distinct types, dichotomous measures, those measures that are either implemented or not, such as VFDs and lighting controls, and measures with continuous or incremental efficiency ratings such as motor efficiency and glazing performance.

A copy of the database containing all of the "as surveyed" models was made after finalization of calibration and quality control. This copy was converted into a "modified" or net savings database. The net savings database consisted of models with adjustments of efficiency levels and removals of some dichotomous measures from the "as-surveyed" database, according to the freeridership assessment.

Dichotomous measures were left in the models when measures had scores of 3.25 or more. The dichotomous measure was removed from the net savings model if the score was less than 3. 25, i.e. if freeridership for the measure was greater the 50%.

For measures with continuous or incremental energy efficiency ratings, an energy rating to use in the simulation was calculated using the following formula.

$$\frac{[(6 - Score)(BaselineRating)] + [(Score)(AsBuiltRating)]}{6} = NetValue$$

For an example, the lighting power density (LPD) measure of one site had a score of 3.5. When asked Q22, the site contact claimed to have been somewhat influenced by the incentive, which counts 0.5 points for the free-rider score. When asked question Q23, the same site contact stated that the incentive made the measure an “easier sell”, counting one point in the free-rider scoring. The respondent answered that the measure probably would not have been installed with out the incentive in response to Q24, resulting in two points. This site had an as-built LPD of 0.94 watts per square foot. The space, which is an office, had a baseline LPD of 1.6 Watts per square foot. These values and the score were plugged into the above equation.

$$\frac{[(6-3.5)(1.6)]+[(3.5)(0.94)]}{6}=1.22$$

Therefore the net LPD for this space was 1.22 watts per square foot. In the net savings simulation model, lighting fixtures were added until the LPD was brought up to 1.22 Watts per square foot. For sites with multiple space types, the same adjustment approach was applied to every space type.

A net savings rating was calculated for all continuous energy ratings to be modified, including motor efficiency, cooling EER, lighting power density, glazing U-value and shading coefficient. These were calculated on a per item basis and adjusted individually to create the net savings models.

For a more complex example, assume the site in the previous LPD example also was incented for VFDs on secondary chilled water pumps. When asked Q22 for the VFDs, the site contact claimed that they were not influenced by the incentive. This response counts zero points toward the score. When asked question Q23, the same site contact claimed that SBD had no influence on this measure, again counting zero points in the scoring. The respondent answered that the measure would have been installed exactly the same in response to Q24. Therefore, the score for the VFDs would be 0, indicating no influence by the program. In this case, the VFD controls would be changed to constant volume in the net savings model.

Having an analogous net savings model for every “as-surveyed” model provided a simple approach to the calculation of net program savings. The ex-post net savings were calculated using the same methodology as whole building savings for the original “as-surveyed models.” The modified net savings “as-built” run for both energy and demand was deducted from the baseline run yielding the ex-post net savings.

To determine the best estimate of net program savings, the analysis followed the following steps:

1. The *ex-post net savings* are determined for each participant at the end-use level.
2. The *program ex-post net savings estimate* is calculated by using the same MBSS methods described for the ex-post gross savings, but using the ex-post net savings estimates for each sampled site.
3. The *Freeridership rate* is calculated as the proportion between the *program ex-post gross* savings less the *program ex-post net savings* divided by the

program ex-post gross savings. The net-to-gross ratio is simply 1 – *Freeridership rate* or the *program ex-post net savings* divided by the *program ex-post gross savings*.

Industrial Site Results

Table 1 and Table 2 show the gross realization rates for the industrial projects sampled in this evaluation. Table 3 shows the gas savings for industrial projects. Note that all savings in this appendix are annual savings, unless otherwise noted.

	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate		Ex-Post Net Savings		Net Realization Rate	
Site ID	**kWh**	**kW**	**kWh**	**kW**	**kWh**	**kW**	**kWh**	**kW**	**kWh**	**kW**
D61222	88,512	4.8	89,422	10.2	101%	2.1	89,422	10.2	101%	213%
G20102	47,923	2.6	48,382	5.4	101%	2.1	48,382	5.4	101%	208%
P11847	1,345,208	52.5	1,139,750	148.9	85%	2.8	759,833	99.3	56%	189%
P13086	1,173,069	122.2	1,204,506	136.1	103%	1.1	1,001,751	113.2	85%	93%
P13906	464,332	1.6	560,720	2.0	121%	1.3	467,267	1.7	101%	106%
P13906	57,292	25.0	63,467	24.6	111%	1.0	42,311	16.4	74%	66%
P13906	9,743	1.3	9,743	1.3	100%	1.0	6,495	0.9	67%	67%
P14127	786,832	0.0	813,230	6.3	103%	N/A	677,421	5.3	86%	N/A
P14127	33,439	13.0	33,439	13.0	100%	1.0	27,855	10.8	83%	83%
P14127	94,161	31.3	138,826	28.8	147%	0.9	115,642	24.0	123%	77%
P14127	9,258	1.1	11,708	3.0	126%	2.7	9,753	2.5	105%	226%
P14707	12,055	0.0	5,354	0.0	44%	N/A	3,569	0.0	30%	N/A
P14707	14,690	4.8	24,189	5.5	165%	1.2	16,126	3.7	110%	77%
P14707	59,322	21.0	59,130	21.6	100%	1.0	49,275	18.0	83%	86%
P14707	49,442	6.4	50,485	8.4	102%	1.3	33,657	5.6	68%	88%
P15492	205,252	33.5	179,106	25.2	87%	0.8	104,472	14.7	51%	44%
P16008	246,127	32.5	338,409	34.9	137%	1.1	197,405	20.4	80%	63%
P19408	282,117	0.0	373,040	10.1	132%	N/A	217,607	5.9	77%	N/A
P19408	7,998	3.9	28,673	4.7	359%	1.2	16,726	2.8	209%	71%
P19708	60,151	6.8	60,120	3.9	100%	0.6	60,120	3.9	100%	58%
P19708	84,599	9.7	58,653	6.7	69%	0.7	58,653	6.7	69%	69%
P19907	57,452	31.0	47,872	28.4	83%	0.9	26,799	24.6	47%	79%
P19907	1,122,198	129.0	1,113,819	148.9	99%	1.2	1,047,981	141.3	93%	110%
P19988	484,044	72.0	377,871	72.0	78%	1.0	377,871	72.0	78%	100%
P20649	937,535	116.4	706,444	135.0	75%	1.2	353,222	67.5	38%	58%
P21230	1,315,810	92.7	1,280,798	88.0	97%	0.9	960,599	66.0	73%	71%
P22051	732,200	161.0	732,200	161.6	100%	1.0	366,100	80.8	50%	50%
P23972	418,492	48.0	392,872	120.2	94%	2.5	327,393	100.2	78%	209%
P24373	60,323	8.6	62,368	6.7	103%	0.8	36,381	3.9	60%	45%
P24374	41,762	6.0	147,533	17.2	353%	2.9	86,061	10.0	206%	167%
P25510	114,293	0.0	160,268	21.2	140%	N/A	160,268	21.2	140%	N/A
P25629	190,674	0.0	315,550	2.7	165%	N/A	262,958	2.2	138%	N/A
P25629	158,315	33.0	157,441	33.0	99%	1.0	104,961	22.0	66%	67%
P25629	36,935	5.7	254,450	22.1	689%	3.9	212,041	18.4	574%	323%
P25829	1,095,943	63.9	1,415,778	153.0	129%	2.4	0	0.0	0%	0%
P26089	1,163,409	91.0	875,903	69.3	75%	0.8	654,547	51.8	56%	57%
P26090	2,162,370	169.0	1,997,920	158.1	92%	0.9	1,470,315	116.4	68%	69%
P26695	116,111	13.3	10,864	3.2	9%	0.2	10,864	3.2	9%	24%
P26696	438,884	50.1	296,110	33.8	67%	0.7	246,758	28.2	56%	56%
P27795	87,004	12.4	69,788	9.7	80%	0.8	40,710	5.7	47%	46%
P27795	191,641	27.3	232,422	28.4	121%	1.0	135,579	16.6	71%	61%

Table 1: Industrial Electric Savings Summary (part 1)

	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate		Ex-Post Net Savings		Net Realization Rate	
Site ID	kWh	kW	kWh	kW	kWh	kW	kWh	kW	kWh	kW
P31609	440,391	75.4	441,707	77.5	100%	1.0	294,471	51.7	67%	69%
P32209	561,988	0.0	566,387	158.4	101%	N/A	471,989	132.0	84%	N/A
P32209	27,844	8.0	26,346	7.2	95%	0.9	21,955	6.0	79%	75%
P32209	135,037	27.0	163,215	46.5	121%	1.7	163,215	46.5	121%	172%
P32209	13,768	1.7	19,984	2.6	145%	1.5	19,984	2.6	145%	153%
P32931	1,019,140	105.5	934,952	109.2	92%	1.0	467,476	54.6	46%	52%
P34929	29,341	15.0	44,254	15.9	151%	1.1	31,347	11.3	107%	75%
P34929	48,089	5.9	70,453	8.0	147%	1.4	49,317	5.6	103%	95%
P35430	319,708	36.5	96,893	27.1	30%	0.7	72,670	20.4	23%	56%
P38969X	957,344	122.7	42,189	11.9	4%	0.1	31,642	8.9	3%	7%
S12274	1,888,449	0.0	1,781,098	248.8	94%	N/A	1,193,336	166.7	63%	N/A
S14114X	4,202,100	483.0	4,418,438	504.8	105%	1.0	2,577,422	294.5	61%	58%
S14168	4,398,720	505.6	4,350,000	500.0	99%	1.0	4,350,000	500.0	99%	99%
S14178	2,775,300	319.0	2,205,216	263.9	79%	0.8	0	0.0	0%	0%
S14201	519,529	0.0	217,090	N/A	42%	N/A	0	N/A	0%	N/A
S15039	2,154,960	246.0	2,377,530	271.4	110%	1.1	1,981,275	226.2	92%	92%
S15240	14,246	3.4	12,522	1.9	88%	0.6	10,431	1.6	73%	47%
S15240	116,618	6.6	93,166	12.6	80%	1.9	77,607	10.5	67%	160%
S16046	3,461,225	480.8	221,530	37.4	6%	0.1	184,608	31.1	5%	6%
S16162	2,400,426	6.6	1,036,925	152.3	43%	23.1	518,462	76.1	22%	1153%
S17012	171,735	22.4	9,934	3.1	6%	0.1	4,139	1.3	2%	6%
D60209	3,136,575	513.8	1,455,538	29.2	46%	0.1	606,474	12.2	19%	2%
S12229	394,644	N/A	254,318	79.3	64%	N/A	10,597	3.3	3%	N/A
S13017	218,124	24.9	590,234	67.7	271%	2.7	344,303	39.5	158%	159%
S14236	247,131	22.0	247,131	22.0	100%	1.0	164,595	9.6	67%	43%
S15099	873,611	33.0	873,611	33.0	100%	1.0	798,439	15.9	91%	48%
S15125	350,939	21.0	334,450	7.3	95%	0.3	123,790	6.5	35%	31%
P15328	801,996	35.0	791,352	26.2	99%	0.7	461,622	15.3	58%	44%
P25992	588,316	177.0	1,027,458	117.1	175%	0.7	770,594	87.8	131%	50%
P25992	100,961	24.0	100,961	24.0	100%	1.0	84,134	20.0	83%	83%
P17655	61,760	2.1	61,760	2.1	100%	1.0	5,147	0.2	8%	8%
S17052	650,037	0.0	624,036	73.2	96%	N/A	104,006	12.2	16%	N/A
P12691	804,211	70.0	0	0.0	0%	0.0	0	0.0	0%	0%
P18087X	2,803,000	320.0	2,803,000	320.0	100%	1.0	2,335,833	266.7	83%	83%
P16527	1,865,719	N/A	2,343,817	N/A	126%	N/A	22,024	N/A	1.2%	N/A
G20420	67,493	33.0	70,655	37.3	105%	1.1	3,016	2.7	4.5%	8%
S15205	1,505,467	173.0	1,396,981	170.2	93%	1.0	1,248,774	148.3	82.9%	86%
Total	**56,182,859**	**5424.3**	**48,043,756**	**5282.7**	**86%**	**1.0**	**30,489,847**	**3510.8**	**54%**	**65%**

Table 2: Industrial Electric Savings Summary (part 2)

	Ex-Ante Gross Savings (therms)	Ex-Post Gross Savings (therms)	Gross Realization Rate	Ex-Post Net Savings (therms)	Net-to-Gross Ratio
P17655	253,000	253,000	100%	21,083	0.08
P18087X	442,620	442,620	100%	368,850	0.83
P25949	1,435,462	847,841	59%	565,227	0.67

Table 3 : Industrial Gas Savings Summary

D61222

CO (Carbon Monoxide) Sensors on Parking Garage Fans

Project 61222 received an incentive of $1,560 to install a CO sensor on a 15 hp parking garage fan. The CO sensor installation was verified and monitored on site by the evaluation team.

<u>Ex-Ante Gross Savings</u>

The baseline for this measure is a continuously running fan, which is required by municipal code in the absence of a CO sensor. Ex-ante gross savings were calculated assuming a 0.99 control fraction, meaning that the sensor reduces runtime and energy consumption by 99%. This control fraction was based on previous metering studies of garage fan CO sensors sponsored by the utility.

<u>Ex-Post Gross Savings</u>

Ex-post gross savings were calculated based on actual fan usage. A meter was installed on the garage fan for three weeks in June and July of 2006. Figure 1 shows the fan rarely operated during the metering period, as was expected. The evaluated energy fan usage was calculated by using the fan rated power and the annual operating hours, determined by the metered data. The operating schedule was grouped into weekdays and weekends since there was a noticeable difference in schedule between the two types. The energy usage for these day types were projected to annual usage and compared the annual baseline usage assuming constant operation, and the difference was the energy savings.

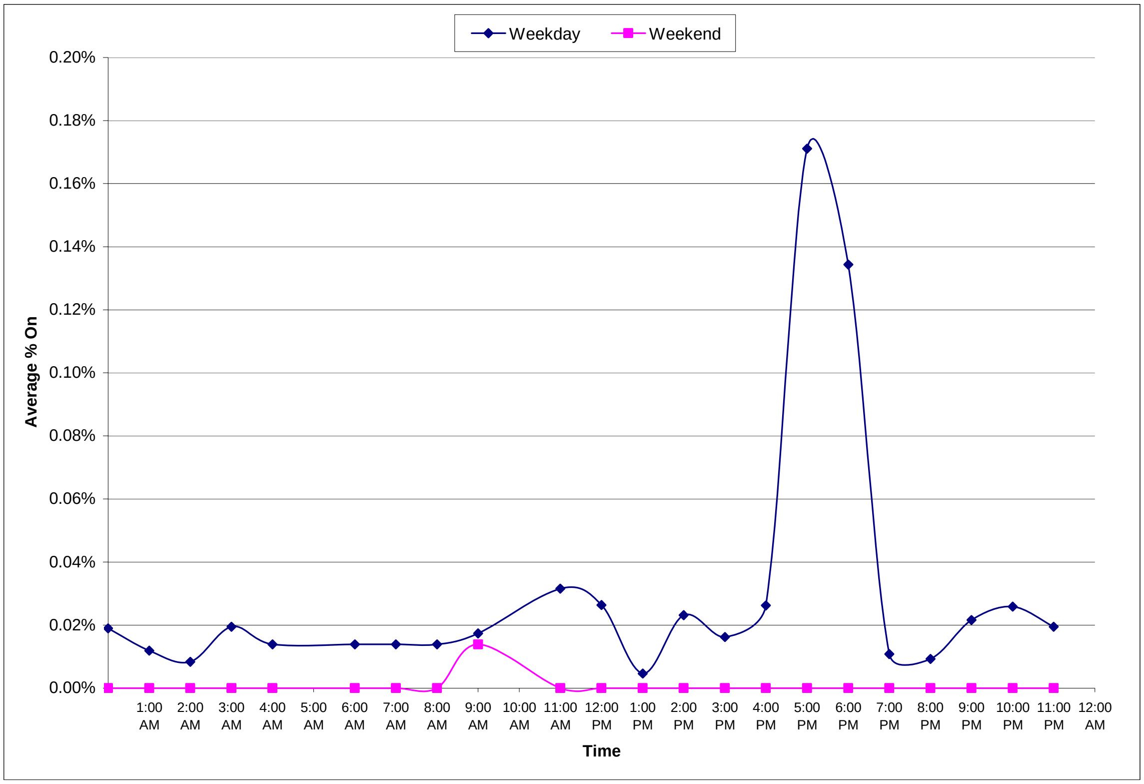


Figure 1: D61222 Average Percent On

<u>Ex-Post Net Savings</u>

During the owner survey, the facility owner indicated that the program was very influential in the implementation of this measure. The respondent stated that SBD suggested they implement the measure and that the measure definitely would not have been installed without any contact with the program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. The ex-post net savings are evaluated as 100% of the ex-post gross savings as summarized in Table 4.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	4.8	10.2	213%	1.00	10.2
kWh	88,512	89,422	101%	1.00	89,422

Table 4: D61222 Overall Savings Comparison

G20102

CO (Carbon Monoxide) Sensors on Parking Garage Fans

Project 20102 received an incentive of $987 to install carbon monoxide (CO) sensors on two 7.5 hp parking garage fans. The baseline for this measure is continuously running fans, which are required by municipal code in the absence of CO sensors. The CO sensors were verified and monitored on site by the evaluation team.

Ex-Ante Gross Savings

The baseline for this measure is a continuously running fan, which is required by municipal code in the absence of a CO sensor Ex-ante gross savings were calculated assuming a 0.99 control fraction, meaning that the sensor reduces runtime and energy consumption by 99%. This control fraction was based on previous metering studies of garage fan CO sensors sponsored by the utility and agrees with previous SBD evaluation findings.

Ex-Post Gross Savings

Ex-post gross savings were calculated based on actual fan usage. A meter was installed on both garage fans for seven weeks from August to October of 2006.

Figure 2 and Figure 3 show that the fan operated rarely during the metering period, as expected. The evaluated energy fan usage was calculated by using the fan rated power and the annual operating hours as determined by the metered data.

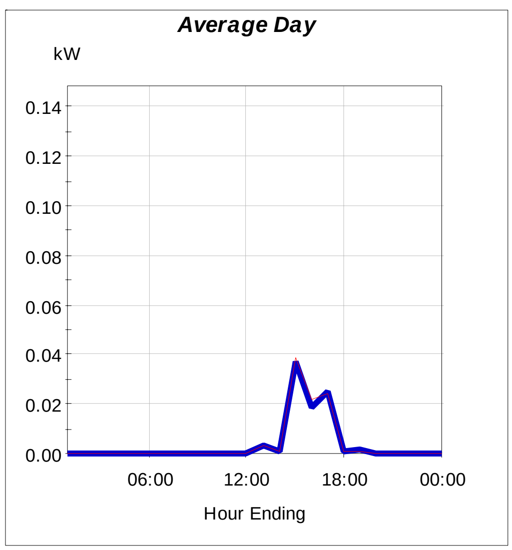


Figure 2: G20102 Average Percent On

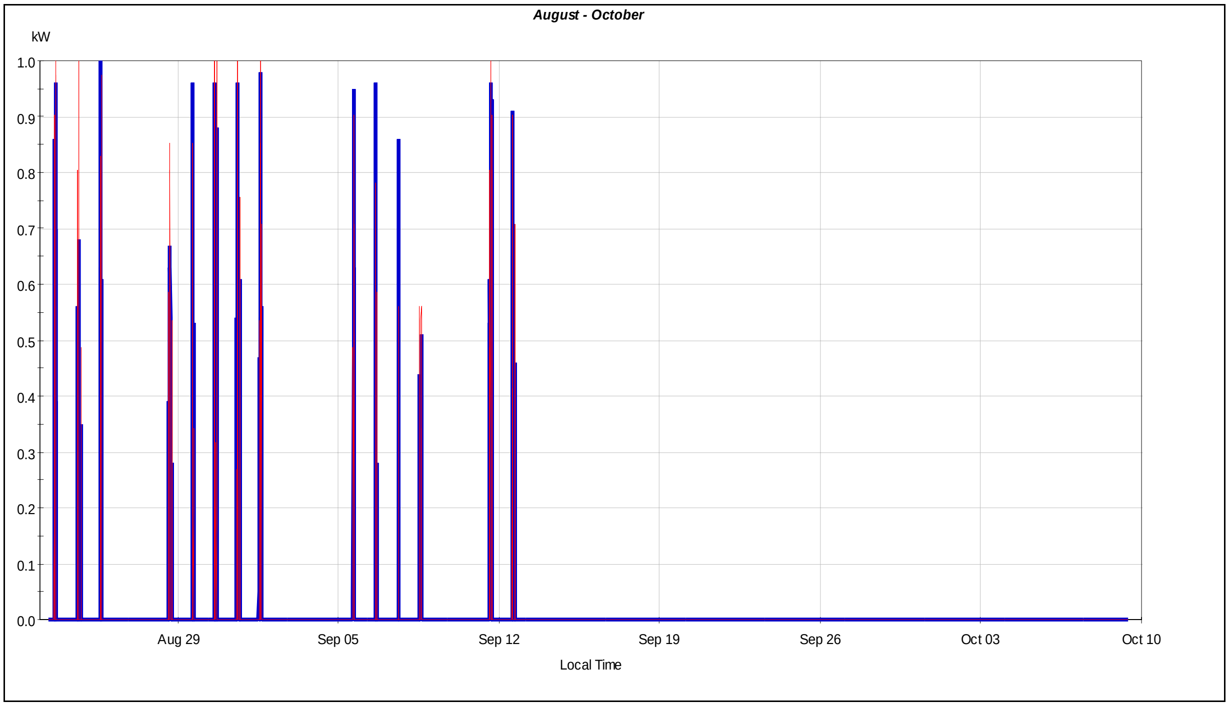


Figure 3:G20102 Exhaust Fan Metered Data

Ex-Post Net Savings

During the owner survey, the facility owner indicated that the program was very influential in the implementation of this measure. An SBD representative first suggested the measure to the facility. The respondent stated that the measure definitely would not have been installed absent any contact with the program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. The ex-post net savings are evaluated as 100% of the ex-post gross savings as summarized in Table 5.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	2.6	5.4	208%	1.00	5.4
kWh	47,923.00	48,381.6	101%	1.00	48381.6

Table 5: G20102 Overall Savings Comparison

P11847

Whole Building

Project P11847 received an incentive of $94,165 for adding multiple energy efficiency measures to their refrigerated warehouse expansion. The project encompassed approximately 60,800 square feet of refrigerated area. The measures included the installation of higher efficiency condensers, floating head pressure, variable set point controls on the condensers, VFD motors on the condensers, VFD motors on the air unit fans, higher efficiency compressor motors, premium efficiency air unit fan motors, and reduced lighting power density. The measures were verified by the evaluation team during a site visit. However, the lighting power density was found to be higher than the baseline and thus there are no lighting savings for this site.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined by using DOE-2.2R simulation software. A variety of parameters were estimated, including the equipment schedules, cooling loads, and temperatures.

<u>Ex-Post Gross Savings</u>

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings. However, equipment at the site was monitored for a period of three weeks and these data was integrated into the models. Table 6 shows the equipment that was metered. These data were incorporated into the model by changing the operational schedules and set points to reflect actual conditions.

Metered Equipment	Quantity Metered
Evaporative Condenser Fans	6
Blast Freezer Fans	6
Penthouse Fans	3
Prep Room Fans	8
Daucey Room Fans	4
Strawberry Room Fans	8
Outside Air Temperature	1
Outside Air Relative Humidity	1
Outside Air Wet Bulb Temperature	1
Ammonia Temperature	1

Table 6: P11847 Metered Equipment

Figure 4 show the metered data for three condenser fans and Figure 5 shows data for room fans during one week of the metering period. Figure 6 shows the hourly average power draw for each fan. These data were used to determine the schedule and power consumption of the facility systems.

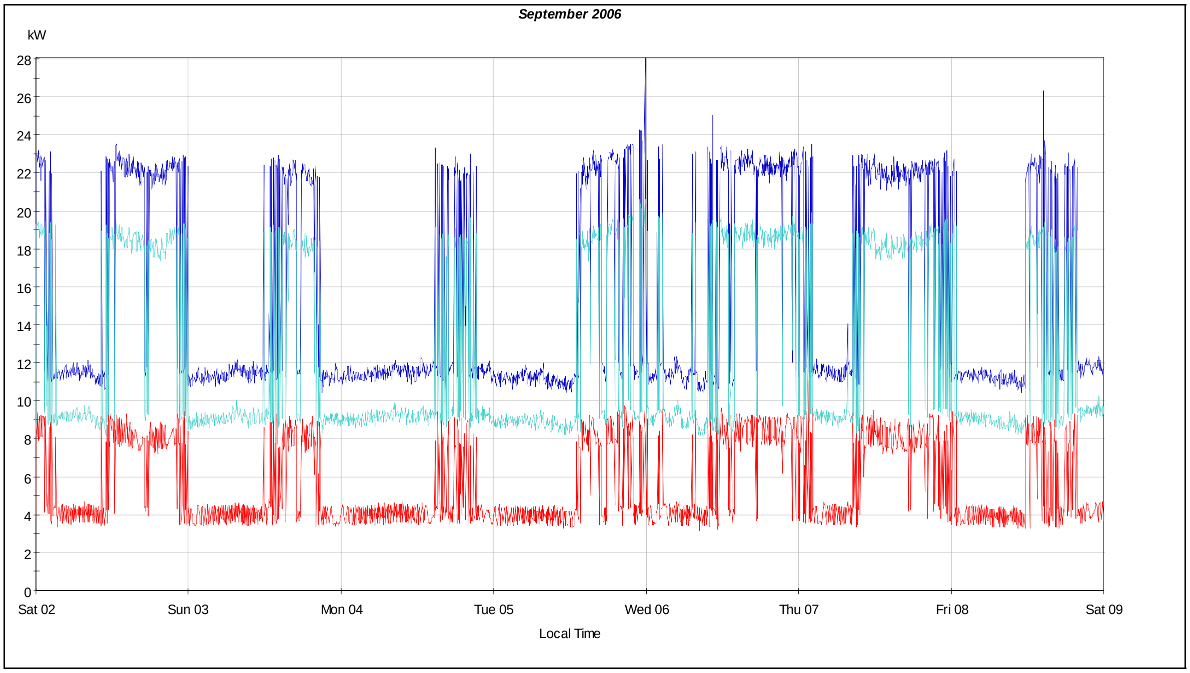


Figure 4: P11847 Metered Power Draw of Three Condenser Fans

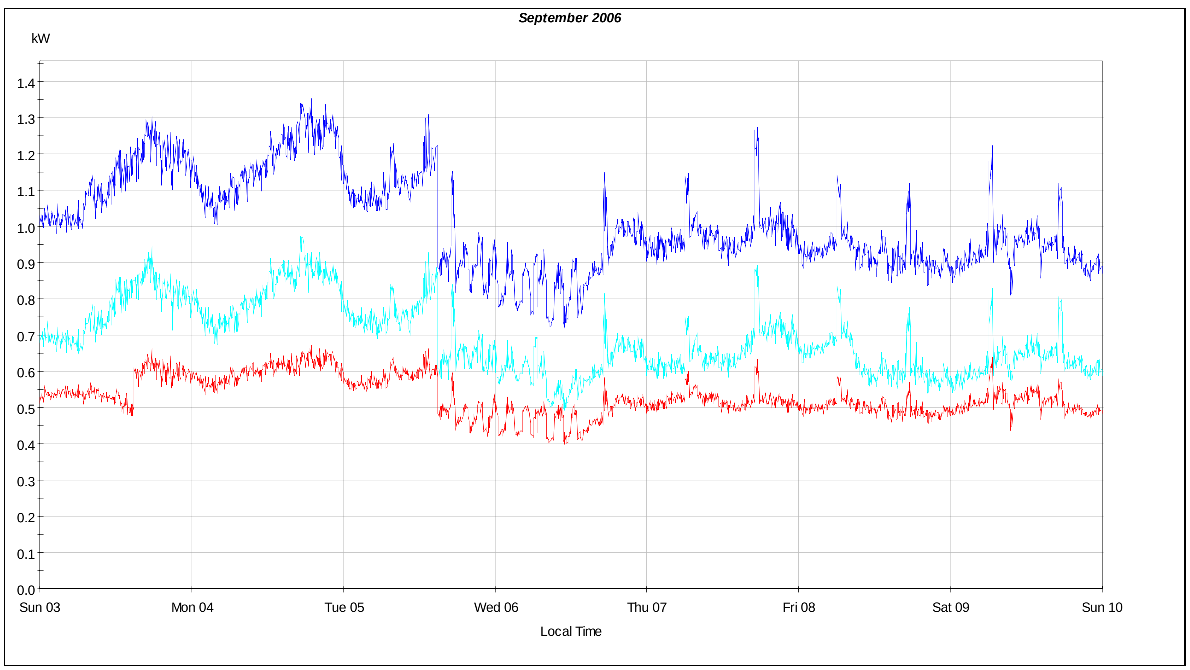


Figure 5: P11847 Metered Power Draw of Prep, Daucey and Strawberry Room Fans

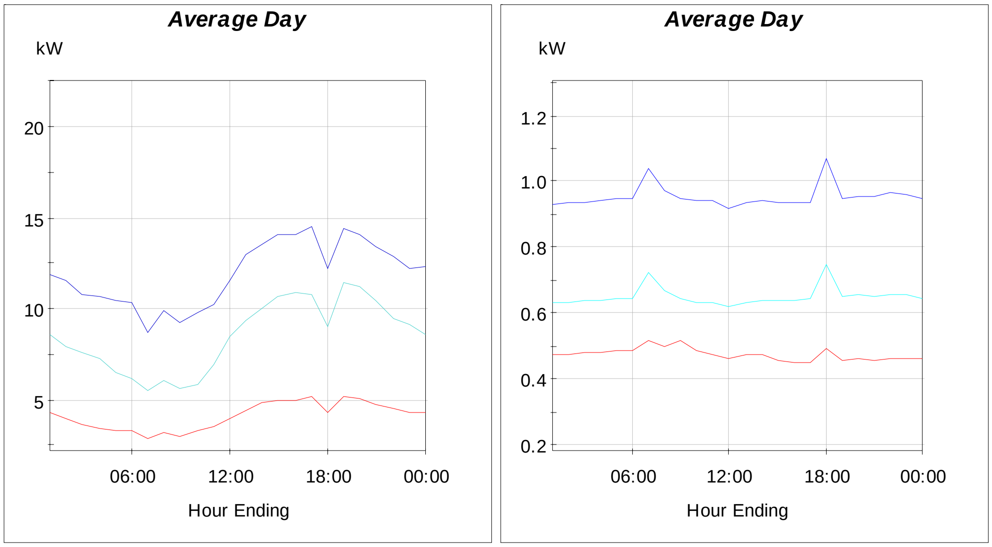


Figure 6: P11847 Average Hourly Power Draw of Condenser Fans (L) and Room Fans (R)

For this site the only model changes made were to the fan and refrigeration schedules, and the lighting power density. The room fans were found to have the same schedule as estimated by the ex-ante gross analysis, operate twenty four hours a day. The blast freezer fans were also on twenty-four hours per day, however the load shape differed from ex-ante gross estimates. The fans operated at full load in the morning, then tended to drop around 7am and slowly increase back up to full load throughout the remainder of the day. Also, the lighting power density was surveyed 0.72 Watts per square foot in the post-field inspection instead of the assumed 0.60 Watts per square foot from the ex-ante gross estimate.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of all measures except for the lighting measure. The lighting measure was only somewhat influenced. The respondent stated that an SBD representative made the other measures an "easier sell." Also, the facility representative stated that the measures would have been installed the same without the SBD program xx. This combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership for all but the lighting measure. The lighting measure received a 3.5, or 42% of ex-post gross savings. Since the lighting measure was found to consume more energy than the baseline, the savings for this measure are zero and the lighting freeridership does not affect the site savings. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings. The savings are summarized in Table 7.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	53	149	284%	0.67	99
kWh	1,345,208	1,139,750	85%	0.67	759,833

Table 7: P11847 Savings Comparison

P13086

Refrigerated Warehouse

Project P13086 received an incentive of $82,115 for addition of a new refrigerated warehouse to the existing facility. This addition consists of a two-story storage cooler and a 39,000 square foot conditioned area. As part of this upgrade the following energy efficiency measures are evaluated are shown in Table 8 below.

	Incented Measures
EEM 1	Floating Head Pressure with Proposed Condenser
EEM 2	Variable Setpoint Control and Condenser Variable Fan Speed
EEM 3	High Efficiency Motors
EEM 4	Variable Speed Control of Cooler Fans
EEM 5	High Efficiency motors for Conveyor System
EEM 6	Proposed Building Insulation
EEM 7	Automatic Daylight Control

Table 8: P13086 List of Energy Efficiency Measures

The base case for these measures was defined using standard industry practice for typical cold storage refrigeration systems, and title 24 standards where applicable. The evaluation team physically verified the installation of the measures.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined through the use of a DOE-2.2R hourly simulation model for the facility. For the proposed refrigeration system a yearly operating schedule, a design conditions for the location and proposed equipment and control sequences.

For the VFD air unit motors, yearly operating schedule and load were assumed to create an annual load profile. The base case model of this measure is a constant speed air unit motor.

Similarly for the premium efficiency motors lower input power was assumed to create the ex-ante gross model. The base case for this measure is standard efficiency motors.

Ex-ante gross savings for the insulation measure was created by using an insulation R value of R-38 for the storage walls and freezer floors and R-25 for the storage cooler roofs.

Lighting savings were estimated by using an LPD of 2.059 W/sf. for both floors of expansion compared to the base case value of 1.0 W/sf.

<u>Ex-Post Gross Savings</u>

Data loggers were installed on the VSD air unit motors and VSD condensers for a period of four weeks. Table 9 below shows the incented equipment on which data loggers were installed.

Ex-post gross savings were calculated by using the same methodology as in the ex-ante gross model. The collected data were used to record the schedule of operation of the different incented equipment. These schedules along with the measured condensing and wet bulb temperatures were then applied to the DOE-2.2R hourly simulation model to generate an evaluation model. Figure 7 and Figure 8 represent the power profile for VSD cooler fan motors and VSD condenser fans respectively. Figure 9 shows the condensing and wet bulb temperature. There were no changes made to these above temperatures in the ex-post gross model as there were minimal differences between them and the assumptions made for the ex-ante gross savings.

Incented Equipment	Metered
Condenser Fans(2)	(YES) 2
Cooler Fans (52)	(YES) 12
High Efficiency Condenser fans and Cooler Fan Motors (52+2)	YES (12+2)
Conveyor Motors (39)	NO
High Pressure Liquid (Condensing) Temperature	YES
Outside Air Temperature	YES
Outside Air Relative Humidity	YES

Table 9: P13086 Monitored Equipment

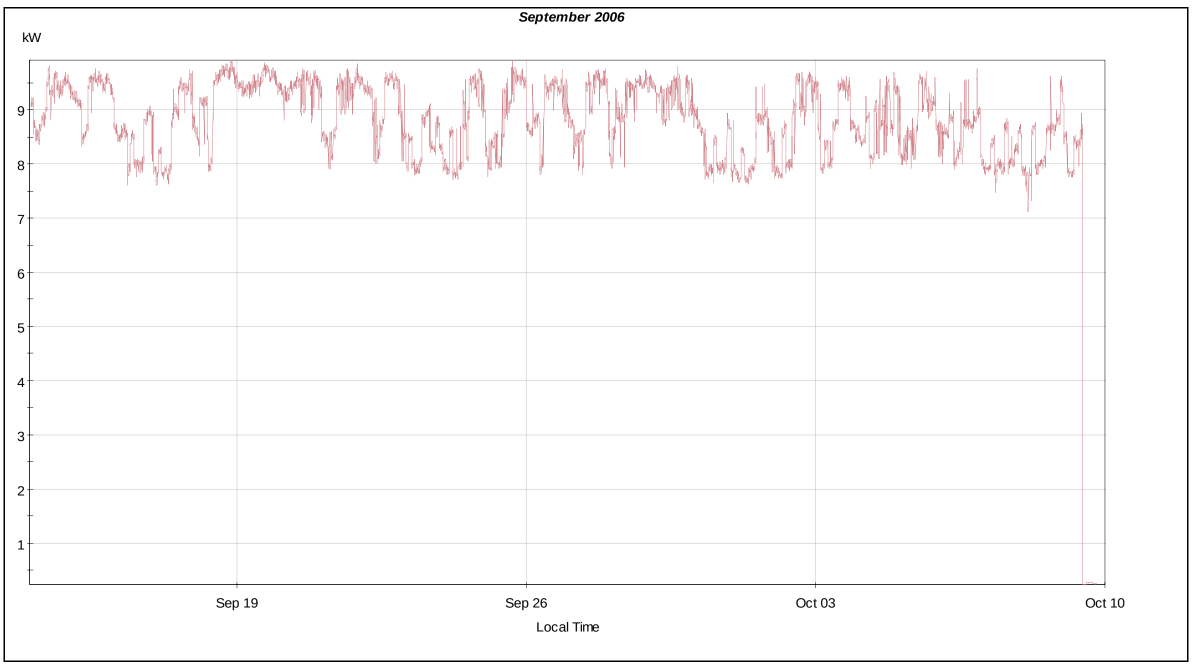


Figure 7: P13086 Cooler Fan Motors Metered Data

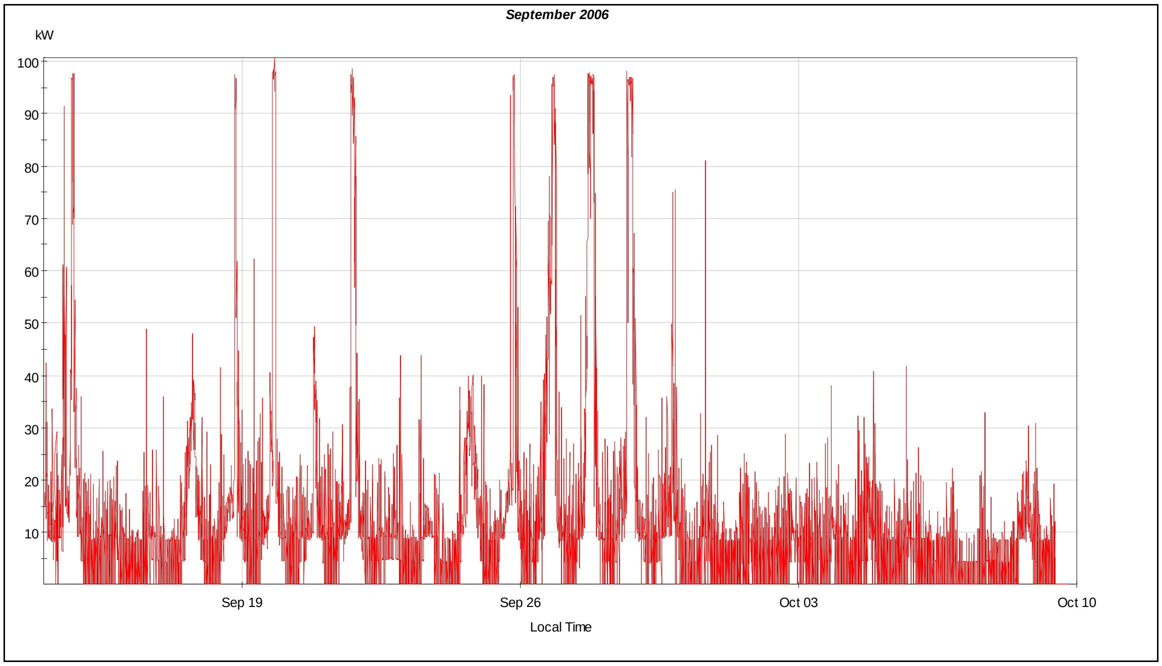


Figure 8: P13086 VSD Condenser Fans Raw Metered Data

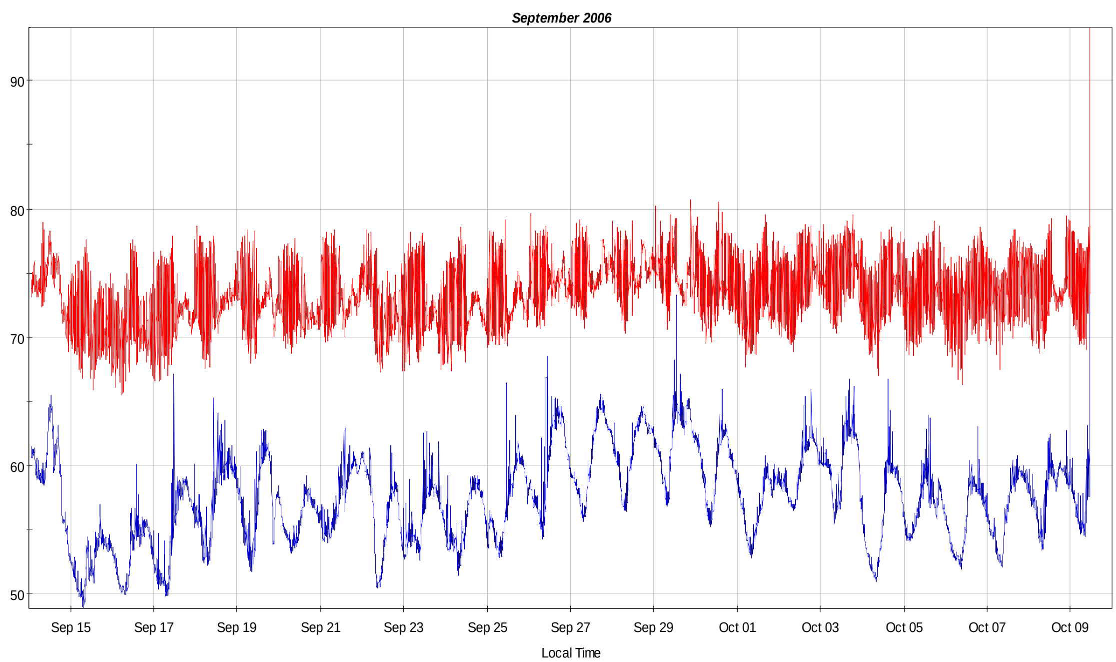


Figure 9: P13086 Condensing Temperature (Red) and Wet Bulb (Blue)Temperature

EEM 1 and EEM 2 saved more than anticipated since the meter data show the refrigeration system was operating 24 hours a day seven days a week whereas the tracking estimates assumed an operating schedule of 17 hours a day, 7 days a week. Figure 10 below reflects the average day profile of the condenser units.

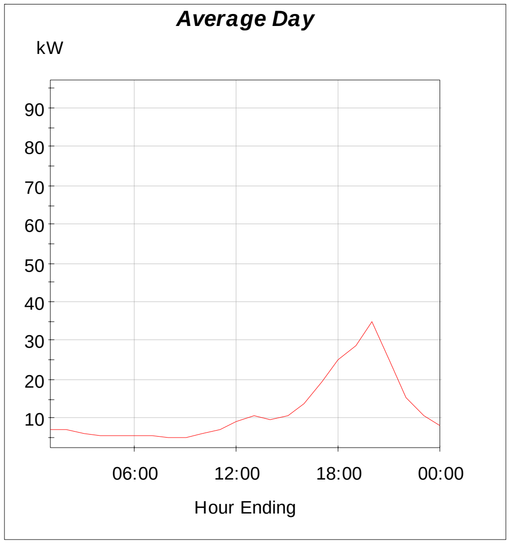


Figure 10: P13086 Condenser Unit Average Day Profile

Ex-Post Net Savings

This facility had different freeridership scores for each measure. For all measures the facility representative indicated that the program was very influential in terms of implementation. They also stated that an SBD representative either suggested the measure and/or performed design analysis for all measures. The respondent indicated that some of the measures definitely would have been installed, while others definitely would not have been installed without the incentive. This combination of all these answer yields a different freeridership score for each measure ranging from 4 to 6 out of 6. The combined savings for this site were weighted by freeridership per measure. On average, the ex-post net savings were evaluated at 83% of the ex-post gross savings. The savings per measure and overall site savings are presented in Table 10.

		Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
EEM2 & 1	peak kW	86.1	106.8	124%	1.00	106.8
	kWh	486,453	516,698	106%	1.00	516,698
EEM3	peak kW	2.2	2.2	100%	1.00	2.2
	kWh	17,824	17,398	98%	1.00	17,398
EEM4	peak kW	73.9	68.3	92%	0.67	45.5
	kWh	574,268	573,156	100%	0.67	382,104
EEM5	peak kW	8.1	8.0	99%	1.00	8.0
	kWh	44,205	43,458	98%	1.00	43,458
EEM6	peak kW	2.8	2.7	96%	0.67	1.8
	kWh	9,711	8,805	91%	0.67	5,870
EEM7	peak kW	-46.2	-46.2	N/A	N/A	N/A
	kWh	93,580	88,276	94%	0.83	73,563
All EEMs Combo	**peak kW**	**122.2**	**136.1**	**111%**	**0.83**	**113.2**
	kWh	**1,173,069**	**1,204,506**	**103%**	**0.83**	**1,001,751**

Table 10: P13086 Savings Comparison

P13906

High Efficiency Lighting

Project 13906 received an incentive of $27,860 to install a low LPD lighting system at a dairy facility. The facility installed metal halide and T8 fluorescent fixtures. The baseline for this measure is determined by Title 24 energy consumption standards of commercial buildings on a square foot basis. Therefore, the only information required for the baseline is the area type (office, bathroom, etc.) and the area in square feet. The evaluation team verified the installation of the measure.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined using projected lighting hours and rated lamp wattage.

<u>Ex-Post Gross Savings</u>

Meters were installed on the lighting shown in Table 11 for three weeks during October and November of 2006.

Incented Area	Metered
Milker's Pits	NO
Cow Platforms	NO
Drip	NO
Sprinkler	NO
Holding	NO
Breezeway	NO
Equipment Room	NO
Milk Room	NO
Chemical Room	NO
Hallway	NO
Storage Spaces	NO
Office	NO
Herdsman Office	NO
Break room	NO
Restrooms	NO
Long Freestall Barn #1	YES
Long Freestall Barn #2	YES
Short West Freestall, Maternity	YES

Table 11: P13906 Metered Areas

The data were imported into Visualize-IT and one week of the data are presented in Figure 11 for all three metered areas. Figure 12 also shows what percentage the three lighting areas are on for an average day. It is apparent that all three metered areas follow the same schedule.

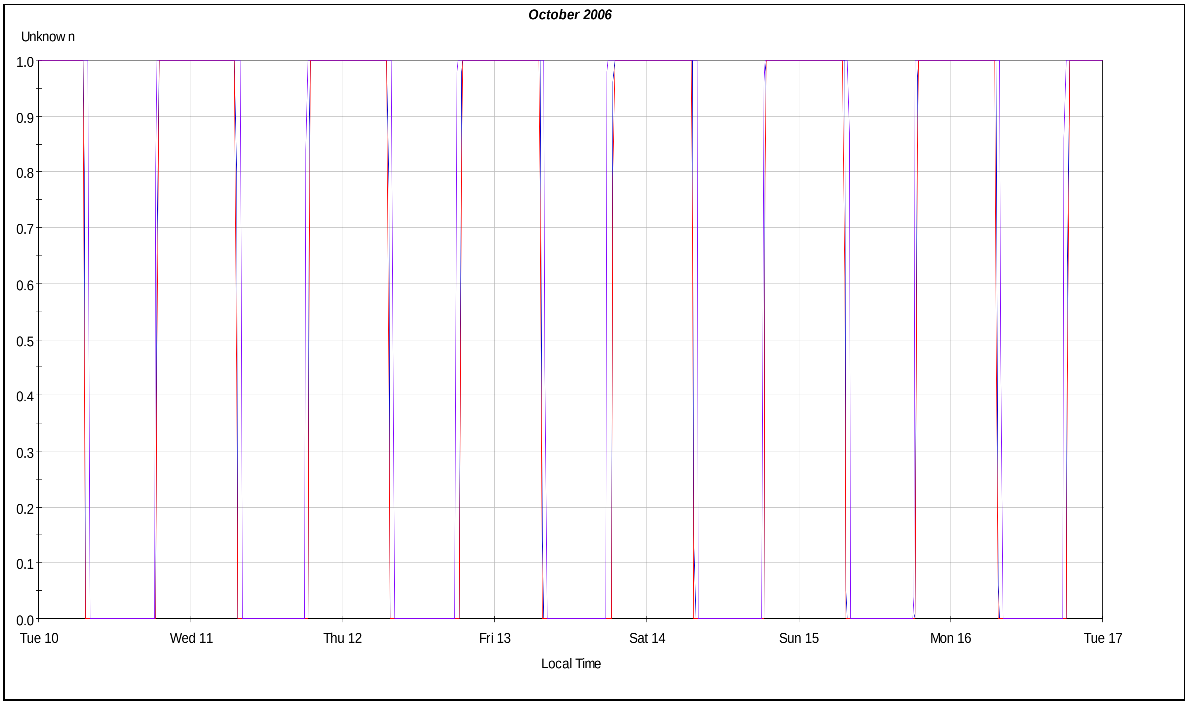


Figure 11: P13906 Lighting Percent On Data

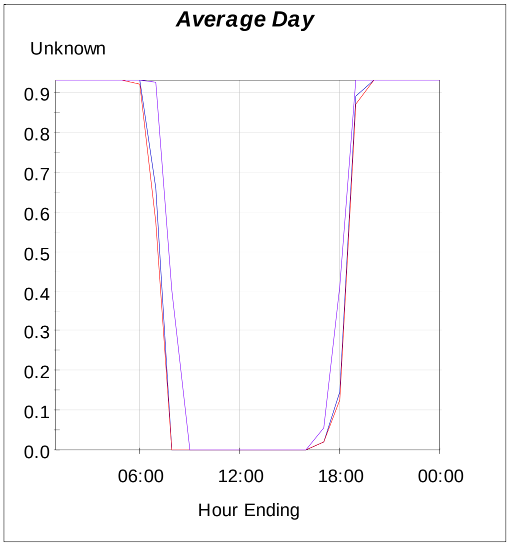


Figure 12: P13906 Lighting Time of Use Profile

The annual operating hours were calculated using the metered data. The rated power and annual hours were then used to calculate energy and peak power. The estimated hours were similar to the actual operating hours.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The contractor recommended the lighting upgrade and helped get SBD involved. The respondent also indicated that the system probably would not have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 12.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	1.6	2.0	127%	0.83	1.7
kWh	464,332	560,720	121%	0.83	467,267

Table 12: P13906 Lighting Savings Comparison

Refrigeration System

Project 13906 received an incentive of $4,010 to install a groundwater cooled condenser and precoolers which precool the fluid using a groundwater heat exchanger. The baseline for this measure is a single-stage chiller with an air-cooled condenser and no fluid precooling.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated using DOE-2.2R simulation software. The refrigeration schedule and load were estimated and an ex-ante gross model was created. A baseline model with no precooling or groundwater condensers was also created. The model outputs energy and peak power usage.

Ex-Post Gross Savings

A meter was installed on the chiller for three weeks during October and November of 2006. The chiller data was used to determine a schedule of operation for the entire refrigeration system, which includes both the groundwater cooled condenser and groundwater heat exchanger. The chiller was only off for approximately two hours per day. These off periods occurred from approximately 5am to 6am and 5pm to 6pm. The schedules are presented in Table 13 and one day of raw data is displayed in Figure 13. Note that the graph displays no measurements when the system is off. In other words, there is a break in the data trend when the system is not operating.

Status	Ex-Ante Gross Model	Ex-Post Gross Model
On	2am-12pm, 2pm-12am	12am-5am, 6am-5pm, 6pm-12am
Off	12am-2am, 12pm-2pm	5am-6am, 5pm-6pm
Daily Hours	20	22

Table 13: P13906 Model Schedules

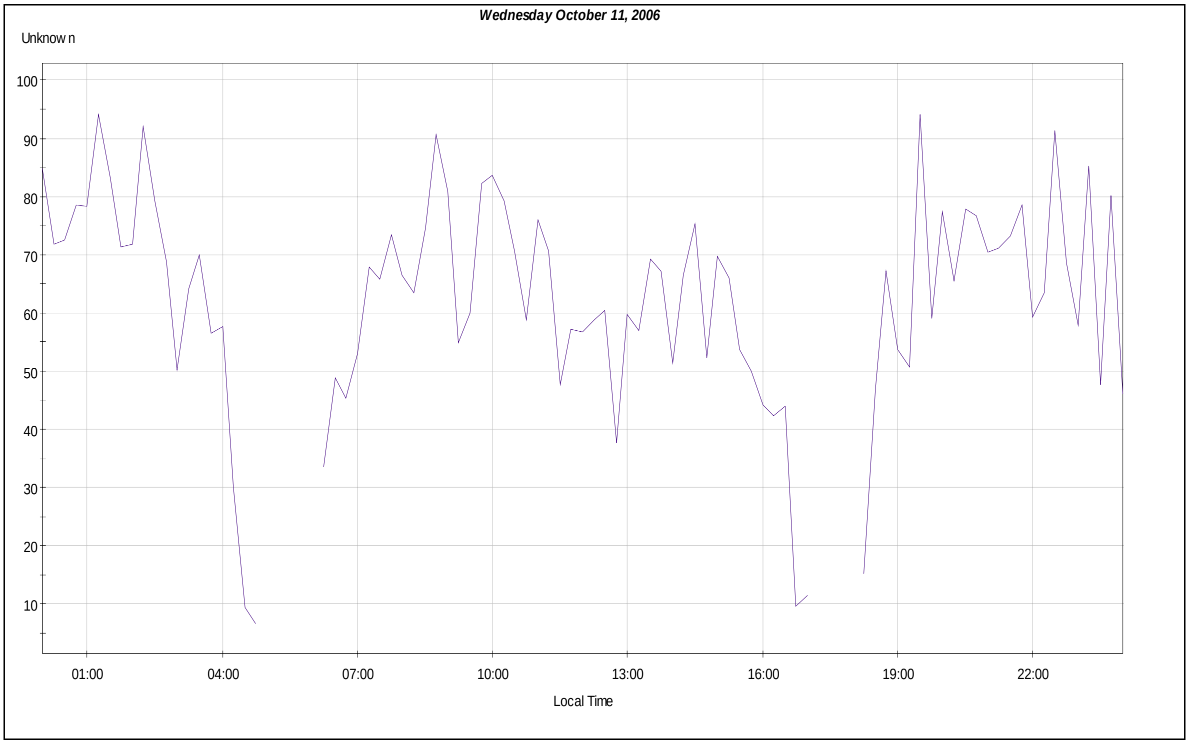


Figure 13: P13906 Chiller Power Data

The ex-ante gross models were manipulated to reflect this operating schedule for both the pumps and refrigeration equipment. The load estimated in the ex-ante gross analysis seemed reasonable, therefore the model load was not changed for this evaluation. The refrigeration system was operating two more hours per day than estimated in the ex-ante gross model, resulting in slightly larger savings than anticipated.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The contractor recommended the refrigeration upgrade and helped get SBD involved. The respondent also indicated that the system probably would have been installed absent any interaction with the Savings by Design program because it was the best system at the time and they wanted to save on the cost of operation. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 14.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	25.0	24.6	98%	0.67	16.4
kWh	57,292	63,467	111%	0.67	42,311

Table 14: P13906 Refrigeration Savings Comparison

Process Systems

Project 13906 received an incentive of $292 to install a premium efficiency (PE) 20 hp motor on a vacuum pump and VFDs on two 2 hp pumps. The baseline for the 2 hp premium efficiency pumps is two 2 hp fixed speed pumps.

Ex-Ante Gross Savings

Ex-ante gross savings were calculated by estimating the operating schedule and efficiencies for all pumps. The 2 hp pump VFD savings were assumed to provide 50% savings over a fixed speed pump at 16 hours per day. The 20 hp PE motor is manufactured at 93.0% efficiency and the baseline efficiency is 91.0%. This pump also operates 16 hours per day.

Ex-Post Gross Savings

Ex-post gross savings are equal to ex-ante gross savings since all of the assumptions are reasonable.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The contractor recommended the VFD upgrade and helped get SBD involved. The respondent also indicated that the system probably would have been installed absent any interaction with the Savings by Design program because of the long term savings. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 15.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	1.3	1.3	100%	0.67	0.9
kWh	9,743	9,743	100%	0.67	6,495

Table 15: P13906 Process Savings Comparison

Total Site Savings

Table 16 shows the combined site savings for all measures.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	27.9	27.9	100%	0.68	19.0
kWh	531,367.0	633,930.4	119%	0.81	516,073.6

Table 16: P13906 Total Site Savings

P14127

High Efficiency Interior Lighting

Project 14127 received an incentive of $47,041 to install energy efficient lighting. The facility installed 320W pulse start metal halide and 32W T-8 fluorescent lighting. The baseline for this measure is determined by Title 24 energy consumption standards of lighting power density by space type. Therefore, the only information required for the baseline is the area type (office, bathroom, etc.) and area in square feet. The evaluation team verified the installation of the measure. Note that there were many discrepancies in the number of lamps installed between the SBD report and the field verification. The lamp count from the field was used.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using projected lighting hours and the rated lamp wattage.

Ex-Post Gross Savings

A meter was installed on the lighting shown in Table 17 for three weeks during September and October of 2006. Many areas were not metered because they were a small portion of the savings. The majority, or 99%, of the lighting savings came from the two metered areas.

Incented Area	Metered
Milker's Pits	No
Cow Platforms	No
Drip Pens	No
Wash Pens	No
Breezeway	No
Equipment Room	No
Milk Room	No
Storage Spaces	No
Offices	No
Break Room	No
Other Spaces	No
Maternity Barn	Yes
Freestall Barn	Yes

Table 17: P14127 Lighting Metered Spaces

The lighting appeared to follow the rated wattage and the schedule predicted by the facility. This is illustrated in Figure 14 which shows one week of the metered data and also in Figure 15 which shows the average power profile.

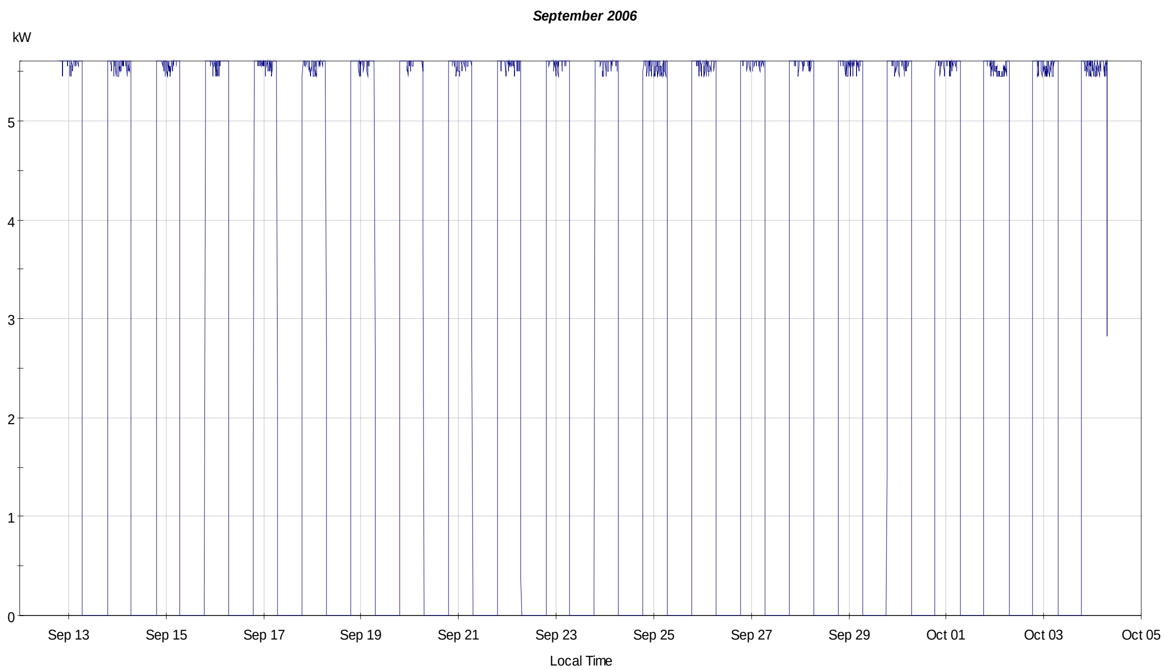


Figure 14: P14127 Lighting Power Data

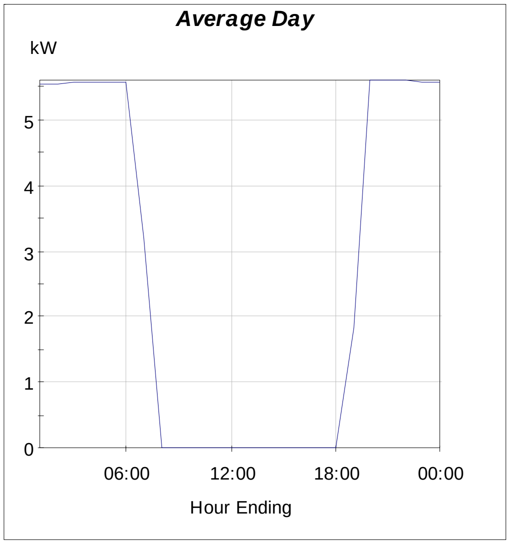


Figure 15: P14127 Hourly Average Power

The ex-post gross savings were calculated using the metered annual operating hours and lamp wattage. Since the operating hours were close to what was predicted, the savings are similar. Many areas were not metered, but their operating hours and rated power seemed reasonable and the ex-ante gross savings were applied as ex-post gross savings. As mentioned earlier, these areas only account for 1% of the savings.

<u>Ex-Post Net Savings</u>

The facility representative indicated that the program was very influential in the implementation of the measures. They stated they needed the lighting anyway, but the electricity savings that an SBD representative showed them made sense and "cents make dollars." The respondent also indicated that the system probably would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 18.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	6.3	N/A	0.833	5.3
kWh	786,832	813,230	103%	0.833	677,421

Table 18: P14127 Lighting Savings Comparison

Automatic Daylighting Controls

Project 14127 received an incentive of $1,338 to install automatic daylighting controls. The controls have photo sensors and turn off the lights when there is adequate sunlight. The baseline for this measure is lighting that operates continuously during sunlight hours.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined using estimated lighting hours and rated lamp wattage.

<u>Ex-Post Gross Savings</u>

The assumptions used to calculate ex-ante gross savings seemed reasonable for all of the daylighting areas. Therefore, meters were not installed on the lamps which were under photocell, as shown in Table 19. Ex-post gross energy savings equal ex-ante gross energy savings.

Incented Area	Metered
Cow Platforms	No
Drip Pens	No
Wash Pens	No
Breezeway	No

Table 19: P14127 Daylighting Incented Spaces

<u>Ex-Post Net Savings</u>

The facility representative indicated that the program was very influential in the implementation of the measures. They stated they needed the lighting anyway, but the electricity savings that an SBD representative showed them made sense and "cents make dollars." The respondent also indicated that the system probably would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 20.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	13.0	13.0	100%	0.833	10.8
kWh	33,439	33,439	100%	0.833	27,855

Table 20: P14127 Daylighting Savings Comparison

Refrigeration System

Project 14127 received an incentive of $6,591 to install a groundwater heat exchanger to precool the fluid. The baseline for this measure is no precooling of the fluid. The evaluation team conducted a site visit and verified the installation of the measure.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were estimated using DOE-2.2R simulation software. The projected refrigeration schedule and anticipated load and proposed equipment were used to create the model. A baseline model with no precooling was also created. The model outputs annual energy usage. and peak demand

<u>Ex-Post Gross Savings</u>

A meter was installed on a refrigeration compressor for three weeks during September and October of 2006. The data was used to determine a schedule of operation for the refrigeration system. The compressors were only off for approximately two and a half hours per day. These off periods occurred from approximately 6am to 7:30am and 6pm to 7pm. The modeling schedules are shown in Table 21, and one day of raw data is displayed in Figure 16. Note that the graph displays no measurements when the system is off. In other words, there is a break in the data trend when the system is not operating. The ex-ante gross models were manipulated to reflect the actual operating schedule for both the pumps and refrigeration equipment. The load estimated in the ex-ante gross analysis seemed reasonable, therefore the ex post model load was not changed for this evaluation. The refrigeration system was operating about seven more hours per day than estimated in the ex-ante gross model, resulting in larger energy savings than reported in the ex-ante gross analysis.

Status	Ex-Ante Gross Model	Ex-Post Gross Model
On	6am-1pm, 3pm-10pm	12am-6am, 7:30am-6pm, 7pm-12am
Off	12am-6am, 1pm-3pm, 10pm-12am	6am-7:30am, 6pm-7:30pm
Daily Hours	14	21.5

Table 21: P14127 Model Schedules

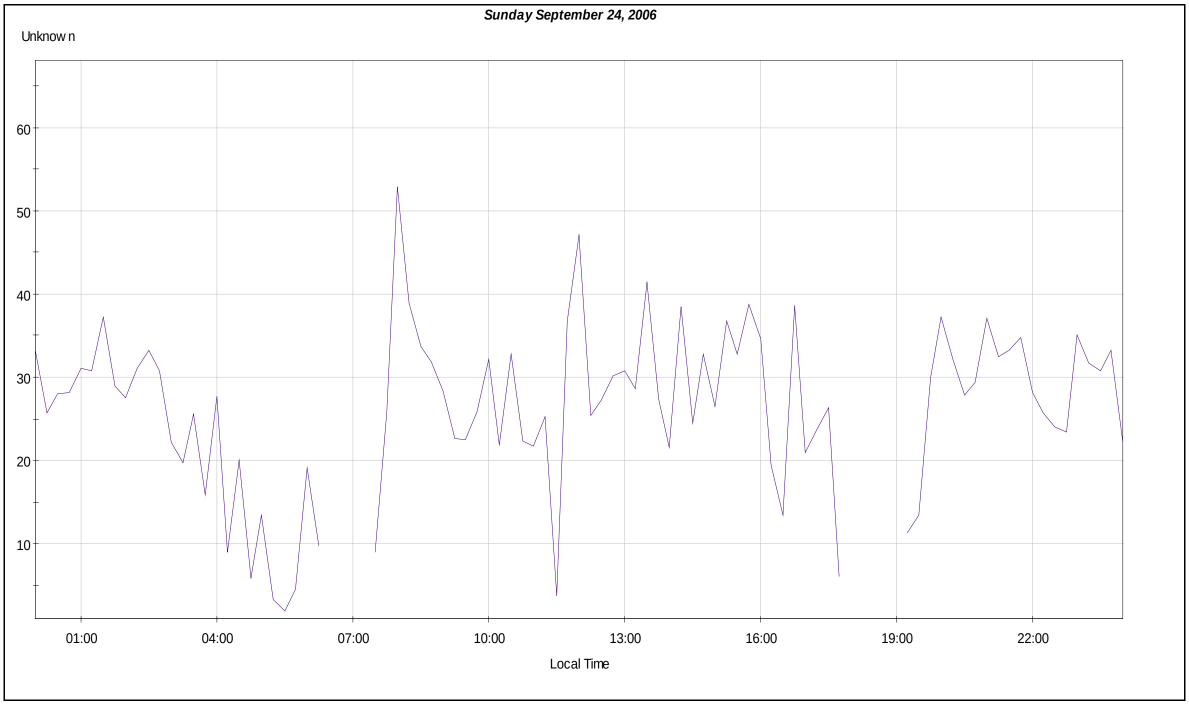


Figure 16:P14127 Refrigeration Compressor Power

<u>Ex-Post Net Savings</u>

The facility representative indicated that the program was very influential in the implementation of the measures. They stated that an SBD representative influenced the decision to install the measure. The respondent also indicated that the system probably would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 22.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	31.3	28.8	92%	0.833	24.0
kWh	94,161	138,826	147%	0.833	115,642

Table 22: P14127 Refrigeration Savings Comparison

Process Systems

Project 14127 also received an incentive of $278 to install two VFDs on two 2 hp pumps. The baseline for the VFD pumps is fixed speed pumps. The VFD installation was verified by the evaluation team during a site visit. Note that the facility was not eligible for the vacuum pump VFD incentive due to herd size restriction for this measure. Also, no premium efficiency motor incentive was given since the installed motors were found to be equal or less than baseline efficiency by a utility representative.

Ex-Ante Gross Savings

Ex-ante gross savings were calculated using the annual operating hours, rated motor power and a fixed savings amount. The fixed savings amount applied by the facility is 50%, indicating that there is a 50% reduction in power draw over a fixed speed pump.

Ex-Post Gross Savings

All of the ex-ante gross savings inputs seem reasonable for the facility. Therefore, the same calculation methodology was used and the only number that was manipulated was the annual hours. It was assumed that the annual hours for the VFD pumps are the same as for the refrigeration system. Therefore, the schedule described for the refrigeration incentive, similar to Figure 16, was used. The operating hours increased, and savings also increased compared to the ex-ante gross analysis. Peak power savings were large because the VFD pumps are always on during peak hours, according to the metered refrigeration schedule.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. They stated that an SBD representative influenced their decision and helped with other energy efficiency measures as well. The respondent also indicated that the system probably would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 23.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	1.1	3.0	271%	0.83	2.5
kWh	9,258	11,708	126%	0.83	9,753

Table 23: P14127 Process Savings Comparison

Total Site Savings

Table 24 shows the combined energy savings of all measures at the site.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	45.4	51.1	113%	0.83	42.6
kWh	923,690.0	997,203.7	108%	0.83	830,670.7

Table 24: P14127 Total Site Savings

P14707

High Efficiency Lighting

Project 14707 received an incentive of $723 to install high efficiency lighting. The facility installed metal halide and fluorescent fixtures. The baseline for this measure is determined by Title 24 area category LPD by space type and assumed LPD for unconditioned spaces where standards are not applicable. Therefore, the only information required for the baseline is the area type (office, bathroom, etc.) and the area in square feet. The evaluation team verified the installation of the measure and conducted fixture counts during a site visit.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using projected lighting hours and rated lamp wattage.

Ex-Post Gross Savings

A meter was installed for four weeks during September 2006 on four of the eleven lighting areas, as shown in Table 25. These areas also installed daylighting controls and there was no metering of lighting in areas without daylighting controls. The schedule for these areas was left at the estimated tacking value.

Incented Area	Metered
Milker's Pit	No
Cow Platforms	Yes
Drip Pen	Yes
Wash Pen	Yes
Breezeway	Yes
Equipment Room	No
Milk Room	No
Soap Room	No
Offices	No
Break Room	No
Rest Room	No

Table 25: P14707 Metered Areas

The metered data was imported into Visualize-IT. Figure 17 shows the raw data for a week of the metering period. It is obvious that every day had a similar schedule. The raw data was then used to create an average hourly profile which is illustrated in Figure 18. This profile showed that the metered lights are operating a couple more hours per day than estimated in the ex-ante gross analysis.

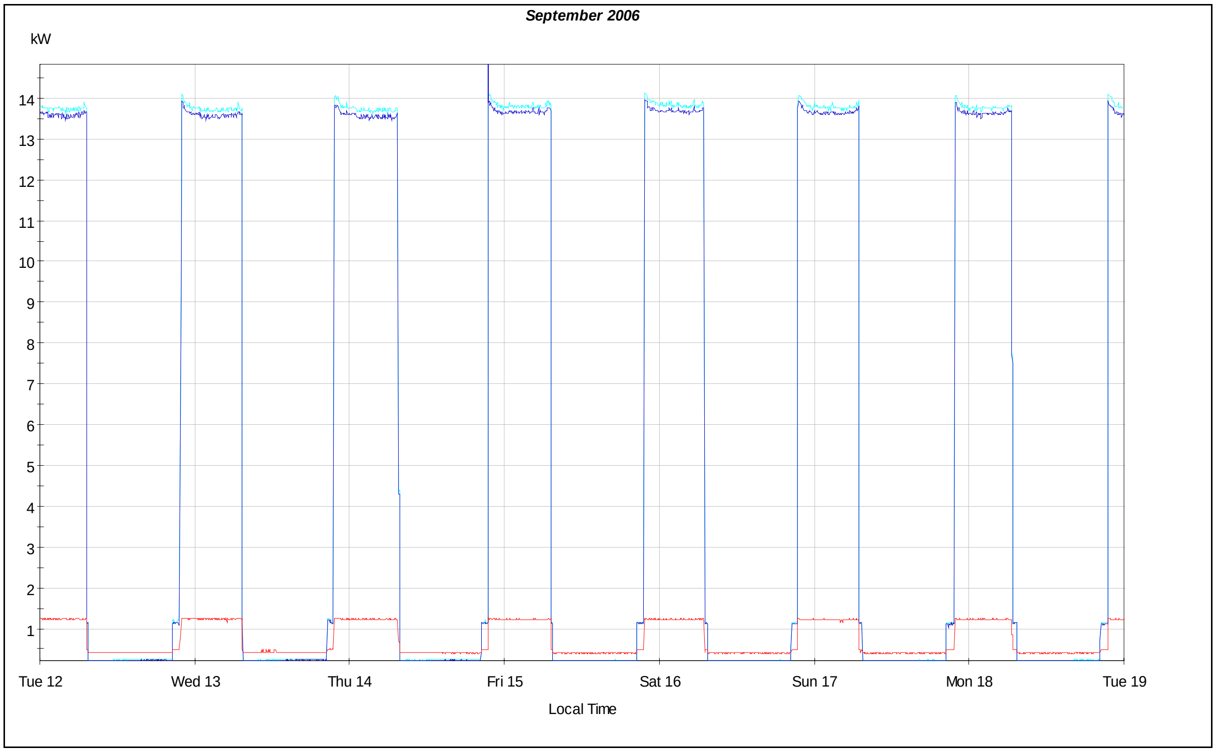


Figure 17: P14707 Metered Data

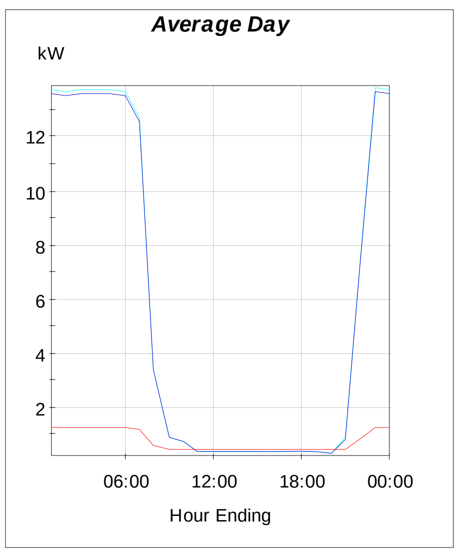


Figure 18: P14707 Hourly Power Profile

Based on the metered data, one would expect the savings to be slightly larger than the ex-ante gross savings estimate since the hours of operation were slightly longer than estimated. However, there appears to be a mistake in the ex-ante gross calculations for the drip pen area. The site estimated they would save 10,130 kWh, but calculations using the ex-ante gross numbers showed that the area would only save 3,444 kWh. Due to this error, the savings are actually reduced since the discrepancy accounts for approximately half of the savings.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent indicated that the equipment salesperson suggested the energy savings, but an SBD representative also helped perform analysis of the lighting. The respondent also indicated that the system probably would have been installed the same regardless of the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 26.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	0.0	N/A	0.0	0.0
kWh	12,055	5,354	44%	0.67	3,569

Table 26: P14707 Lighting Savings Comparison

Automatic Daylight Control

Project P14707 received an incentive of $588 to install photocell daylighting controls. The photocell enables the lights to turn off while there is sufficient daylight for lighting. The baseline of this measure is the lighting that operates continuously during the daylight hours.

Ex-Ante Gross Savings

Ex-ante gross savings are estimated using the proposed hours and lamp wattage and an assumed control fraction.

Ex-Post Gross Savings

One data logger was installed on all of the daylighting fixtures as shown in for a period of 4 weeks in September 2006. The data appeared to follow the ex-ante gross schedule estimate. The lighting was off slightly more hours during the day than estimated in the ex-ante gross analysis, but this was attributed to the metering being in September when the daylight hours are longer. The daylighting data can be seen in Figure 17 and Figure 18.

Incented Area	Metered
Cow Platforms	Yes
Drip Pens	Yes
Wash Pens	Yes
Breezeway	Yes

Table 27: P14707 Operating Schedule of the Lights on Photocell

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent indicated that the equipment salesperson suggested the energy savings, but an SBD representative also helped perform analysis of the lighting. The respondent also indicated that the system probably would have been installed the same regardless of the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 28.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	4.8	5.5	115%	0.67	3.7
kWh	14,690	24,189	165%	0.67	16,126

Table 28: P14707 Daylight Savings Comparison

Refrigeration System

Project 14707 received an incentive of $4,746 to install precoolers using a groundwater heat exchanger that precools freshly pumped milk before refrigeration. The baseline for this measure is a single-stage chiller with an air-cooled condenser and no precooling. The incentive also included the installation of groundwater cooled condensers with a 90°F condensing temperature.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated using DOE-2.2R simulation software. The refrigeration schedule and process load were estimated and the proposed model was created to reflect process equipment and characteristics. A baseline model with no precooling was also created. The ex ante savings are simply the differences in annual usage and peak demand between the proposed and baseline models.

Ex-Post Gross Savings

Most components of the refrigeration system were monitored with data loggers for four weeks in September 2006. Table 29 presents the features that were metered. Figure 19 shows data for two compressors for a week during the monitoring period.

Incented Equipment
Groundwater Milk Precooling
Groundwater Condensing
Metered Equipment
Entering Compressor Temperatures
Groudwater Condenser Temperatures
Chilled Water Temperatures
Milk Temperatures
Refrigerant Temperatures

Table 29: P14707 Metered Items

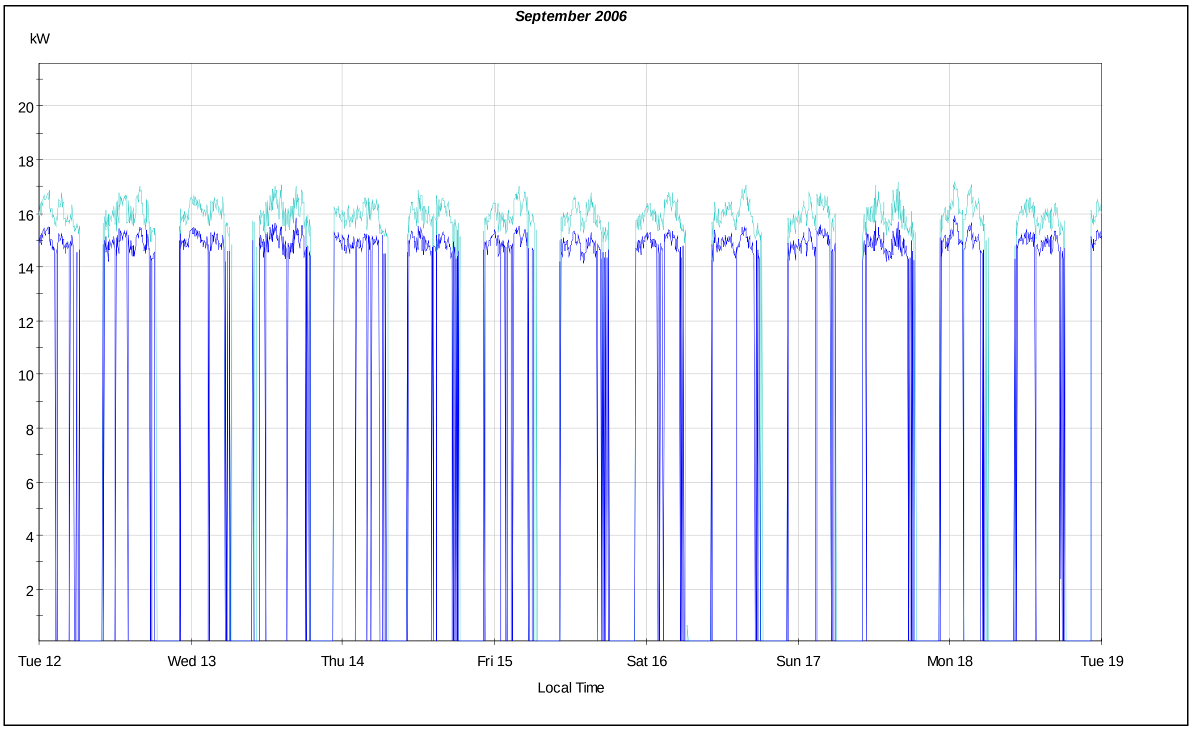


Figure 19: P14707 Metered Data of Compressors

Figure 20, Figure 21, Figure 22, and Figure 23 present the average hourly profiles for various components of the refrigeration system. The schedule shows the equipment shuts off for two periods throughout the day, one in the early morning, and one in the evening.

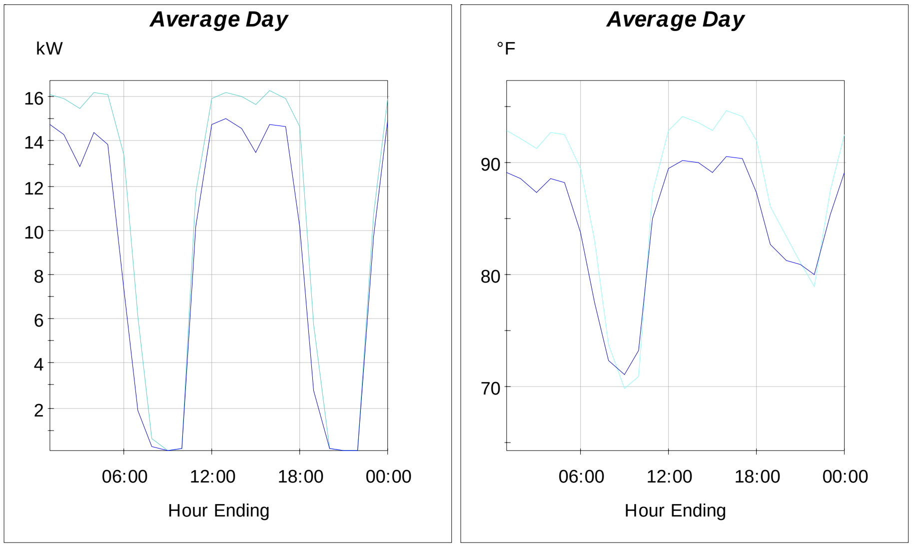


Figure 20: P14707 Hourly Compressor Power Consumption and Entering Compressor Temperature

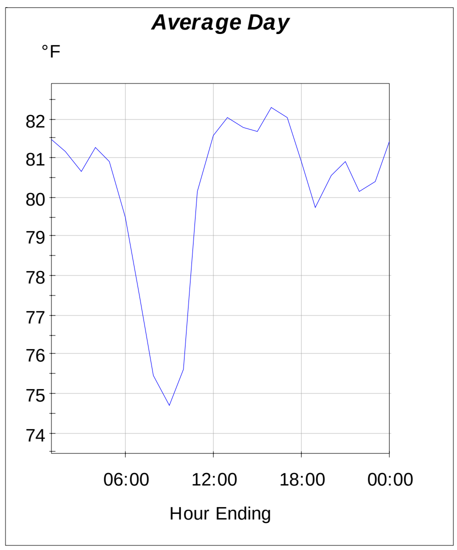


Figure 21: P14707 Hourly Groundwater Temperature leaving First Cooling Stage

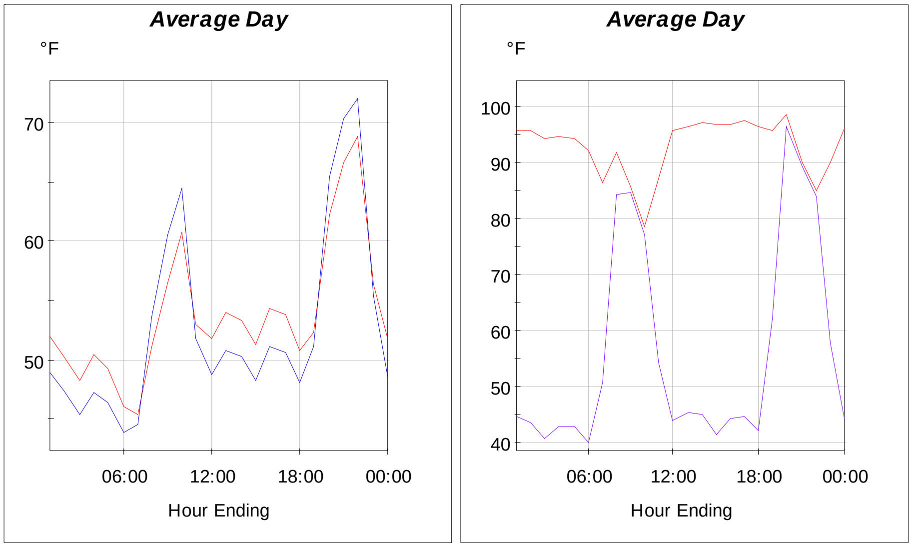


Figure 22: P14707 (L) Average Hourly Chilled Water Temperatures of Second Cooling Stage, (R) Milk Temperature Entering First Cooling Stage and Leaving Second Cooling Stage

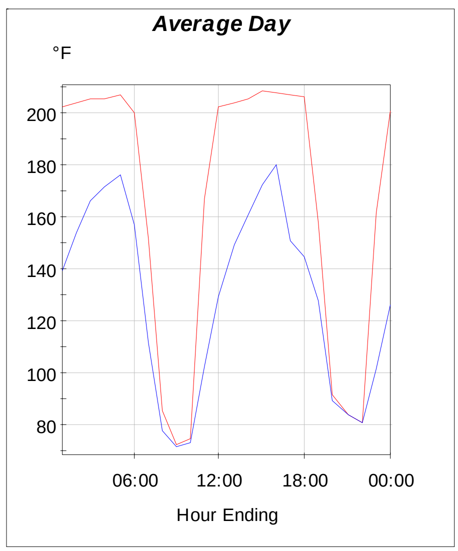


Figure 23: P14707 Average Hourly Desuperheater Refrigerant Temperatures Entering and Leaving Compressor

The metered data were used to determine a schedule of operation for the refrigeration system. The ex-ante gross model estimated that the system was only off from 5pm to 12am each day. However, all of the data indicate that the system is off for approximately four hours in the morning and four hours in the evening. The ex-ante gross models were manipulated to reflect this operating schedule for the refrigeration loads and pump schedule. The loads in the model seemed reasonable and since no flow rates were available, the load was assumed to be the same as original estimates.

The 90°F condensing temperature was verified with the data and not changed in the model. Since the total hours of operation were close, the savings are also similar.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the precooler measure. The respondent indicated that an SBD incentive helped the measure meet the investment criteria. Unlike the other measures at this site, the respondent indicated that the system probably would not have been installed the same without contact with the Savings by Design program representatives. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 30.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	21.0	21.6	103%	0.83	18.0
kWh	59,322	59,130	100%	0.83	49,275

Table 30: P14707 Refrigeration System Savings Comparison

Process Systems

Project 14707 received an incentive of $4,944 to install VFDs on three pumps at a dairy facility; one 15hp vacuum pump, and two 5hp milk pumps. This measure also included an incentive for premium efficiency motors on the same vacuum pump, milk pumps, two 5 hp pumps, one 10 hp air compressor, and a 10 hp tanker pump-out pump. The baseline for the VFD pumps is fixed speed pumps. The baseline efficiency for the premium efficiency motors is determined by the Energy Policy Act of 1992 (EPAct), the minimum motor efficiency is established by motor size, speed and type of enclosure.

Ex-Ante Gross Savings

The ex-ante gross savings include savings for premium efficiency pumps and VFD pumps. Ex-ante gross energy usage for the VFD was calculated by using the rated motor power, motor efficiency and estimates of the operating schedule. The pump VFD savings were assumed to provide 50% savings over a fixed speed pump, or 50% of the baseline energy usage. The premium motor savings were calculated based on the difference in baseline and installed efficiency, the motor horsepower, and the number of hours of operation per year.

Ex-Post Gross Savings

True power data loggers were installed on two VFD premium efficiency motors for four weeks in September of 2006. All of the metered equipment is shown in Table 31.

Incented Equipment	Quantity	Incented	Quantity Metered
15 hp Vacuum Pump	1	VFD, PE	1
2 hp Milk Pumps	2	VFD, PE	1
5 hp CHW Pumps	2	PE	0
10 hp Air Compressor	1	PE	0
10 hp Tanker Pump-Out Pump	1	PE	0

Table 31: P14707 Metered Equipment

Figure 24 presents a week of data for the vacuum pump and Figure 25 shows the average power draw for the vacuum and milk pumps by hour. The hourly profiles were analyzed to compute the energy consumption and savings for both the VFD and premium efficiency motors. Note that the red is the baseline in the charts below, while the blue is the metered data.

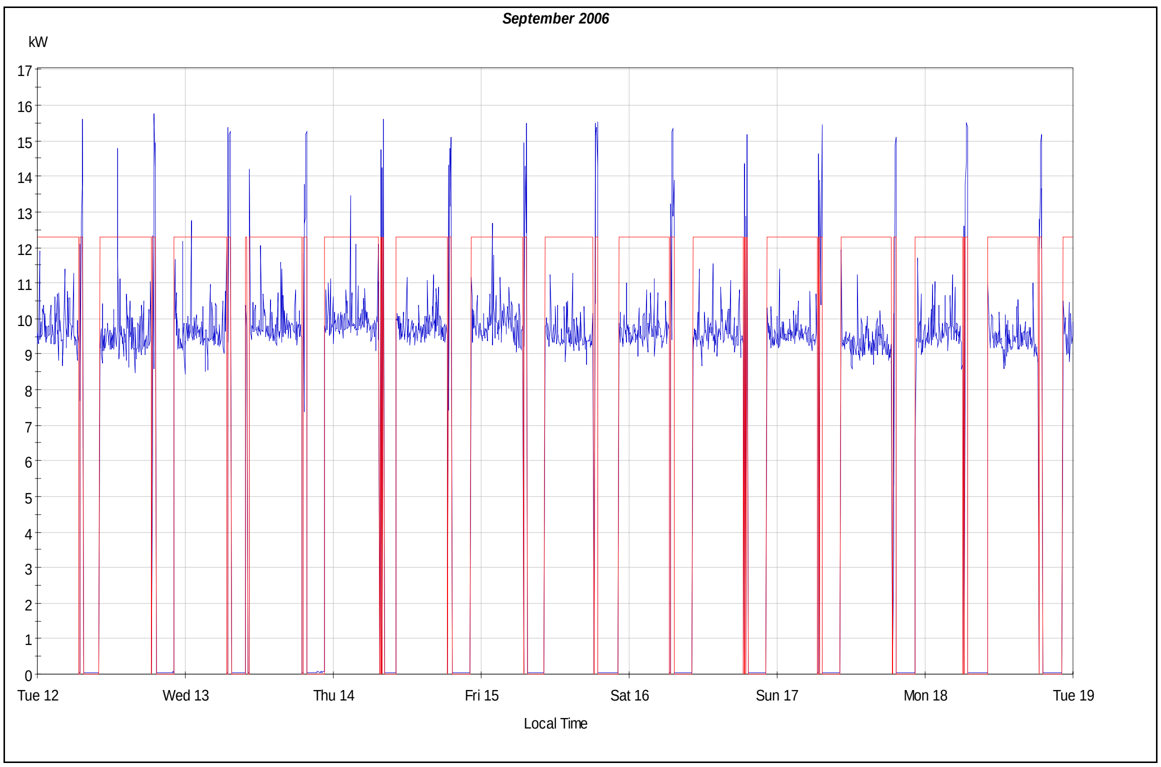
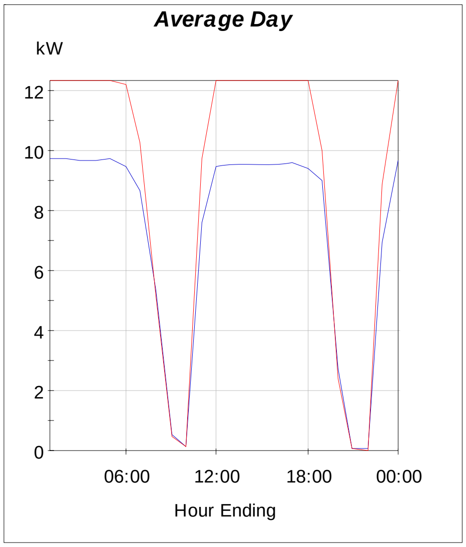


Figure 24: P14707 Vacuum Pump Metered Data



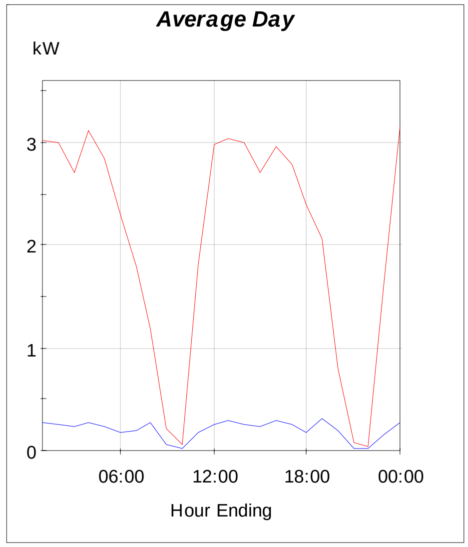


Figure 25: P14707 Average Hourly Power Draw for Vacuum and Milk Pumps

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent indicated that an SBD representative helped the measure meet the investment criteria. The respondent also indicated that the system probably would have been installed the same regardless of the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 32.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	6.4	8.4	132%	0.67	5.6
kWh	49,442	50,485	102%	0.67	33,657

Table 32: P14707 Process Savings Comparison

Total Site Savings

The combined site savings are shown in Table 33.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	32.20	35.55	110%	0.77	27.30
kWh	135,509.00	139,158.55	103%	0.74	102,627.37

Table 33: P14707 Total Site Savings

P15492

VFD Controlled Blower

Project 15492 was incented for $5,337 and $4,001 to install a VFD on a 60 hp premium efficiency blower motor and high efficiency recuperative heat exchanger, respectively. The evaluation team verified the existence of VFD on the blower motor during the site visit. However the evaluation found that no heat exchanger had been installed. Hence, the analysis is only based on the VFD blower. The baseline for the blower measure is a fixed speed blower with a modulating outlet damper flow control strategy.

Ex-Ante Gross Savings

The ex-ante gross savings were calculated by comparing the baseline blower motor usage (outlet damper control) with a VFD retrofitted premium efficiency blower motor. The ex-ante gross analysis estimates a total savings of 205,252 kWh / yr and 33.5 kW.

Ex-Post Gross Savings

A data logger was installed on the blower motor for a period of three weeks during October and November of 2006. The data is presented in Figure 26. The logger data showed the facility operates almost 24 hours a day and seven days a week. It was also used to calculate the annual power consumption on an average day, as shown in Figure 27. This evaluated power and energy were compared to the baseline and ex-ante gross energy usage and the results are presented in Table 34.

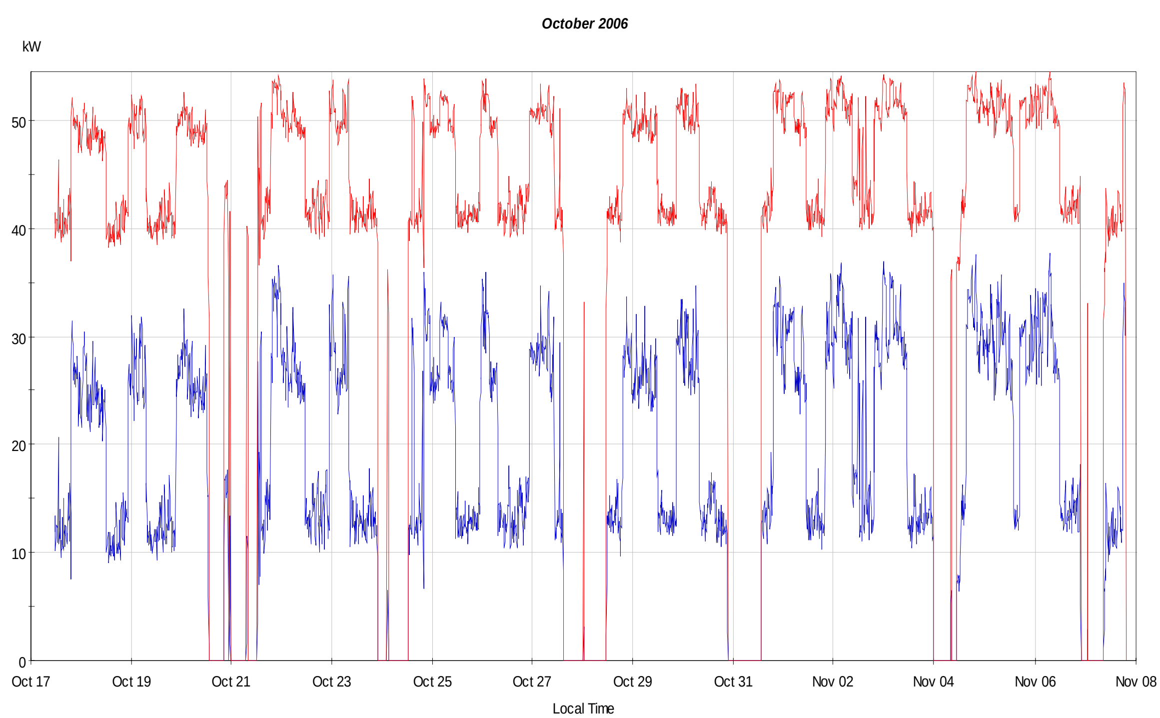


Figure 26: P15492 Blower Metered Power (Red-Baseline and Blue-Evaluated)

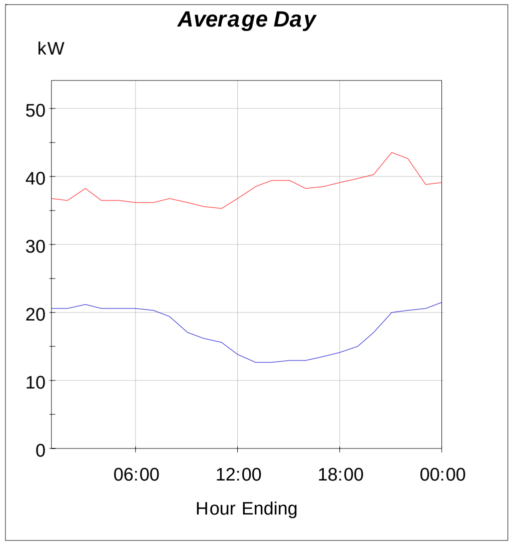


Figure 27: P15492 Average Hourly Power (Red-Baseline and Blue-Evaluated)

The estimated baseline demand was 37.7 kW and the evaluated demand was 12.24 kW. The ex-ante gross demand was 33.5 kW. The program was evaluated to save 179,106 kWh per year. There is also a demand reduction of 25 kW.

Ex-Post Net Savings

The facility engineer indicated that the program was somewhat influential in the implementation of this measure. The respondent suggested that the SBD representative introduced this measure to them. They also mentioned that before getting involved with SBD they had some plans to go with a premium efficiency motor to save energy. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated at 58% of the ex-post gross savings as summarized in Table 34.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
Peak kW	33.5	25.2	75%	0.58	14.7
kWh	205,252	179,106	87%	0.58	104,472

Table 34: P15492 Overall Savings Comparison

P16008

All Measures

Project P16008 is a refrigerated warehouse in which the new construction totals approximately 8,000 square feet. The project received an incentive of $19,690 for adding three energy efficiency measures, a groundwater cooled condenser, VFD controlled air unit motors, and VFD controlled compressor motors. The measures were verified by the evaluation team during a site visit.

Ex-Ante Gross Savings

Ex-ante gross savings were determined by using DOE-2.2R simulation software. A variety of parameters were estimated, including the equipment schedules, cooling loads, and temperatures.

Ex-Post Gross Savings

Ex-post gross savings were calculated using DOE-2.2R and the same methodology as the ex-ante gross savings. The items that were monitored at the site are shown in Table 35. They were monitored during September and October for four weeks.

Incented Equipment
Water Cooled Condenser
VSD Air Unit Motor
VSD Compressor Motor
Metered Equipment
Compressor
Well Pumps
Cooler Fans
Groundwater Temperature entering Condenser
High Pressure Liquid Temperature

Table 35: P16008 Metered Equipment

Figure 28 shows the groundwater and condensing temperatures. The ex-ante gross model estimated the average groundwater and condensing temperature to be 72 °F and 85 °F, respectively. Although the average metered temperatures were 68 °F and 79 °F, these values are within range of the ex-ante gross estimates. Also, the minor temperature discrepancies may be due to seasonality. Therefore, no changes were made in the model and the set point temperatures were assumed to be accurate.

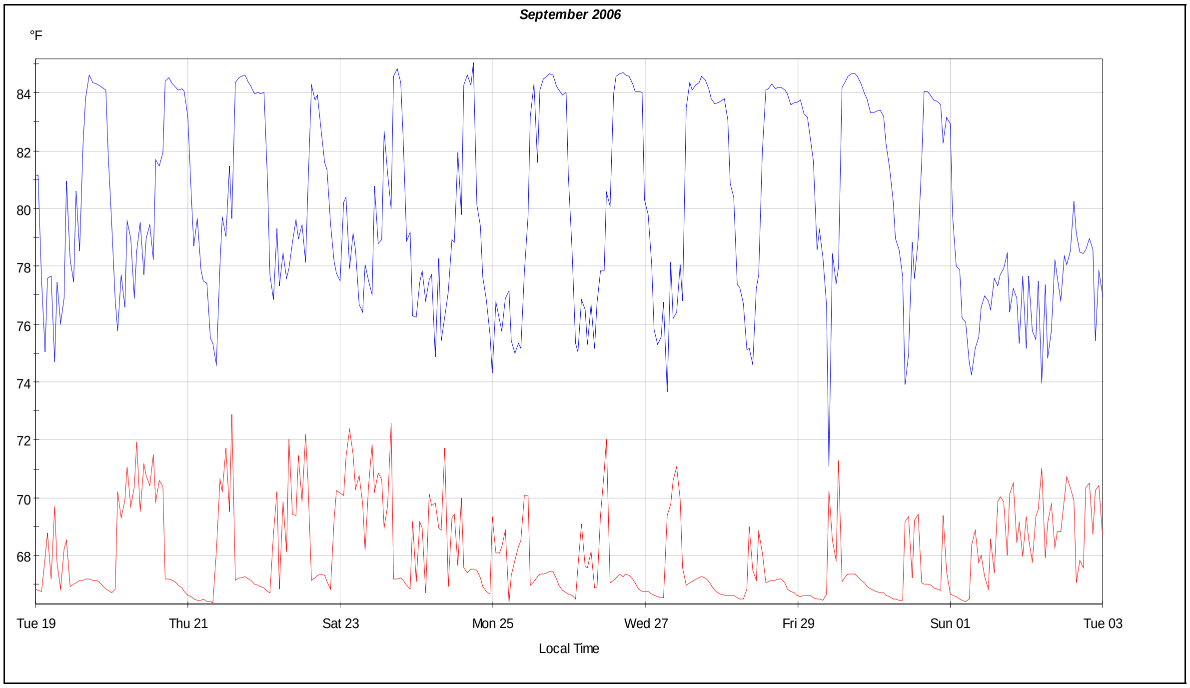


Figure 28: P16008 Metered Groundwater Temperature (Red) and Condensing Temperature (Blue)

Figure 29 shows the metered well pump and cooler fan power consumption. The well pump uses approximately 2.3 kW on average, while the model estimates it to use 2.4 kW. This value was adjusted to the meter data in the model. The pump operates twenty-four hours per day which is reflected in the model. The cooler fans appear to be operating twenty-four hours per day which is also simulated in the model.

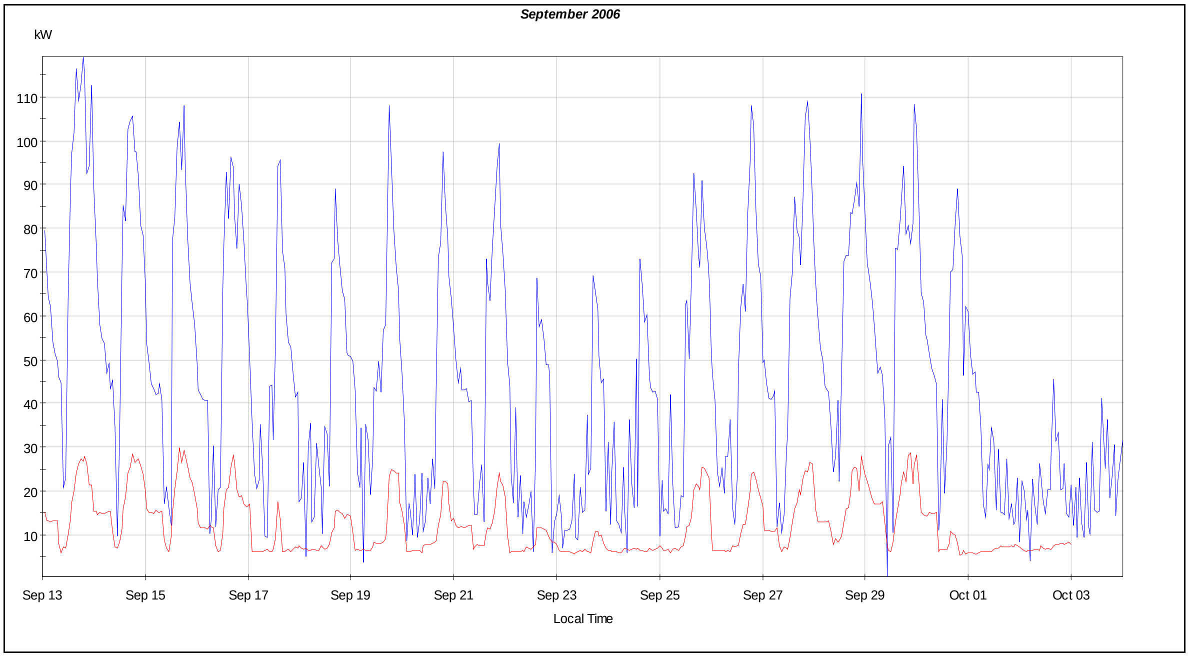


Figure 29: P16008 Well Pump (Red) and Cooler Fans (Blue) Power Consumption Data

The compressor power draw is shown in Figure 30. The compressor is cycling on and off throughout the day, as it is set to do in the model. Additionally, the compressor metered data shows similar energy consumption as the estimation model Therefore, no changes were made to the compressor measure in the model.

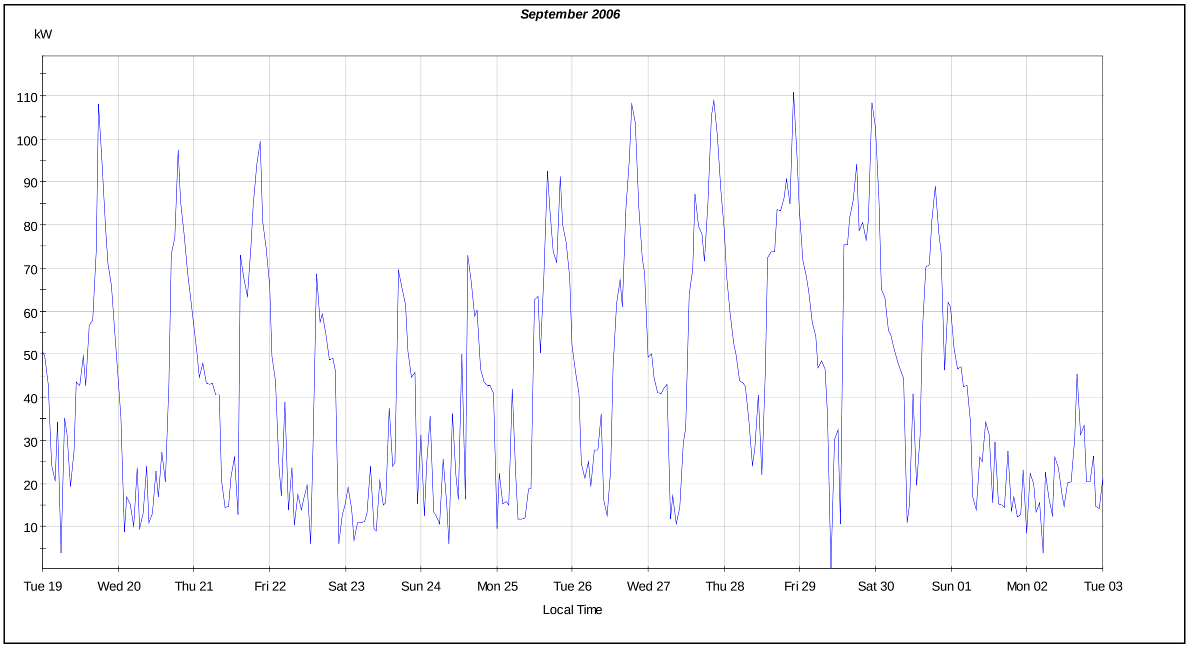


Figure 30: P16008 Compressor Power Consumption Data

Ex-Post Net Savings

A freeridership survey was not completed for this site. Therefore, the average free-rider score of all the sites was used. The average score was a 2.5 out of 6, so the ex-post net savings are calculated as 58% of ex-post gross savings. The results are shown in Table 36.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	32.5	34.9	107%	0.58	20.4
kWh	246,127.0	338,409.0	137%	0.58	197,405.3

Table 36: P16008 Savings Comparison

P19408

High Efficiency Lighting

Project 19408 received an incentive of $16,927 to install high efficiency lighting. The facility installed metal halide and fluorescent fixtures. The baseline for this measure is determined by Title 24 energy consumption standards of commercial buildings on a square foot basis. Therefore, the only information required for the baseline is the area type (office, bathroom, etc.) and the area in square feet. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using projected lighting hours and rated lamp wattage.

Ex-Post Gross Savings

A meter was installed on the lighting shown in Table 37 for three weeks in October, 2006. Many areas were not metered because they were a small portion of the savings. Ninety percent of the lighting savings came from the two barn areas. Although only one freestall barn was metered, its schedule is assumed representative of all four freestall barns as well as the maternity barn.

Incented Areas	Metered
Milker's Pits	NO
Cow Platforms	NO
Drip Pens	NO
Wash Pens	NO
Breezeway	NO
Equipment Room	NO
Milk Room	NO
Soap Room	NO
Hallway	NO
Medical Room	NO
Storage Spaces	NO
Offices	NO
Break Room	NO
Basement	NO
Restrooms	NO
Maternity Barn	NO
Freestall Barn- 4 total	1 Metered

Table 37: P19408 Metered Areas

The data were imported into Visualize-IT. The lighting appeared to follow the rated wattage and the schedule predicted by the facility. This is illustrated in Figure 31 which shows one week of the metered data and also in Figure 32 which shows the average power profile.

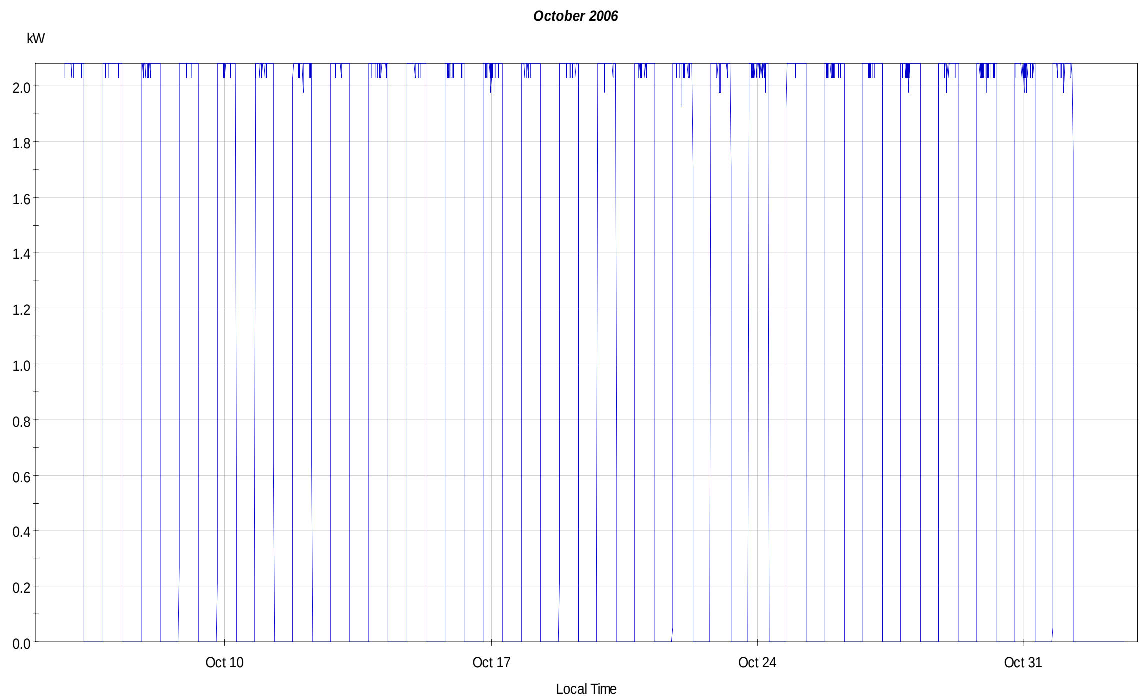


Figure 31: P19408 Lighting Power Data

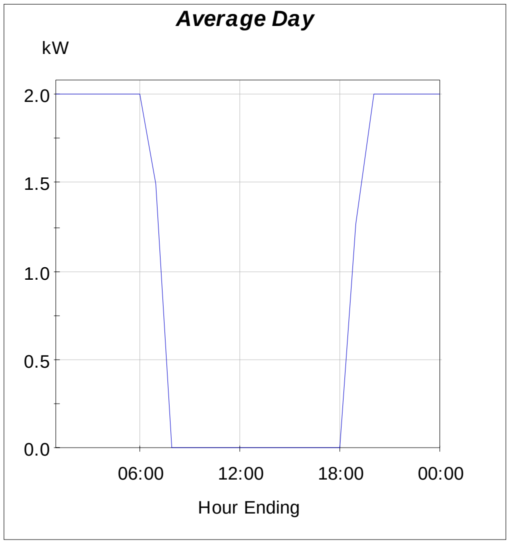


Figure 32: P19408 Hourly Average Power

The ex-post gross savings were calculated using the annual operating hours and rated lamp power draw. The metered power was not included in the calculations because it did not correspond to the rated power of the metered area. Many areas were not metered, but their operating hours and rated power seemed reasonable. Therefore, the ex-ante gross savings were assumed equal to ex-post gross savings. As mentioned earlier, these areas only account for 10% of the savings. The facility has slightly larger savings than estimated in the ex-ante gross analysis and the results are presented below.

Ex-Post Net Savings

A facility representative indicated that the program was somewhat influential in the implementation of the measure. The facility wanted to put in efficient lighting to save money and reduce the cost of operations. An SBD representative introduced the facility to the specific measure and estimated the associated savings. The respondent also indicated that the system probably would have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated at 58% of the ex-post gross savings as summarized in Table 38.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	10.1	N/A	0.58	5.9
kWh	282,117	373,040	132%	0.58	217,607

Table 38: P19408 Lighting Savings Comparison

Process Systems

Project 19408 received an incentive of $240 to install premium efficiency motors and a VFD on one vat pump. The baseline for this measure is standard efficiency motors and a fixed speed vat pump with the same operating schedule as found by the evaluation. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

Ex-ante gross savings for the premium efficiency motors were calculated by estimating the annual operation hours for each motor, using a baseline efficiency determined by the Energy Policy Act of 1992 (EPAct) and using the manufacturer rated efficiency. Ex-ante gross savings for the VFD was calculated by estimating that the VFD would provide 50% savings over a fixed speed pump. I also assumed the vat pump operated four hours per day, or 1,460 hours annually.

Ex-Post Gross Savings

A meter was installed on the vat pump and well pumps for three weeks during October and November of 2006. Table 39 shows the metered and incented equipment.

Process Equipment	Incented	Metered
Vacuum Blower (2)	Premium Efficiency	NO
Well Pumps (2)	Premium Efficiency	YES
Sprinkler Pumps (2)	Premium Efficiency	NO
Pressure Pumps (2)	Premium Efficiency	NO
CIP Pumps (2)	Premium Efficiency	NO
Vat Pump	VFD	YES

Table 39: P19408 Metered Process Equipment

Figure 33 shows data from a week of the metering period for the vat pump. The graph shows that the pump followed a routine schedule since there are noticeable patterns in the data.

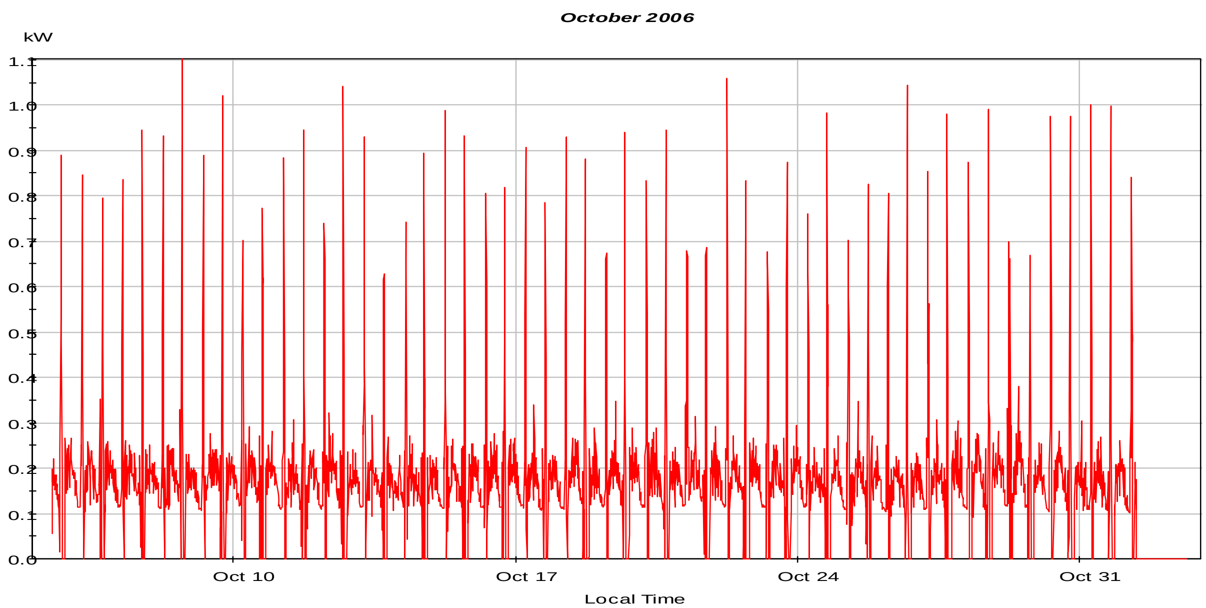


Figure 33: P19408 Vat Pump Power Data

Figure 34 presents the load profile for the vat pump on an average day.

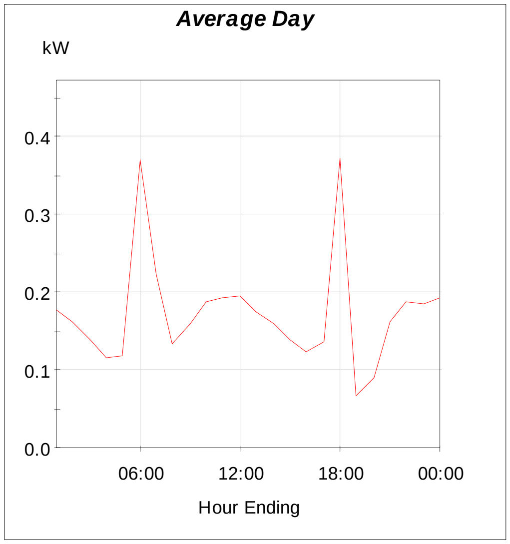


Figure 34: P19408 Vat Pump Hourly Power Profile

The metered data show that the vat pump is operating for approximately 20 hours per day, increasing the savings noticeably. Once the hourly load profile was created, the energy savings were calculated by using the measured power and annual operating hours.

The premium efficiency motors of the well pumps were metered. The data for the entire metering period are shown in Figure 35. The well pumps account for over 80% of the premium efficiency motor savings. The savings were calculated using the rated power draw, difference between baseline efficiency and premium efficiency, and annual operating hours. All other non-metered high efficiency pumps were given ex-post gross savings equal to ex-ante gross savings since the program analysis assumptions seemed reasonable. The premium efficiency motors also operated more hours than expected which created larger savings than reported from the ex-ante gross analysis.

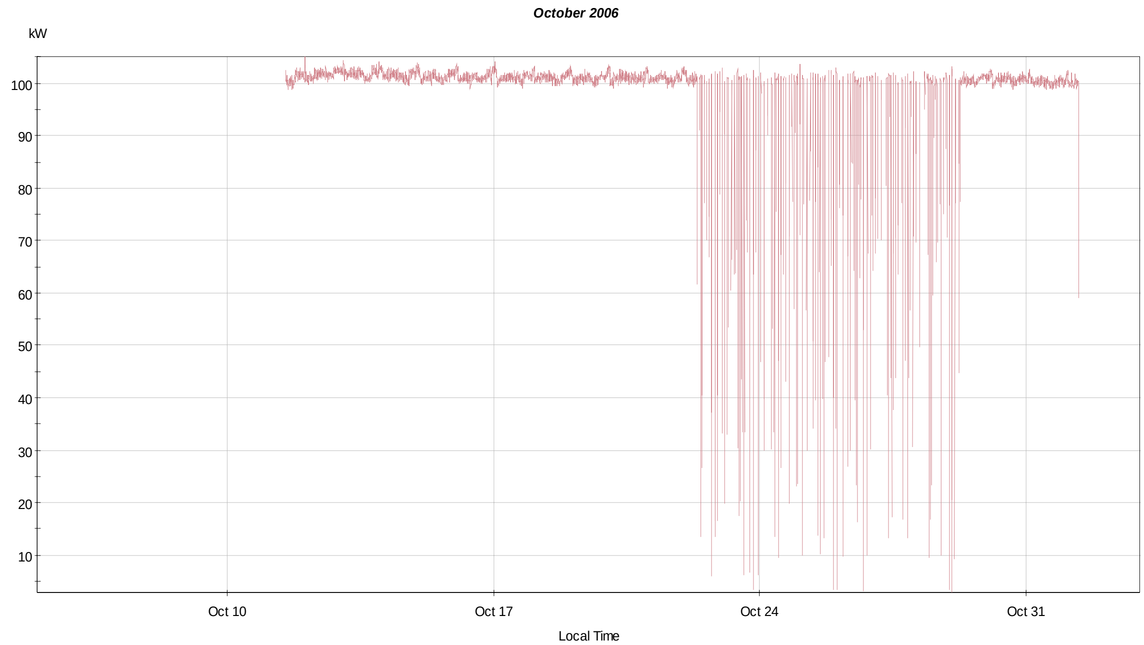


Figure 35: P19408 Well Pump Power Data

<u>Ex-Post Net Savings</u>

A facility representative indicated that the program was somewhat influential in the implementation of the measure. The facility wanted to upgrade the vat pump to save money and reduce the cost of operations. An SBD representative introduced the facility to the specific measure and the estimated the associated savings. The respondent also indicated that the system probably would have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated at 58% of the ex-post gross savings as summarized in Table 40.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	3.9	4.7	122%	0.58	2.8
kWh	7,998	28,673	359%	0.58	16,726

Table 40: P19408 Process Savings Comparison

Total Site Savings

The combined energy savings for all measures at this site are shown in Table 41.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	3.9	14.9	381%	58%	8.7
kWh	290,115.0	401,712.9	138%	58%	234,332.5

Table 41: P19408 Total Site Savings

P19708

Efficient Air Distribution System

Project P19708 received an incentive of $7,439 for installing a new, more efficient compressed air system, including replacing their 75 hp VSD rotary screw air compressor. The incented efficient compressed air system includes a new thermal mass dryer, four no-loss air loss drains and a system pressure reduction to 90 psi from 100 psi. However, the evaluation team observed that the actual compressor operating pressure was 93 psi.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using AirMaster+ software. The compressed air system was simplified and put into the program for both the baseline and the proposed models.

Ex-Post Gross Savings

Data loggers were installed on both the air compressor and air dryer for a period of five weeks during July and August of 2006. This is presented in Table 42.

Incented Equipment	Metered
75hp Air Compressor	YES
Dryer	YES
No Air Loss Drains (4)	NO
System Pressure Reduction	Recorded

Table 42: P19708 Metered Equipment

Figure 36 below shows the compressor power draw during the monitoring period.

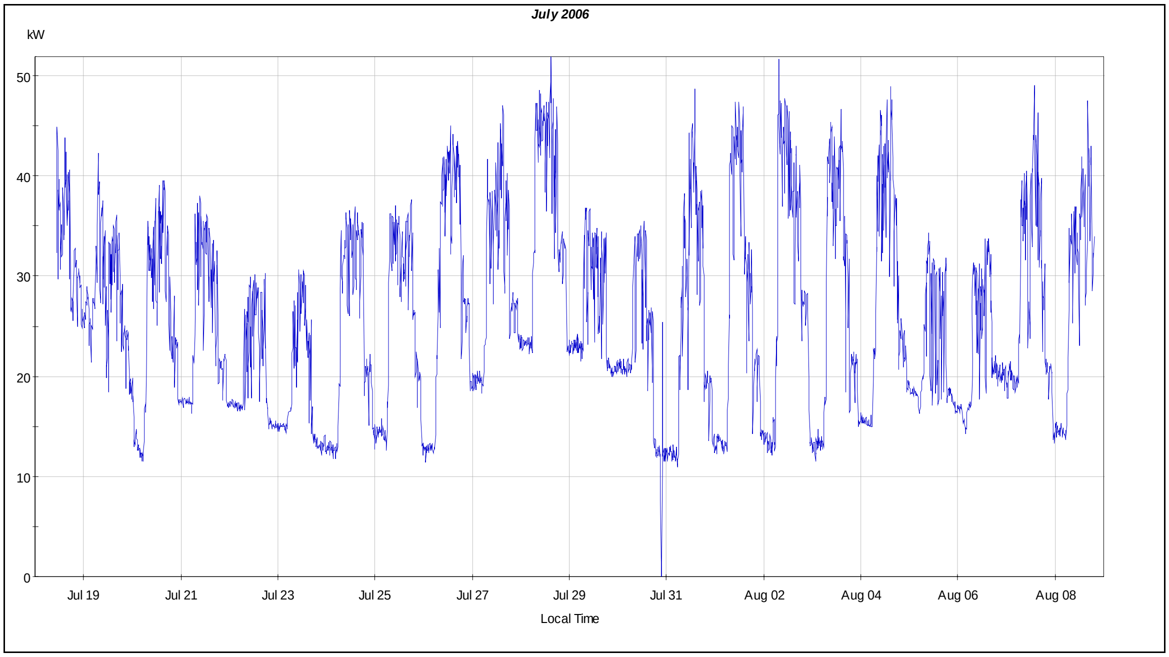


Figure 36: P19708 Compressor Power for Monitored Period

The hourly profile is shown in Table 43. The logger data shows that the compressor operates twenty four hours a day seven days a week. The hourly power profile for an average day was generated from the raw data.

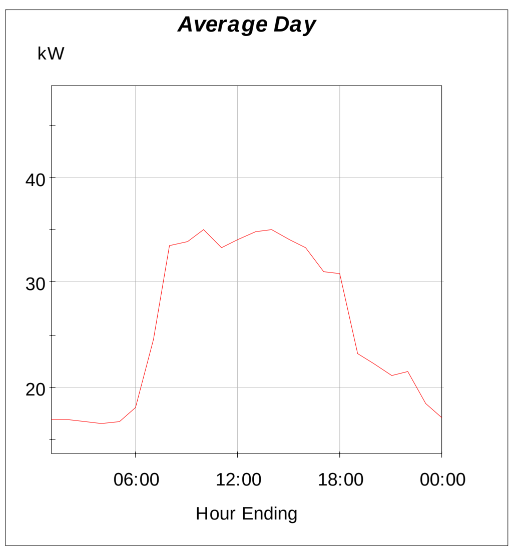


Table 43: P19708 Compressor Power Profile

Next, models were built in AirMaster+. The software requires inputs such as facility elevation, air system pressure, air storage capacity (receivers), and production day types. The metered data indicated that there were some days when the facility operated at full load and other days when it operated at partial load. Therefore, two day types were created. Next, the compressors were selected according to operating pressure and the system automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The AirMaster+ compressor profile was then modified to reflect VSD controls. Finally, the hourly power data recorded by the meter was input for each day type. Once all of these options were selected, the program modeled the actual behavior of the compressor.

For the baseline model all inputs stayed the same, except for the compressor controls and the hourly power consumption profile. No modifications were made to the program-generated compressor controls since they are standard and did not include VSDs. The system airflow is the variable that stays constant between the baseline and evaluation model. The hourly power profile was input in the evaluation model and the program calculated hourly airflow rates based on that profile. Those same hourly airflows were put into the baseline model instead of a power profile. Note that no other energy efficiency measures were included in the models, since a separate model was made for the baseline and evaluation models.

The AirMaster program generates both evaluated and baseline energy usage. The ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

The energy efficiency measures saved the same amount of energy despite the compressor running at 93 psi as compared to the 90 psi claimed in the ex-ante gross analysis. Peak savings were less, indicating that the compressor is not running as often during peak hours as expected from the ex-ante gross analysis.

Ex-Post Net Savings

The facility owner indicated that the program was very influential in the implementation of this measure and a SBD representative first suggested this measure. He also mentioned that they definitely would not have installed it if they had no interaction with the Savings by design Program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings as summarized in Table 44.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	6.8	3.9	58%	1.00	3.9
kWh	60,151	60,120	100%	1.00	60,120

Table 44: P19708 Savings Comparison

High Efficiency Lighting

Project P19708 received an incentive of $5,076 to install high efficient metal halide and sodium vapor fixtures. The baseline of this measure is determined by Title 24 energy consumption standard for high bay power use on square foot basis. The information required to define the baseline usage is the square footage of the lighted area which is 1.2 watts/sf. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

The ex-ante gross savings were determined by using projected lighting hours and the rated lamp wattage and the number of lamps installed.

Ex-Post Gross Savings

Time of use lighting loggers were installed on the HID fixtures in the production area for a period of four weeks. The annual operating hours were estimated by projecting logger data to a full year. The input power and the annual hours are used to calculate the energy and peak power. The program anticipated hours are similar to the actual operating hours. The savings were a little less than expected because the ex-ante gross savings were estimated by using rated lamp wattage without a ballast factor.

Ex-Post Net Savings

The facility owner indicated that the program was very influential in the implementation of the lighting measure and an SBD representative first suggested this measure. He also mentioned that they definitely would not have installed the lighting if they had no interaction with the Savings By Design Program. For the ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings as summarized in Table 45.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	9.7	6.7	69%	1.0	6.7
kWh	84,599	58,653	69%	1.0	58,653

Table 45: P19708 Savings Comparison

Total Site Savings

The combined energy savings of all measures at the site are shown in Table 46.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	16.5	10.7	65%	1.00	10.7
kWh	144,750	118,774	82%	1.00	118,774

Table 46: P19708 Total Site Savings

P19907

Whole Building- Air Compressor and Wastewater Systems

Project P19907 received an incentive of $70,978 for whole building savings, which included adding efficiency measures for compressed air and wastewater treatment systems. The project reached the incentive cap of $75,000 and the remaining incentive was provided for the refrigeration system, which is discussed after the whole building measures.

VSD Air Compressor

Project 19907 received approximately $13,897 of their $75,000 incentive to replace an existing 125 hp rotary screw air compressor with a new 75 hp screw compressor with a VSD to meet compressed air demand at their winery. The 75 hp compressor operates twenty-four hours a day, seven days a week. The evaluation team verified the installation of the new compressor and the VSD controls. In addition, extra storage capacity was added, a sequencer was added, and the system pressure was reduced to 90psig. The baseline for this measure is a 125 hp fixed speed air compressor with a system pressure of 100psig.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using AirMaster+ software. The compressed air system was simplified and put into the program for both the baseline and ex-ante gross models.

Ex-Post Gross Savings

A meter was installed on the equipment shown in Table 47 for two-three week periods. The first period was during the non-peak season of July and the beginning of August of 2006. The second metering period occurred during the peak season from mid to late August. When the data was analyzed it was found that the peak period did not begin until one week after the second metering period began. Therefore, four weeks of non-peak data and two weeks of peak data was collected.

Incented Equipment	Metered
75hp compressor	YES
Extra Storage	NO
Sequencer	NO
Pressure Reduction	Recorded

Table 47: P19907 Air Compressor Metered Equipment

The data were reduced to hourly consumption for three day types: average peak days, non-peak weekends, and non-peak weekdays. The hourly profiles for the three day types are shown in Figure 37.

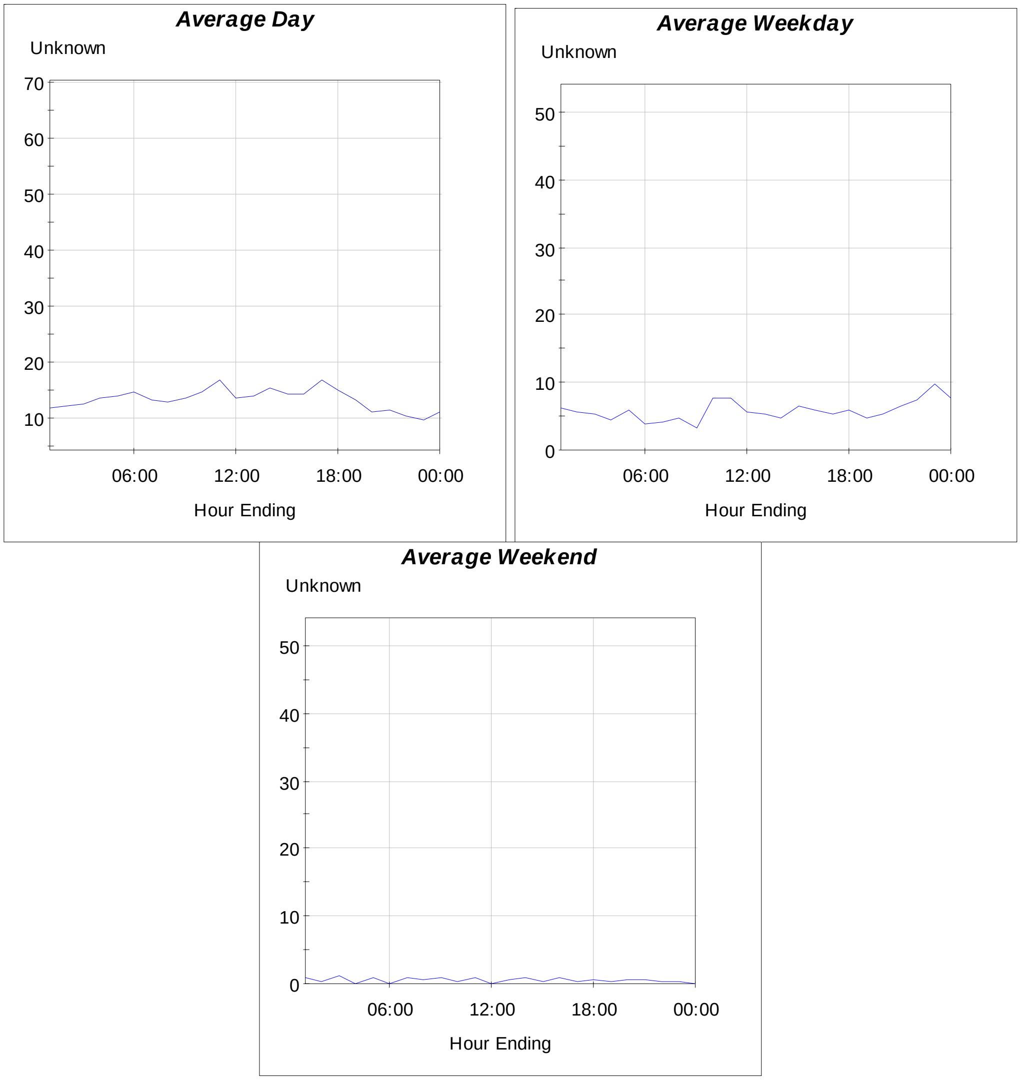


Figure 37: P19907 Air Compressor Hourly Profiles, Top Left: Peak, Top Right: Non-Peak Weekday, Bottom: Non-peak Weekend

Next, models were built in AirMaster+. The software requires inputs such as facility elevation, air system pressure, air storage capacity (receiver volume), and production day types. The three day types described above were used. Next, the compressor was selected according to operating pressure and the system automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The AirMaster+ compressor profile was then modified to reflect VSD controls. Finally, the hourly power data recorded by the meter was input for each day type. Once all of these options were selected, the program modeled the actual behavior of the compressor.

For the baseline model, all inputs stayed the same, except for the compressor controls and the hourly power consumption profile. No modifications were made to the program-generated compressor controls since they are standard and did not include VSDs. The system airflow is the variable that stays constant between the baseline and evaluation model. The hourly power profile was input in the evaluation model and the program calculated hourly airflow rates based on that profile. Those same hourly flow rates were put into the baseline model instead of a power profile. Note that no other energy efficiency measures were included in the models, since a separate model was made for the baseline and evaluation models.

The program returned the actual annual energy usage, as well as the baseline energy usage. The evaluated ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. An SBD representative introduced the facility to the pressure reduction, but the facility indicated that they only made parts of the measure an “easier sell.” They indicated that the system probably would have been installed the same absent the SBD program, except for the pressure reduction. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 3 out of 6, or 50% freeridership. Therefore, the ex-post net savings are evaluated at 50% of the ex-post gross savings as summarized in Table 48.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	25.8	17.7	81%	0.57	10.1
kWh	218,166	152,914	82%	0.57	87,076

Table 48: P19907 VSD Air Compressor Savings Comparison

Wastewater Systems

The wastewater measures included the installation of fine bubble aeration, and a VSD on the aeration pump with premium efficiency motors. The baseline for these measures is mechanical aerators with a standard efficiency, constant speed motor.

Ex-Ante Gross Savings

Savings for the wastewater system were estimated with hand calculations which included horsepower savings per pond and an estimated motor speed by month. The baseline mechanical aerator motors were three fixed speed 130 hp motors, while the evaluated motors were 130 hp variable speed motors. The ex-ante gross analysis estimated that the fine bubble aerators would reduce the pump power by 30 hp, while the VSD would change the speed based on the load, also reducing pump power.

Ex-Post Gross Savings

The ex-post gross savings analysis was based on metered data. A meter was installed on the equipment. The ex-post gross savings for the fine bubble aerators were calculated using metered data. The data were used to generate a power consumption profile for an average day.. Then the baseline was created using the pump input power and was as well reduced to an average hourly baseline profile. The two profiles are shown in Figure 38. The baseline is the red line and the meter data is the blue line.

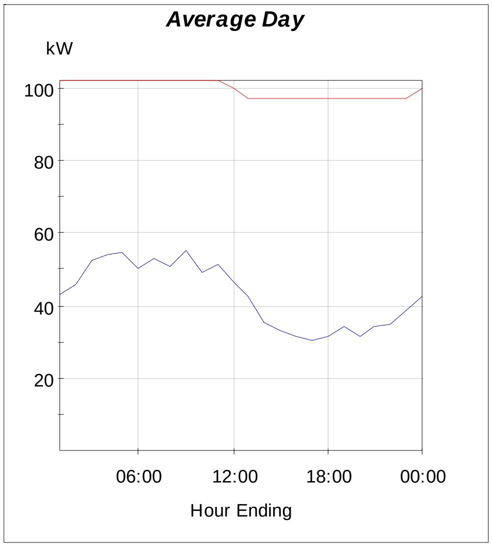


Figure 38: P19907 Wastewater Pump Average Hourly Profiles

Savings were calculated using the difference in the baseline and evaluated profiles. On average, the meter data showed the 130 hp pump used only using 57 kW. This is one reason for increased savings, since the ex-ante gross analysis estimated a reduction in power to only approximately 84 kW. The pump was found to be operating twenty-four hours a day as estimated in the ex-ante gross analysis.

Ex-Post Net Savings

The facility representative indicated that the SBD program was very influential to installation of the wastewater pumps. They also stated that the measures definitely would not have been installed without the program and they were suggested by an SBD representative. The ex-post net savings are evaluated at 100% of ex-post gross savings. The measure savings are shown in Table 49.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	103.2	131.2	127%	1.00	131.2
kWh	904,032	960,905	106%	1.00	960,905

Table 49: P19907 Wastewater Pump Saving Comparison

Refrigeration

Project P19907 received approximately $3,653 of their $75,000 incentive to install efficient refrigeration measures. The incented refrigeration measures include the installation of a high efficiency evaporative condenser, variable set point control and a variable speed fan for the condenser, and a VSD on one of the refrigeration compressor motors. The baseline for these measures is a standard efficiency condenser, no variable set point control or variable speed fan, and a fixed speed slide valve refrigeration compressor motor.

Ex-Ante Gross Savings

Ex-ante gross savings were computed using DOE-2.2R simulation software for the refrigeration measures. A variety of parameters were estimated, including the equipment schedules, cooling loads, and temperatures were used to construct the baseline and proposed models to estimate measure impacts.

Ex-Post Gross Savings

Ex-post gross savings were also calculated by manipulated the proposed model DOE-2.2R to reflect metered data. The evaluation team collected meter data for a number of refrigeration system components, along with the wastewater components. The equipment was metered for approximately six weeks.

The meter data showed that all of the metered components operating as predicted for the DOE-2.2R ex-ante model. Therefore, no changes were made to the model. Figure 39 shows the refrigeration compressor power consumption over the meter period. The compressor motor is 400 hp and the metered data show that it is using different amounts of power at different times, indicating operating VSD. The other two compressors were not monitored because they did not receive an incentive. The model simulates the compressor as cycling on and off twenty-four hours a day. The meter data shows that this is also the case since there is no clear, predetermined schedule to the compressor power consumption.

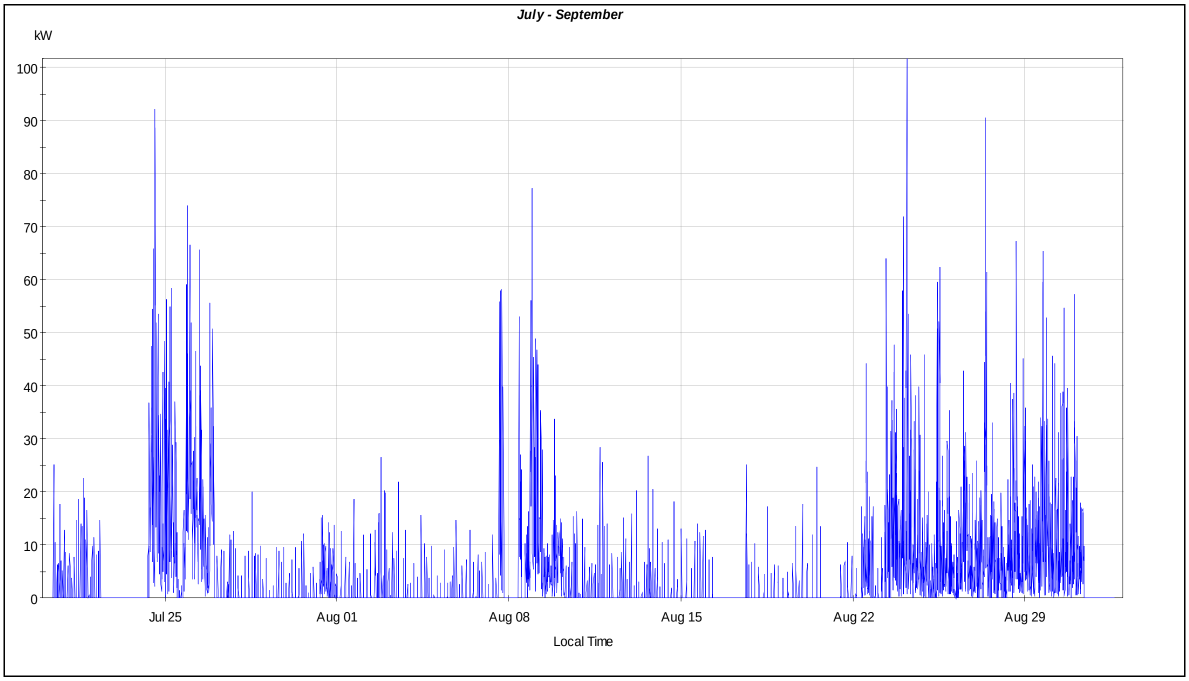


Figure 39: P19907 Metered Refrigeration Compressors

Likewise, Figure 40 shows metered data for the condenser fans. The condenser is operating almost twenty-four hours as predicted. It is apparent that the VSD is operating since the fan power is fluctuating.

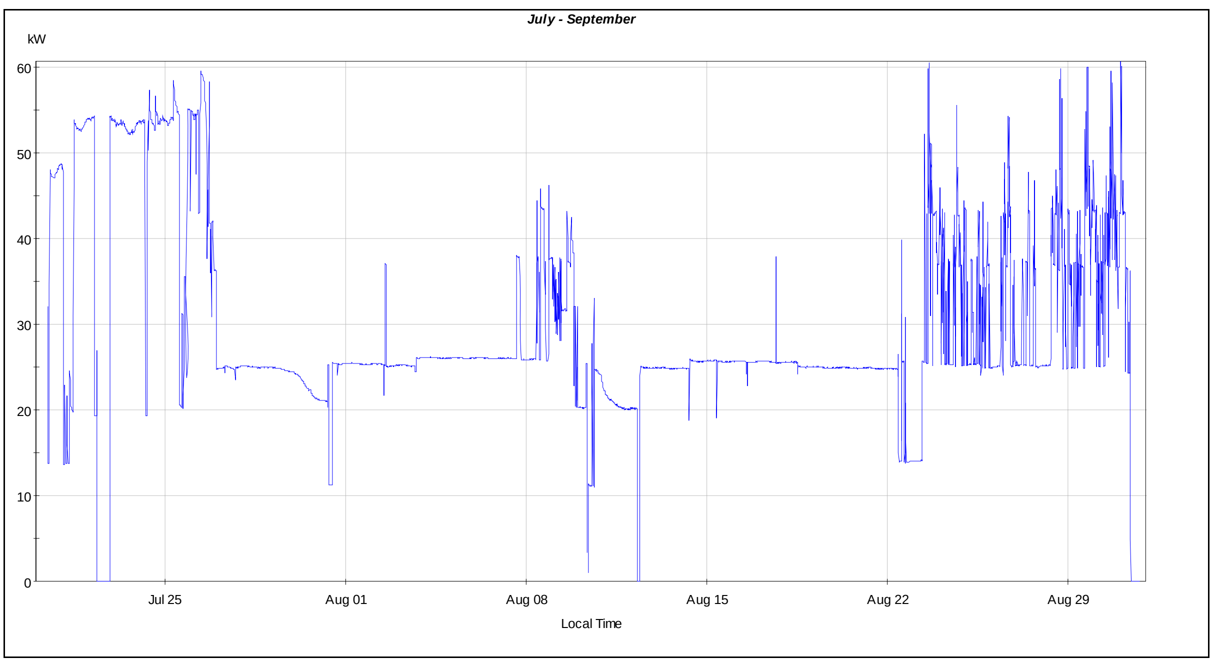


Figure 40: P19907 Metered Condenser Fans

Ex-Post Net Savings

Each of the measures in the refrigeration system received different freeridership scores. The efficient condenser was somewhat influenced, suggested by an SBD representative, and definitely would not have been installed without the program. The compressor VSD was highly influenced, suggested by an SBD representative, but would have been installed regardless of the program. The condenser controls were only slightly influenced, was an easier sell due to the SBD representative, and probably would have been installed absent the program. These responses indicate freeridership for the efficient condenser, VSD compressor and condenser controls of 8%, 50% and 63%, respectively. Therefore, ex-post net savings were weighted by freeridership per measure. On average, the net energy savings are evaluated at 86% of ex-post gross savings, while the net power savings are evaluated at 56% of ex-post gross savings. The two NTG ratios are different because the proportions of energy and power savings for each measure are different when compared to the total savings. Table 50 presents the refrigeration savings.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	31.0	28.4	92%	0.86	24.6
kWh	57,452	47,872	83%	0.56	26,799

Table 50: P19907 Refrigeration Savings Comparison

Total Site Savings

The combined site savings are shown in Table 51.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	160	177	111%	0.94	166
kWh	1,179,650	1,161,691	98%	0.93	1,074,780

Table 51: P19907 Total Site Savings

P19988

Whole Building

The project P19988 received an incentive of $38,724 for upgrading their processing facility. This upgrade consists of variable speed control air unit fan motors in different production areas, a waste water heat exchanger to precool the process make-up water and increasing the insulation in the walls and ceiling. The baseline of these measures is defined using Title 24 standards, where applicable, and typical industrial refrigeration construction and system design for refrigeration systems. The evaluation team verified the installation of the measures and performed short term metering activities at the facility.

Ex-Ante Gross Savings

Ex-ante gross savings were determined by using DOE-2.2R simulation software. For the VSD air unit motors yearly operating schedule and load was assumed to create an annual ex-ante model. The base case model of this measure was also created, which is a constant speed air unit motor.

Similarly for the waste water heat exchanger an ex-ante gross model was created by using DOE-2.2R simulation software by estimating the flow rate and the temperature differential of the heat exchanger. The baseline model was also developed. The base case of this measure was a refrigeration system without precooling of the make up water to the chiller.

Ex-ante gross savings for the insulation measure were estimating by modeling the insulation R-value R-24 for the walls and R-33 for the ceiling. The baseline of this measure was also created by using R-20 and R-23 for walls and ceilings respectively.

The DOE-2.2R model gives annual energy usage (kWh/yr) and coincident peak power draw (kW) for both proposed and baseline models for all three measures. Then, the ex-ante gross savings were calculated subtracting ex-ante gross usage from the baseline usage.

Ex-Post Gross Savings

A data logger was installed on the VSD air unit motors. No data loggers could be installed on the refrigeration system due to site conditions. Figure 41 presents a day of the metered air unit motor's data and Figure 42 presents the power profile for the monitoring period.

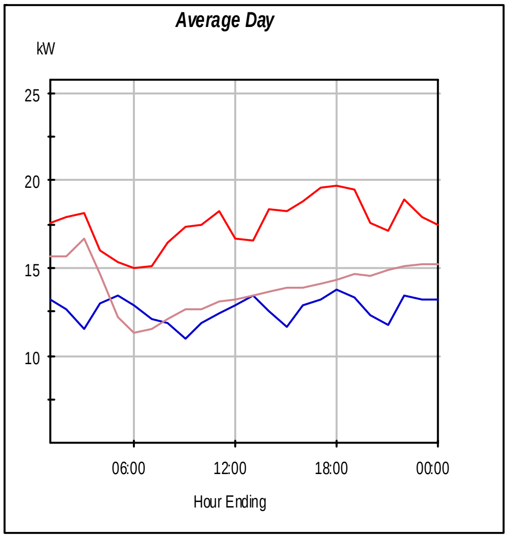


Figure 41: P19988 Average day Metered Data

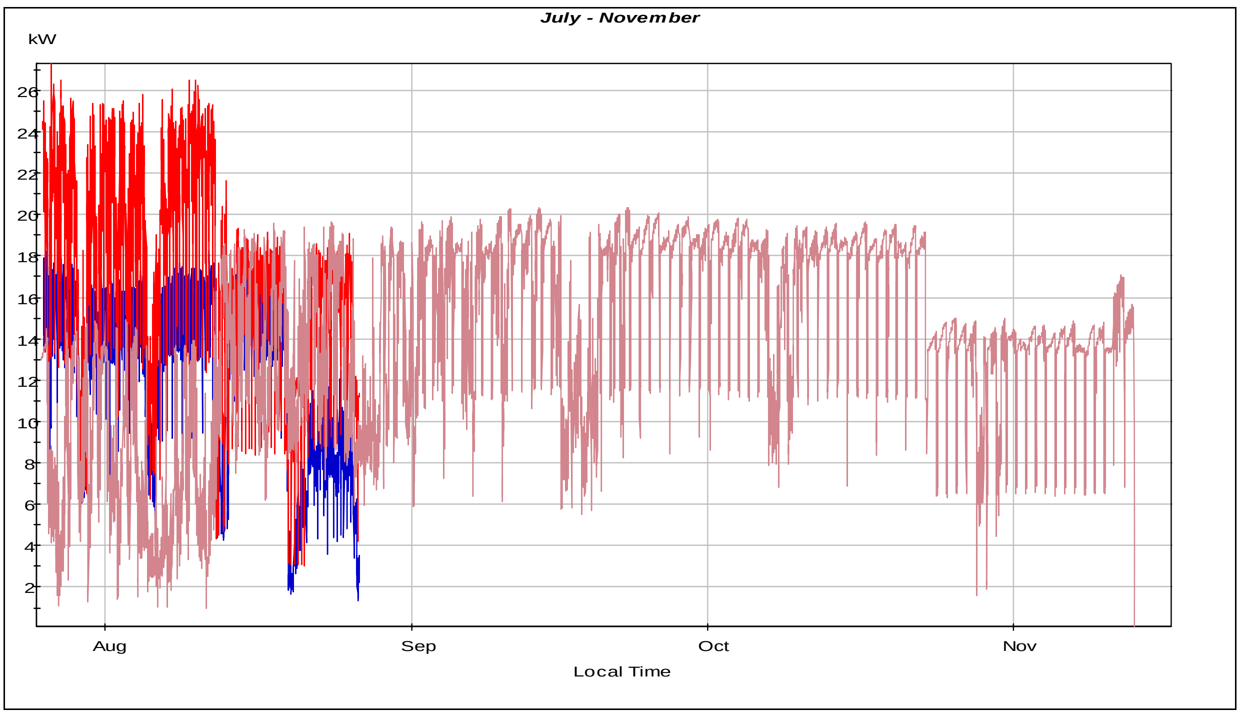


Figure 42: P19988 Air Unit Motors Metered Data for the Monitoring Period

The metered data shows the air unit motors run 24 hours a day, 7 days a week, as predicted, but the load on the air unit motors was found to be somewhat different than predicted. These metered data were used to create an ex-post DOE-2.2R simulation model. Then, the evaluated energy consumption was compared with ex-ante gross and baseline energy consumption.

For the waste water heat exchanger the delta T was found to be 15^0 F instead of 17^0 F as predicted and the waste water circulation pump was found to be 5 hp instead of 7.5 hp as mentioned in the ex-ante gross estimate. By incorporating the above data into the proposed model, an evaluation model was created. The output of this model was then compared with ex-ante gross and baseline energy usage.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. An SBD representative first suggested these measures and helped them meet the investment criteria. The respondent also indicated that the system definitely would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings as summarized in Table 52.

		Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
EEM1	peak kW	-4.0	5.6	-140%	1.0	5.6
	kWh	147,171	66,915	45%	1.0	66,915
EEM2	peak kW	72.0	64.0	89%	1.0	64.0
	kWh	326,220	296,149	91%	1.0	296,149
EEM3	peak kW	1.0	1.0	100%	1.0	1.0
	kWh	6,861	6,864	100%	1.0	6,864
All EEMs Combo	peak kW	72.0	72.0	100%	1.0	72.0
	kWh	484,044	377,871	78%	1.0	377,871

Table 52: P19988 Savings Comparison

P20649

Whole Building

Project P20649 is a refrigerated warehouse addition where new construction area includes approximately 62,900 square feet of refrigerated space. The project received an incentive of $75,003 for adding several measures at the facility. The measures included evaporative condensers with floating head pressure, variable set point and variable speed condenser fans, precooler VSD fan control, product cooler VSD fan control, efficient compressor motors, increased insulation, and reduced lighting power density in the cold storage areas. The measures were verified by the evaluation team during a site visit. This site has a widely fluctuating load due to the produce arriving in from the fields at various time schedules seasonally.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined by using DOE-2.2R simulation software. A variety of parameters were estimated, including the equipment schedules, cooling loads, and temperatures.

<u>Ex-Post Gross Savings</u>

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings. Certain parameters, shown in Table 53, at the site were monitored for a period of four weeks in August and September of 2006. The data show that there was no consistent schedule for many of the fan and air units. Most of the units seemed to be cycling on and off throughout the entire day. Since the units were set to operate 24 hours a day on demand in the model, no changes were made to the model fan or air units.

Incented Measures
Evaporative Condensers
Floating Head Pressure Condenser Controls
Variable Set Point Condenser Controls
VFD Condenser Fan Motors
VSD Precooler Fan Motors
VSD Product Cooler Fan Motors
Efficient Compressor Motors
Increased Insulation
Reduced Lighting Power Density
Metered Equipment
Cooler Fans
Condenser Fans
Precooler Overhead Fans
High Pressure Liquid (Condensing) Temperature
Outside Air Temperature
Outside Air Relative Humidity
Outside Air Wet Bulb Temperature

Table 53: P20649 Metered Equipment

Figure 43 shows the wet bulb and high pressure liquid temperatures for the variable set point control measure. This measure is based on wet bulb temperature reset so that the condensing set point follows slightly above the ambient wet bulb temperature. The temperature difference was estimated to be 6°F when above the minimum set point temperature of 60°F. However, the data proved the temperature difference is actually 19°F when above the set point.

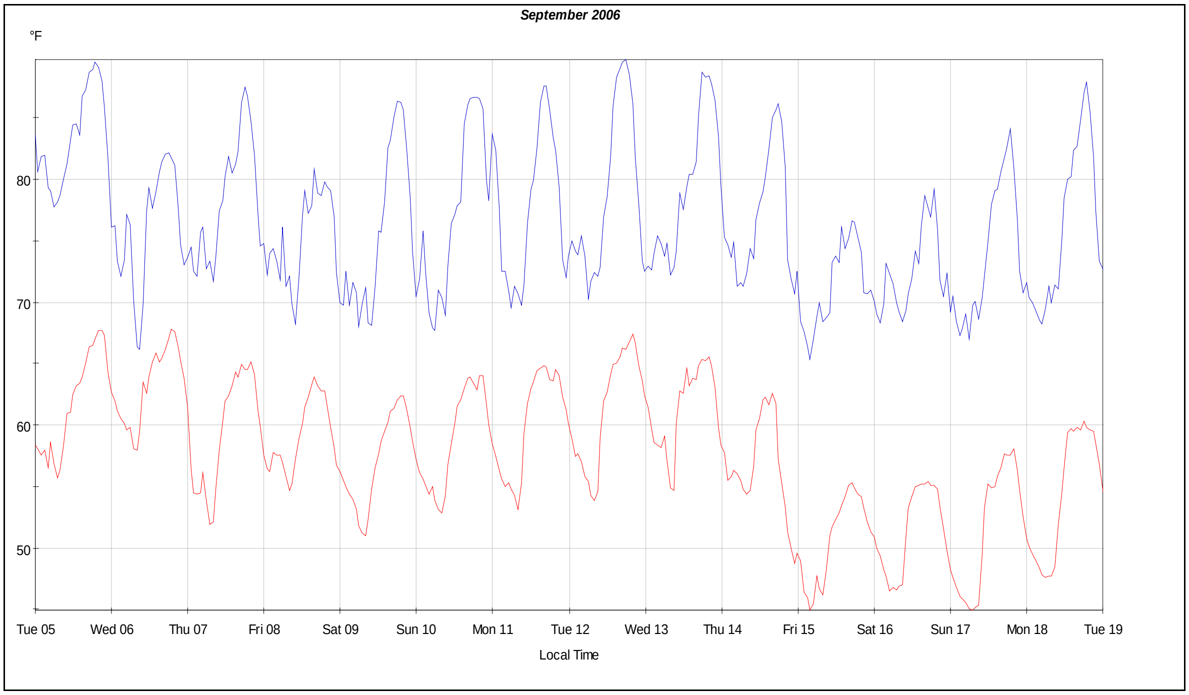


Figure 43: P20649 Metered Wet Bulb Temperature (Red) and High Pressure Liquid Temperature (Blue)

Figure 44 illustrates the variable load of the condenser fans at the facility since some days, the fans peak at 55 kW, while most the fans peak at 5 kW. Since the evaluation team did not have access to load schedules during the metering period, no changes could be made in the model to account for the fluctuating load. However, it does appear that the fans are cycling on and off twenty-four hours a day which is also what the model is simulating. As a result, no changes were made to these fan loads or schedules in the model. These data are the sum of the individual condenser fan consumptions.

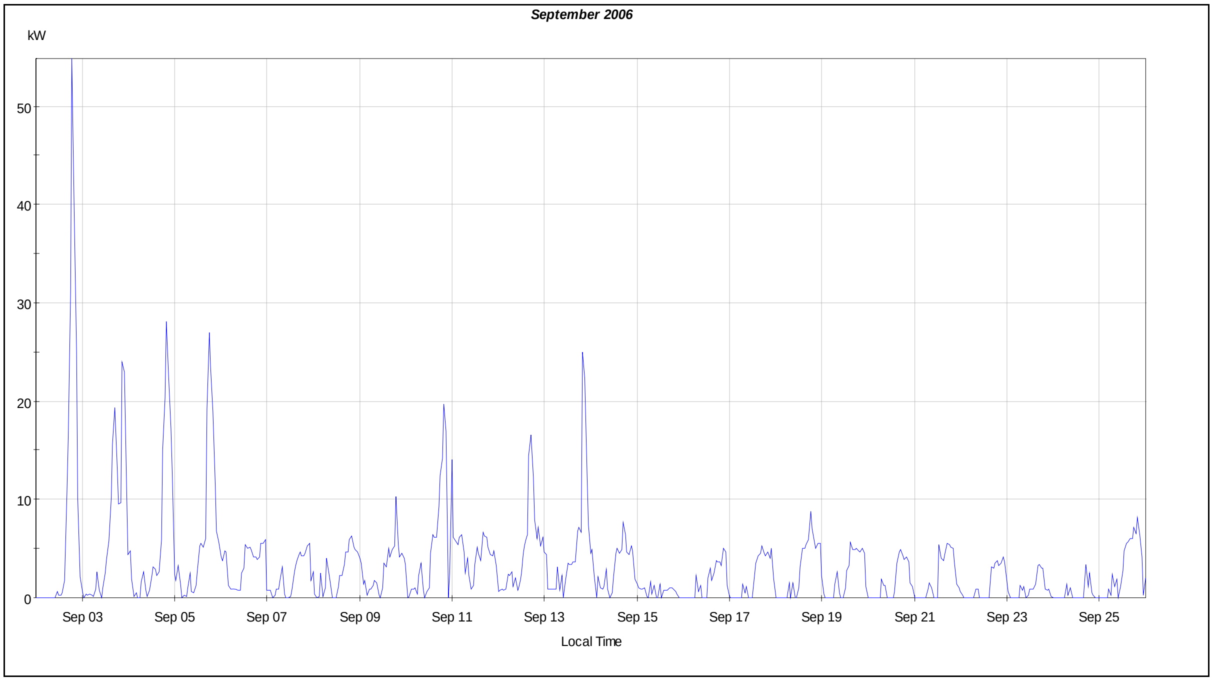


Figure 44: P20649 Power Consumption of Condenser Fans

Figure 45 and Figure 46 also show fans that appear to cycle throughout the day with no predetermined schedule. This is also what the model predicted and therefore no changes were made to the model for these fans. These data are the sum of the individual fan consumptions.

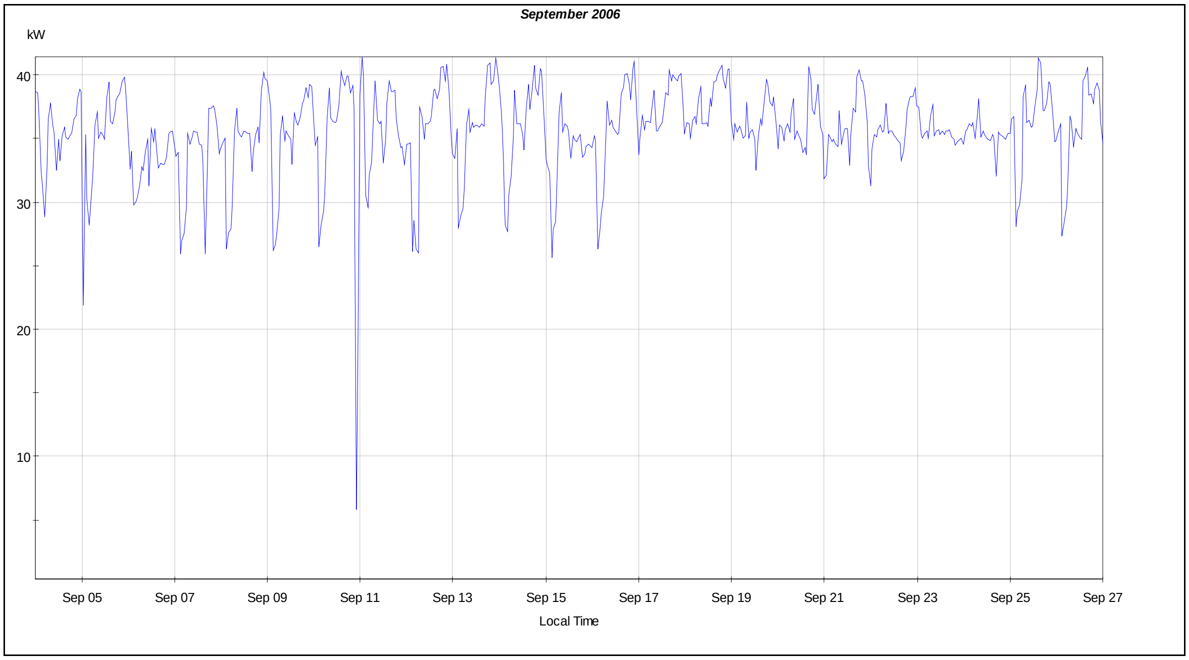


Figure 45: P20649 Total Cooler Fans Power Consumption

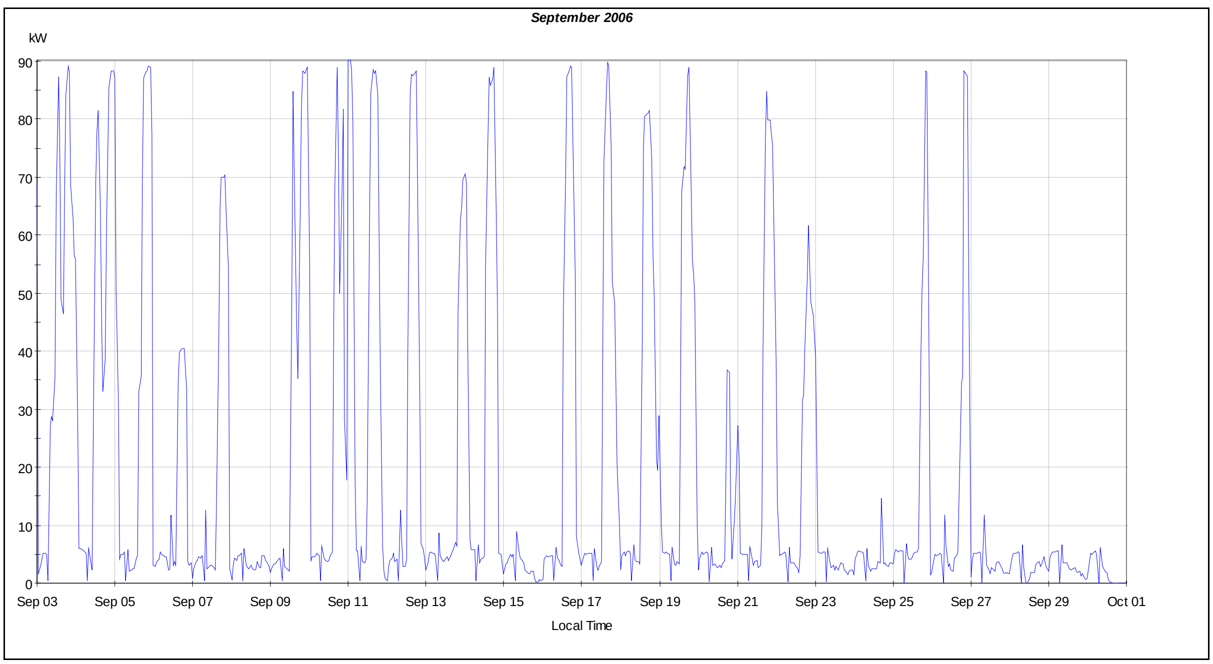


Figure 46: P20649 Total Precooler Fans Power Consumption

Overall, there were only two model adjustments for this site. One was the modification of the wet bulb and condensing temperature difference from 6°F to 19°F. The other was changing the lighting power density to 0.43 W/sf instead of the ex-ante estimate of 0.47 W/sf. The installed LPD was based on the post-field inspection report.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. The respondent stated that prior SBD projects have had success with these measures in the past. The facility knew that long term savings were possible and they followed the recommendations of a previous participant. However, the respondent stated that the measures would have been installed exactly the same absent the SBD program due to the recommendations of the previous participant. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 3 out of 6, or 50% freeridership. Therefore, the ex-post net savings are evaluated at 50% of the ex-post gross savings as summarized in Table 54.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	116.4	135.0	116%	0.50	67.5
kWh	937,535.0	706,444.0	75%	0.50	353,222.0

Table 54: P20649 Savings Comparison

P21230

Whole Building

P21230 is an approximately 150,000 square foot warehouse addition where 100,000 square feet are refrigerated. The project received an incentive of $42,600 for adding a host of efficiency measures at the facility. The measures included variable run time controls on the air units, floating head pressure and variable set point control logic on the condensers, increased insulation in the cooler and freezer, skylights in the dry storage area, and more efficient compressor motors. The measures were verified by the evaluation team during a site visit.

Ex-Ante Gross Savings

Ex-ante gross savings were determined by using DOE-2.2R simulation software. A variety of parameters, including the equipment schedules, cooling loads, and temperatures were estimated to create the baseline and proposed models to generate savings estimates.

Ex-Post Gross Savings

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings. Certain parameters, shown in Table 55, at the site were monitored for a period of four weeks in September. Some of the data were used to verify modeling inputs such as the condensing temperature range and lighting schedule. However, there was no consistent schedule the fan and air unit data. Most of the units seemed to be cycling on and off throughout the entire day. Most fans appeared to be able to operate twenty-four hours per day. Since the units were set to operate twenty-four hours a day and cycle in the model, no changes were made to the model fan or air units.

Incented Equipment
FHP & Variable Setpoint Condenser Controls
Air Unit Variable Run Time Controls
Increased Insulation
Skylights
Efficieny Compressor Motors
Metered Parameters
Condenser Fans
Cooler Air Units
Freezer Air Units
Production Air Units
Lighting Circuits
High Pressure Liquid (Condensing) Temperature
Outdoor Air Temperature
Outdoor Air Relative Humidity
Outdoor Air Wetbulb Temperature

Table 55: P21230 Metered Equipment

Figure 47, Figure 48, Figure 49, Figure 50, and Figure 51 show metered equipment power and temperatures. The lighting data has a consistent daily schedule that shows the majority of the lights are turned off during daylight hours. The variable set point controls measure is based on wet bulb temperature reset so that the set point is slightly above the wet bulb temperature. Although the general trend shown in Figure 48 is as expected since the condensing temperature mimics the wet bulb trend, the temperature difference between the two is approximately 9.7 °F on average when above the 65 °F set point. The ex-ante gross analysis estimated the temperature difference at 8 °F. The data for some of the freezer units were unpredictable and appeared to cycle on and off when necessary. Likewise, the production air unit data and condenser fan data had similar, inconsistent data. Note that the charts below may not show the entire metering period in order to make the charts more clear.

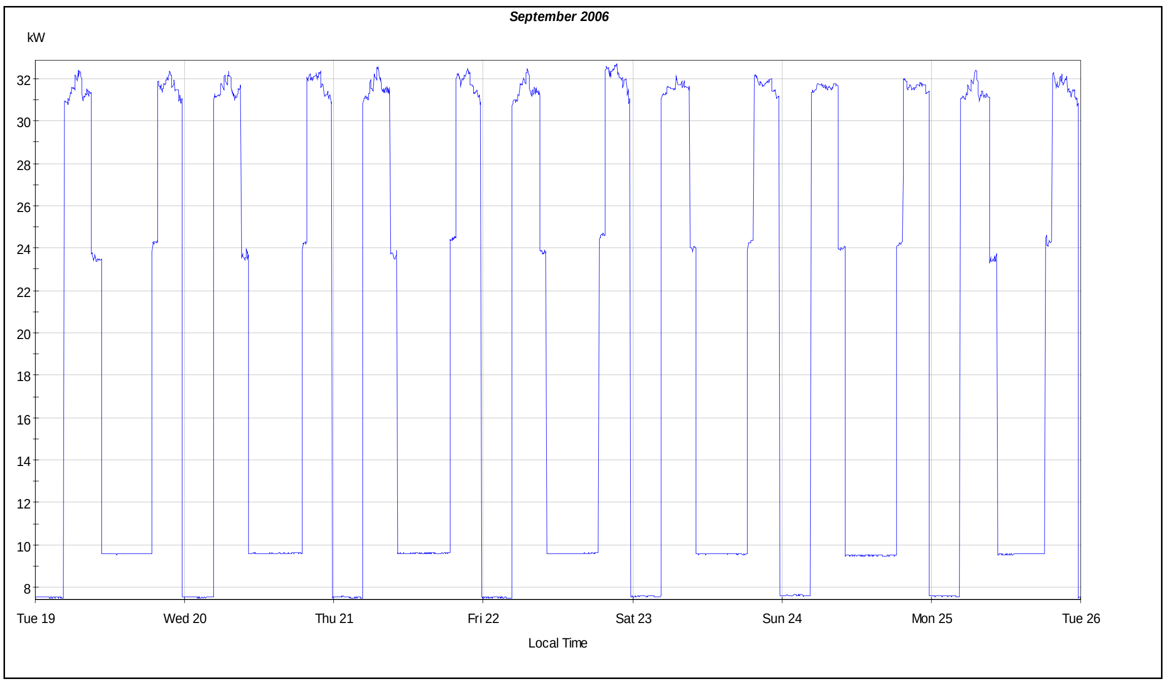


Figure 47: P21230 Metered Lighting

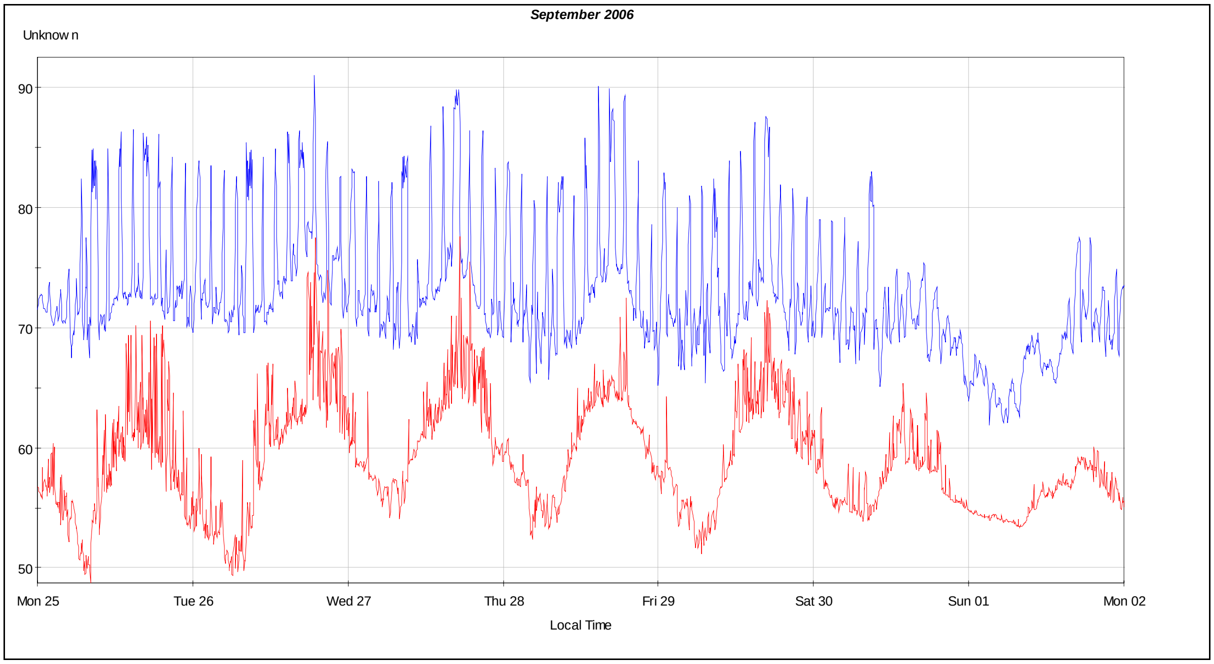


Figure 48: P21230 Metered Wet Bulb Temperature (Red) and High Pressure Liquid Temperature (Blue)

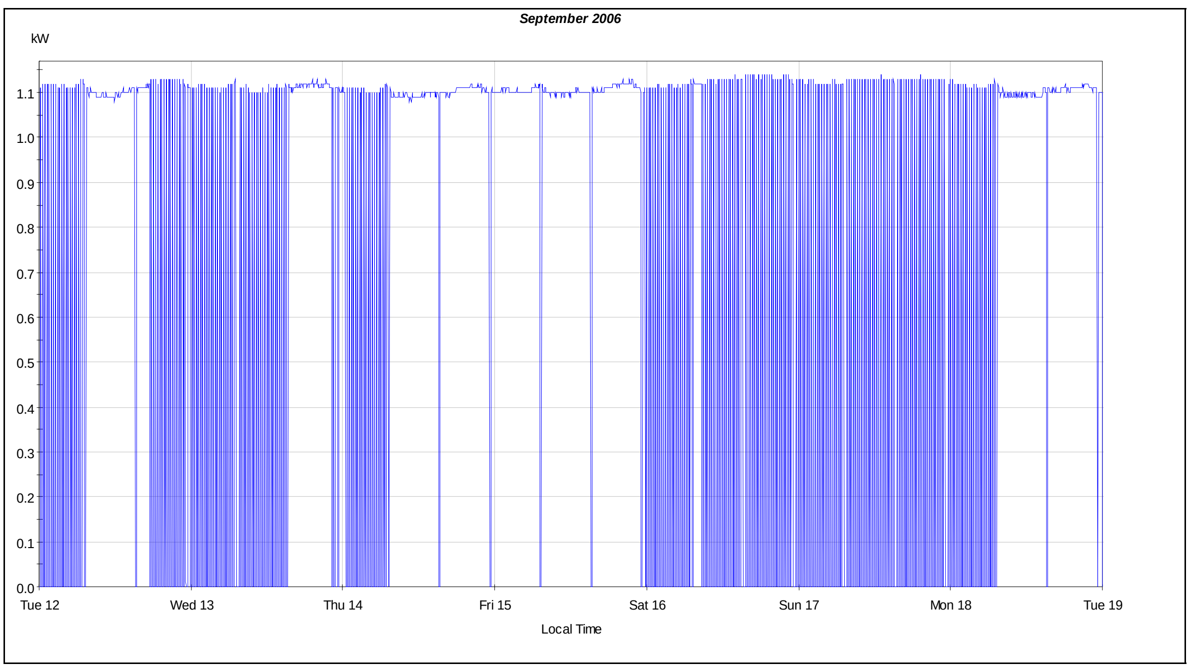


Figure 49: P21230 Inconsistent Freezer Air Unit Metered Data

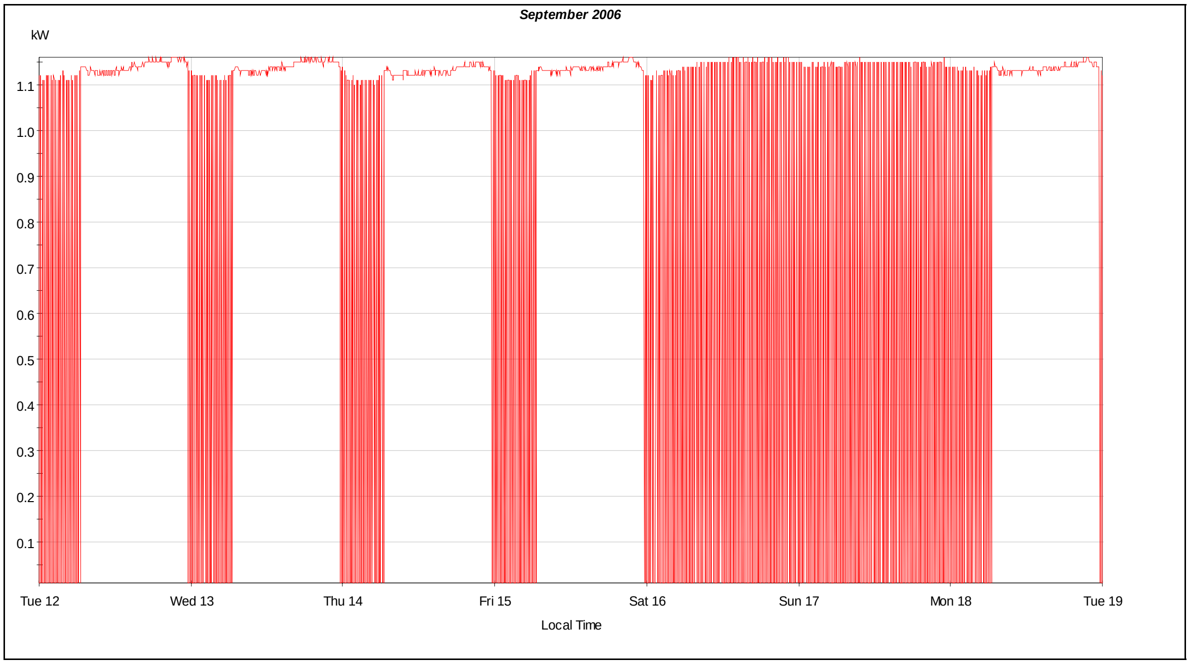


Figure 50: P21230 Production Air Unit Meter Data

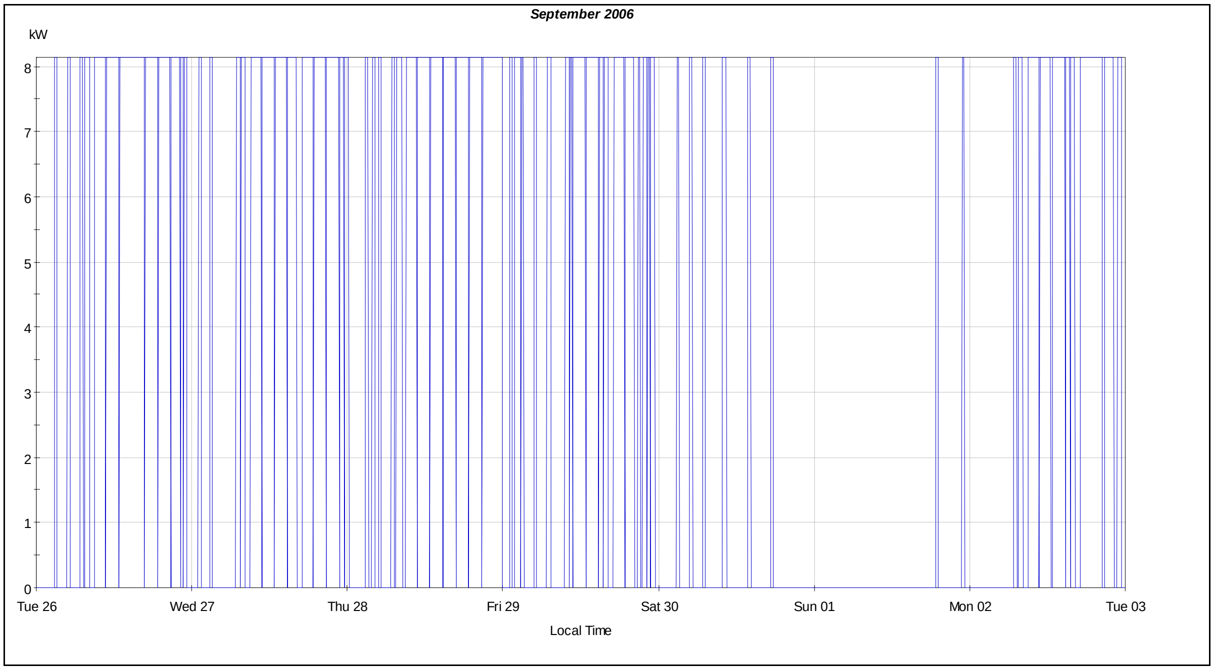


Figure 51: P21230 Cycling Condenser Fan Meter Data

The only parameter changed in the model was the wet bulb reset and condensing temperature difference. The ex-ante model estimated the difference at 8 °F and it was changed to 9.7 °F in the ex-post model. The lighting schedule was verified and the fans were observed cycling on and off twenty-four hours per day as in the ex-ante gross model. Therefore, the savings are slightly lower than expected solely due to the slight increase in condensing temperature difference.

Ex-Post Net Savings

The facility representative indicated that the program was somewhat influential in the implementation of the measures. The respondent also stated that an SBD representative helped validate the investment and proved that the upgrade was worth the extra initial cost. The respondent stated that without the extra validation and explanation from the representative the measures probably would not have been installed. For the ex-post net savings evaluation this combination of answers yields a partial freeridership score of 4.5 out of 6, or 25% freeridership. Therefore, the ex-post net savings are evaluated at 75% of the ex-post gross savings as summarized in Table 56.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	92.7	88.0	95%	0.75	66.0
kWh	1,315,810	1,280,798	97%	0.75	960,599

Table 56: P21230 Savings Comparison

P22051

Wastewater heat exchanger

Project P22051 received an incentive of $58,576 for upgrading their refrigeration system, which incorporates a heat recovery system. Wastewater used to wash produce inside the refrigerated warehouse is run through a heat exchanger in order to precool wash water entering the facility. A flow rate of 850 GPM entering and exiting the heat exchanger and a 15° F reduction in incoming make-up water temperature reduce the cooling load on the refrigeration system. The baseline of this measure is standard industrial refrigeration construction and system design. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

The ex-ante gross analysis estimates the energy savings by using the existing flow rate and the temperature entering and exiting the heat exchanger.

Ex-Post Gross Savings

The ex-post gross savings were essentially a verification of program estimate. The reported facility operating hours and temperature differences across the heat exchanger were verified during a site inspection. However, the flow rate could not be verified since the plant's meter flow included an indeterminate amount of bypass around the heat exchanger. The flow rate was assumed to be similar to the projected flow and therefore, ex post savings were assumed to be equivalent to the ex ante estimates.

Ex-Post Net Savings

The plant decision maker indicated that the program was very influential in the implementation of this measure. He also stated that an SBD representative helped the incentive meet the investment criteria. However, he also stated that they would have eventually installed the project exactly the same absent interaction with the SBD program. These responses resulted in a partial freeridership score of 3 out of 6, or 50% freeridership. Therefore ex-post net savings are evaluated at 50% of the ex-post gross savings as summarized Table 57.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	161	162	100.4%	0.50	80.8
kWh	732,200	732,200	100.0%	0.50	366,100.0

Table 57: P22051 Savings Comparison

P23972

Pump-Off Controllers

Project 23972 received an incentive of $41,849 to install eighteen pump-off controllers on new oil well pumps. The baseline for this measure is a fixed speed pump that runs continuously at an operating factor of 95%. The baseline energy usage was calculated using the rated pump power, operation schedule and a load factor (load factor description discussed below). The evaluation team verified the installation of the eighteen pump-off controllers during the site visit. Note that the project file indicates that all eighteen pumps were 20 hp, but 25 hp pumps were installed instead.

Ex-Ante Gross Savings

The ex-ante gross savings were calculated by comparing the baseline pump energy usage with that necessary using the pump-off controllers. The pumps off controllers were expected to reduce runtime by 25% and energy usage by 18.75%. The ex-ante gross analysis estimates a total savings of 418,492 kWh per year and 48 peak kW.

Ex-Post Gross Savings

A data logger was installed on 17 of the 18 new pumps for a period of three weeks during August and September of 2006. A list of the metered pumps is shown in Table 58.

Incented Pump	Metered	Type
1-9F	YES	TOU
10-9C	YES	TOU
11-8-WAR	YES	TOU
11-9D	YES	TOU
11-9E	YES	TOU
11-9F	YES	TOU
11-9-WB	YES	TOU
11-10G	YES	TOU
11-11G	YES	TOU
12-9B	YES	TOU
12-10C	YES	TOU
12-10-WA	YES	TOU
12-8G	YES	Amp
12-9A	YES	Amp
12-10D	YES	Amp
12-11D	YES	Amp
12-11E	YES	Amp
Pump #18	NO	-

Table 58: P23972 Metered Equipment

Twelve time-of-use (TOU) loggers monitored twelve of the pumps for runtime. Five other pumps were metered with loggers that recorded pump amperage, which was converted to pump power (kW). Figure 52 and Figure 53 show the raw data for one week during the metering period for both types of loggers.

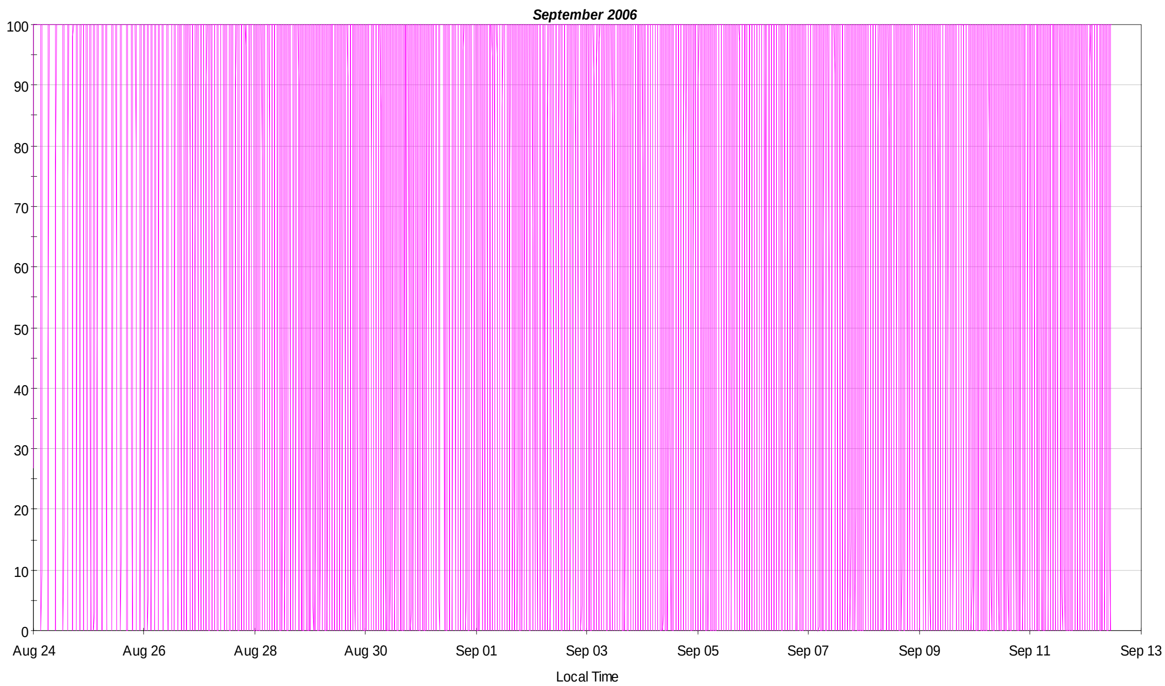


Figure 52: P23972 Pump Time of Use Data

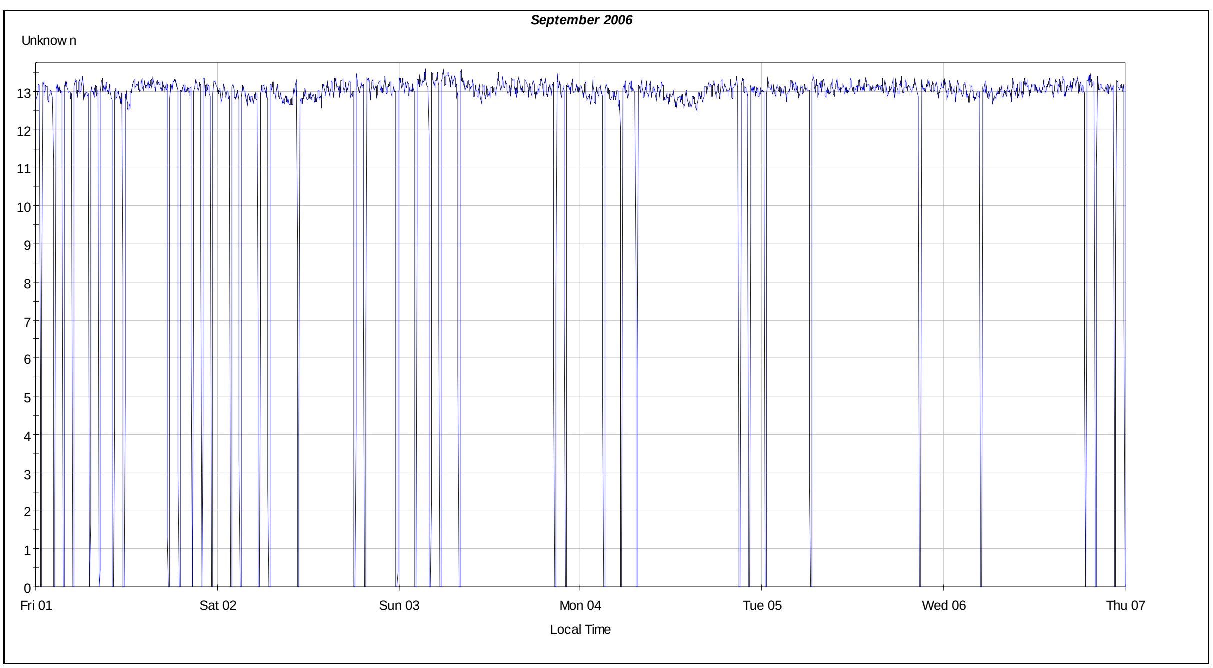


Figure 53: P23972 Pump Power Data

The TOU logger data was used to find the annual operating hours of each pump. Figure 54 shows the average percent on by hour for four of the pumps monitored with TOU loggers, where one pump ran continuously and another only operated approximately 30% of the time. The annual energy usage was calculated by using the annual operating hours, rated pump power and a pump load factor. A load factor is a ratio of average energy demand, or measured power, to max demand, or rated pump power. The pump load factor was derived from the five loggers that recorded power. Those meters were regularly measuring actual pump power far below the rated pump power. This indicated that a load factor needed to be applied. The load factor for each pump was calculated as the normal power measured by the meter while the pump was on divided by the rated power of the pump. The load factors for each of the five pumps and the resulting average is shown in Table 59. The average of the load factors was 52% and was applied to all of the TOU logger data.

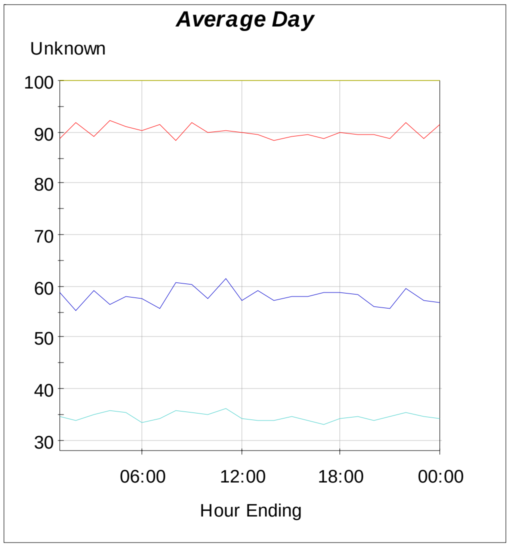


Figure 54: P23972 Average Percent On for Four TOU Loggers

Pump	Load Factor
12-11D	53%
12-11E	62%
12-8G	61%
12-9A	55%
12-10D-VFD	30%
Average	**52%**

Table 59: P23972 Load Factor

The metered power data was used to create average hourly profile for each pump. The profile for all five pumps is illustrated in Figure 55. The annual energy consumption was calculated using the annual operating schedule, pump power, and load factor.

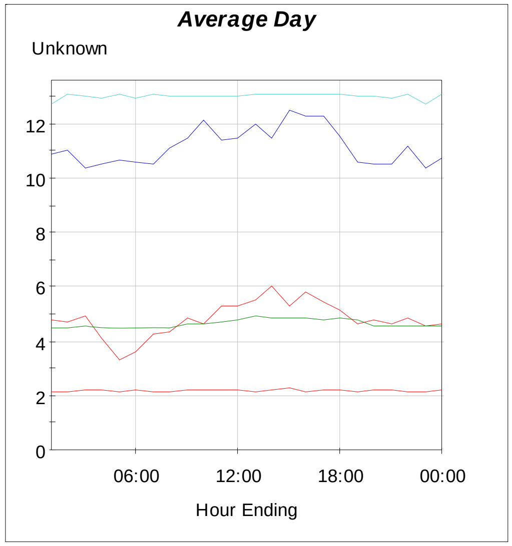


Figure 55: P23972 Pumps

The estimated baseline energy usage was 1,497,925 kWh and the evaluated energy usage was 1,105,053 kWh. The program was evaluated to save 392,872 kWh. There is also a demand reduction of 120.2 kW.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. The SBD incentive helped the pump-off controllers meet the investment criteria. The respondent indicated that the system probably would not have been installed if they had no interaction with the Savings by Design program. They also stated that they typically install pump-off controllers on 10% of their new wells, but the SBD program influenced them to install the controllers on 100% of new well pumps. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 60.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	48.0	120.2	250%	0.83	100.2
kWh	418,492.0	392,871.9	94%	0.83	327,393.3

Table 60: P23972 Overall Savings Comparison

P24373

121 Ton Electric Molding Machine

Project P24373 received an incentive of $6,023 for installing a new electric injection molding machine. The baseline for this measure was a 121-ton standard hydraulic injection molding machine. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

The ex-ante gross savings were calculated by comparing the energy consumption of the baseline standard hydraulic injection molding machine to an electric injection molding machine. The program estimate assumed 0.2 kWh/kg of product for the proposed all-electric machine and a baseline usage of 0.93 kWh/kg. The ex-ante analysis estimates a total energy usage savings of 60,323 kWh/ yr and a demand savings of 8.6 kW.

Ex-Post Gross Savings

A true power data logger was installed on the 121 ton electric injection molding machine for four weeks during July and August of 2006. Figure 56 shows the raw data for one week during the metering period. Meter data indicate the machine runs 24 hours a day and seven days a week. Note that the red is the estimated baseline power draw while the blue is the metered power draw of the machine.

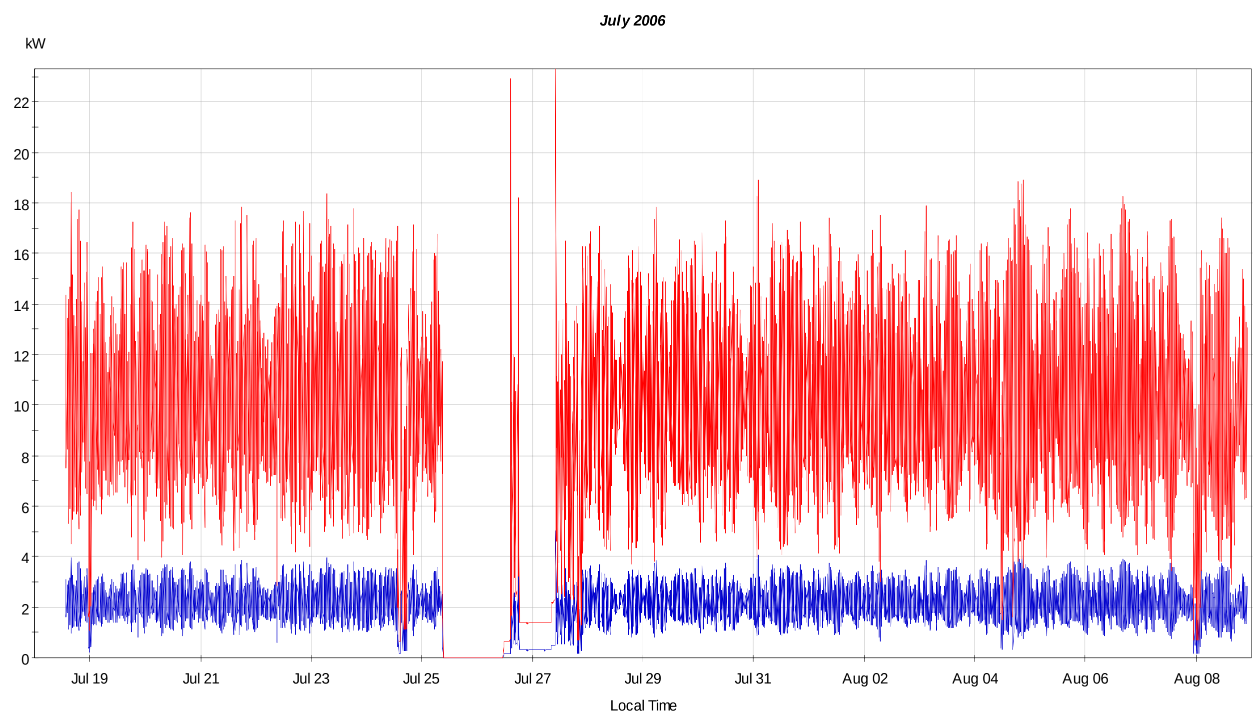


Figure 56: P24373 Baseline and Metered Power Draw

The raw meter data were converted to a single average day load profile. This load profile was used to calculate the energy consumption per year. The evaluated power and energy were compared to the baseline and ex-ante gross energy usage.

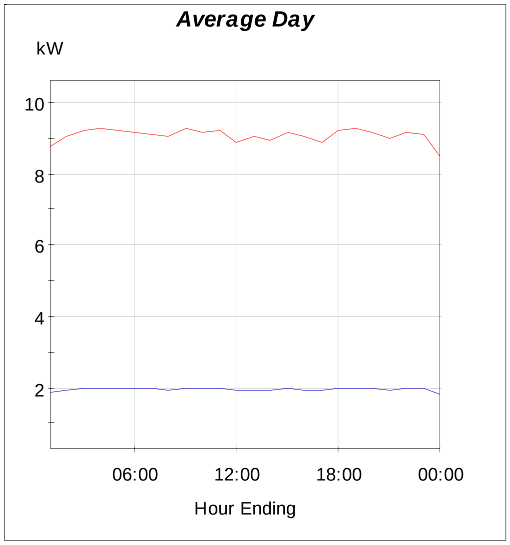


Figure 57: P24373 Average Baseline and Metered Power Draw

The evaluation estimated a baseline power draw of 8.6 kW for the machine and an ex-post gross power draw of 1.9 kW. This resulted in savings of 62,368 kWh per year and a demand reduction of 6.7 kW. The actual throughput for this project was found to be 20.6 lbs/ hr per machine, whereas the ex-ante estimates used an assumed throughput of 26 lbs/hr per machine. Note that one of the primary factors affecting energy consumption of injection molding machines is the throughput of the machines.

Ex-Post Net Savings

The facility owner stated that the program was somewhat influential in the implementation of this measure and an SBD representative first suggested this measure. This combination of answers yields a complete freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated as 58% of the ex-post gross savings. This is summarized in Table 61.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	8.6	6.7	78%	0.58	3.9
kWh	60,323	62,368	103%	0.58	36,381

Table 61: P24373 Overall Savings Comparison

P24374

55 Ton Electric Molding Machine

Project P24374 received an incentive of $4,176 for installing two 55 ton all electric injection molding machines. The baseline of this measure was two 55 ton standard hydraulic injection molding machines. The evaluation team verified the existence of this measure during a site visit.

Ex-Ante Gross Savings

The ex-ante gross savings were calculated by comparing the baseline standard hydraulic injection molding machines with the electric molding machines. The ex-ante gross analysis estimates a total energy usage savings of 41,762 kWh/yr and a demand savings of 6.0 kW for both 55 ton electric molding machines.

Ex-Post Gross Savings

A true power data logger was installed on both of the 55 ton electric machines for five weeks in July and August of 2006. The meter data shows that the facility operates 24 hours a day, seven days a week, as shown in Figure 58. The above data was used to calculate the hourly power consumption for an average day, shown in Figure 59. Then, this hourly profile was used to calculate the annual energy usage. This ex-post gross energy usage is then compared with baseline and ex-ante gross energy usage.

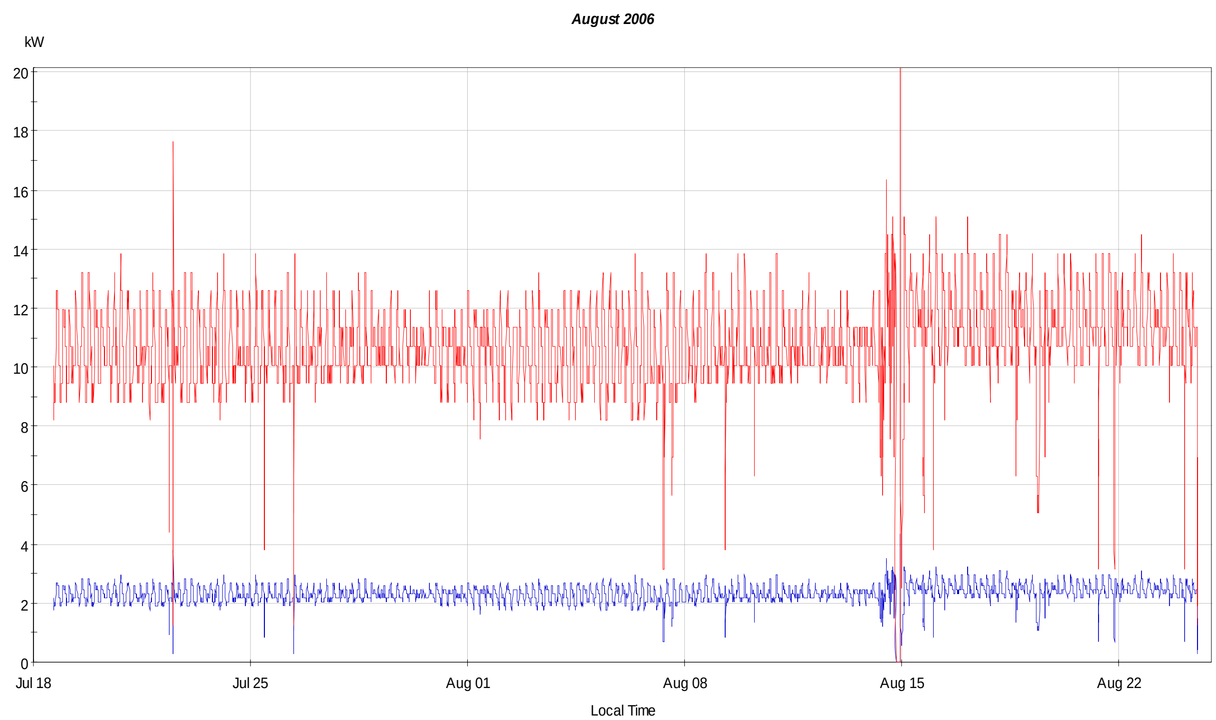


Figure 58 : P24374 55 ton IMM Raw Data and Estimated. Baseline

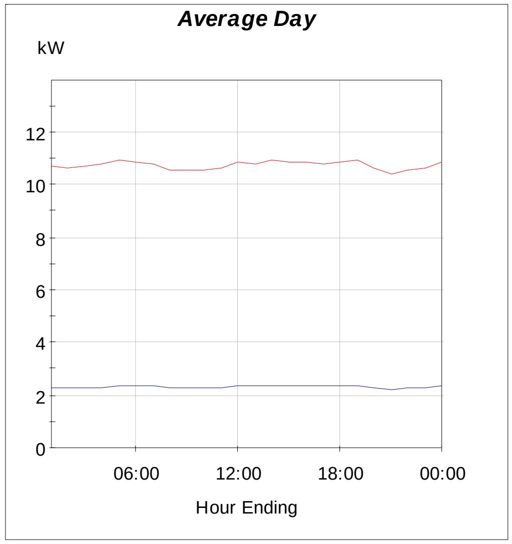


Figure 59: P24374 Average Day Power Profiles

The evaluation estimated a baseline power draw of 21.8 kW for both the machines. The ex-post gross power draw was 4.6 kW, or approximately 2.3 kW per machine. This resulted in savings of 147,533 kWh per year and a demand reduction of 17.2 kW. The savings are greater than anticipated because the actual throughput for this measure was 25.6 lbs/ hr per machine, whereas the assumed ex-ante throughput was 9 lbs/ hr per machine. One of the primary factors affecting energy consumption of injection molding machines is the throughput.

Ex-Post Net Savings

The facility owner stated that the program was somewhat influential in the implementation of this measure and an SBD representative first suggested this measure. This combination of answers yields a complete freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated as 58% of the ex-post gross savings. This is summarized in Table 62.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	6.0	17.2	286%	0.58	10.0
kWh	41,762	147,533	353%	0.58	86,061

Table 62: P24374 Overall Savings Comparison

P25510

Air Compressor VSD

Project 25510 received an incentive of $11,767 to install a VSD on a new, rotary screw 75 hp air compressor. The baseline for this measure is a fixed speed 75 hp compressor with inlet modulation and unloading. The facility is also installing two thermal mass (TMS) dryers and two no air loss drains. The evaluation team noted during an on-site visit that two 75 hp VSD compressors were installed instead of one. The two compressors were meant to rotate lead in order to provide equal aging of the equipment. The evaluation team verified the installation of all other measures.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using AirMaster+ software. The compressed air system was simplified and put into the program for both the baseline and ex-ante gross models. Note that the ex-ante gross model was for a system with only one 75 hp compressor.

Ex-Post Gross Savings

A meter was installed on both air compressors and both TMS dryers for five weeks during August, September and October of 2006. Table 63 shows the metered and incented equipment.

Incented Equipment	Metered
75 hp Compressor (1)	75 hp Compressors (2)
Thermal Mass Dryer (2)	YES
No Air Loss Drains (2)	Verified

Table 63: P25510 Metered Equipment

The data was imported into a visualization program, Visualize-IT. The lead-lag schedule of the compressors is shown in Figure 60 which proves that only one compressor is operating at a time. Furthermore, the data proves the compressors rotate operation every other day. In other words, one compressor leads one day and the next day the other compressor leads.

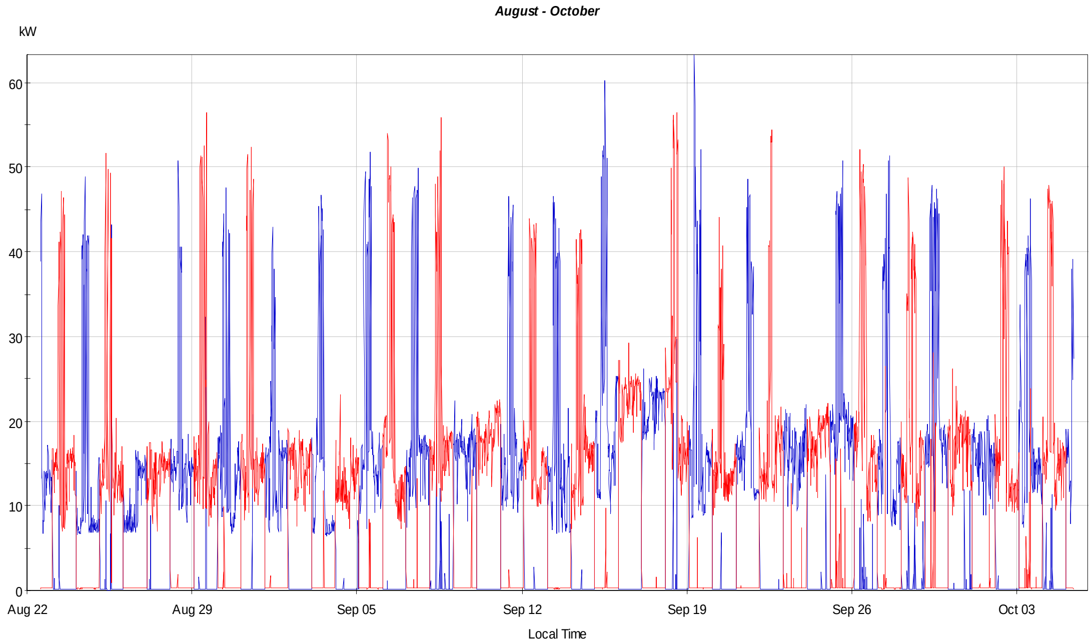


Figure 60: P25510 Compressor Power Consumption

The raw data were processed to generate average weekday and weekend power profiles for each compressor as graphically presented in Figure 61. The graphs show a noticeable difference in the energy usage between weekday and weekend day types.

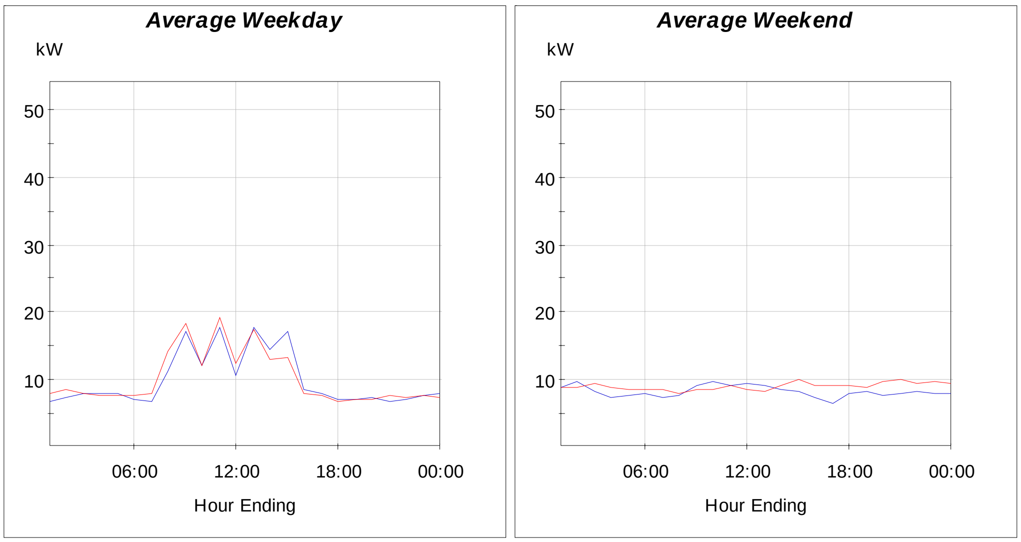


Figure 61: P25510 Hourly Compressor Load Profiles

Next, compressed air energy simulation models were built in AirMaster+. The software requires inputs such as facility elevation, air system pressure, air storage capacity (receivers), and production day types. Next, the compressors were selected according to operating pressure and the software automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The AirMaster+ compressor profile was then modified to reflect VSD control power curve. Finally, the hourly power data recorded by the meter was input for each day type. Once all of these options were selected, the program modeled the actual behavior of the compressor.

For the baseline model all inputs stayed the same, except for the compressor controls and the hourly power consumption profile. No modifications were made to the program-generated compressor controls since they are standard and did not include VSDs. The system airflow is the variable that stays constant between the baseline and evaluation model. The hourly power profile was input in the evaluation model and the program calculated hourly airflow rates based on that profile. Those same hourly airflows were put into the baseline model instead of a power profile. Note that no other energy efficiency measures were included in the models since a separate model was made for the baseline and evaluation models.

The program returned the evaluated annual energy usage, as well as the baseline energy usage. The ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

Dryer savings were calculated by using the average metered dryer power and the annual operating schedule. The metered data for both dryers for a few days during the metering period is shown in Figure 62.

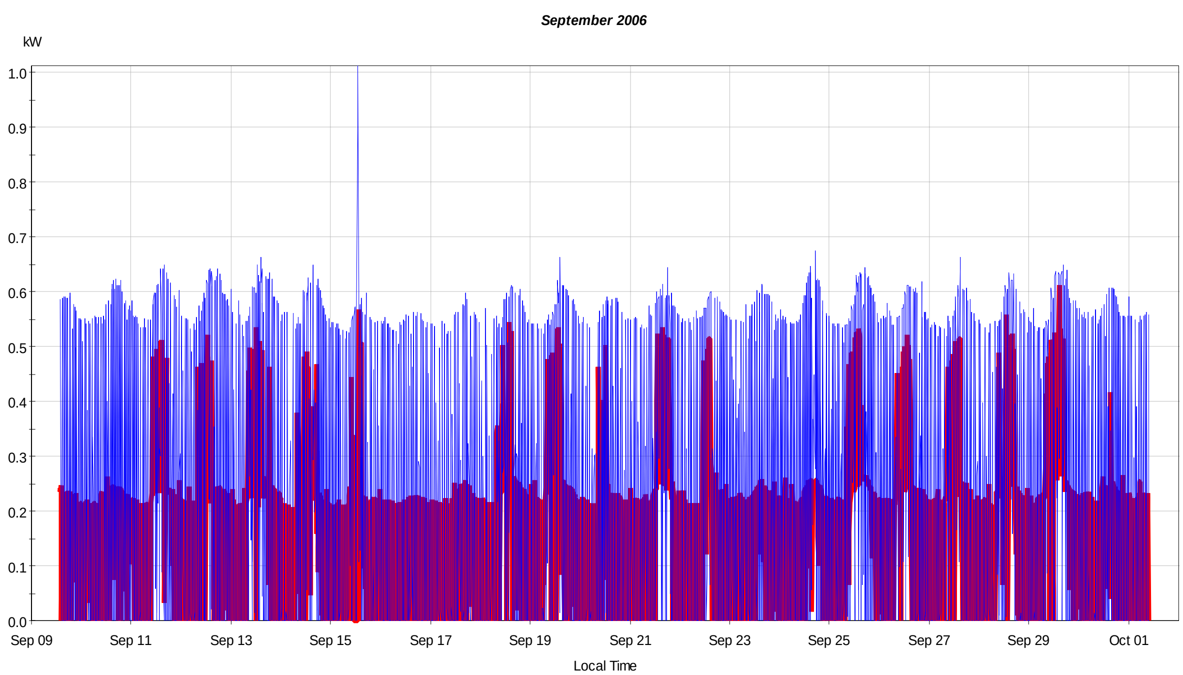


Figure 62: P25510 Air Dryer Power Consumption

Ex-post gross savings for the no air loss drains were assumed to be equal to the ex-ante gross savings. All of the inputs for the ex-ante air drain calculation seemed reasonable and the drains account for less than 3% of the site energy savings.

As claimed in the ex-ante gross analysis the facility was indeed running twenty-four hours a day, seven days a week. At least one compressor was always running during the monitoring period.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. The SBD incentive helped the measures meet investment criteria. The respondent also indicated that the system definitely would not have been installed if they had no interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings as summarized in Table 64.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	21.2	N/A	1.00	21.2
kWh	114,293.0	160,268.5	140%	1.00	160,268.5

Table 64: P25510 Overall Savings Comparison

P25629

High Efficiency Lighting

Project 25629 received an incentive of $11,440 to install low LPD lighting system with metal halide and fluorescent fixtures. The baseline for this measure is determined by common practice or maximum allowable LPD for the most similar Title 24 applicable occupancy, The evaluation team verified the installation and counts of the lighting fixtures.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined using projected lighting hours and rated fixture wattages.

<u>Ex-Post Gross Savings</u>

A meter was installed on two barns, as shown in Table 65. This was the only area metered as it represented over three-quarters of the savings for this project. The operational schedule and number of lamps are the same for each of the barns, so the metering captured usage for all eight barns.

Incented Area	Metered
Milker's Pits	NO
Cow Platforms	NO
Drip Pens	NO
Wash Pens	NO
Breezeway	NO
Equipment Room	NO
Milk Room	NO
Soap	NO
Hall	NO
Storage	NO
Storage (upstairs)	NO
records	NO
Herdsman Office	NO
Break Rooms	NO
Stairway	NO
Rest Rooms	NO
Freestall Barn (8)	2 Metered

Table 65: P25629 Metered Areas

Figure 63 shows the raw data for a week of the metering period for the two barns. The raw data were used to create an average hourly power profile which is illustrated in Figure 64. This profile and the annual operating hours were used to calculate the ex-post gross energy usage. This was compared to the baseline and the ex-ante estimate of energy usage. The evaluated operating hours were about 1.5 times the program tracking operating hours, which resulted on larger savings than estimated in the ex-ante gross numbers. Additionally, the metering of the lighting system a power draw slightly less than rated power, which adds to the project savings.

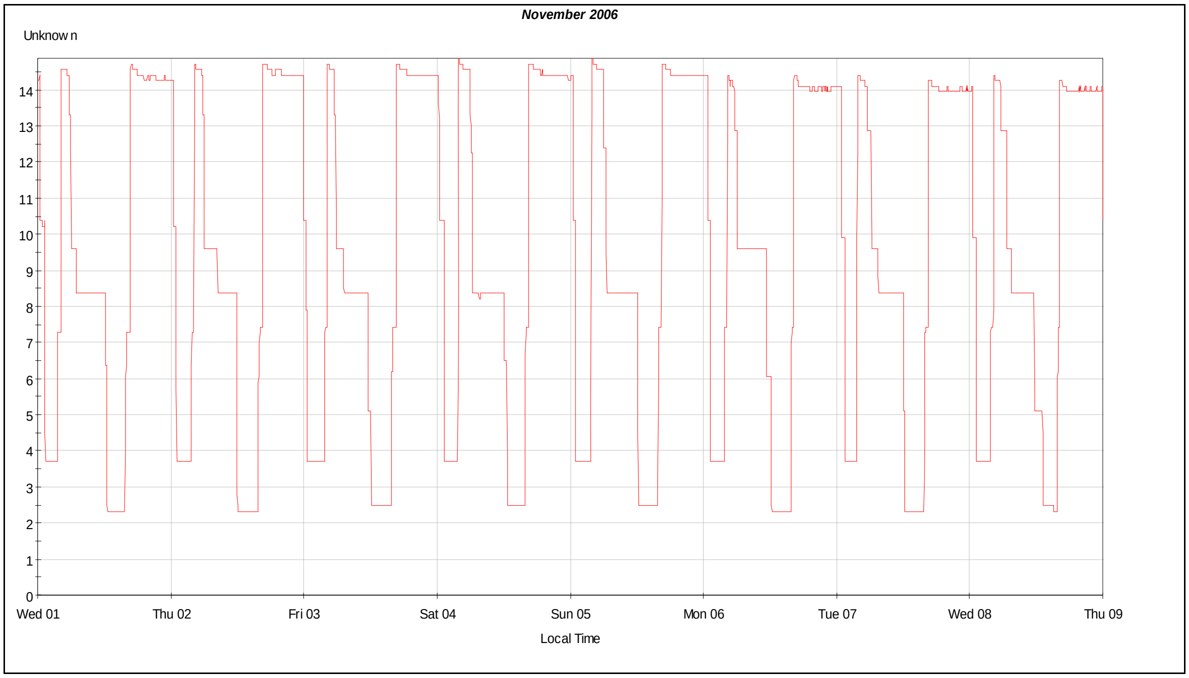


Figure 63: P25629 Metered Data

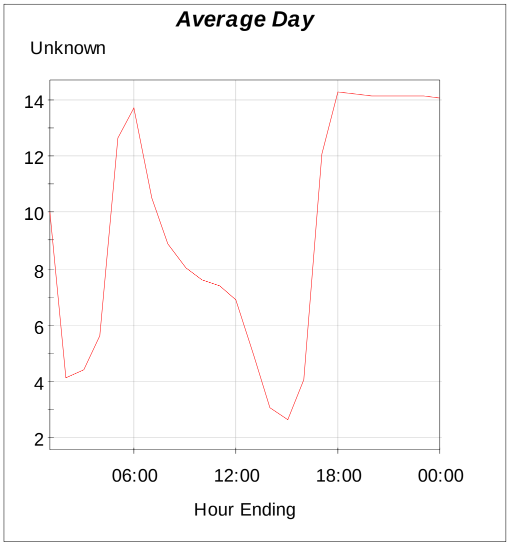


Figure 64: P25629 Hourly Power Profile

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent indicated that SBD performed design analysis and substantiated measure cost, as well as educated the facility on how to more efficiently use energy. The respondent also indicated that the system probably would not have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 66.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	2.7	N/A	0.83	2.2
kWh	190,674	315,550	165%	0.83	262,958

Table 66: P25629 Lighting Savings Comparison

Refrigeration System

Project 25629 received an incentive of $12,665 to install precoolers which precool the fluid using a groundwater heat exchanger. The baseline for this measure is a single-stage chiller with an air-cooled condenser and no precooling.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated using DOE-2.2R simulation software. The refrigeration schedule and load were estimated and an ex-ante model was created. A baseline model with no precooling was also created. Annual energy and demand savings are the difference between these two models consumption.

Ex-Post Gross Savings

The ex-post savings were calculated by adjusting to ex ante model to better reflect conditions observed as operated at the facility. **Error! Reference source not found.** lists the metered equipment and Figure 65 presents a day of the metered pump data. The schedule shows the equipment shuts off for two periods throughout the day, one in the early morning, and one in the afternoon. No meters were installed directly onto the refrigeration system. However, it was assumed that the schedule from the metered pumps for the process evaluation, described below, is the same as the refrigeration system.

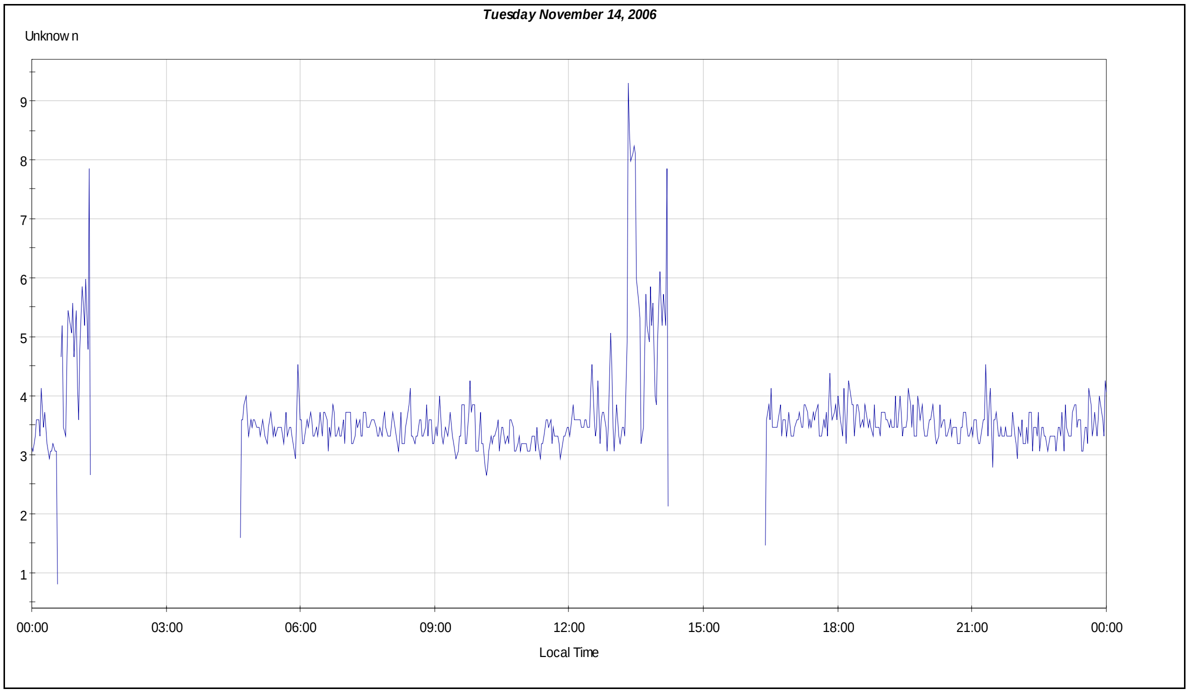


Figure 65: P25629 Metered Data from a Vacuum Pump

The data were used to determine a schedule of operation for the refrigeration system. The ex-ante gross models were manipulated to reflect this operating schedule for both the pumps and refrigeration equipment. The schedule is presented in Table 67. The load estimated in the ex-ante gross analysis seemed consistent with actual operation, so the load was not changed for the evaluation. The schedule of operation was found to be very close to the ex-ante gross analysis, resulting in similar savings, i.e., 100% realization rate on gross peak kW savings and 99% realization rate on annual energy savings.

Status	Ex-Ante Gross Model	Ex-Post Gross Model
On	12am-2am, 4am-2pm, 4pm-12am	1am-12pm, 1pm-10pm
Off	2am-4am, 2pm-4pm	12am-1am, 12pm-1pm, 10pm-12am
Daily Hours	20	20

Table 67: P25629 Model Schedules

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. An SBD representative worked with the project designer. The respondent stated that the system probably would have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33%

freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 68.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	33.0	33.0	100%	0.67	22.0
kWh	158,315	157,441	99%	0.67	104,961

Table 68: P25629 Refrigeration System Savings Comparison

Process Systems

Project 25629 received an incentive of $3,694 to install VFDs on two 5 hp pumps and two 20 hp motors, premium efficiency motors on two 20 hp pumps (same motors as VFD), two 75 hp pumps, and two 30 hp pressure pumps, and 52 high efficiency circulation fans. The baseline for the VFD pumps is a fixed speed pump. The baseline efficiency for the premium efficiency motors is determined by the Energy Policy Act of 1992 (EPAct), in which minimum energy efficiency is established for motors as a function of size, speed and type of enclosure.

<u>Ex-Ante Gross Savings</u>

The ex-ante gross savings include savings for premium efficiency pumps, premium efficiency fans and VFD pump motors. Ex-ante gross energy usage for the VFD was calculated by using the rated motor power, motor efficiency and estimates of the operating schedule. The pump VFDs were assumed to provide 50% savings over a fixed speed pump, or 50% of the baseline energy usage. The premium motor savings were calculated based on the difference in baseline and installed efficiency, motor horsepower, and annual hours of operation. High efficiency fan savings were determined by assuming a nominal flow rate, fan size, the difference in fan efficiency between the baseline and installed fans, and the annual hours of operation.

<u>Ex-Post Gross Savings</u>

For a period of three weeks in October and November of 2006 all of the equipment was metered except for the fans, as shown in Table 69.

Incented Equipment	Incentive	Metered
PE vacuum blower (2)	Premium Efficiency	YES
PE well pump (2)	Premium Efficiency	YES
PE pressure pump (2)	Premium Efficiency	YES
HE fans (52 total)	Premium Efficiency	NO
Vat Pumps (2)	VFD	YES

Table 69: P25629 Metered Equipment

Figure 66 presents a week of data for both vacuum pumps. The metered data was used to calculate the annual operating hours for each piece of metered equipment. The two 20 hp motors are only consuming approximately 3 to 4 kW for the majority of their operating time. This created large savings for the vacuum pump VFDs.

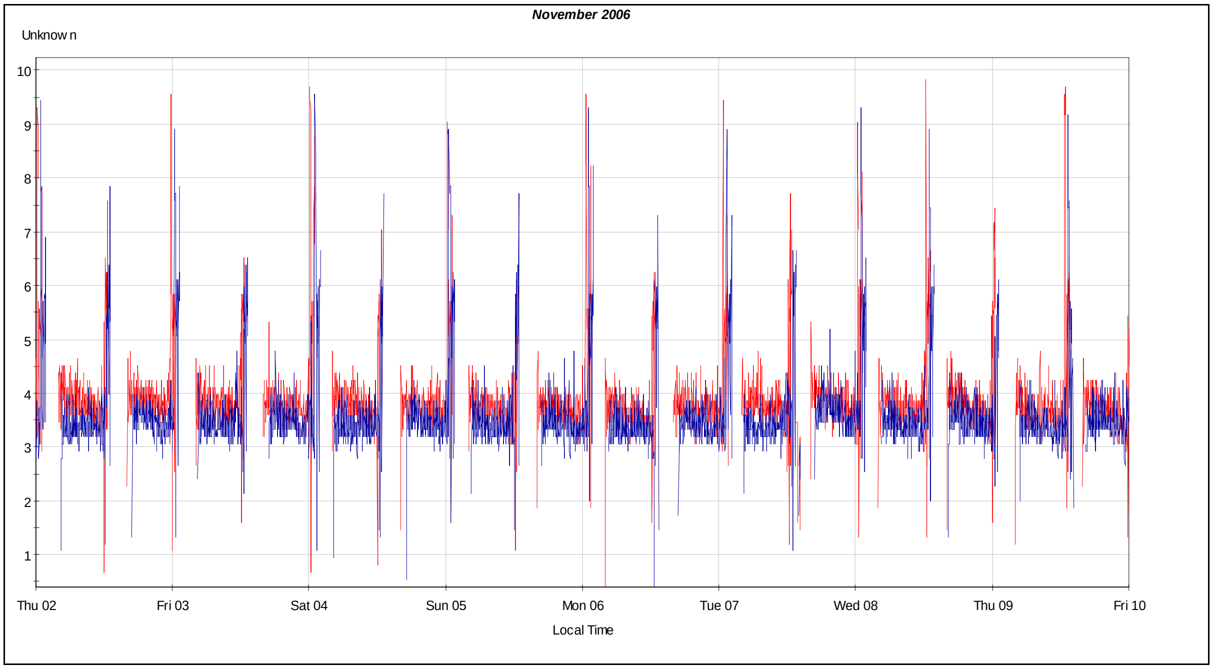


Figure 66: P25629 Vacuum Pump Metered Data

The ex post premium efficiency pump motor savings were calculated using logged hours, the rated motor power, and the difference between the baseline and premium efficiencies. The VFD savings were calculated using the metered hours, rated pump power and a load factor. A load factor is a ratio of the energy demand, or measured power, to max demand, or rated pump power.

Data loggers installed on the motors for three weeks. The data were used to determine the number of operating hours per year. The calculation methodology was the same as for the ex-ante gross savings, except the actual annual hours were used.

On average, the meters were measuring actual pump power below the rated pump power. This indicated that a load factor needed to be applied. The load factor for each pump was calculated as the maximum power measured by the meter divided by the rated power of the pump. The load factors are 78% for both VFD pumps as presented in Table 70.

Equipment	Load Factor
Vat Pump 1	78%
Vat Pump 2	78%

Table 70: P25629 Load Factors

The high efficiency fan ex-post gross savings are equal to ex-ante gross savings since all of the assumptions seem reasonable. The fan savings are less than 5% of the overall process savings.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent stated that SBD helped perform some design analysis. The respondent also indicated that the system probably would not have been installed absent any interaction with the Savings by Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 71.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	5.7	22.1	388%	0.83	18.4
kWh	36,935	254,450	689%	0.83	212,041

Table 71: P25629 Process Savings Comparison

Total Site Savings

The combined energy savings for all measures at this site are shown in Table 72.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	38.7	57.8	149%	0.74	42.7
kWh	385924.0	727440.5	188%	0.80	579960.3

Table 72: P25629 Total Site Savings

P25829

Whole Building

Project P25829 received an incentive of $87,675 for installing energy efficiency measures in the expansion of a refrigerated warehouse. This upgrade consists of installation of a new 250 hp booster refrigeration compressor, a 400 hp high stage compressor and an efficient evaporative condenser. The above upgrade also included premium efficiency motors in the freezer area, VFDs on air unit motors, an LPD reduction in freezers and docks, increasing wall and ceiling insulation with higher R value and installing occupancy sensors to control freezer lighting. The baseline of these measures is defined using Title 24 standards, where applicable, and typical industrial refrigeration construction and system design for the refrigeration system. The evaluation team verified the installation of the measures.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined by using DOE-2.2R simulation software. Annual operating schedule and product loads were assumed to build the ex-ante gross model.

For the VFD controlled cooler fan motors, annual operating schedule and load was assumed to create the ex-ante gross model. The baseline model of this measure is a constant speed air unit motor.

Similarly, for premium efficiency motors lower input power was assumed to create the ex-ante gross model. The baseline of this measure is standard efficiency motors.

Ex-ante gross savings for the insulation measure were created by using an insulation R-value of R-25 for the dock walls, R-30 for the dock roof, freezer walls and freezer floors and R-50 for the freezer roofs.

Lighting savings were estimated by using an LPD of1.46 W/S.F. for Truck Dock area and 0.41 W/S.F., 0.46 W/S.F, and 0.45 W/S.F for Freezer #7, Freezer #8 and Freezer # 9, respectively.

<u>Ex-Post Gross Savings</u>

Data loggers were installed on the VSD cooler fan motors and lighting panels for a period of four weeks. No data logger could be installed on the refrigeration system due to poor site condition. Table 73 shows the incented equipment and the equipment that were monitored. Figure 67 and Figure 68 represents the power profile for the air unit motors and lighting, respectively.

Incented Equipment	**Metered**
Refregeration Compressors (2)	NO
Evaporative Condenser	NO
VSD Air Unit Fans (24)	YES(8)
Lighting	YES
Insulation	Verified
PE Motors (2+24+16)	YES(8)

Table 73: P25829 Incented Equipment

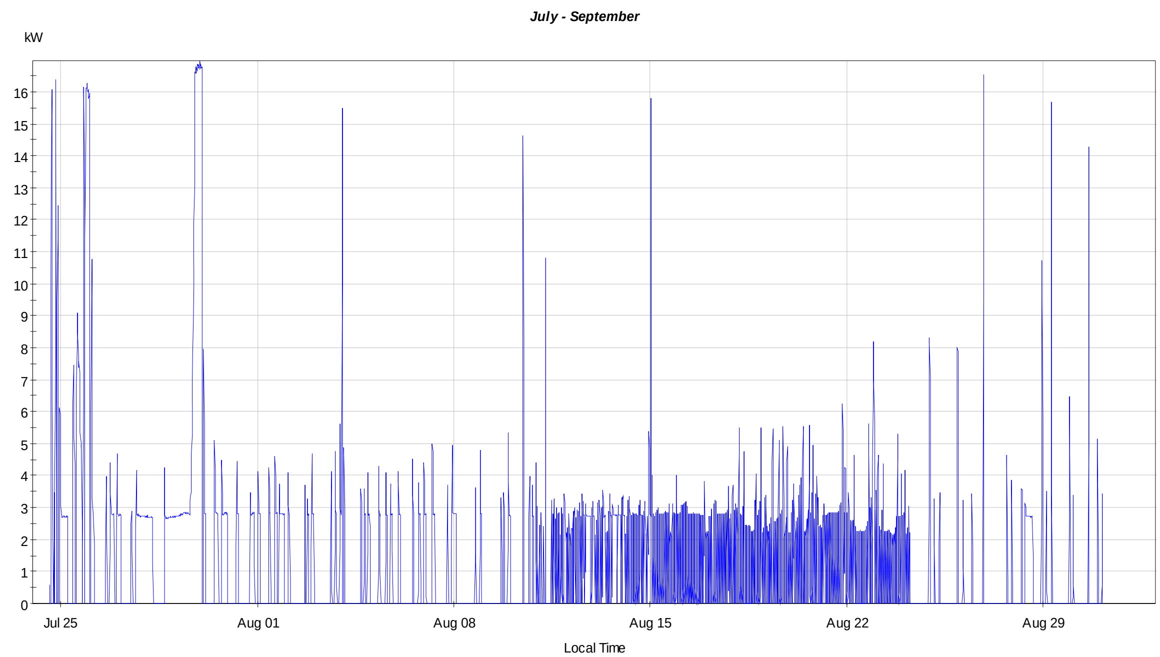


Figure 67: P25829 Air Unit Motor Metered Data for the Monitoring Period

Figure 68: P25829 Lighting Metered Data for the Monitoring Period

The VFDs on air unit motors save more energy than anticipated since the meter data established they run 24 hours a day, 7 days a week as compared to the estimated 12 hours a day, 7 days a week used in the ex-ante gross analysis. Also, it was observed that the air unit motors run at a lower load factor than the ex-ante gross estimate providing a reason for the substantial increase in demand savings. These metered data were used to calibrate the DOE-2.2R evaluation model.. Then, the ex-post gross energy consumption were simply compared with ex-ante gross and baseline energy consumption.

Ex-Post Net Savings

The facility representative indicated that the program was not influential in the implementation of any of the measures, except for the efficient motors measure in which they were minimally influenced. The respondent also indicated that the incentive was a bonus as they already had plans to do what the SBD representative suggested. The representative simply made the efficient motors measure an "easier sell." For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 0 out of 6, or 100% freeridership for all of the measure except the efficient motors measure. That measure receives a score of 1.25, or 80% freeridership. Therefore, the ex-post net savings are evaluated at 0% of the ex-post gross savings for all measures except the efficient motors, which receive 21% of the ex-post gross savings. This is summarized in Table 74. Note that the savings for each measure cannot be added directly to calculate the total savings since they have interactive effects.

		Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
EEM1	peak kW	23.1	23.1	100%	0.00	0.0
	kWh	89,366	89,366	100%	0.00	0
EEM2	peak kW	23.7	23.7	100%	0.00	0.0
	kWh	372,910	372,910	100%	0.00	0
EEM3	peak kW	17.3	104.2	602%	0.00	0.0
	kWh	493,929	880,196	178%	0.00	0
EEM5	peak kW	4.3	4.3	100%	0.21	0.9
	kWh	40,484	40,484	100%	0.21	8,434
EEM6	peak kW	7.8	7.8	100%	0.00	0.0
	kWh	29,477	29,477	100%	0.00	0
EEM7	peak kW	11.8	10.4	88%	0.00	0.0
	kWh	101,150	101,150	100%	0.00	0
EEM8	peak kW	0.0	1.9	N/A	0.00	0.0
	kWh	127,433	82,941	65%	0.00	0
All EEMs Combo	peak kW	63.9	153.0	239%	0.00	0.0
	kWh	1,095,943	1,415,778	129%	0.00	0

Table 74: P25829 Savings Comparison

P26089 & P26090

Whole Building

Project P26089 and P26090 are incentive projects for two separates phases of expansion at the same refrigerated warehouse facility. These projects were evaluated together because the final analysis has interactive effects between phases. Project P26089, or phase 1, includes the distribution areas, while project P26090, or phase 2, is for the production areas. The entire facility is approximately 340,000 square feet of conditioned space, of which 155,000 is in the production area. Phase 1 received an incentive of $93,073 and Phase 2 received an incentive of $150,000. The measures for Phase 1 were efficient evaporative condensers and floating head pressure, variable set point and variable speed condenser fans, efficient compressor motors, efficient air unit fan motors, increased insulation, lighting controls in the freezer, and reduced lighting power density in the office areas. The Phase 2 measures consisted of efficient evaporative condensers with floating head pressure, variable set point and variable speed condenser fans, efficient compressor motors, efficient air unit fan motors, reduced lighting power density in the office areas, and over sizing the regeneration heat exchanger. The measures were verified by the evaluation team during a site visit.

The project file indicates there was an accounting error when processing the ex-ante gross savings for this site. The post-field inspection performed by the utility showed that some of the measures were not installed as proposed and the ex-ante gross savings estimates were reduced. However, the rebate check was still written for the original savings amount resulting in an overpayment of$2,821.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined with DOE-2.2R simulation model of the facility. A variety of parameters were based upon the anticipated operation of the facility, including the equipment schedules, product cooling loads, and space temperatures.

<u>Ex-Post Gross Savings</u>

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings in DOE-2.2R. The ex-ante gross model was adjusted to simulate the trends that the meter data show. Data loggers were installed on a variety of the incented equipment at the site for four weeks in September and October of 2006. The monitored equipment is shown in Table 75. Each of the monitored items is discussed below.

Incented Measures
Evaporative Condensers
Floating Head Pressure Condenser Controls
Variable Set Point Condenser Controls
VFD Condenser Fan Motors
Premium Efficiency Compressor Motors
Premium Efficiency Air Unit Motors
Increased Insulation
Freezer Lighting Controls
Reduced Lighting Power Density- Offices
Efficient Regeneration HX
Metered Equipment
Freezer Lighting
Evaporative Condenser Fans
Dock Air Unit Fan Motors
Freezer Evaporator Fans
High Pressure Liquid (Condensing) Temperature
Outside Air Temperature
Outside Air Relative Humidity
Outside Air Wet Bulb Temperature

Table 75: P26089 Metered Equipment

Figure 69 shows the wet bulb and high pressure liquid temperatures for the variable set point controls measure. This measure is based on wet bulb temperature reset so that the condensing set point is slightly above the wet bulb temperature. The temperature difference was estimated to be 10°F when above the minimum set point temperature of 60°F. However, the data proved the temperature difference is actually 13°F when above the set point. This control was changed in the evaluation model.

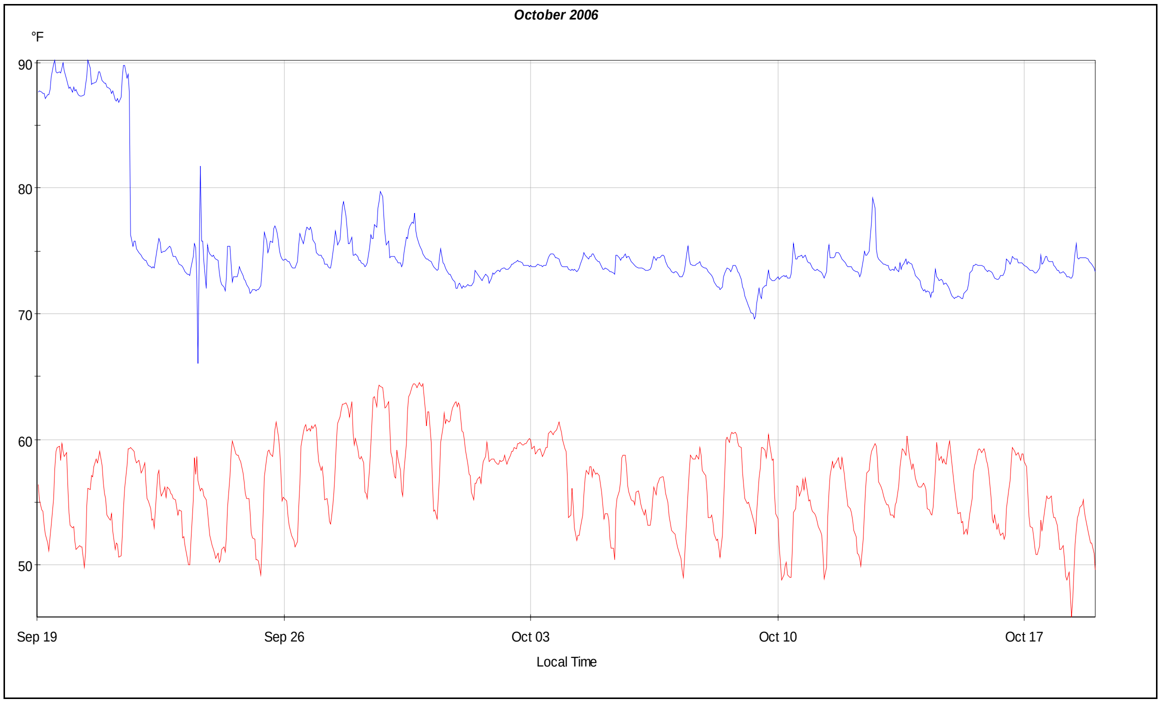


Figure 69: P26089 Metered Wet Bulb Temperature (Red) and High Pressure Liquid Temperature (Blue)

Figure 70 shows the freezer lighting power consumption. The ex-ante gross model estimated that the occupancy sensors will decrease the lighting usage and power by 27%, or the lights would be on 73% of the time. The meter data showed that on average occupancy sensors reduced the on by 16%. The evaluation model was modified to reflect this finding

Also, the post-field inspection found that the office lighting power density was actually 1.875 Watts per square foot as opposed to program estimated the power density at 1.13 Watts per square foot. Since baseline LPD for offices is 1.3 Watts per square foot. Therefore, there are no lighting savings for office areas.

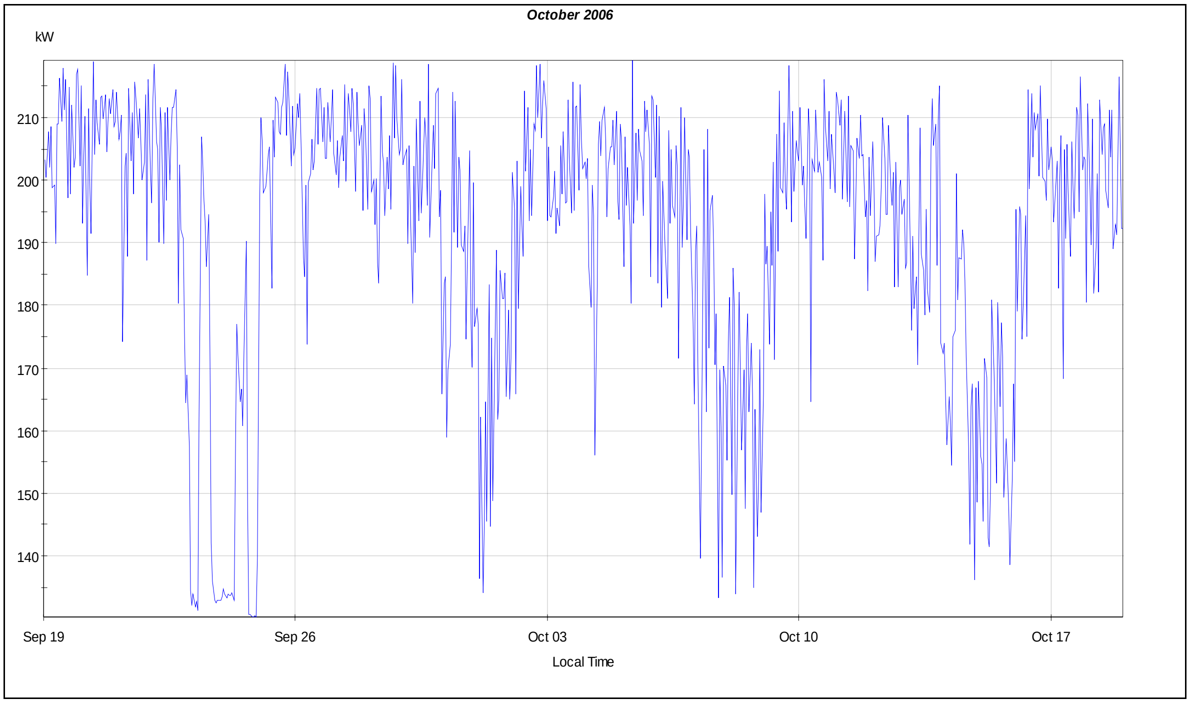


Figure 70: P26089 Freezer Lighting

Figure 71 shows the sum of the individual condenser fans' energy usage. Clearly the fan load varied significantly during the metering period since the fans use over 110 kW some peak hours and less than half that during an average hour. The ex-ante gross model has the fans set to cycle on and off twenty-four hours per day with an average load. The meter data shows that the fans are indeed cycling throughout the entire day and there is no consistent, predictable condenser fan schedule. Therefore, no changes were made in the model for the condenser fans

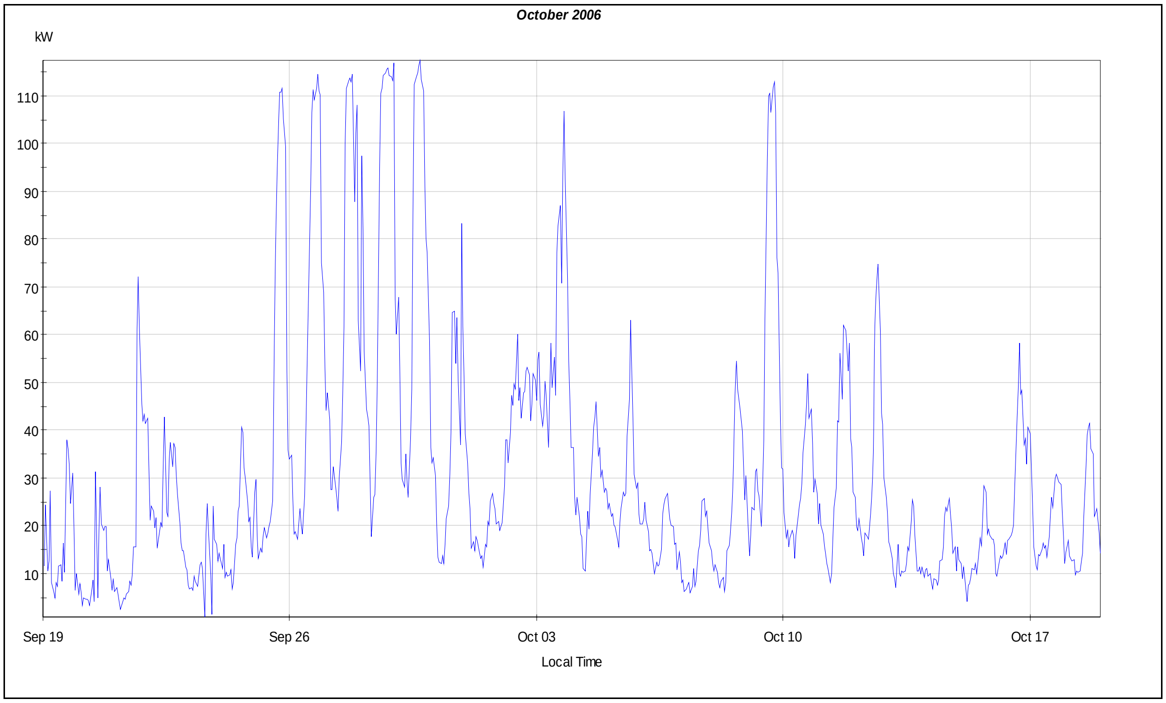


Figure 71: P26089 Condenser Fans Metered Data

Figure 72 show the meter data for the dock fans (red) and freezer fans (blue). The consumption shown is actually the sum of the individual fans. Both fan types appear to have a cyclic pattern. Also, both fans are consuming a reasonable amount of energy given the fan motor horsepower. Both fan types are operating twenty-four hours per day. Figure 73 shows the data reduced to the hourly consumption for an average day of the metering period. Clearly, the load is changing throughout the day for both fan types. The ex-ante gross model had a constant load. Therefore, these load shapes were incorporated into the model by varying the hourly load as a percentage of the maximum load.

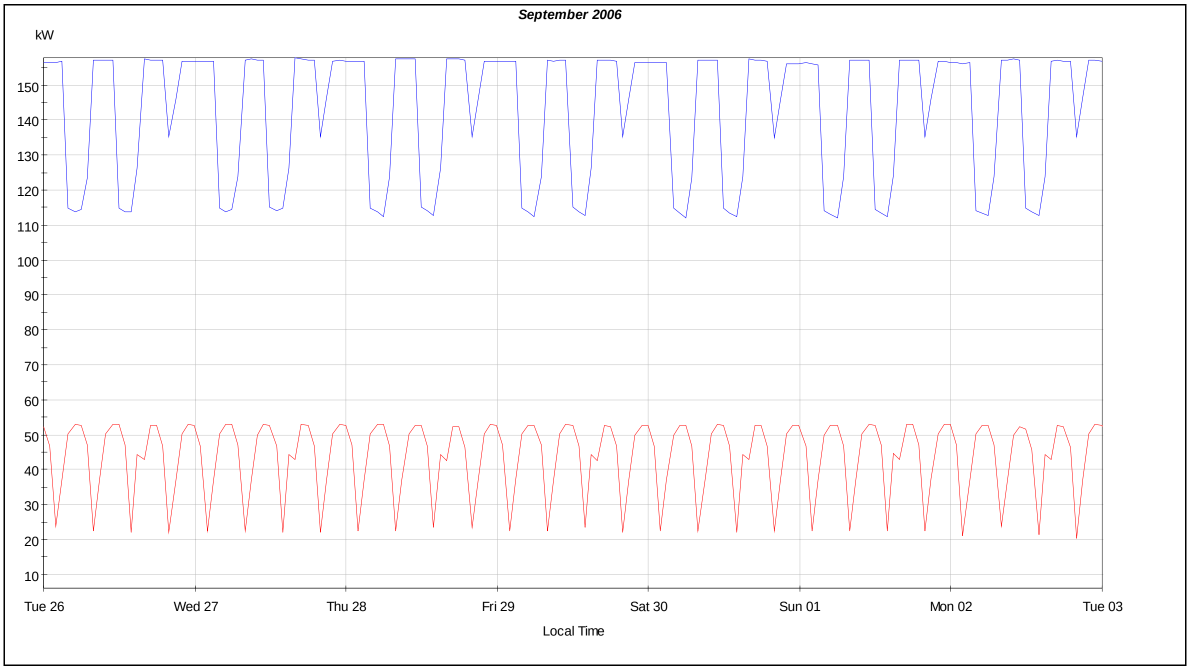


Figure 72: P26089 Dock Fans (Red) and Freezer Fans (Blue) Data

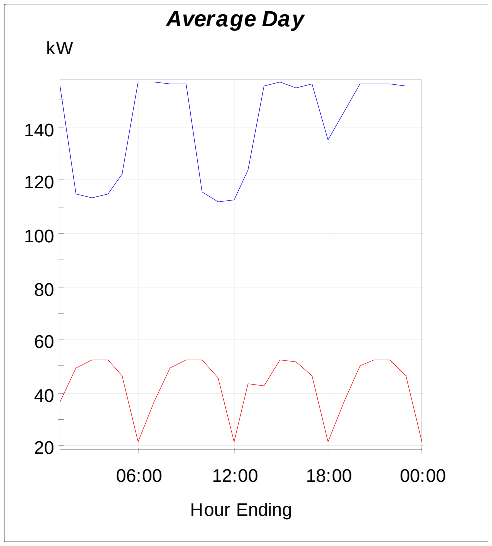


Figure 73: P26089 Hourly Power Consumption for Dock (Red) and Freezer Fans (Blue)

Aside from the model changes described above, a few motor efficiencies were modified based upon field observations.

Since the model output combines energy usage for both projects, the energy savings had to be separated through proportions for those measures that were included in both projects. There were four of these measures and they were separated into one of three categories: refrigeration, lighting power density, or fans. The refrigeration measure savings were proportioned by the consumption of cooling energy (in units of MBtu). The lighting power density savings were split according to square footages of the installed measure. The fan measure savings were divided in proportion to the total fan power distribution for each project. Then, the savings for each measure were weighted by the appropriate category. The peak kW savings were estimated by multiplying the total peak savings for both projects by each project's percentage of total energy savings.

Ex-Post Net Savings

The ex-post net savings analysis for this site is more complicated than most sites. Free-ridership was assessed per measure for each project. In general, the facility chose measures that were simple and quick to construct. However, the facility representative did indicate that for all measures an SBD representative either performed calculations to confirm the savings or introduced the measure. Some of the measures were not influenced by SBD because they had already been designed and just happened to be qualified for the SBD program. Yet, other measures were highly influenced by the program, such as the floating head pressure and variable set point condenser controls. Likewise, some of the measures would have definitely been installed regardless of SBD, while others definitely would not have been installed. If the freeridership score is weighted by savings, the overall freeridership is 25% for Phase 1 and 26% for Phase 2. This corresponds to free-rider scores of approximately 4.5. Therefore, ex-post net savings are 75% of ex-post gross savings for Phase 1 and 74% for Phase 2. The freeridership scores are shown in Table 76 and Table 77. The overall energy savings are presented in Table 78 and Table 79. Note that the savings for EEM 1 and EEM 2 are combined since the measures cannot be split up by savings.

P16089	Measure Description	FR Score	FR Ratio	Ex-Post Gross kWh Savings	Ex-Post Net kWh Savings
Phase 1 Distribution	EEM 1: Efficient	3.25	46%	558,968	430,871
Phase 1 Distribution	EEM 2: FHP, Variable	6	0%		
Phase 1 Distribution	EEM 9: Efficient	3.25	46%	27,449	14,868
Phase 1 Distribution	EEM 10: Premium	3	50%	40,469	20,235
Phase 1 Distribution	EEM 11: Increased	2	67%	90,665	30,222
Phase 1 Distribution	EEM 12: Occ Sensors in	6	0%	158,352	158,352
Phase 1 Distribution	EEM 13: LPD in Offices	2	67%	0	0
Phase 1 Total				**875,903**	**654,547**

Table 76: P26089 Ex-Post Gross and Ex-Post Net Savings by Measure

P16090	Measure Description	FR Score	FR Ratio	Ex-Post Gross kWh Savings	Ex-Post Net kWh Savings
Phase 2 Production	EEM 1: Efficient	3.25	46%	1,429,446	1,101,864
Phase 2 Production	EEM 2: FHP, Variable	6	0%		
Phase 2 Production	EEM 9: Efficient	3.25	46%	70,195	38,022
Phase 2 Production	EEM 10: Premium	3	50%	108,097	54,049
Phase 2 Production	EEM 13: LPD in Offices	2	67%	0	0
Phase 2 Production	EEM 15: Oversized	4.25	29%	390,183	276,380
Phase 2 Total				**1,997,920**	**1,470,315**

Table 77: P26090 Ex-Post Gross and Ex-Post Net Savings by Measure

PHASE 1	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	91.0	69.3	76%	0.75	51.8
kWh	1,163,409	875,903	75%	0.75	654,547

Table 78: P26089 Phase 1 Savings Comparison

PHASE 2	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	169.0	158.1	94%	0.74	116.4
kWh	2,162,370	1,997,920	92%	0.74	1,470,315

Table 79: P26090 Phase 2 Savings Comparison

P26695

VSD Air Compressors

Project P26695 received an incentive of $14,130 to install two new air compressors. One 15 hp VSD controlled compressor and a 20 hp modulating/unloading compressor. The 20 hp compressor supplies the base load demand and the 15 hp VSD compressor supplies the swing demand. The baseline of this measure was a 50 hp rotary screw compressor with inlet modulation and unloading. The facility also installed two thermal mass (TMS) dryers and four no air loss drains which were included in the incentive savings. The evaluation team verified the installation of the measure during the site visit.

Ex-Ante Gross Savings

Ex-ante gross savings were determined with help of AirMaster+ software. The compressed air system was simplified and analyzed using the software for both the baseline and proposed models. Note that a major part of the energy savings came from the air compressors.

Ex-Post Gross Savings

Data loggers were installed on both the air compressors and TMS dryers, as illustrated in Table 80, for a period of four weeks in October and November of 2006.

Incented Equipment	Metered
20 hp compressor	YES
15 hp VSD compressor	YES
Air Dryer (2)	2 Metered
No air loss drains (2)	Verified

Table 80: P26695 Metered Equipment

The recorded data was imported into the Visualize-IT program. Visualize-IT showed the average operating hours and power draw of the compressors for each day of the week, weekends, and weekdays. Neither compressor was on during the weekend; therefore the profile for an average weekday was used. Figure 74 shows the raw data for both the compressor for monitoring period. Figure 75 below shows the average compressor profile for both compressors during the metering period. The data showed that both compressors operate simultaneously and only operate during the weekdays for 8 hours a day.

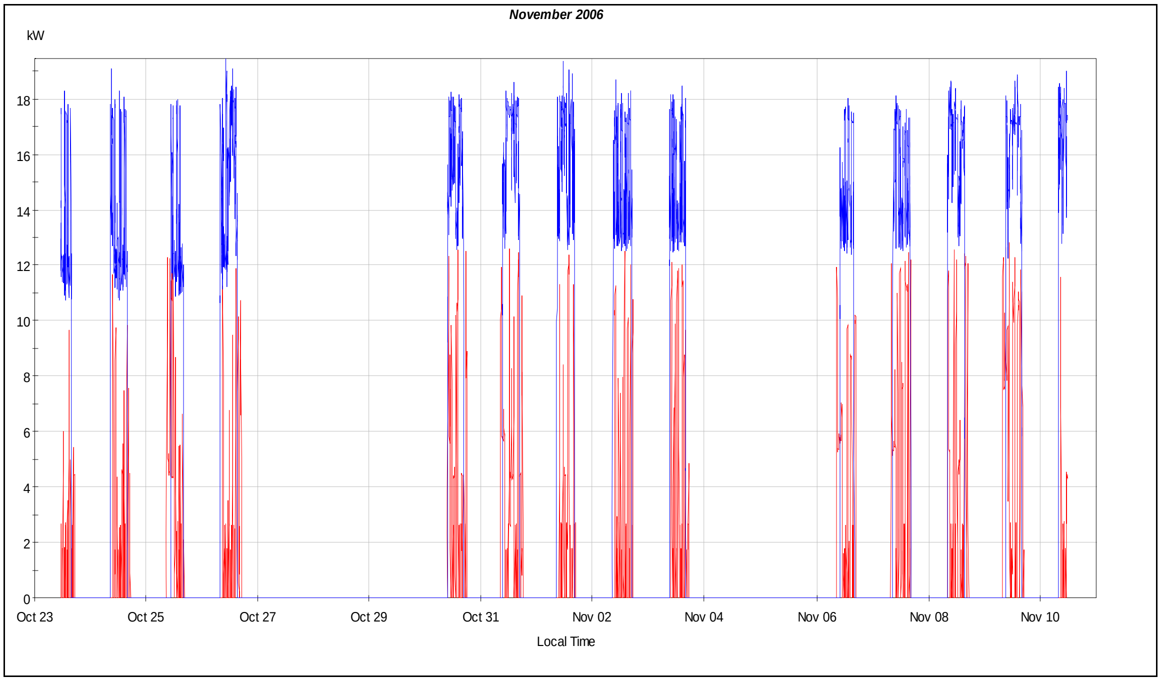


Figure 74: P26695 Air Compressor Power Profile during the Monitoring Period

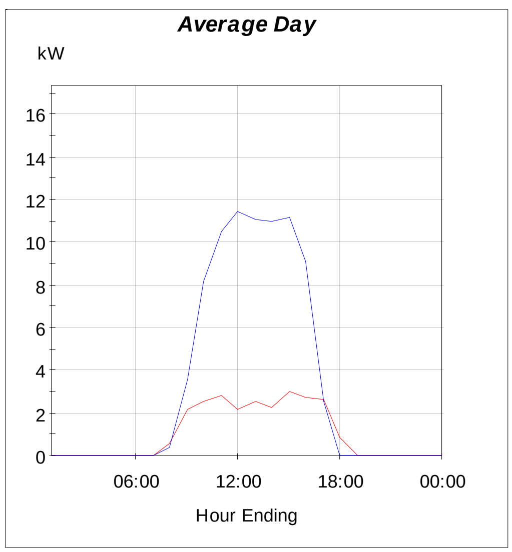


Figure 75: P26695 Air Compressor Average Weekday Power Consumption

Next, models were built in AirMaster+. The software requires inputs such as facility elevation, air system pressure, air storage capacity (such as receivers), and production day types. The metered data indicated that there were some days when the facility operated at full load and other days when it operated at partial load. Therefore, two day types were created. Next, the compressors were selected according to operating pressure and the system automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The AirMaster+ compressor profile was then modified to reflect VSD controls. Finally, the hourly power data recorded by the meter was input for each day type. Once all of these options were selected, the program modeled the actual behavior of the compressor.

For the baseline model all inputs stayed the same, except for the compressor controls and the hourly power consumption profile. No modifications were made to the program-generated compressor controls since they are standard and did not include VSDs. The system airflow is the variable that stays constant between the baseline and evaluation model. The hourly power profile was input in the evaluation model and the program calculated hourly airflow rates based on that profile. Those same hourly airflows were put into the baseline model instead of a power profile. Note that no other energy efficiency measures were included in the models, since a separate model was made for the baseline and evaluation models.

The Air Master program generates both evaluated and baseline energy usage. The ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

The dryer savings were calculated by creating a power consumption profile for an average weekday. The energy usage was calculated using this profile since it contains both the annual operating hours as well as power draw. The profile is presented in Figure 76. Peak hours were defined as 12pm to 6pm, Monday through Friday.

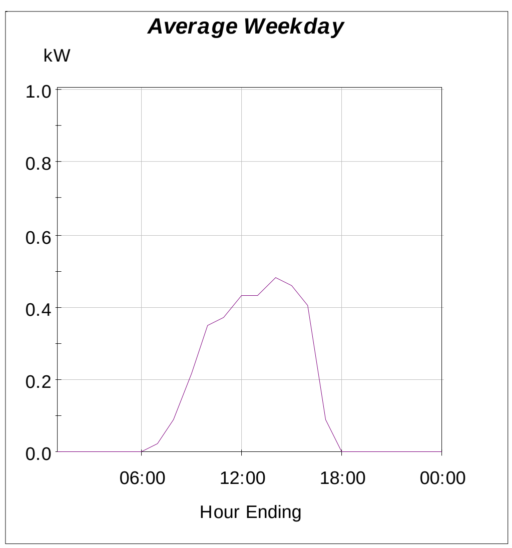


Figure 76: P26695 Dryer Hourly Power Consumption

The no air loss drains were given ex-post gross savings equal to ex-ante gross savings since all of the ex-ante gross analysis assumptions seemed reasonable. Also, the no air loss drains only account for approximately 6% of the savings.

The energy efficiency measures saved a lot less energy than expected because the facility was running only eight hours a day, five days week as compared to the ex-ante gross analysis which estimated twenty four hours a day, seven days a week. Also, there is large reduction in demand savings since the evaluation team noticed that the compressor was running at 120 psi as compared to the 80 psi claimed in the ex-ante gross analysis.

Ex-Post Net Savings

The facility owner stated that the program was very influential in the implementation of this measure and an SBD representative first suggested this measure. He also mentioned that had they not found out about the program they would have purchased pre-owned equipment that was significantly less efficient. This combination of answers yields a complete freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings. This is summarized in Table 81.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	13.30	3.16	24%	1.00	3.16
kWh	116,111.00	10,864.42	9%	1.00	10,864.42

Table 81: P26695 Savings Comparison

P26696

VSD Air Compressor

Project P26696 received an incentive $43,888 for efficiency measures in the expansion of the site's compressed air system. This expansion consisted of the installation of a VSD 200 hp rotary screw air compressor, installation of a desiccant dryer with an EMS system, reduction of system distribution pressure to 80 psi below baseline pressure of 90 psi and installation of three no air loss drains. The baseline of the VSD compressor is a constant volume air compressor with inlet vane modulation and unloading. The evaluation team verified the installation of the measures. Note that all the energy savings came from the air compressor.

<u>Ex-Ante Gross Savings</u>

The ex-ante gross savings were determined by using AirMaster+ software. The compressed air system was simplified and put into the program for both the baseline and ex-ante gross models.

<u>Ex-Post Gross Savings</u>

A true power data logger was installed on the 200 hp VSD air compressor during the month of September and October 2006 for a period of four weeks.

The metered data show the air compressor operates 24 hours a day and 7 days a week. Figure 77 and Figure 78 show the raw kW data and average day hourly data, respectively, for the monitoring period. The data were used to find the hourly energy consumption of the compressor. This hourly kW data along with the other parameters such as building elevation, air storage capacity, and operating pressure were put into AirMaster+ to create an evaluation model. Next, the compressors were selected according to operating pressure and capacity and the software automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The AirMaster+ compressor profile was then modified to reflect VSD controls. Finally this AirMaster+ model spits out hourly system air flow of the compressor.

The above hourly system air flow is re-entered into AirMaster+ and modified to create the baseline profile. For the baseline profile all inputs remain the same except the control parameters and power consumption profile. In the baseline model the hourly air flow is used as an input variable instead of the hourly power consumption profile. The system airflow is the variable that stays constant between the two models.

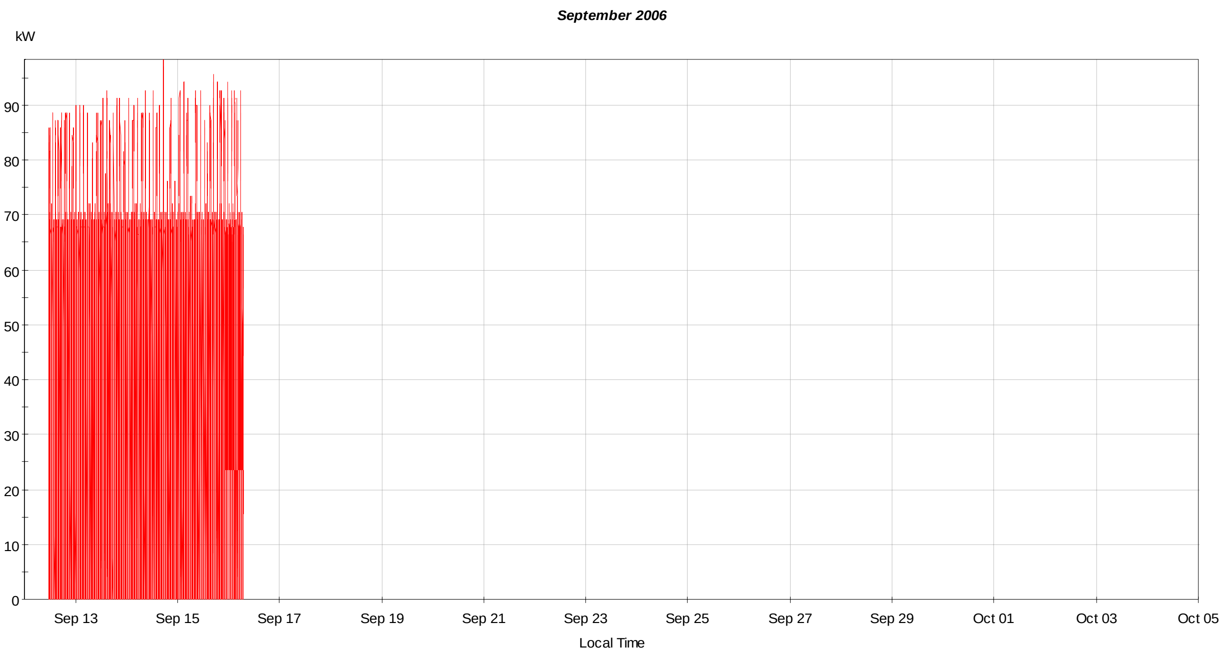


Figure 77:P26696 Air Compressor Power Consumption

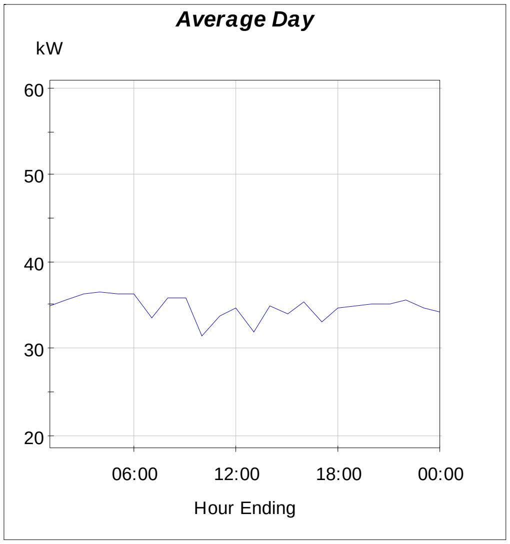


Figure 78: P26696 Air Compressor Average Day Profile

The program returned the evaluated annual energy usage, as well as the baseline energy usage. The evaluated ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

The EEMs saved less than anticipated because the evaluated operating pressure of the compressor was observed at 122 psi whereas the ex-ante gross model was created with an assumed operating pressure of 90 psi.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of these measures. The SBD representative assisted in the design analysis and the respondent stated that they wouldn't have been able to see the savings from the upgrade without this help. They also indicated that they can save a lot of energy and at the same time meet their capacity. A combination of these answers yields a freeridership score of 5 out of 6 or 17 % of freeridership. Therefore the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 82.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	50	34	67%	0.83	28
kWh	438,884.00	296,110.00	67%	0.83	246,758.33

Table 82: P26696 Savings Comparison

P27795

Electric Injection Molding Machine

Project P27795 received an incentive of $17,675 for installing two new electric injection molding machines (IMMs). One of the machines is 150 ton and the other one is 242 ton. The baseline equipment for this measure are standard hydraulic injection molding machines of a similar size. The evaluation team verified the installation of these measures during the site visit.

Ex-Ante Gross Savings

The ex-ante gross savings are calculated by comparing the baseline standard hydraulic injection molding machine with the electric molding machine. The ex-ante gross analysis estimates a total energy usage savings of 87,004 kWh / yr and a demand savings of 12.4 kW for the 150 ton electric machine and a total energy usage savings of 191,641 kWh/yr and a demand savings of 27.3 kW for the 242 ton electric molding machine.

Ex-Post Gross Savings

The metering period for the 150 ton IMM was four weeks during July and August of 2006. The 242 ton IMM was metered for 30 minutes.

Raw data for the 150 ton machine are shown in Figure 79. The red trace represents the estimated baseline power draw and the blue trace is the metered data. The raw data for the 242 ton IMM is shown in Figure 80.

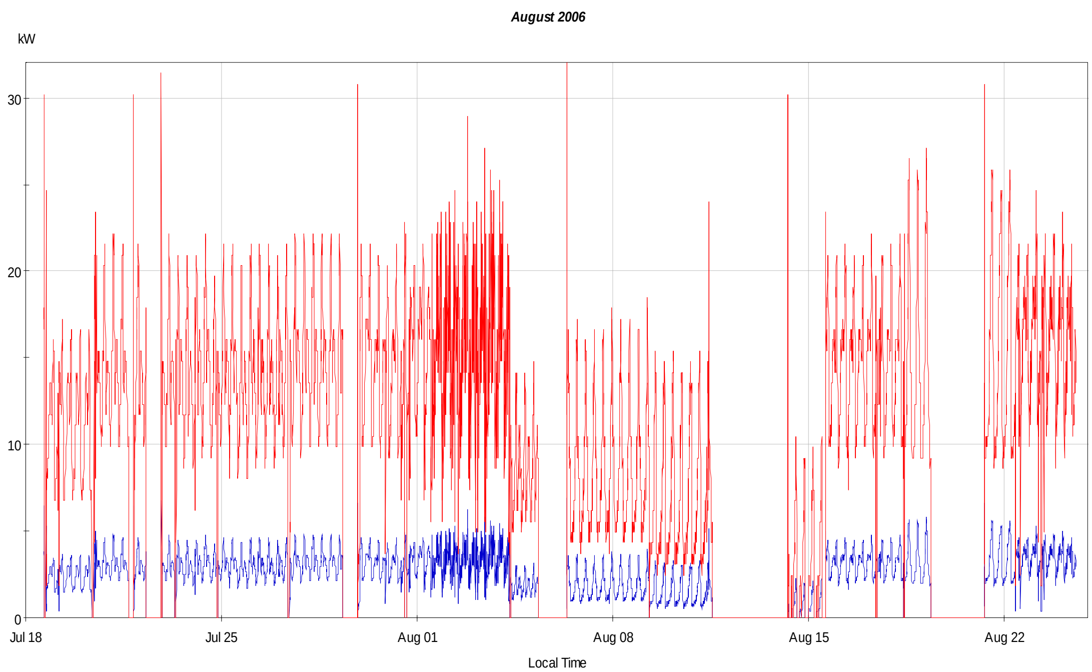


Figure 79: P27795 150 Ton Baseline (red) and Metered (blue) Power Draw

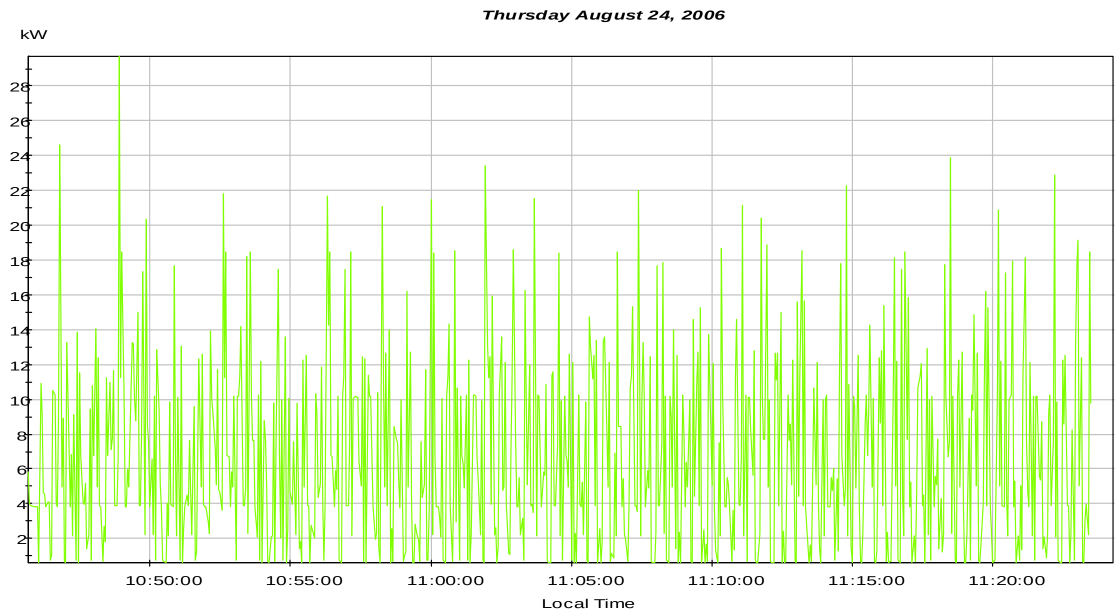


Figure 80: P27795 242 Ton IMM Raw Metered Data

The recorded data and the information collected from facility personnel show the 150 ton molding machine runs 24 hours a day, seven days a week, whereas the 242 ton molding machine runs 22.5 hours a day, seven days a week. The metered data was used to calculate the hourly power consumption profile for an average day and annual energy usage. The average day power profile is shown in Figure 81. The evaluated energy usage was then compared with baseline consumption.

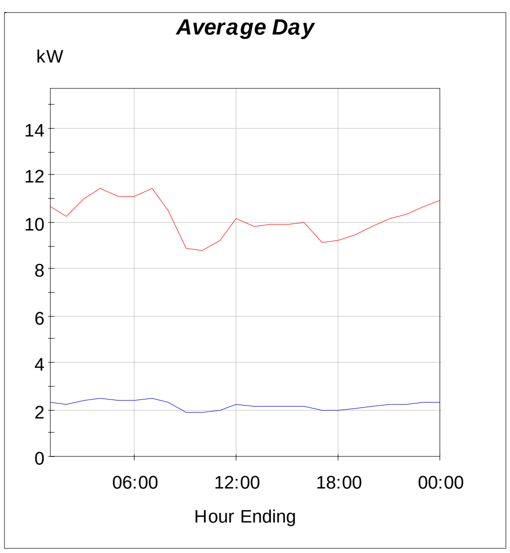


Figure 81: P27795 Average Power Draw Profile for Baseline (red) and Metered

(blue) 150 Ton IMM

The evaluation estimated a baseline power draw of 11.9 kW for the 150 ton electric machine and 36.1 kW for the 242 ton electric machine. The ex-post gross power draw was 2.18 kW and 7.7 kW for the 150 ton and 242 ton electric molding machines, respectively. This resulted in savings of 69,788 kWh per year and a demand reduction of 9.7 kW for the 150 ton machine. The 242 ton machine produced 232,422 kWh per year savings and a demand reduction of 28.4 kW.

The ex-post gross mass flow rate was 28.1 lbs/hr and 85.5 lbs/hr for the 150 ton and 242 ton machines, respectively. The ex-ante gross mass flow rates were found to be 38 lbs/ hr and 82.2 lbs/hr for the 150 ton and 242 ton machines, respectively. Note that one of the primary attributing factors of energy consumption of the IMMs is the product throughput.

<u>Ex-Post Net Savings</u>

The facility owner stated that the program was somewhat influential in the implementation of this measure and a SBD representative first suggested this measure. The facility representative also stated that they probably would have been installed the electric machines with the absent interaction of the program. This combination of answers yields a freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated as 58% of the ex-post gross savings. The results are shown in Table 83 and Table 84.

150 ton Electric Molding Machine					
	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	12.4	9.7	78%	0.58	5.7
kWh	87,004	69,788	80%	0.58	40,710

Table 83: P27795 150 Ton Savings Comparison

242 ton Electric Molding Machine					
	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	27.3	28.4	104%	0.58	16.6
kWh	191,641	232,422	121%	0.58	135,579

Table 84: P27795 242 Ton Savings Comparison

P31609

Tank Insulation

Project 31609 received an incentive of $35,231 to install insulation on sixteen existing wine storage tanks. The baseline for this measure is the tanks without insulation. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using tank dimensions, proposed insulation R-value, annual operation hours for the equipment, tank temperatures, and facility location. This information for each tank size was input into an energy savings spreadsheet developed by the utility. The spreadsheet outputs an estimated power and energy savings.

Ex-Post Gross Savings

Ex-post gross savings were calculated using the same spreadsheet as for the ex-ante gross savings, but with slightly different inputs. All spreadsheet inputs seemed reasonable, however, the inside tank temperature had changed. The change was based on an interview with the facility engineer. This was the only input that was modified even though meters were installed on the refrigeration compressors and condenser water pump. This metered data was not used because the savings spreadsheet did not require the hourly power for each piece of equipment. The monitored equipment is shown in Table 85.

Incented Equipment	Metered Equipment
Tank Insulation	20 hp Condenser Fan
	100 hp Compressor
	125 hp Compressor
	Condenser Water Pump

Table 85: P31609 Metered Equipment

As expected, the savings are very similar since very few inputs were changed. The savings are presented below.

Ex-Post Net Savings

A facility representative indicated that the program was very influential in the implementation of the measure. The respondent indicated that they wanted the insulation designers to work with SBD from the beginning of the project and SBD made the project an “easier sell.” The respondent indicated that the system probably would have been installed absent any interaction with the Savings by Design program since tank insulation is, “nothing new.” They think they would have installed less efficient equipment. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 86.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	75.4	77.5	103%	0.67	51.7
kWh	440,391.0	441,707.0	100%	0.67	294,471.3

Table 86: P31609 Savings Comparison

P32209

High Efficiency Interior Lighting

This project received an incentive of $33,719 for installing high efficiency lighting in a milking barn and confinement area at a dairy facility. This high efficiency lighting consists of 320 W pulse start metal halide lamps and T8-32 linear fluorescent lamps.

The baseline design of this measure was Title-24 energy consumption standards for commercial buildings. The defined Title-24 standards are based on W/ft^2. Therefore the baseline energy consumption will solely depend upon the square footage of the illuminated area. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated by using the proposed lamp wattage and projected operating hours of the illuminated area.

Ex-Post Gross Savings

A data logger was installed on some of the lighting circuits for a period of 3 weeks in the month of October. Many of the areas were not logged because of the poor site condition. However, the areas logged were representative of the whole facility lighting schedule. Table 87 shows the areas where loggers were installed.

Incented Area	Metered
Milker's Pits	YES
Cow Walkways	YES
Drip Pen	YES
Sprinkler Pen	YES
Breezeway	YES
Equipment rRoom	NO
Milk Room	YES
Soap Room /Laundry	NO
Shop	NO
Storage	NO
Offices	NO
Break room	NO
Rest Rooms	NO
Freestall Barn	NO
Maternity Barn	NO

Table 87:P32209 Metered Areas

The logger data was imported into Visualize-IT. The imported data was analyzed to estimate a whole facility lighting schedule. Figure 82 and Figure 83 illustrate the weekly power draw and average day power profile for the above listed areas.

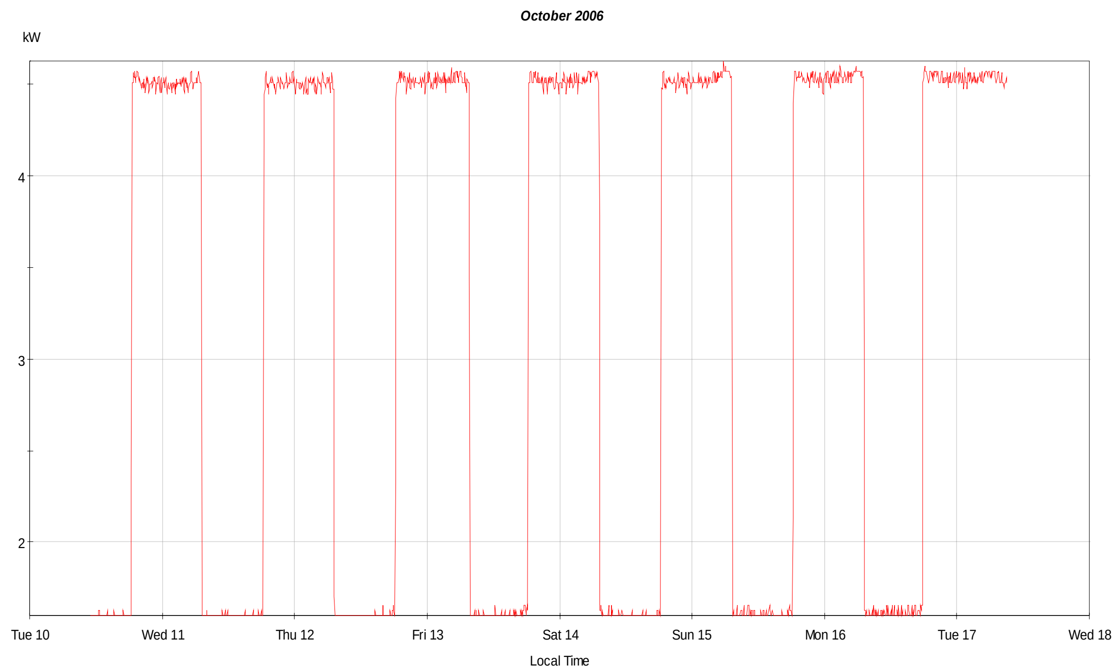


Figure 82: P32209 Power Profile for One Week of the Monitoring Period

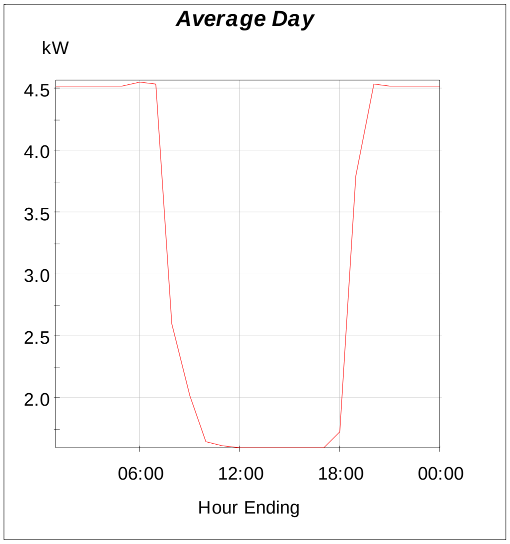


Figure 83:P32209 Average Day Power Profile

The ex-post gross savings were calculated using the annual operating hours and rated lamp power. The metered power was not included in the calculations because it did not correspond to the rated power of the metered area. Many areas were not metered, but their operating hours and rated power seemed reasonable. Therefore, the ex-ante gross savings were applied as ex-post gross savings. These areas only account for

10% of the total savings. The facility has slightly larger savings than estimated in the ex-ante gross analysis and the results are presented below.

Ex-Post Net Savings

The facility representative indicated that this program was very influential. They also mentioned that an SBD representative helped make the measures meet the investment criteria. The respondent also indicated that they probably would not have installed these measures without any interaction with the Savings by Design Program. This combination of answers yields a freeridership score of 5 out of 6, or 17% freerider. The ex-post net savings are calculated at 83% of the ex-post gross savings, as summarized in Table 88.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	158.4	N/A	0.83	132.0
kWh	561,988	566,387	101%	0.83	471,989

Table 88: P32209 Lighting Savings Comparison

Automatic Daylight Control

Project P32209 received an incentive of $1,114 to install photocell controls. The photocell enables the lights to automatically turnoff when there is sufficient daylight in the area. The baseline of this measure is the lighting that operates continuously during the daylight hours.

Ex-Ante Gross Savings

Ex-ante gross savings are estimated using the proposed hours and lamp wattage.

Ex-Post Gross Savings

A data logger was installed in the photocell controlled circuit for a period of 3 weeks. The data appeared to follow the ex-ante gross estimate and the lights were off for 10 hours (8 am to 6 pm). Figure 84 shows the schedule of operation of the lighting system.

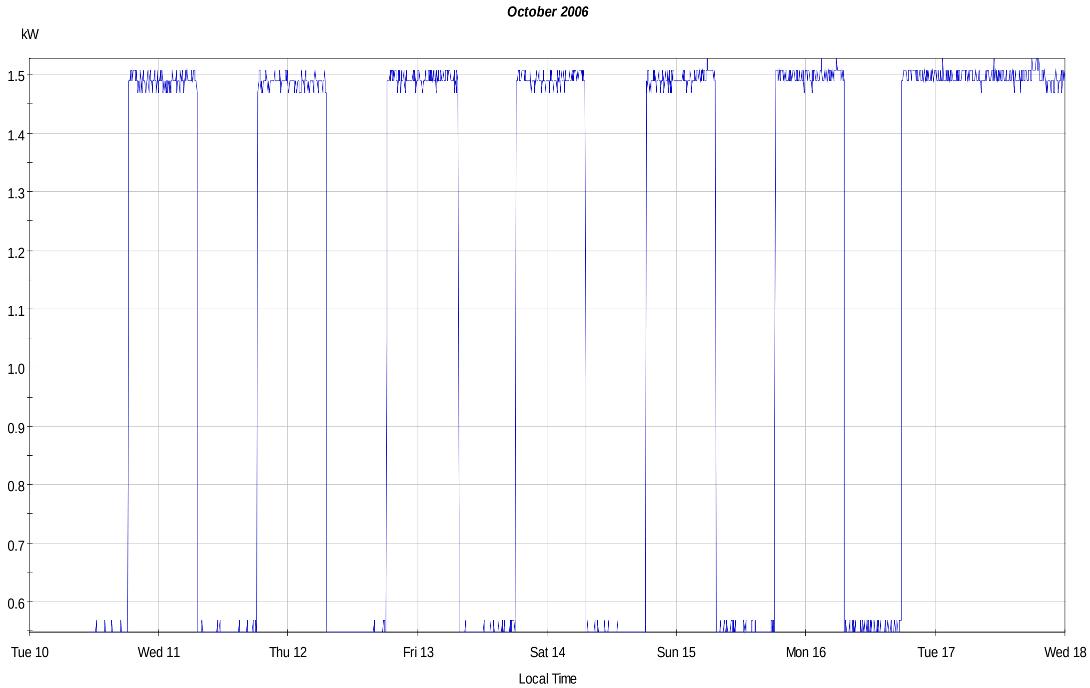


Figure 84: P33209 Operating Schedule of the Lights on Photocell

<u>Ex-Post Net Savings</u>

The facility representative indicated that this program was very influential. They also mentioned that an SBD representative helped make the measures meet the investment criteria. The respondent also indicated that they probably would not have installed these measures without any interaction with the Savings by Design Program. This combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Hence the ex-post net savings are calculated at 83% of the ex-post gross savings which is summarized Table 89.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	8.0	7.2	90%	0.83	6.0
kWh	27,844	26,346	95%	0.83	21,955

Table 89: P32209 Daylight Savings Comparison

Refrigeration System

Project P32209 received an incentive of $10,803 for using ground water to precool milk from a temperature of 98 °F to 75 °F using 72 °F of ground water. The baseline of this measure is an air cooled condenser without precooling. The facility was originally going to be incented for a ground water condenser, but during the project the facility communicated to the SBD program that this was not going to be installed. However, when the evaluation team performed the onsite inspection, the groundwater condenser was installed. This evaluation has given savings for this measure and this is one reason why the ex-post gross savings are higher for this measure.

Ex-Ante Gross Savings

Ex-ante gross model was estimated using DOE-2.2R simulation software. The refrigeration schedule was estimated and incorporated in the DOE-2.2R software to build an ex-ante gross model. A baseline model was also created with help of the above software tool.

Ex-Post Gross Savings

A data logger was installed on the compressor to record the power consumption. The schedule derived from this metered data formed the basis of our evaluation. Table 90 shows the metered equipment and Figure 85 presents the refrigeration compressor power consumption during the monitoring period.

Incented Equipment	Metered
Groundwater Heat Exchanger	Chiller

Table 90: P32209 Metered Equipment

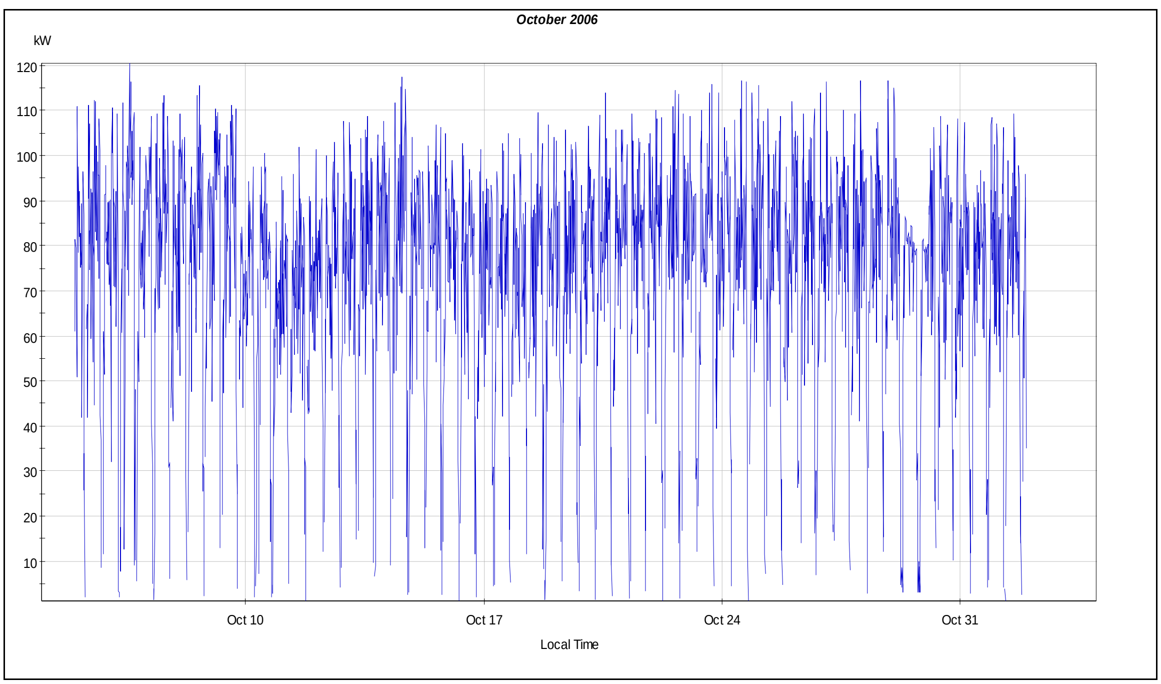


Figure 85: P32209 Power Draw of the Chiller during Monitoring Period

The metered data were used to determine the schedule of operation of the refrigeration system. The schedule on the DOE-2.2R ex-ante gross model was manipulated to create an ex-post gross model. The two schedules were found to be very close. Table 91 shows a comparison of the ex-ante gross and ex-post gross schedule.

Status	Ex-Ante Gross Model	Ex-Post Gross Model
On	1am-12pm, 1pm-12am	12am-6am, 8am-5pm, 6pm-12am
Off	12am-1am, 12pm-1pm, 11pm-12am	7am-8am, 5pm-6pm
Daily Hours	21	22

Table 91: P32209 Refrigeration Schedule

<u>Ex-Post Net Savings</u>

The facility representative indicated that this program was very influential. The SBD incentive helped the measure meet the investment criteria. The respondent also indicated that they probably would not have installed these measures without any interaction with the Savings by Design Program. This combination of answers yields a freeridership score of 6, or 0% freeridership. Hence the ex-post net savings are calculated at 100% of the ex-post gross savings which is summarized in Table 92.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	27.0	46.5	172%	1.00	46.5
kWh	135,037	163,215	121%	1.00	163,215

Table 92: P32209 Refrigeration System Savings Comparison

Process System

Project P32209 received an incentive of $422 for installing a VFD controls on a 5hp milk vat pump and replacing a standard efficiency sprinkler pump motor with a premium efficiency motor. The baseline of the VFD 5 hp milk pump was a constant speed pump and the baseline of the sprinkler pump was a standard efficiency pump motor. The baseline efficiency for the premium efficiency motors is determined by the Energy Policy Act of 1992 (EPAct), in which minimum energy efficiency is established for a certain motor size, speed and type of enclosure.

<u>Ex-Ante Gross Savings</u>

The ex-ante gross savings for the VFD milk vat pump is estimated by assuming an operational schedule of 20 hours per day and a motor load factor of 50%. The annual energy savings were calculated to be approximately 13,615 kWh per year. The energy savings for the premium efficiency motor were calculated based on the difference of efficiency between standard efficiency and installed efficiency, the motor horsepower and annual operating hours. The ex-ante gross savings estimated for this measure were around 154 kWh per year.

Ex-Post Gross Savings

A data logger was installed on the VFD milk vat pump for three weeks in October of 2006. Figure 86 presents the power consumption of the milk vat pump for the metering period. Also, Figure 87 shows the average day energy consumption of the above pump. The ex-post gross annual energy consumption was calculated by using the logged motor power and operating hours. The energy consumption was calculated as 9,603 kWh per year. Similarly baseline energy consumption was also determined by using rated motor power, maximum load factor and annual operating hours. Ex-post gross savings were calculated by subtracting the evaluated energy consumption from the baseline energy consumption.

As the premium efficiency motor measure was a miniature part of the total energy consumption, no logging equipment was installed on this motor. Xx The ex-post gross savings were estimated to be the same as the ex-ante gross savings.

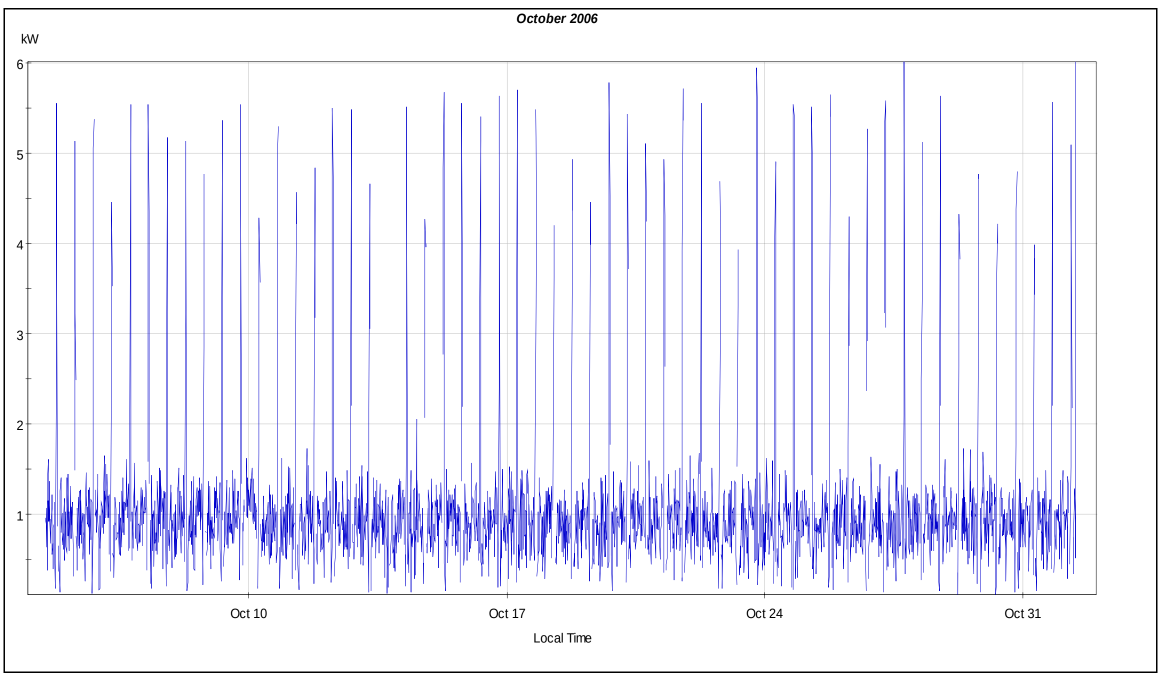


Figure 86: P32209 Milk Vat Pump Metered Data

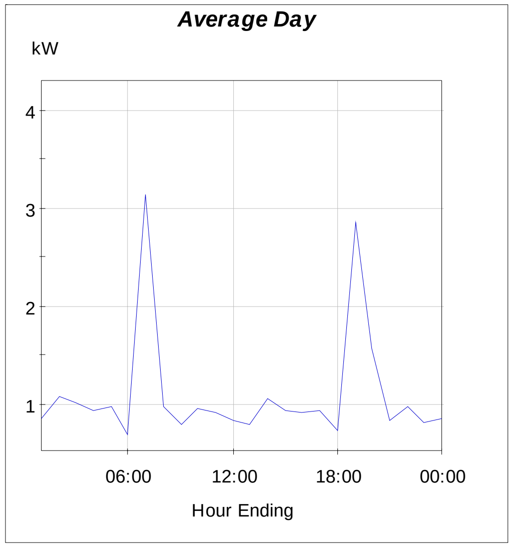


Figure 87: P32209 Milk Vat Pump Average Day Profile

Ex-Post Net Savings

The facility representative indicated that this program was very influential. He also mentioned that the SBD incentive helped the measure meet the investment criteria. The respondent also indicated that they probably would not have installed these measures without any interaction with the Savings By Design Program. The combinations of all these answers yield a freeridership score of 6 or 0% freeridership. Hence the ex-post net savings are calculated at 100% of the ex-post gross savings which is summarized in Table 93.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	1.7	2.6	153%	1.0	2.6
kWh	13,768	19,984	145%	1.0	19,984

Table 93: P32209 Process Savings Comparison

Total Site Savings

Table 94 shows the combined measure savings for the site.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	37	215	585%	0.87	187
kWh	738,637	775,932	105%	0.87	677,143

Table 94: P32209 Total Site Savings

P32931

All Measures

Project P32931 is a refrigerated warehouse in which the new construction totals approximately 57,000 square feet of refrigerated space. The project received an incentive of $81,531 for adding many energy efficient measures to the facility. The measures included evaporative condensers with floating head pressure, variable set point and variable speed condenser fans, precooler VSD fan control, product cooler VSD fan control, efficient compressor motors, increased insulation, and reduced lighting power density in the cold storage areas. The measures were verified by the evaluation team during a site visit. This site has a widely fluctuating load due to the produce arriving in from the fields at various time schedules.

Ex-Ante Gross Savings

Ex-ante gross savings were determined by using DOE-2.2R simulation software. A variety of parameters were estimated, including the equipment schedules, cooling loads, and temperatures.

Ex-Post Gross Savings

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings. Certain parameters at the site, shown in Table 95, were monitored for a period of four weeks in September. Some of the data was used to verify modeling inputs such as the condensing temperature range and lighting schedule. However, there was no consistent schedule for many of the fans and air unit data. Most of the units seemed to be cycling on and off throughout the entire day. Since the units were set to operate 24 hours a day and cycle in the model, no changes were made to the model fan or air units.

Incented Measures
Evaporative Condensers
Floating Head Pressure Condenser Controls
Variable Set Point Condenser Controls
VFD Condenser Fan Motors
VSD Precooler Fan Motors
VSD Product Cooler Fan Motors
Efficient Compressor Motors
Increased Insulation
Reduced Lighting Power Density
Metered Equipment
Cooler Fans
Condenser Fans
Condenser Pumps
Precooler Overhead Fans
High Pressure Liquid (Condensing) Temperature
Outside Air Temperature
Outside Air Relative Humidity
Outside Air Wet Bulb Temperature

Table 95: P32931 Metered Equipment

Figure 88 shows the wet bulb and high pressure liquid temperatures for the variable set point control measure. This measure is based on wet bulb temperature reset so that the condensing set point is slightly above the wet bulb temperature. The temperature difference was estimated to be 6 °F when above the minimum set point temperature of 60 °F. However, the data proved the temperature difference is actually 12.8 °F when above the set point. Note the charts below may be zoomed in on only a portion of the metering period to enhance clarity of the data.

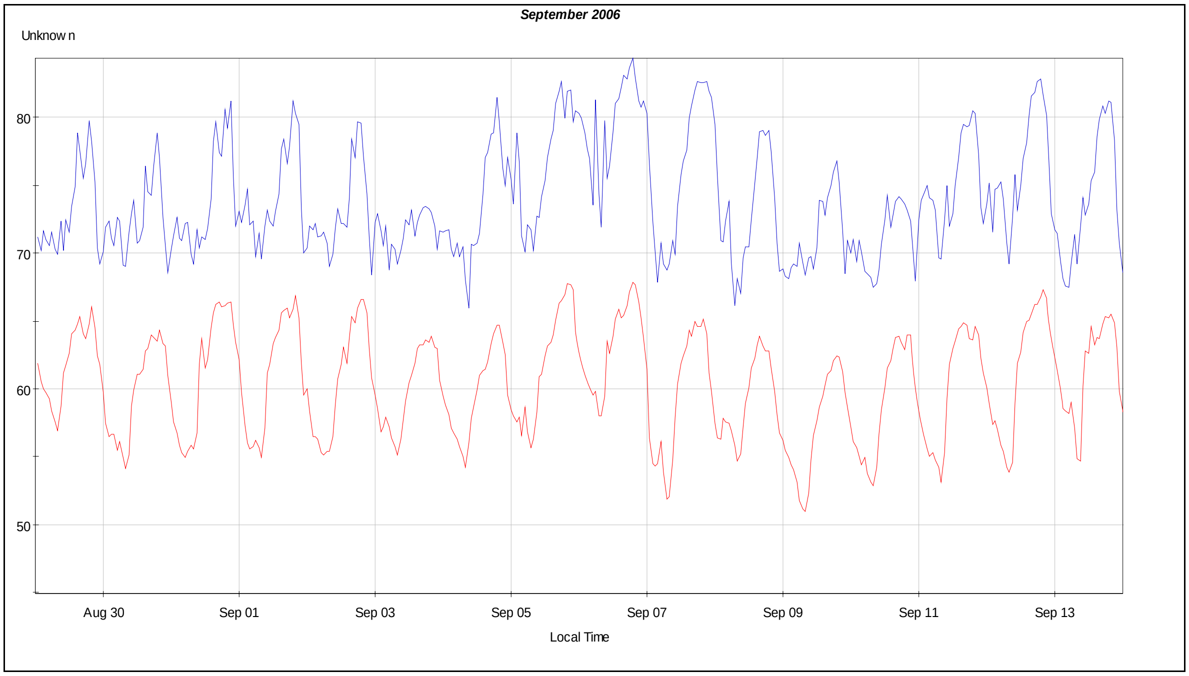


Figure 88: P32931 Metered Wet Bulb Temperature (Red) and High Pressure Liquid Temperature (Blue)

Figure 89 illustrates the variable load of the condenser fans at the facility since some days use up to 33 kW, while most use approximately 5 kW. Since the evaluation team did not have access to load schedules during the metering period, no changes could be made in the model to account for the fluctuating load. However, it does appear that the fans are cycling on and off twenty-four hours a day which is what the model is simulating. As a result, no changes were made to these fan loads or schedules in the model. These data are the sum of the individual condenser fan consumptions.

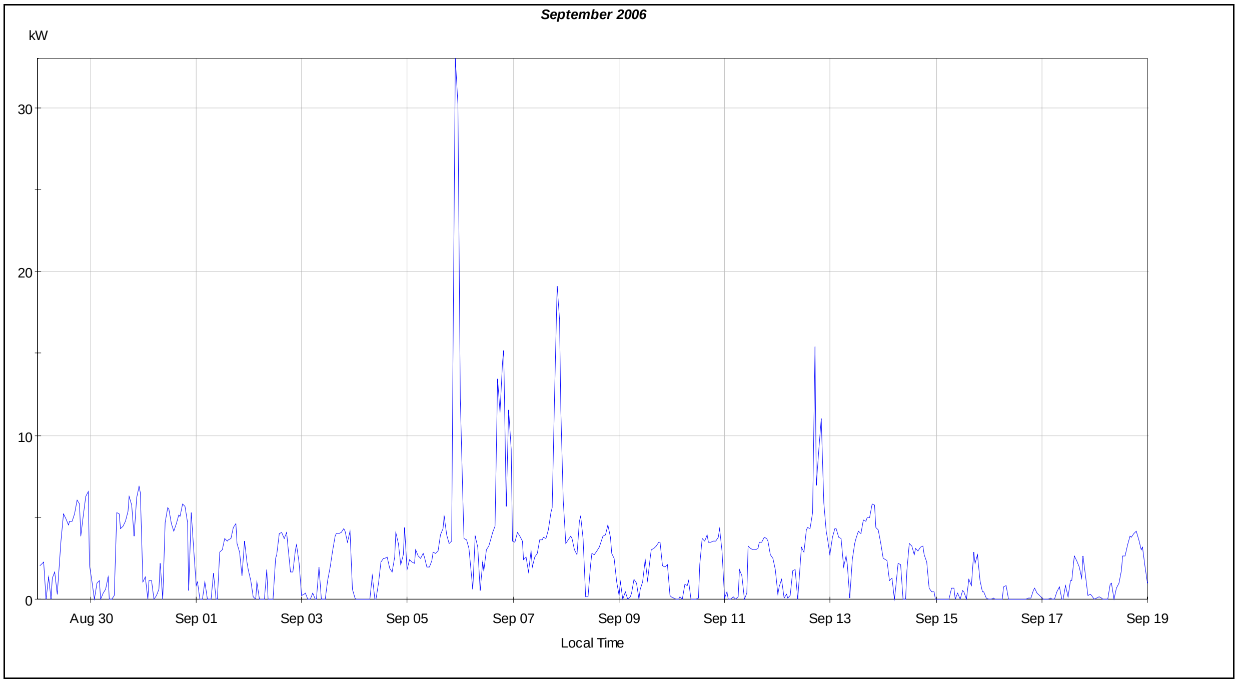


Figure 89: P32931 Varying Power Consumption of Condenser Fans

Figure 90 and Figure 91 also show fans that appear to cycle throughout the day with no predetermined schedule. This is also what the model is simulating and therefore no changes were made to the model for these fans. These data are the sum of the individual fan consumptions.

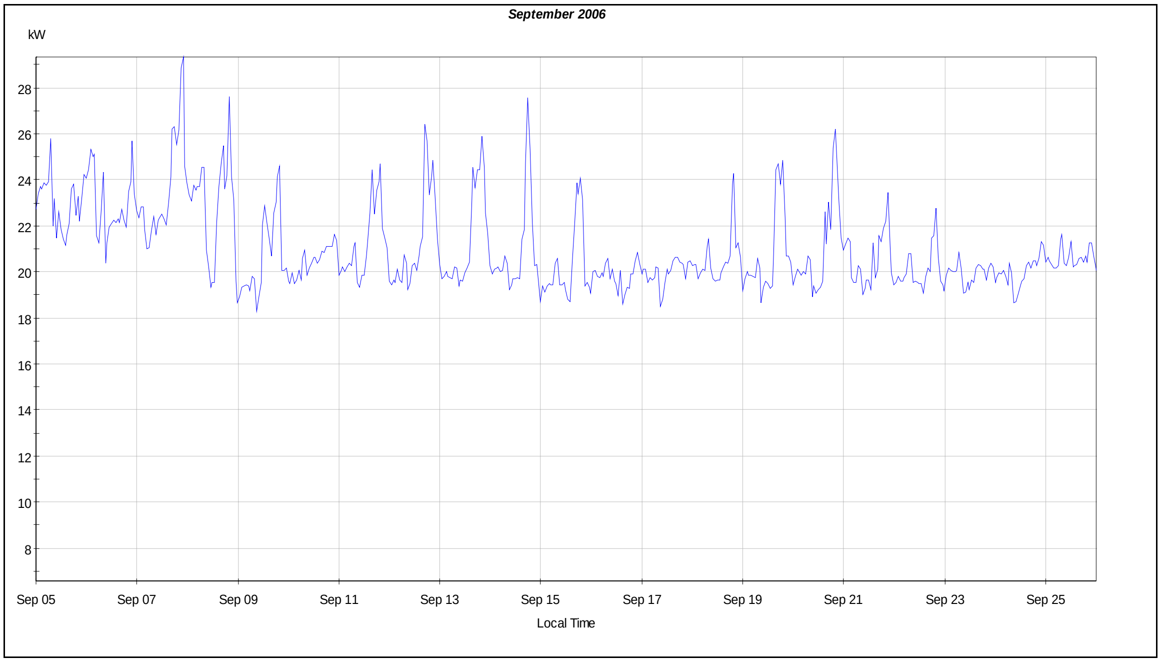


Figure 90: P32931 Total Cooler Fans Power Consumption

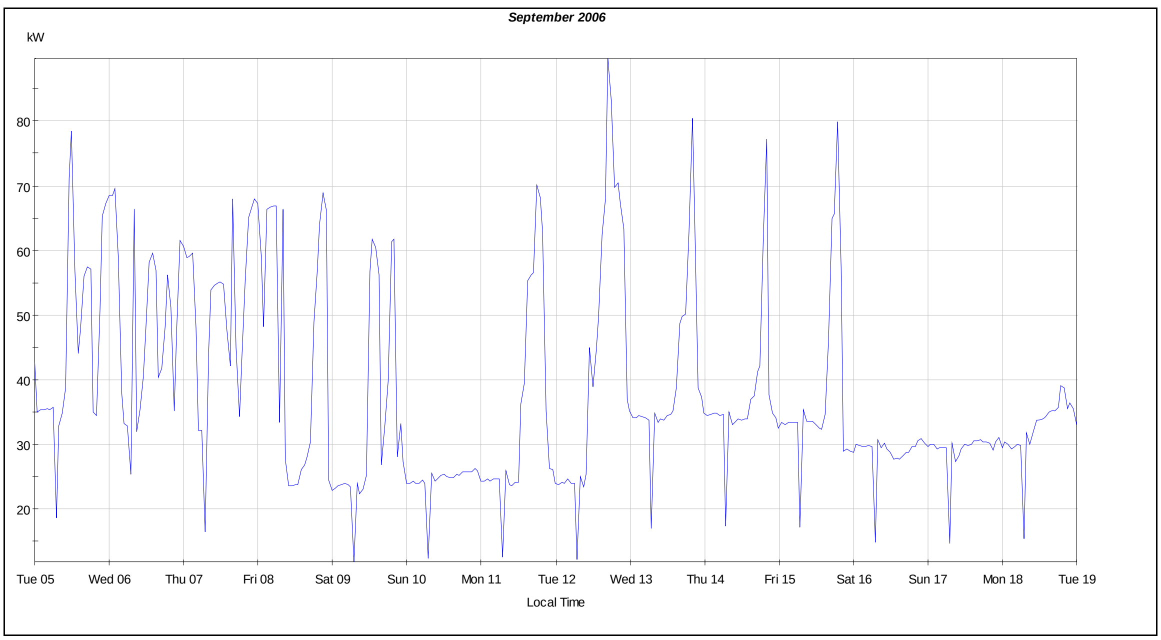


Figure 91: P32931 Total Precooler Fans Power Consumption

Overall, the only model change for this facility was the adjustment of the wet bulb and condensing temperature difference from 6 °F to 12.8 °F.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of the measures. The respondent stated that prior SBD projects have had success with this measure in the past. The facility knew the long term savings were possible and they followed the recommendations of a previous participant. However, the respondent stated that the measures would have been installed exactly the same absent the SBD program. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 3 out of 6, or 50% freeridership. Therefore, the ex-post net savings are evaluated at 50% of the ex-post gross savings as summarized in Table 96.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	106	109	104%	0.50	55
kWh	1019140	934952	92%	0.50	467476

Table 96: P32931 Savings Comparison

P34929

Refrigeration System

Project P34929 received an incentive of $2,347 for using the ground water to precool the milk from a temperature of 98 °F to 81 °F using 75 °F of ground water. The baseline of this measure is air cooled condenser without precooling.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross model was estimated using DOE- 2.2 simulation software. The refrigeration schedule was estimated and incorporated in the software to create an ex-ante gross model. A baseline model was also created with help of this software tool.

<u>Ex-Post Gross Savings</u>

A data logger was installed on the compressor to record the power consumption. The schedule derived from the metered data formed the basis of our evaluation. Table 97: shows the metered equipment and Figure 92 presents the refrigeration system schedule during three weeks of the monitoring period. Also Figure 93 shows the average day profile of the logged compressor.

Incented Equipment	Metered
Ground Water Heat Exchanger	Refrigeration Compressor

Table 97:P34929 Metered Equipment

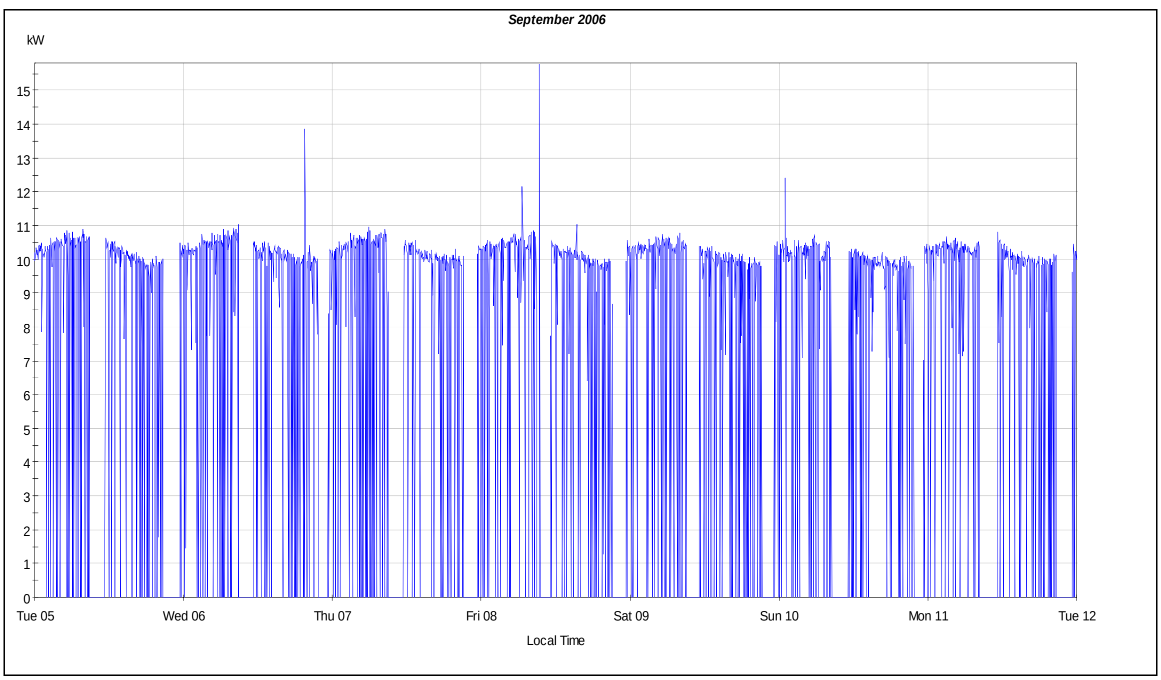


Figure 92: P34929 Compressor Power Draw during the Monitoring Period

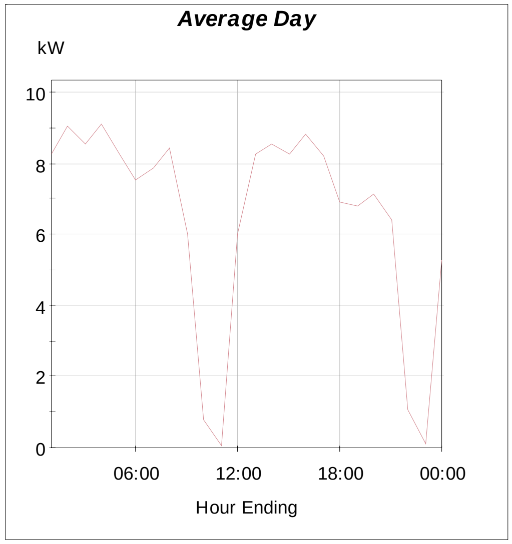


Figure 93: P34929 Average Day Compressor Profile

The metered data were used to determine the schedule of operation of the refrigeration system. The schedule on the DOE-2.2R ex-ante gross model was manipulated to create an ex-post gross model. This EEM saved a lot more than anticipated because the evaluated operating hours of the refrigeration compressor were found to be 22 hours a day, whereas the ex-ante gross model was created based on the operating schedule of 14 hours a day. Table 98 shows a comparison of the two schedules.

Status	Ex-Ante Gross Model	Ex-Post Gross Model
On	5am-12pm,2pm-9pm	12am-10am,11am-10pm,11pm-12am
Off	12am-5am,12pm-2pm,9pm-12am	10am-11 am,10pm-11pm
Daily Hours	14	22

Table 98: P34929 Refrigeration Schedule

Ex-Post Net Savings

The facility representative indicated that the program was slightly influential on the implementation of the measure. The SBD incentive helped the measure meet investment criteria. The respondent also indicated that they would have installed less efficient equipment without any interaction with the Savings by Design Program. The combination of these answers yields a freeridership score of 4.25 or 29% freeridership. Hence all ex-post net savings are calculated at 71% of the ex-post gross savings which is summarized in Table 99.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	15.0	15.9	106%	0.71	11.3
kWh	29,341	44,254	151%	0.71	31,347

Table 99: P34929 Refrigeration System Savings Comparison

Process Systems

Project P34929 received an incentive of $4,809 to upgrade their process systems. This upgrade includes installation of a 15 hp VSD premium efficiency vacuum pump, two 2 hp VSD premium efficiency milk vat pumps, a 10 hp premium efficiency gate hydraulic pump and six high efficiency circulation fans. The baseline for the VSD premium efficiency pumps are pumps with on/off control with standard efficiency motors. The baseline for the premium efficiency gate hydraulic pump and circulation fans are a pump and fans with standard efficiency motors. The baseline standard efficiency for premium efficiency motors is determined by the Energy Policy Act of 1992 (EPAct), in which minimum energy efficiency is established for a certain motor size, speed and type of enclosure.

Ex-Ante Gross Savings

The ex-ante gross savings for the VSD pumps are estimated by assuming an operation schedule of 18 hours per day and motor load factors of 50%. The energy savings for the premium efficiency motor was the difference of efficiency between standard efficiency and installed efficiency, the motor horse power and annual operating hours. Similarly the energy savings for the high efficiency circulation fans were calculated based on the difference of baseline cfm/watt and proposed cfm/watt, operating hours and nominal flow rate.

Ex-Post Gross Savings

Data loggers were installed on the 15 hp VSD vacuum pump and 2 hp VSD milk pumps for a period of three weeks in September 2006. Figure 94 presents the energy consumption of the vacuum pump and milk pumps for the monitoring period. Figure 95 shows the average daily energy consumption of the above pumps. There were no meters installed on the gate hydraulic pump and high efficiency circulation fans as they save a miniature amount of energy compared to the whole process system. The evaluated annual energy consumption was calculated by using the logged motor power and operating hours. Similarly, baseline energy consumption was also determined by using rated motor power, an assumed similar load factor and annual operating hours. Ex-post gross savings were calculated by subtracting the evaluated energy consumption from the baseline energy consumption. Table 100 shows the equipment which was part of this measure.

Incented Equipment	Metered
15 hp VSD Premium Efficiency Vacuum Blower	YES
2 hp VSD Premium Efficiency Milk Pump (2)	YES(1)
10 hp Premium Efficiency Gate Hydraulic Pump	NO
36' Circulation Fan (6)	NO

Table 100: P34929 Incented Equipment

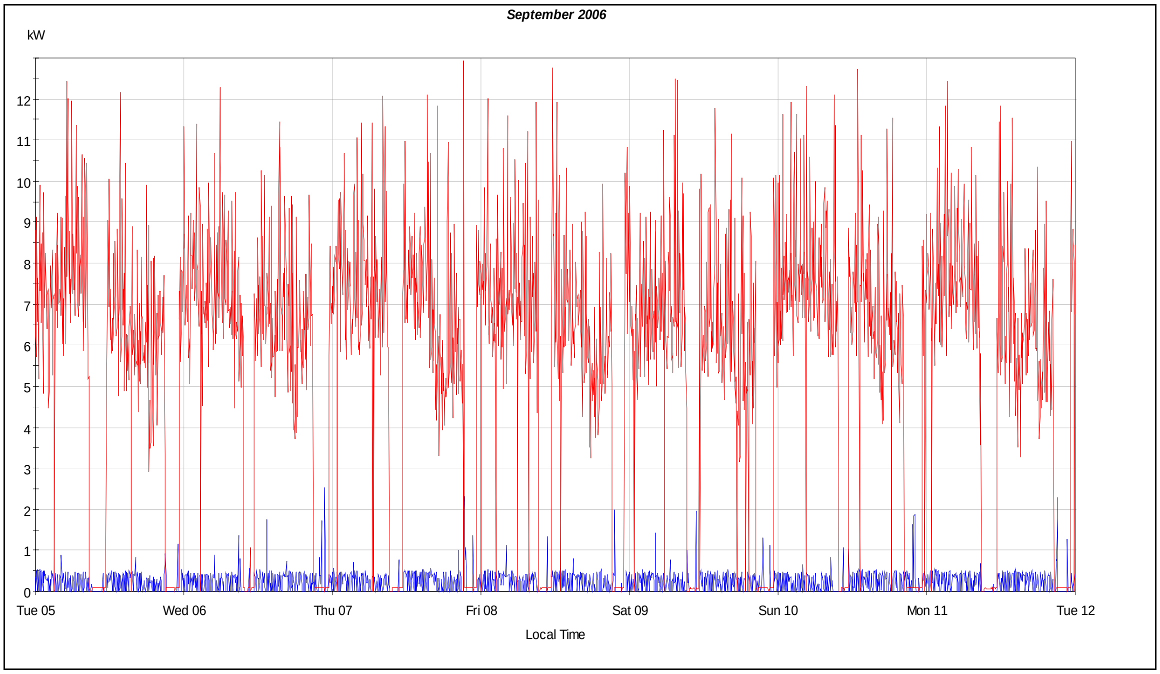


Figure 94: P34929 Vacuum Pump (red) and Milk Pump (blue) Metered Data

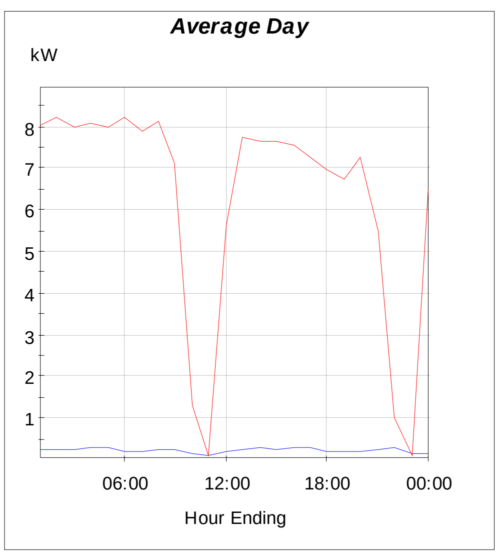


Figure 95: P34929 Average Day Profile for Vacuum Pump (red) and Milk Pump (blue)

This EEM saved more than expected because the evaluated operating hours of the pumps were found to be 24 hours a day, whereas the ex-ante gross calculations were based on the operating schedule of 18 hours a day.

Ex-Post Net Savings

The facility representative indicated that this program was slightly influential on the implementation of these measure. The SBD incentive helped the measure meet investment criteria. The respondent also indicated that they would have installed less efficient equipment without any interaction with the Savings By Design Program. The combination of these answers yields a partial freeridership score of 4.25 or 29% freeridership. Hence all ex-post net savings are calculated at 71% of the ex-post gross savings which summarized in Table 101.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	5.9	8.0	136%	0.70	5.6
kWh	48,089	70,453	147%	0.70	49,317

Table 101: P34929 Savings Comparison

Total Site Savings

The combined energy savings for all measures at this site are shown in Table 102.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	20.90	23.91	114%	0.71	16.9
kWh	77,430.00	114,707.37	148%	0.70	80,663.9

Table 102: P34929 Total Site Savings

P35430

VSD Air Compressor

Project 35430 received an incentive of $21,305 to replace an existing 100 hp air compressor with a 150 hp air compressor with a VSD. Other upgrades included an efficient air dryer, three no air loss drains, and a system pressure reduction from 100psig to 85psig. The baseline for this measure is a fixed speed air compressor with a standard dryer, no drains and a system pressure of 100 psig.

However, the evaluation team noticed that two compressors were installed, one 100 hp and one 50 hp. Both are rotary screw compressors with variable speed drives. The evaluation team also recorded that the actual compressor operating pressure was between 92 and 98 psig.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were determined using AirMaster+ compressed air modeling software. The compressed air system modeled two compressors for both the baseline and ex-ante gross models. Note that the ex-ante model had only one 150 hp compressor.

<u>Ex-Post Gross Savings</u>

Meters were installed on the equipment shown in Table 103. The metering period lasted four weeks during August and September of 2006.

Equipment Incented	Metered
100 hp Compressor	Yes
50 hp Compressor	Yes
Dryer	Yes
Drain 1	No
Drain 2	No
Drain 3	No
Pressure Reduction	Recorded

Table 103: P35430 Metered Equipment

The two compressors were logged on the same meter, making it hard to determine when each compressor was operating. Instead, only the total power being consumed by both compressors was recorded. After viewing the metered data, a cutoff was created to estimate the compressor staging, or when the 50hp compressor turned off and the 100 hp compressor switched on. This cutoff was chosen to be 20 kW and was based on graphs that showed the compressors making a significant jump in power, indicating a staging change. Figure 96 shows an example of the power jump around 20 kW. After deciding when each compressor was on or off, an hourly power profile was created for each compressor.

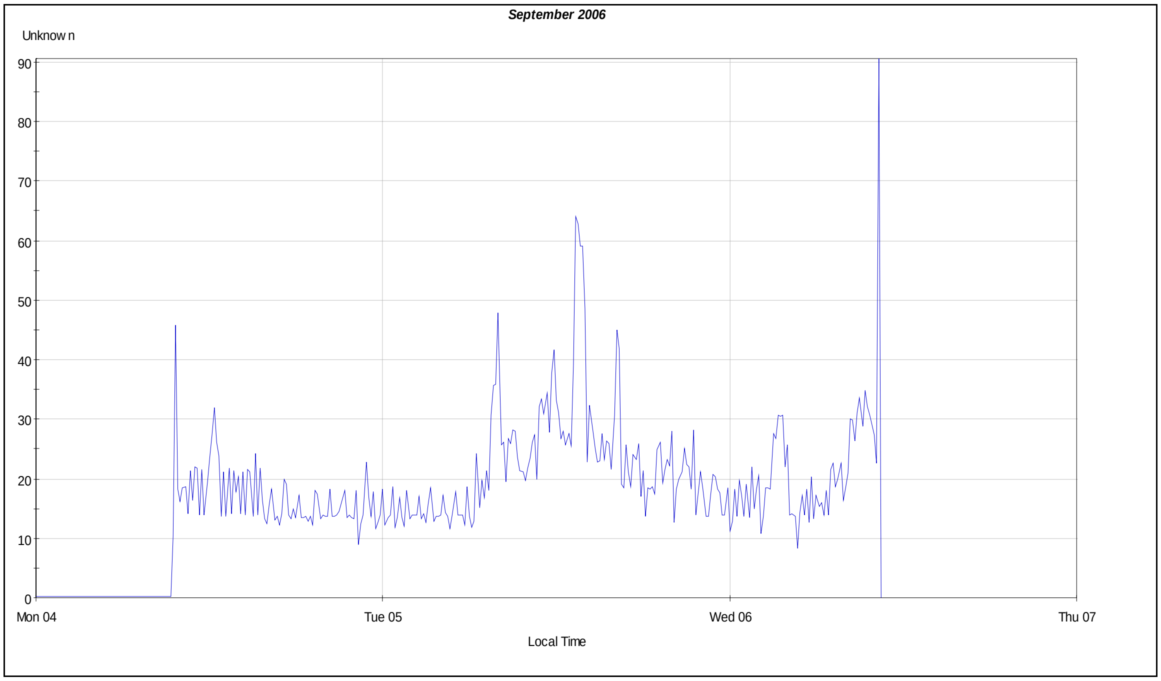


Figure 96: P35430 Compressor Power Cutoff

Next, models were built in AirMaster+. The software requires inputs such as facility elevation, air system pressure, air storage capacity (receivers), and production day types. The metered data indicated that there were some days when the facility operated at full load and other days when it operated at partial load. Therefore, two load profiles were created each day type. Next, the compressors were selected according to operating pressure and the system automatically assumed an airflow range based on this pressure. The compressor controls were selected as inlet modulation with unloading since AirMaster+ does not currently have a VSD control option. The power profiles were then modified to approximate an efficiency current representative of a VSD controlled unit. Once all of these options were selected, the program generated estimated annual usage and coincident peak power draw of the compressor.

For the baseline model all inputs stayed the same, except for the compressor controls and the power profiles. One 100 hp and 50 hp pump with inlet modulation and unloading were chosen, however no modifications were made to the compressor controls since they are standard and did not have VSDs. The system airflow is the variable that stays constant between the baseline and evaluation model. A power profile was input in the evaluation model and the program calculated airflows based on that profile. Those same airflows were put into the baseline model instead of a power profile. Note that no energy efficiency measures were included in the models, since a separate model was made for the baseline and evaluation models.

The program returned the actual (evaluated) annual energy usage, as well as the baseline annual energy usage. The evaluated ex-post gross savings are simply the baseline energy usage less the evaluated energy usage.

The energy savings are significantly less from the ex-post gross analysis, as shown in Table 104. This is largely because the ex-ante gross savings assumes the plant is operating twenty-four hours per day, seven days a week. The metered data show activity 40% of the time. The 50 hp compressor operates almost 40% of the year and the load is large enough to run the 100 hp compressor 22% of the year. Figure 97 shows both compressors' power during the metering period. It is apparent the compressors are off for a significant portion of monitored period.

COMPRESSORS	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	35.4	25.7	73%	0.75	19.3
kWh	309,939	80,211	26%	0.75	60,158

Table 104: P35430 Air Compressor Savings

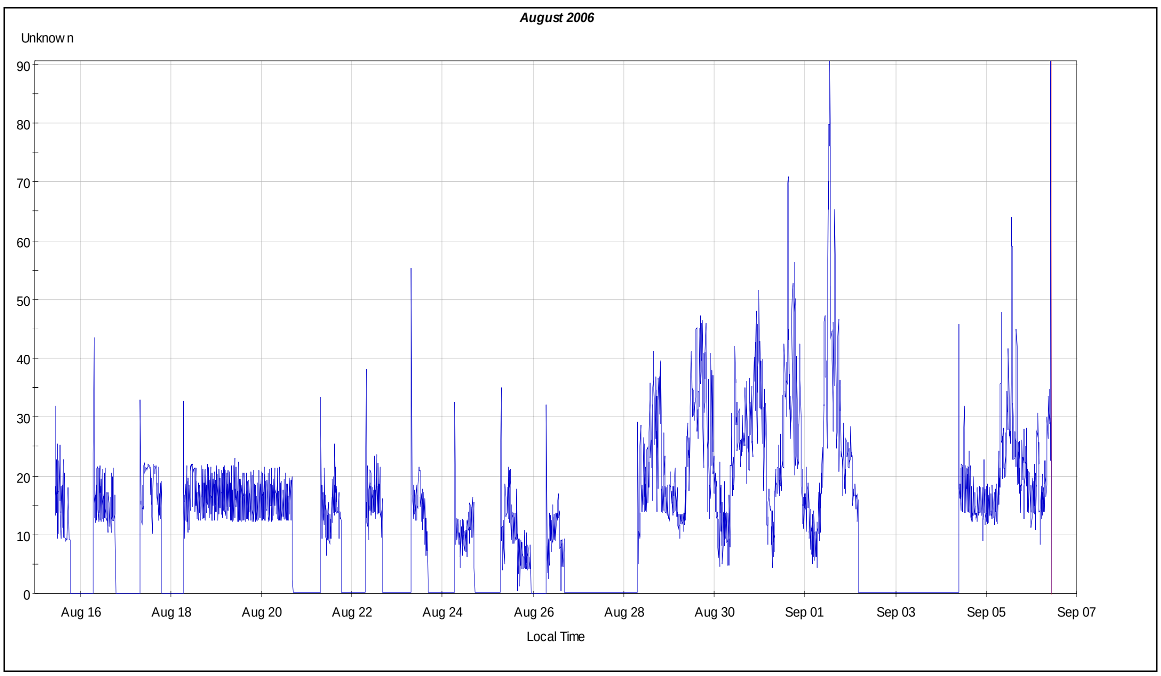


Figure 97: P35430 Monitoring Period Compressor Power

Dryer savings were calculated by using the rated dryer power and the annual operating schedule determined from the metered data. The dryer metered data is shown in Figure 98.

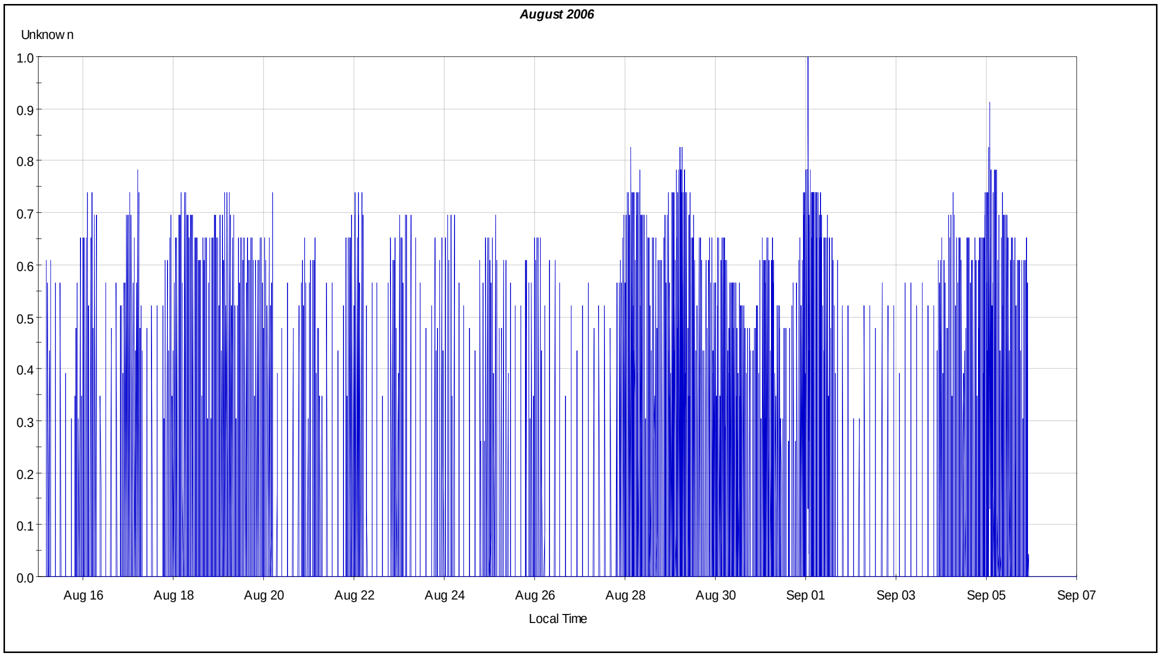


Figure 98: P35430 Percent On for Dryer

The results for the dryer are shown in Table 105. The dryer was found to only operate approximately 350 hours per year, resulting in large savings. The dryer savings account for over 10% of the site energy savings.

DRYER	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.4	1.4	359%	0.75	1.1
kWh	3,856	10,769	279%	0.75	8,077

Table 105: P35430 Dryer Savings

Ex-post gross savings for the no air loss drains were assumed to be equal to the ex-ante gross savings. This is because all of the inputs for the ex-ante gross calculation seemed reasonable and the drains were not logged with a meter. In addition, the drains account for less than 2% of the site energy savings.

Ex-Post Net Savings

The facility representative indicated that the program was somewhat influential in the implementation of these measures. The representative also suggested the SBD incentive helped ensure the measures met the investment criteria, although the facility would have installed the equipment anyway absent any contact with SBD. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 4.5 out of 6, or 25% freeridership. Therefore, the ex-post net savings are evaluated at 75% of the ex-post gross savings as summarized in Table 106.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	36.50	27.14	74%	0.75	20.35
kWh	319,708.00	96,893.44	30%	0.75	72,670.08

Table 106: P35430 Overall Savings Comparison

P38969X

Electric Injection Molding Machines

Project P38969X received an incentive of $ 40,700 for installing four electric injection molding machines. Three of the machines have a rated capacity of 120 tons and had a 200 ton rated capacity. The evaluation team verified the installation of these machines during a site visit.

Ex-Ante Gross Savings

The ex-ante gross savings are calculated by comparing the estimated usage of the proposed all-electric molding machines the with baseline machines. The baseline for this measure is four variable volume hydraulic injection molding machines of the equivalent capacity. The calculations used an assumed product mass flow rate , expected operation hours and energy usage per unit mass by machine type. The calculation kWh/lb usage of 0.93 for hydraulic machines and 0.2 for all-electric machines determined from SCE sponsored study.

The ex-ante gross analysis estimates a total energy usage savings of 834,024 kWh /yr and a demand savings of almost 108 kW for all three 120 ton machines and a total energy usage savings of 123,320 kWh/yr and a demand savings of 15 kW for the 200 ton machine.

Ex-Post Gross Savings

Data loggers were installed in all four molding machines for a period of four weeks in November 2006. The logger data showed that each of the molding machines has a different annual operating schedule.

The data collected from facility personnel and the meter data show that two of the 120 ton machines operate 245 days a year, the third 120 ton machine operates 197 days a year and the 200 ton machine runs for only 15 days a year. The annual energy usage and demand were calculated by using the power profile and the yearly operating schedule of the molding machines. This ex-post gross energy usage and demand were then compared with the ex-ante gross and baseline energy usage. The raw data for the monitoring period for all four evaluated machines are shown in Figure 99 and the hourly power profiles for all the machines are shown in Figure 100. Note that the pink profile is representative of the two identical 120 ton electric molding machine (MS-14 and MS-16). The blue profile is the third 120 ton machine (MS-15) and the green profile is the 200 ton machine (MS-17).

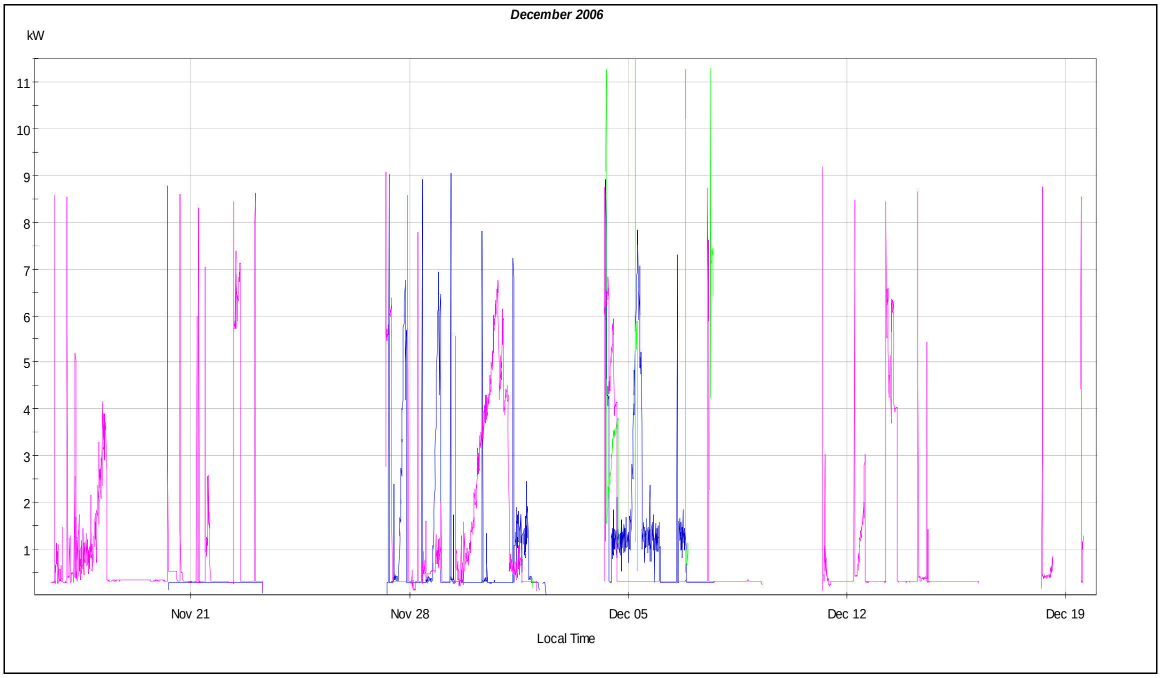


Figure 99: P38969X Metered Data

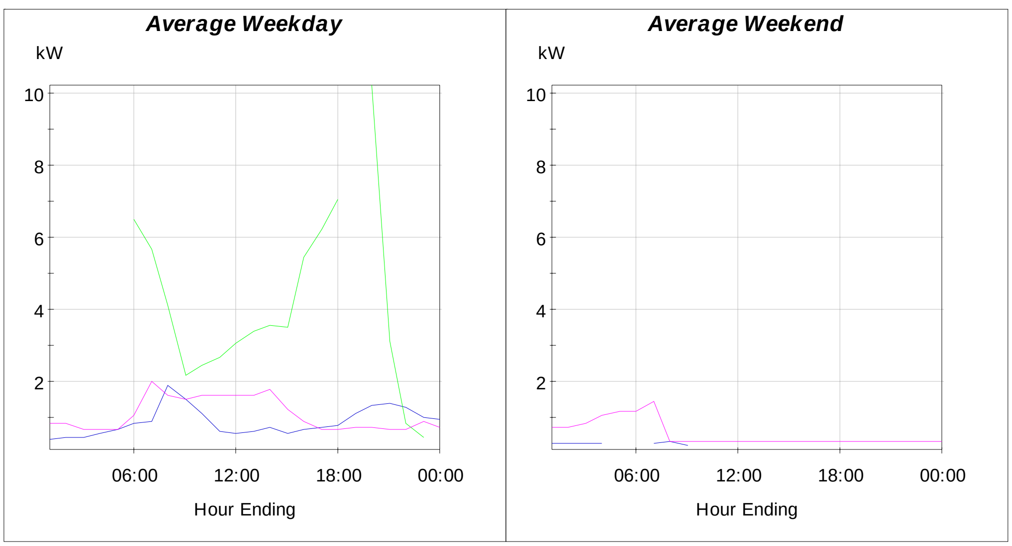


Figure 100: P38986X Average Weekday and Weekend Power Profile

The estimated baseline, ex-ante gross and ex-post gross demand and energy consumption are reflected in Table 107 below.

Incented Machines	120 T IMM MS-14	120T IMM MS-15	120T IMM MS-16	200T IMM MS-17
Annual Days	244.6	197.1	244.6	14.6
Ex-Ante Mass Flow Rate(lbs/hr)	80.0	80.0	80.0	100.0
Ex-Post Mass Flow rate(lbs/hr)	10.4	7.6	10.4	50.8
Baseline kWh	29,406	8,387	29,406	549
Baseline kW	2.5	1.8	2.5	12.2
Ex-Ante Gross Savings kWh	278,008	278,008	278,008	123,320
Ex-Ante Gross Savings kW	35.9	35.9	35.9	15.0
Ex-Post Gross Savings kWh	11,093	3,167	11,093	207
Ex-Post Gross Savings kW	0.9	0.7	0.9	4.6

Table 107: P38969X Comparison of Baseline, Ex-ante gross and Evaluated Energy Consumption

The energy savings are significantly lower for the ex-post gross analysis, as shown in Table 107. This is largely because the ex-ante gross calculation assumed a higher mass flow rate whereas the actual gross mass flow rate was found to be quite lower, ~75% less than the assumed rates. Additionally, the ex-ante calculations assumed that all the incented machines run 8,600 hours a year whereas the evaluated operating hours were found to be much lower that assumed. .

<u>Ex-Post Net Savings</u>

The facility representative indicated that the program was somewhat influential in the implementation of this measure. They also stated that the SBD representative performed design analysis and they probably wouldn't have installed the measure without the SBD program. The combination of all this answers yields a freeridership score of 4.5 out of 6, or 25% freeridership. Therefore ex-post net savings are evaluated at 75% of the ex-post gross savings as summarized in Table 108.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	122.7	11.9	9.7%	0.75	8.9
kWh	957,344.0	42,189.1	4.4%	0.75	31,641.8

Table 108: P38969X Savings Comparison

S12274

Pump VSD

Project 12274 received an incentive of $56,653 to install VSDs controls on ten pumps at their waste water treatment plant. Three of the pumps are 180 hp influent pumps, two are 10 hp WAS pumps, and the remaining five are RAS 30 hp pumps. The 180 hp influent pumps make up almost 85% of the savings. The evaluation team verified the installation of the VSDs during a site visit. The baseline for this measure is a fixed speed pump of the same horsepower.

Ex-Ante Gross Savings

The ex-ante gross analysis estimates a total savings of 1,888,448 kWh from the VSD installation on the pumps. Of this, 1,597,282 kWh are from the 180 hp pumps, 35,632 kWh from the 10 hp pumps and 255,535 kWh from the 30 hp pumps. These numbers were based upon motor rated power, manufacturer equipment performance and an assumed schedule for the load and facility.

Ex-Post Gross Savings

A meter was installed on the equipment shown in Table 109 for three weeks in August and September of 2006. Note that the raw data showed that one of the influent pumps was not operating during the metering period and the data from the remaining influent pump was used to represent all three influent pumps.

Equipment Incented	Metered
Influent Pump (3)	2 Metered
RAS Pump (5)	YES
WAS Pump (2)	YES

Table 109: S12274 Metered Equipment

The evaluation team was provided with pump curves for the baseline pump and VSD pumps for all three pump types. The RAS pumps had the most complicated analysis since the baseline pumps were throttled down. This means that the pump's power draw varied with speed. The pump curves were used to go from the metered VSD pump power to baseline pump power. Figure 101 illustrates the order in which the calculations occurred for the RAS pumps. xxx

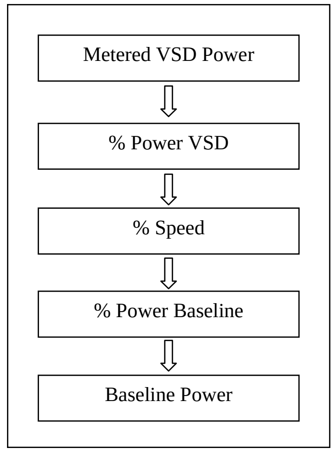


Figure 101: S12274 RAS Pump Calculation Sequence

First, the percent power that the VSD used was calculated by dividing the metered power by the rated motor power for every metered reading which was taken at five minute intervals. Next, the VSD percent speed was calculated using the pump curve shown in Figure 102. The percent power was plugged into the equation generated from the curve and the percent speed was calculated.

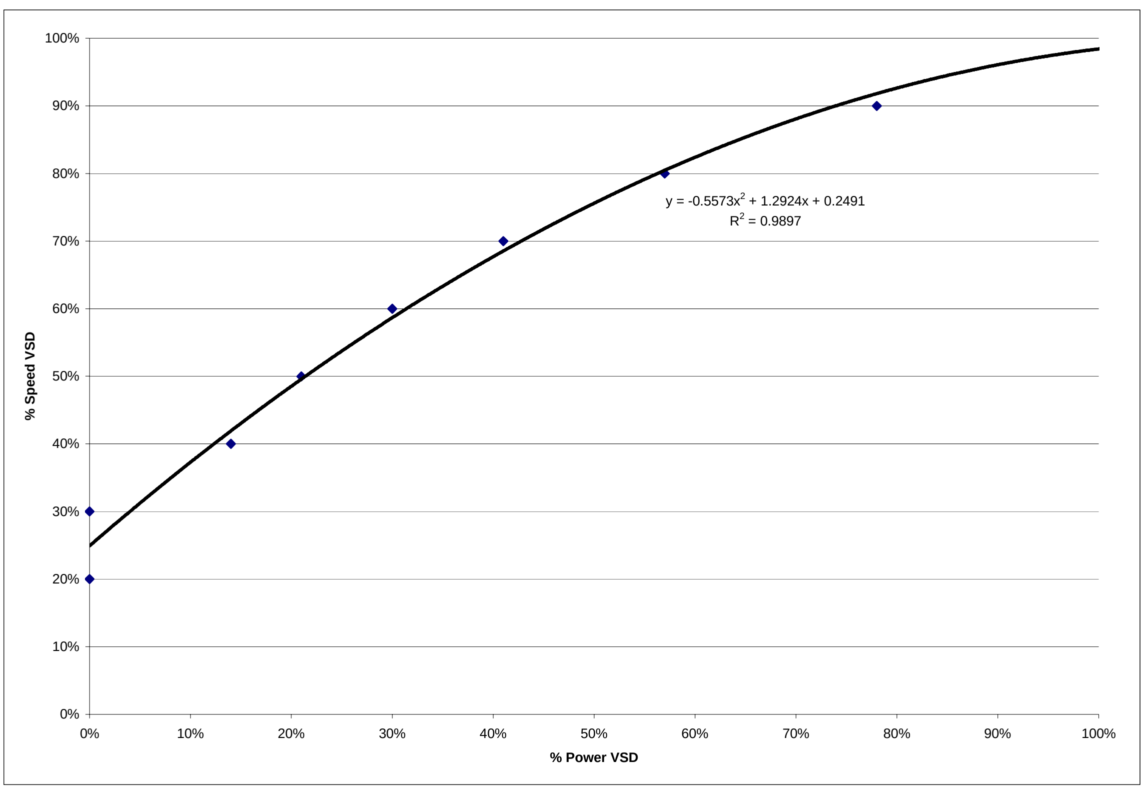


Figure 102: S12274 RAS VSD Pump Power v. Speed Curve

The speed ratio is the same for the baseline and installed motor. This means the speed ratios calculated in the previous step could be used in the power/speed curve for the baseline. This curve is presented in Figure 103.

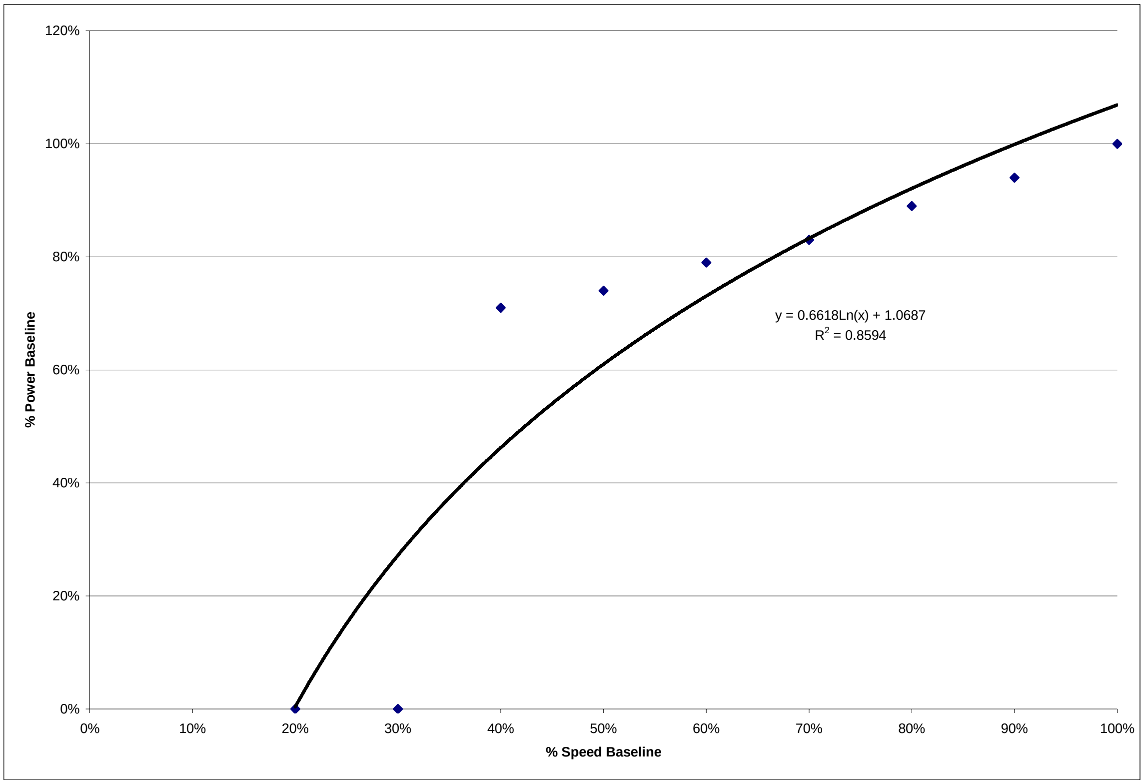


Figure 103: S12274 RAS Baseline Pump Speed v. Power Curve

The final step in the RAS pump analysis is simply converting the power ratio to actual baseline power by multiplying by the rated input power. Next, the difference in energy usage between the baseline and installed RAS pumps was calculated. This method was the same for all pump types and is described below.

The analysis for the influent and WAS pumps was much simpler since the baseline pumps were bypassed, or fixed power. This means that no matter what the speed of the pump it still uses the same amount of power. In other words, no pump curves were required since the pump was always using the same amount of power during operation.

The savings were calculated using the operating schedule and comparing the power draw of the baseline and installed pumps. An hourly power profile for an average day was calculated with the visualization software, Visualize-IT. The power profiles for the RAS and influent pumps are shown below in Figure 104. The red line represents the baseline power and the blue is the metered pump power.

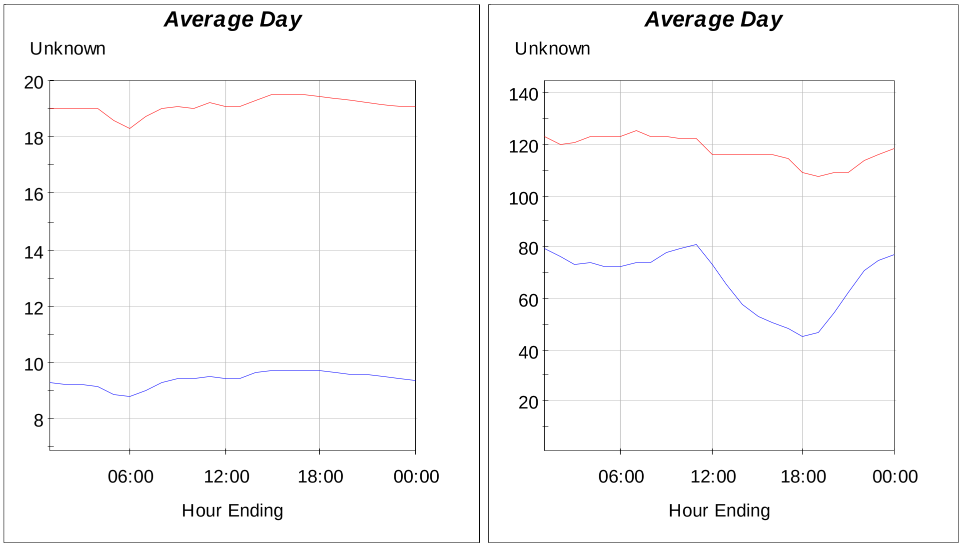


Figure 104: S12274 RAS (left) and Influent (right) Pump Hourly Power Profile

Note that the data for the WAS pumps was not good. The power draw was very low in comparison to the rated power which might have happened due to glitches in the logger and this is illustrated in Figure 105. Therefore, the ex-post gross savings are considered equal to the ex-ante gross savings for the two WAS pumps. Also, the ex-ante gross analysis used reasonable assumptions when calculating savings. Furthermore, these two pumps account for less than 2% of the total site energy savings.

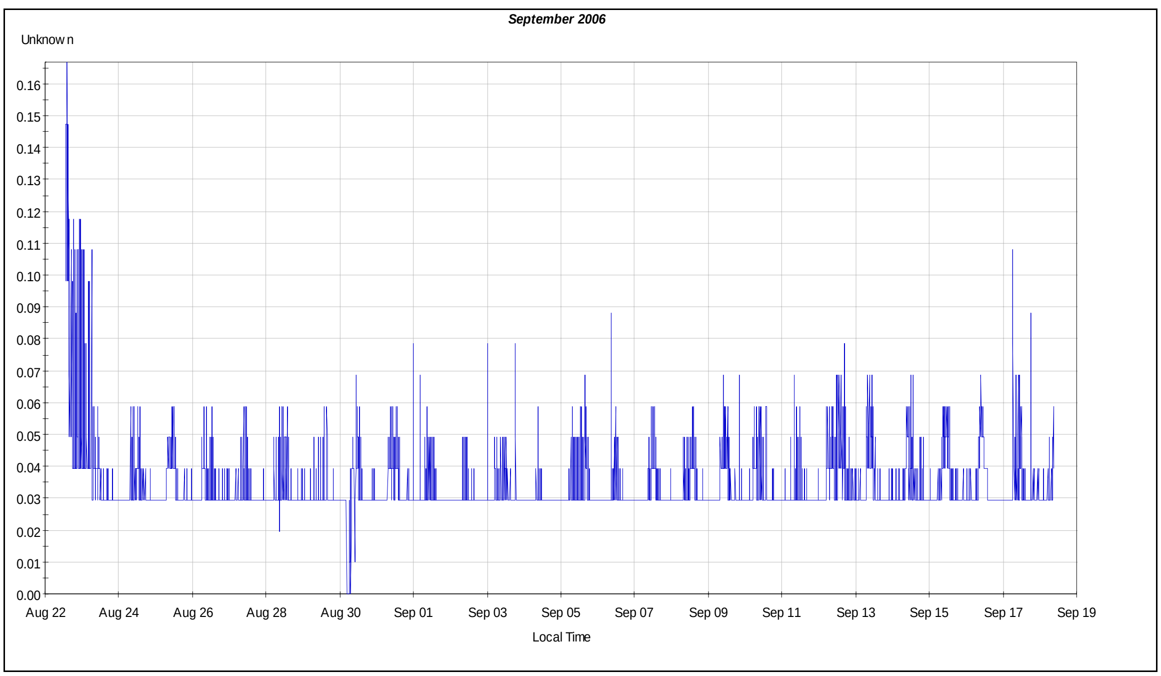


Figure 105: S12274 WAS Pump Metered Data

The savings for each type of pump is shown in Table 110. The savings for the influent pumps were slightly low because the metered data showed the pumps were not operating as many hours as the ex-ante gross analysis estimated. Altogether, the influent pumps were operating approximately 83% of the time, while ex-ante gross estimated they operated 100% of the time. Therefore, the ex-post gross savings are approximately 83% of ex-ante gross savings.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate
Influent Pumps kWh	1,597,282	1,320,411	83%
RAS Pumps kWh	255,535	425,056	166%
WAS Pumps kWh	35,632	35,632	100%

Table 110: S12274 Power Savings Comparison by Pump Type

Ex-Post Net Savings

The facility owner indicated that the program was very influential in the implementation of this measure, but the VSDs probably would have been installed without any contact with the Savings by Design program. The SBD representative did perform post-verification calculations to verify the savings. The owner wanted to save on energy as well as the operational costs and maintenance. They also stated that SBD assisted with the design of the measure. For our ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 4 out of 6, or 33% freeridership. Therefore, the ex-post net savings are evaluated at 67% of the ex-post gross savings as summarized in Table 111. Note that the peak period hours were Monday through Friday from 12pm to 6pm. The peak savings did not include any savings from the WAS pumps since the ex-ante gross estimate did not include any peak savings.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	248.8	N/A	0.67	166.72
kWh	1,888,449	1,781,098	94%	0.67	1,193,335.98

Table 111: S12274 Motor VSD Savings Comparison

S14114X

Low Pressure UV System

Project S14114X received an incentive of $75,000 for installing a low pressure UV system to remove ground water contaminants. The system consists of four reactors, each having nine rotational units. Under normal operating conditions, seven rotational units per reactor will be operated, with two units serving as back-ups. The nominal power draw of the system is approximately 156.8 kW. The baseline for this measure is a medium pressure UV system which has a power draw of 640 kW. The evaluation team verified the installation of the UV system during a site visit.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were calculated with the rated unit wattage and an estimated operating schedule. The ex-ante gross analysis estimates an annual savings of 4,202,100 kWh and a demand reduction of 483 kW.

<u>Ex-Post Gross Savings</u>

Data loggers were installed on all four reactors for three weeks during December 2006 and January 2007. The meter data shows that the low pressure UV system operates 24 hours a day, seven days a week. Figure 106 below shows the metered data for the monitoring period. Also Figure 107 reflects the hourly power draw of the low pressure UV system.

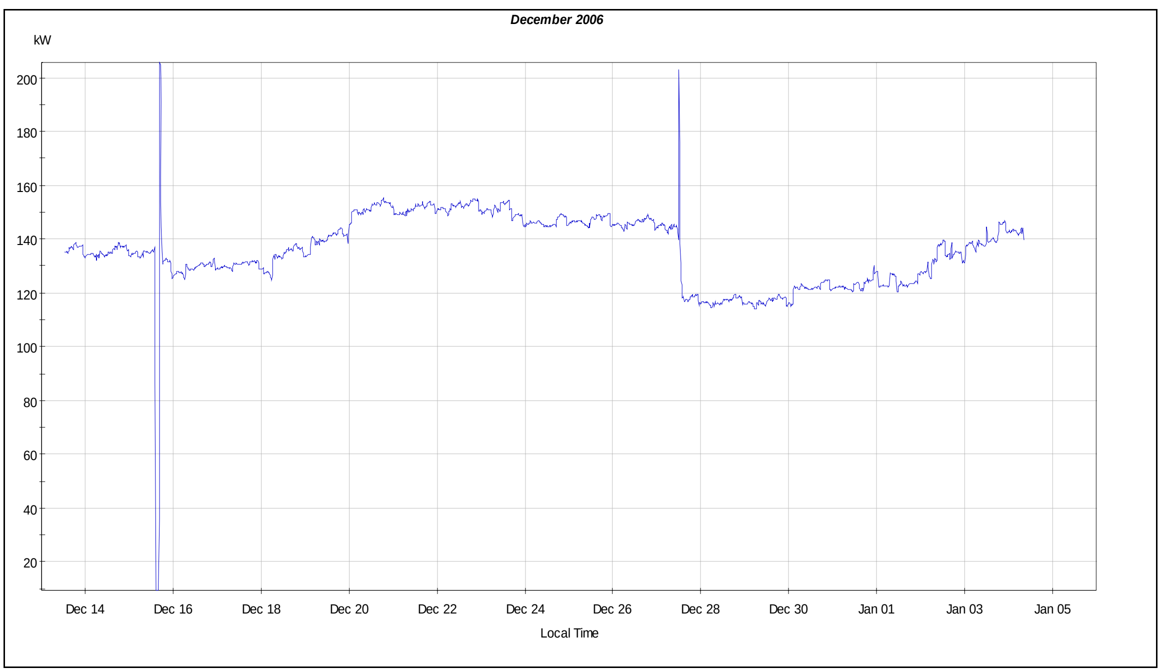


Figure 106: S14114X Metered Data

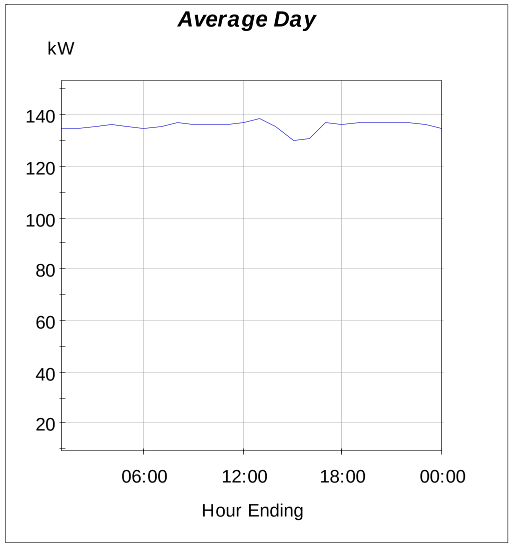


Figure 107: S14114X Average Hourly Data

The data were used to calculate the average hourly power draw for an average day and calculate the annual energy usage. The ex-post gross energy usage is then compared with the baseline and ex-ante gross energy usage. The ex-ante power draw of the system was 640 kW. The ex-post power draw was 135 kW. Overall, the ex-post gross savings amounted to 4,418,438 kWh per year and a demand reduction of almost 505 kW. Figure 106 shows some parts of the monitoring cycle a larger or lower power draws than the average. This is because the stand-by rotational units were either switched on or off during that part of the cycle.

Ex-Post Net Savings

The facility owner stated that the program was somewhat influential in the implementation of this measure and a SBD incentive made this measure an easier sell. The facility representative also mentioned that they probably would not have installed less efficient equipment without the help of an SBD representative. This combination of answers yields a complete freeridership score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated as 58% of the ex-post gross savings. This is summarized in Table 112.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	483	505	105%	0.58	294.5
kWh	4,202,100	4,418,438	105%	0.58	2,577,422.3

Table 112: S14114X Overall Savings Comparison

S14168

Low Pressure UV System

Project 14168 received an incentive of $75,000 to install a Trojan low pressure UV lamp system to kill contaminants in the groundwater. The system consists of four reactors with eight rotational units each (six rotational units operate while two are on stand-by). The nominal electrical draw of the system is 140 kW. The baseline system has two towers with 18 lamps per tower (16 lamps operate while two are on stand-by). The total baseline electrical draw is 640 kW. The evaluation team verified the installation of the UV system during a site visit.

Ex-Ante Gross Savings

Ex-ante gross savings were calculated with the rated unit wattage and an estimated operating schedule. The ex-ante gross analysis estimates an annual savings of 4,398,720 kWh.

Ex-Post Gross Savings

Loggers were installed on four of the thirty-two units for three weeks during August and September of 2006. The meter data should show that the rotational units have a similar power draw when operating. Instead, the data showed a large discrepancy ranging from approximately 2 to 10 kW. A portion of the metering period is shown in Figure 108.

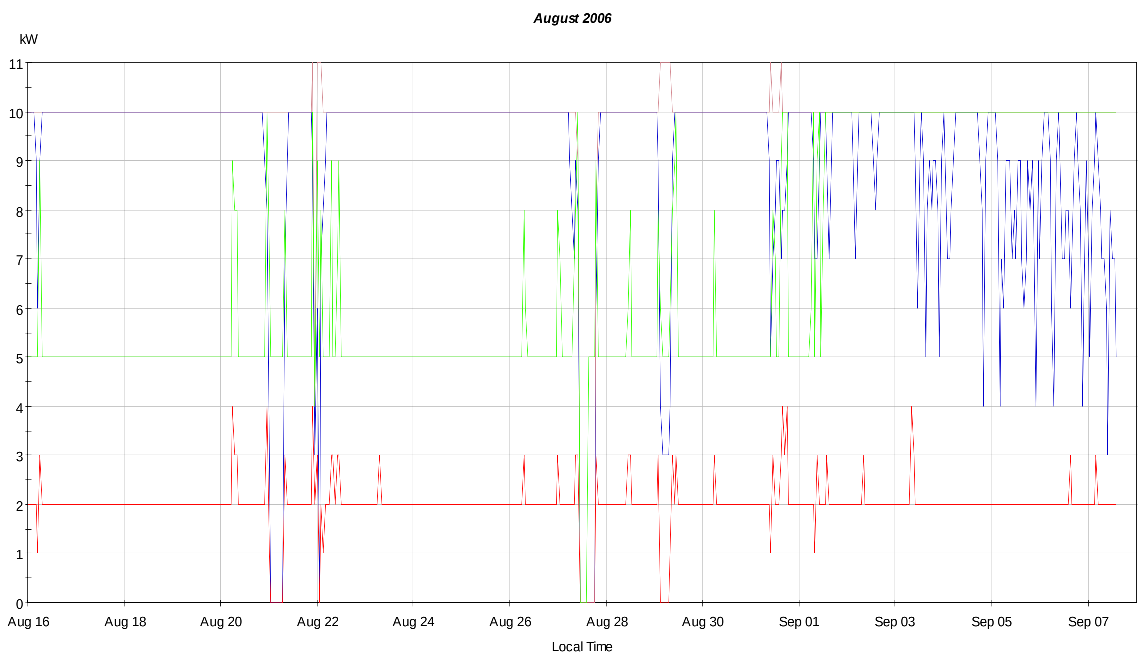


Figure 108: S14168 Lamp Power

Fortunately, a spot-watt was taken while the evaluation team was at the facility. The spot-watt was similar to the sum of all of the lamps' rated power, indicating an accurate measurement. This led to further questions such as whether the meters were installed on a reactor or a rotational unit. The electrical draw recorded from the spot watt was multiplied by the annual operating hours (assumed to be 8,700 hours since the UV lamps operate continuously according to the meter data) to get ex-post gross savings.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of these measures. The respondent also stated the SBD representative suggested the design change. They also stated that the SBD incentive made this measure an easier sell and the efficient system definitely would not have been installed absent any contact with the program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 6 out of 6, or 0% freeridership. Therefore, the ex-post net savings are evaluated at 100% of the ex-post gross savings as summarized in Table 113.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	505.6	500	99%	1.00	500
kWh	4,398,720	4,350,000	99%	1.00	4,350,000

Table 113: S14168 Overall Savings Comparison

S14178

Efficient Blowers

Project 14178 received an incentive of $75,000 to replace two low efficiency blowers with three 350 hp high efficiency blowers. The new blowers can effectively turn down in order to meet the low flow requirements of the water treatment facility. The baseline for this measure is a standard blower with limited turn down capability. The evaluation team verified the installation of the new high efficiency blowers during a site visit.

Ex-Ante Gross Savings

The ex-ante gross savings were calculated based on an estimated schedule and the rated power of the blowers.

Ex-Post Gross Savings

Ex-post gross savings were calculated based on actual blower energy usage. A meter was installed on each of the three blowers for three weeks during September and October of 2006. Table 114 presents the metered equipment below.

Incented Equipment	Metered
350 hp Blower 1	Yes
350 hp Blower 2	Yes
350 hp Blower 3	Yes

Table 114: S14178 Incented Equipment

The meters recorded the power being used by each piece of equipment every fifteen minutes during the metering period. The data showed the facility operates twenty-four hours a day, seven days a week. The data was also used to create the average hourly power consumption for the blowers on an average day. The hourly power profile is shown in Figure 109. The power profile presented is a sum of the power for all three blowers. Individual blower power can be seen in Figure 110.

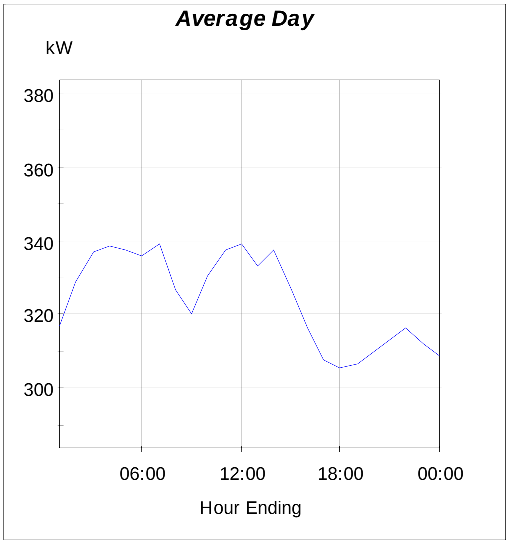


Figure 109: S14178 Average Energy Profile

The power profile was used in conjunction with the operating schedule and the annual energy usage was calculated. The assumed baseline power draw was 580 kW for all three blowers. The ex-post power draw averaged 324 kW, which is equivalent to the power draw of 1.25 blowers. The ex-ante gross analysis assumed only one blower would operate at a time (261 kW), resulting in slightly smaller savings for this evaluation. The overall results are presented below in Table 115.

Note that a facility representative indicated that one blower would operate at full load, one blower would operate at partial load and the last blower would be stand-by. This was verified by the metered data, as shown in Figure 110 which shows the time and blower power for each blower. Each color represents a different blower.

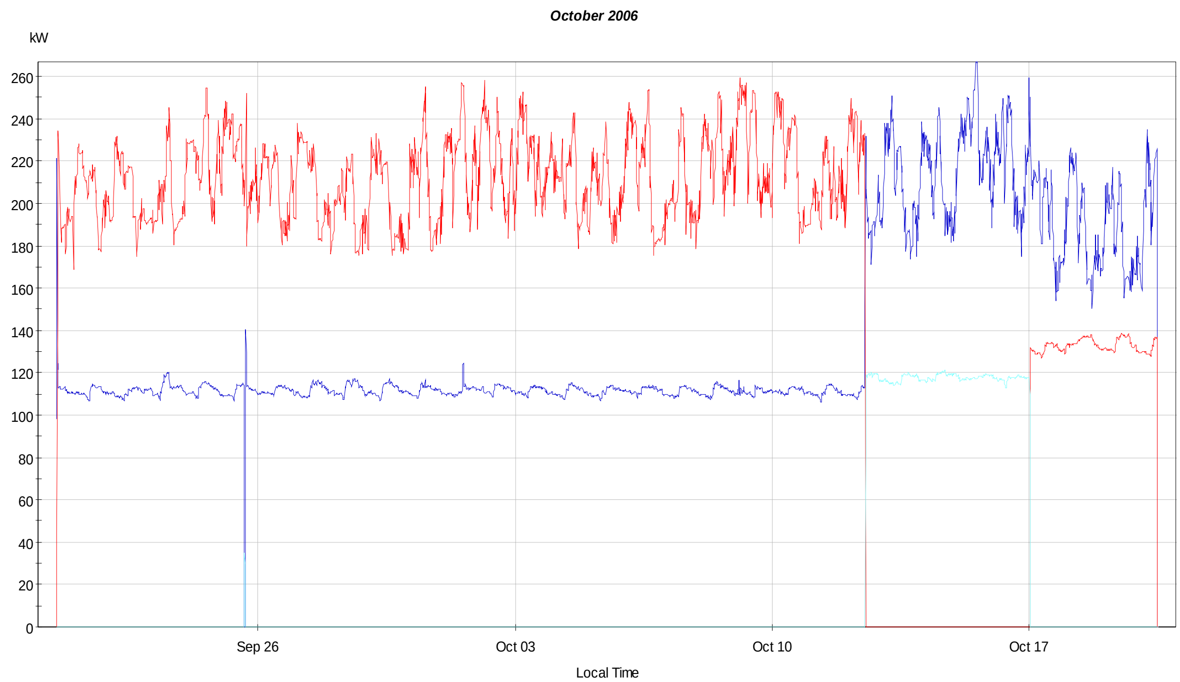


Figure 110: S14178 Blower Metered Data

<u>Ex-Post Net Savings</u>

The facility representative indicated that the program was very influential in the implementation of this measure and that an SBD representative also helped the measure meet the investment criteria. They also confirmed the blowers would have been installed exactly the same if they had no interaction with the Savings by Design program. The owner stated that the blowers were great technology and the money was nice to receive, although it was not a decision factor. Despite the conflicting answers, this combination of answers yields a complete freeridership score of 0 out of 6, or 100% freeridership. Therefore, the ex-post net savings are 0. This is summarized in Table 115.

	Ex-Ante Gross Savings	**Ex-Post Gross Savings**	**Gross Realization Rate**	**Site Net-to-Gross Ratio**	**Ex-Post Net Savings**
peak kW	319.0	263.9	83%	0.00	0%
kWh	2,775,300.0	2,205,216.0	79%	0.00	0%

Table 115: S14178 Overall Savings Comparison

S14201

High Efficiency Motors

Project 14201 received an incentive of $15,586 to install premium efficiency motors on four 125 hp pumps. The evaluation team verified the installation of the measure, however, there were only three pumps installed. This does not affect ex-ante gross savings since it was calculated based on overall flow rate and did not include the number of pumps. The baseline of this measure is 150 hp pumps with baseline efficiency motors.

Ex-Ante Gross Savings

Ex-ante gross savings were determined by calculating the brake horsepower and estimating the annual operating hours. This calculation involved the pump flow rate in gallons per minute, difference in pump head between the baseline and proposed pump, and pump efficiency. The pumps were assumed to be operating constantly, or 8,760 hours per year.

Ex-Post Gross Savings

Ex-post gross savings were calculated using the same methodology as the ex-ante gross savings, except that field and meter data were substituted for assumptions. A meter was installed on all three pumps for three weeks during November and December of 2006. These data were used to create an hourly operation schedule which is presented in Figure 111. The pumps were found to operate approximately 30% of the time, resulting in smaller savings than reported in the ex-ante gross analysis. Figure 112 shows the kW data of the evaluated pump for the monitoring period. However, the meter data showed the motors were operating approximately 18% of the peak hours during the metering period.

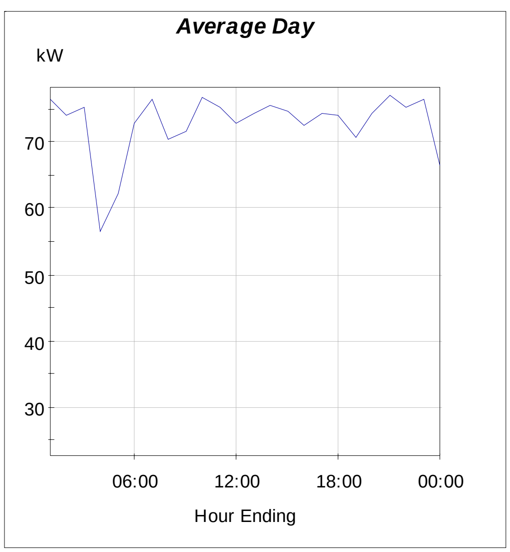


Figure 111: S14201 Hourly Power Consumption

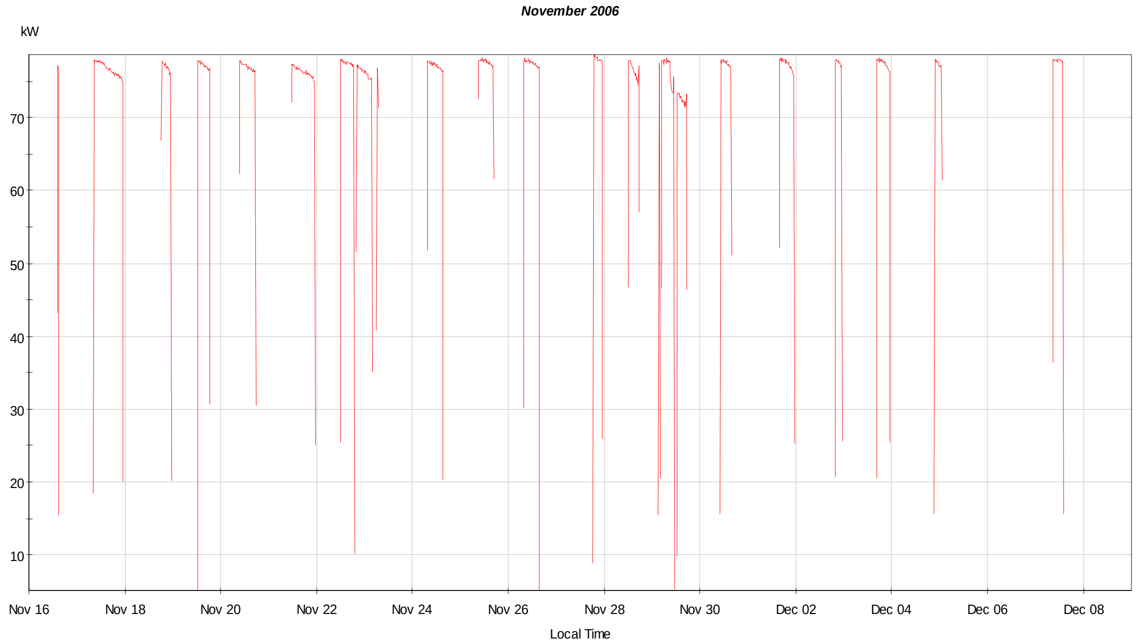


Figure 112: S14201 Raw Pump Data for the Monitoring Period

Ex-Post Net Savings

A facility representative indicated that the program was not at all influential in the implementation of the measure. The respondent indicated that SBD had no influence on the installation of this measure since they were primarily motivated by the potential energy savings. The respondent indicated that the system would have been installed exactly the same absent any interaction with the Savings By Design program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 0 out of 6, or 100% freeridership. Therefore, the ex-post net savings are evaluated at 0% of the ex-post gross savings as summarized in Table 116.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0	N/A	N/A	N/A	N/A
kWh	519,529.0	217,089.7	42%	0.00	0%

Table 116: S14201 Savings Comparison

S15039

Low Pressure High Intensity UV System

Project S15039 received an incentive of $64,649 to install a low pressure high intensity UV system to remove ground water contaminant. The evaluation team observed during our site visit that two UV systems were installed. One system operates as a primary system and the other one is for back-up. Each system consists of four reactors. Each reactor consists of a 72 UV lamp matrix with a nominal power draw of 18.5 kW. The total power draw of the whole system is 48.8 kW. According to the facility personnel only three of the four reactors run on the primary system. The baseline of this system is a Calgon's Rayox System which consists of one tower containing 18 medium pressure lamps (16 lamps operating while 2 as standby). Under normal operating condition the total electrical draw was 320 kW.

Ex-Ante Gross Savings

The ex-ante gross analysis calculates an annual energy usage savings of 2,154,960 kWh and a demand reduction of 246 kW. These calculations were based on rated power for the baseline and installed equipment, as well as operating hours.

Ex-Post Gross Savings

A data logger was installed on the low pressure high intensity UV system for a period of two weeks in November 2006. The recorded data as seen in Figure 113 and Figure 114 shows the above operates 24 hours a day, seven days a week.

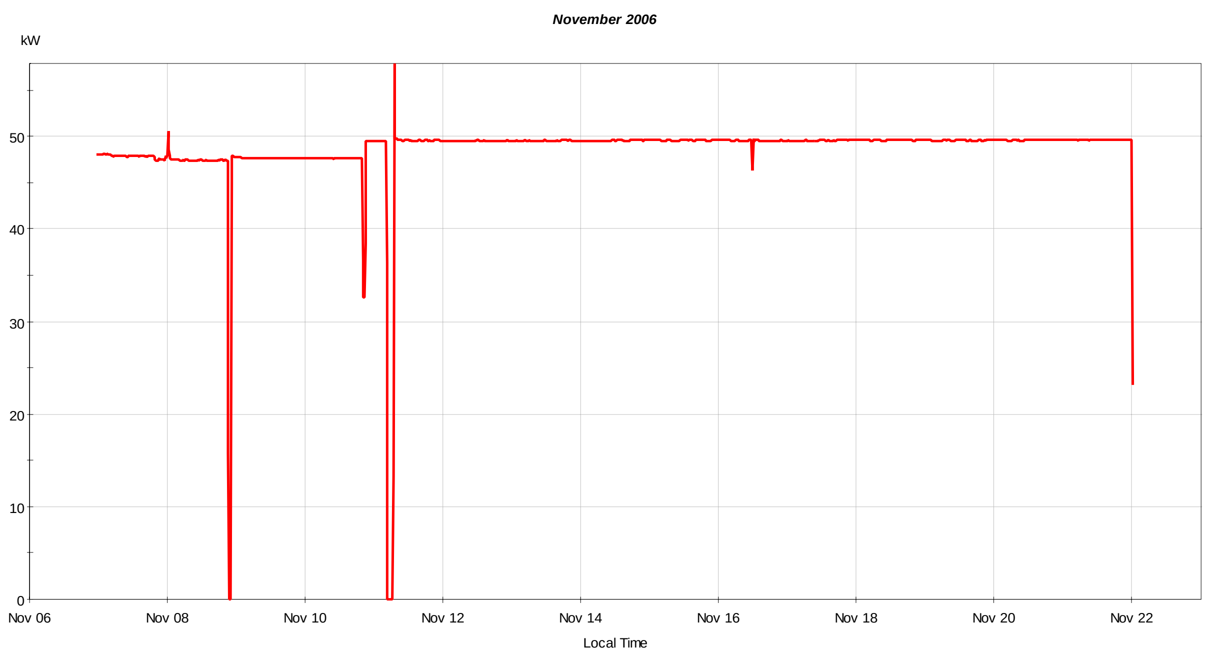


Figure 113: S15039 Metered Data

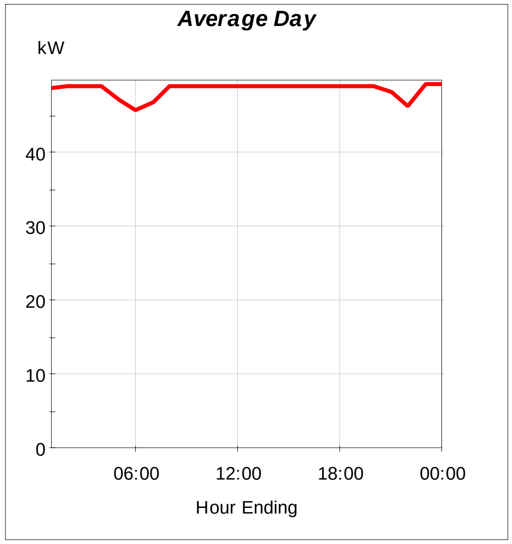


Figure 114: S15039 Hourly Power Profile

The data were used to calculate the average hourly power consumption for an average day and also to calculate the annual energy usage. The ex-post gross energy usage is then compared with the baseline usage.

The baseline power draw for the system was 320 kW. The measured power draw was approximately 49 kW. Overall the program evaluated to save 2,377,530 kWh per year with a demand reduction of around 271 kW.

Ex-Post Net Savings

The facility owner stated that the program was very influential in the implementation of this measure and an SBD representative helped to put the whole package together by providing data on the projected energy savings. The facility representative also mentioned that they probably would not have installed they system without the help of an SBD representative. The combination of answers yields a complete freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated as 83% of the ex-post gross savings. This is summarized in Table 117.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	246.0	271.4	110%	0.83	226.2
kWh	2,154,960.0	2,377,529.7	110%	0.83	1,981,274.8

Table 117: S15039 Overall Savings Comparison

S15240

High Efficiency Lighting

Project 15240 received an incentive of $427 to install energy efficient lighting. The facility installed 320W pulse start metal halide lighting fixtures. The baseline for this measure is determined by Title 24 energy consumption standards of commercial buildings on a square foot basis. Therefore, the only information required for the baseline is the area type (office, bathroom, etc.) and the area in square feet. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using projected lighting hours and the rated lamp wattage.

Ex-Post Gross Savings

One meter was installed on the controlled lighting circuit for four weeks in October and November of 2006. A week of the data is shown in Figure 115.

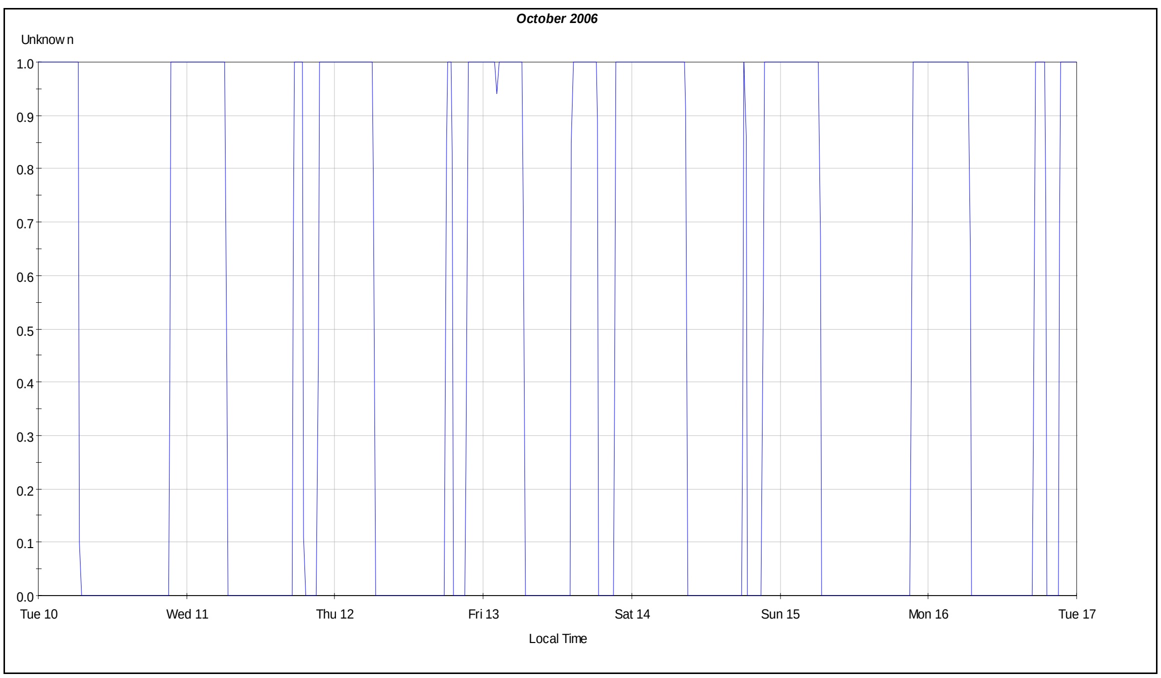


Figure 115: S15240 Lighting Data Power

The annual operating hours were calculated using the data to be 3,693 hours per year. The rated power and annual hours were then used to calculate energy and peak power and the results are shown below. The lights were rarely on during daylight hours, so the peak savings are small.

Ex-Post Net Savings

The facility owner indicated that the program was very influential in the implementation of the measures. The owner stated they would work with the program anytime because they were very trustworthy. An SBD representative was the first to suggest upgrading the lighting. The respondent also indicated that they would have installed less efficient equipment without the SBD program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 118.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Ex-Post Net Savings	Net Realization Rate
peak kW	3.4	1.9	57%	1.6	47%
kWh	14,246	12,522	88%	10,431	73%

Table 118: S15240 Lighting Savings Comparison

VFD Pumps

Project 15240 received an incentive of $3,499 to install VFDs on two 2 hp pumps and a 20 hp pump. The baseline for this measure is a fixed speed pump for each of the two pump sizes with the same operating schedule. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

Ex-ante gross savings were determined using projected operating hours, pump horsepower and pump efficiency.

Ex-Post Gross Savings

A meter was installed on all of the pumps for three weeks in October of 2006. See Table 119 below.

Incented Pumps	Metered
Pump- East (2hp)	YES
Pump- West (2hp)	YES
Vacuum Pump (20hp)	YES

Table 119: S15240 Incented Equipment

Unfortunately, the wrong type of meter was used for the two 2 hp pumps and the data was unusable. The meter recorded percent on for the pumps, which will not indicate savings for a VFD. The ex-post gross savings were given as ex-ante gross savings since all of the ex-ante gross analysis inputs seemed reasonable. Also, the two pumps account for only 15% of the VFD savings from all three pumps.

The remaining data from the 20 hp pump was imported into a visualization program, Visualize-IT. The data were used to find the number of operating hours per year, as well as the average load profile illustrated in Figure 116.

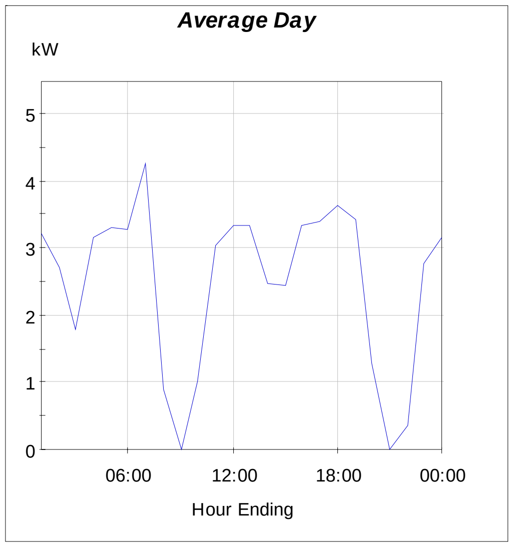


Figure 116: S15240 Average Pump Power

The hourly power profile and annual hours were then used to calculate energy and peak power. The pump was operating approximately 70% of the metering period. The 20 hp pump operated more peak hours than expected and a large peak power savings was realized.

Ex-Post Net Savings

The facility owner indicated that the program was very influential in the implementation of the measures. The owner stated they would work with the program anytime because they were very trustworthy. An SBD representative was the first to suggest using VFDs. The respondent also indicated that they would have installed less efficient equipment without the SBD program. For our ex-post net savings evaluation, this combination of answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, the ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 120.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	6.6	12.6	191%	0.83	10.5
kWh	116,618	93,166	80%	0.83	77,607

Table 120: S15240 VFD Savings Comparison

Total Site Savings

The energy savings for both measures combined are shown in Table 121.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	10.04	14.58	145%	0.83	12.1
kWh	130,863.74	105,688.02	81%	0.83	88,038.12

Table 121: S15240 Total Site Savings

S16046

Variable Volume Injection Molding Machines

Project S16046 received an incentive of $75,000 for installing four variable volume injection molding machines. Three of the machines are 880 tons and one is 300 tons. The baseline for this measure was four constant volume standard hydraulic injection molding machines of equivalent capacity. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

The ex-ante gross savings are calculated as comparing the baseline constant volume standard hydraulic machines with variable volume hydraulic machines. The ex-ante gross analysis estimates a total energy usage savings of 3,461,225 kWh/yr and a demand savings of 480.8 kW for all four molding machines

Ex-Post Gross Savings

Data loggers were installed on two (1-300 ton and 1-880 ton) of the four molding machines for a period of four weeks in August 2006.

The logger data showed the each of the molding machines had different operating schedules throughout the monitoring period. The data collected from facility personnel and the meter data shows that three of the 300 ton machine operates 365 days a year whereas the 880 ton machine operates 230 days a year. The annual energy usage and demand were calculated by using the power profile and the yearly operating schedule of the molding machines. The baseline energy usage and demand was calculated by using the baseline kW/kg ratio (0.93 kW/kg for hydraulic) and annual operating hours. Then the ex-post gross energy usage and demand were compared with the ex-ante gross and baseline energy usage. The raw data for the monitoring period for the two metered injection molding machines are shown in Figure 117 (blue is the 300 ton machine, red is the 880 ton). Also, Figure 118 shows average day profile for the metered molding machines. Overall, the 300 ton variable volume molding machine evaluated to save 80,924 kWh per year and there is demand reduction of 10.9 kW whereas the 880 ton variable volume molding machine evaluated to save 46,869 kWh per year and also there is demand reduction of 8.8 kW.

The ex-post mass flow rate was 158.3 lbs/hr for the 300 ton variable volume machine and 59 lbs/hr for the 880 ton variable volume machine. The ex-ante gross mass flow rates were estimated to be 250 lbs/ hr and 880 lbs/hr for the 300 ton and 800 ton machines, respectively. Note that one of the primary factors affecting energy consumption of the injection molding machine is the throughput of the machines.

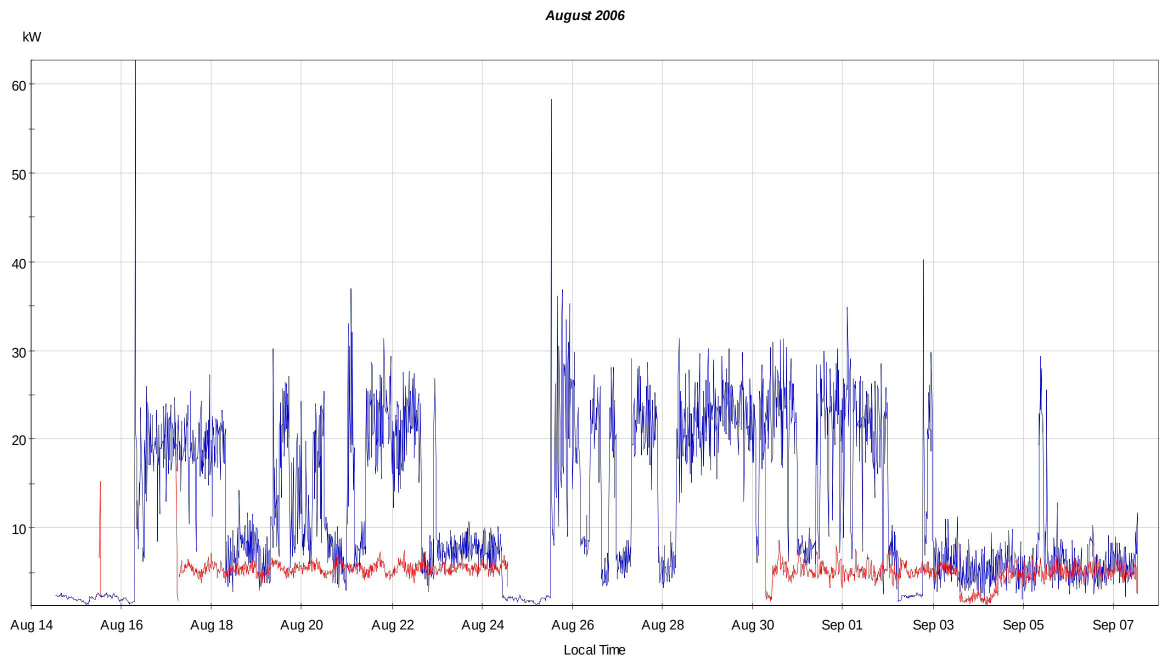


Figure 117: S16046 Injection Molding Metered Data

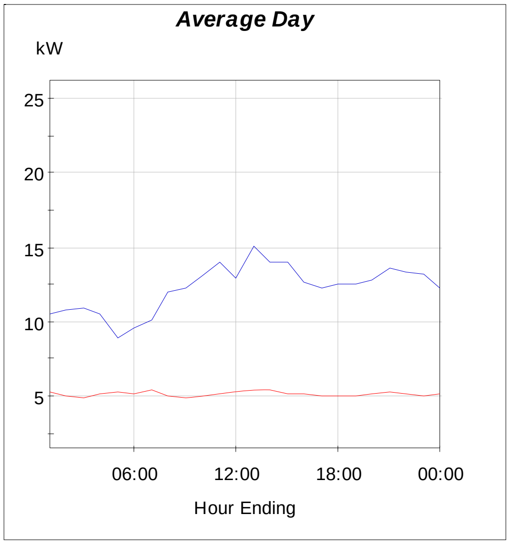


Figure 118: S16046 Injection Molding Average Day Profile

This project saves substantially less that expected because the ex-post mass flow rates for both the 300 ton and 880 ton machines are found to be much lower that the ex-ante gross estimates. Table 122 shows the mass flow rates. Note that ex-post gross savings for three 880 ton machines are calculated based on the obtained evaluated savings from the one monitored machine.

Variable Volume IMM	Ex-Ante MFR (lbs/hr)	Ex-Post MFR (lbs/hr)
300 ton	250	158
880 ton	800	59

Table 122: S16046 Mass Flow Rate Comparison

Ex-Post Net Savings

The facility representative indicated that this program was very influential. They also mentioned that the incentive allowed them to offset the incremental cost increase and meet investment criteria. The respondent also indicated that they probably would not have installed the measure without the interaction with the Savings by Design Program. The combination of the above answers yields a freeridership score of 5 out of 6, or 17% freeridership. Hence all savings are calculated as 83% of the ex-post gross savings which is summarized in Table 123.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	480.8	37.354	7.8%	0.83	31.13
kWh	3,461,225	221,530	6.4%	0.83	184,608.10

Table 123: S16046 Savings Comparison

S16162

VSD Pumps

Project S16162 received an incentive of $32,692 to install three 250 hp VSD pumps and a fourth 250 hp VSD pump solely as backup. However, the evaluation team observed all four pumps to be running during the site visit. The baseline for this measure is a constant volume centrifugal pump.

Ex-Ante Gross Savings

The ex-ante gross analysis estimates a total energy usage savings of 2,400,426 kWh and a demand savings of 6.6 kW for three VSD pumps.

Ex-Post Gross Savings

A data logger was installed on the four pumps for a period of four weeks during November and December of 2006. Table 124 shows the equipment that received an incentive and what was metered.

Incented Equipment	Metered
Pump 1	YES
Pump 2	YES
Pump 3	YES
Pump 4	YES

Table 124: S16162 Metered Equipment

The logger data showed the plant operates twenty four hours a day, seven days a week. The data was used to generate the average hourly power consumption for an average day and the results are shown in Figure 119. Both the baseline and metered power draws are shown on the graphs. The baseline profile was created by using the rated power draw at all times when the pumps are operating. Note that the baseline is the line with the higher consumption. The annual energy can be calculated using the plot since it contains the annual operating schedule and power draw per hour.

Figure 119: S16162 Average Power Consumption (P-1, P-2, P-3 and P-4)

The baseline power draw was 483 kW for all four blowers. The ex-post power draw averaged 331 kW. The ex-ante gross data assumed only three pumps operate at a time, while actually four pumps are operating. Altogether, the program was evaluated to save 1,036,925 kWh per year. There is also a coincident peak demand reduction of approximately 152 kW.

The ex-post gross peak demand savings are significantly high, as shown in Table 125. This is largely because the ex-ante gross analysis was based on the assumption that the savings are only from premium efficiency motors whereas the evaluation data showed that to be incorrect. There is a large amount of kW savings from the premium efficiency motors as well as from the VFD retrofit to the blowers.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of this measure. They also stated that the SBD representative performed some of the design analysis, but they would have installed the measure exactly the same if they had no interaction with the Savings by Design program. The combination of these responses yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 125.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	6.60	152.25	2307%	0.50	76.1
kWh	2,400,426	1,036,925	43%	0.50	518462.4

Table 125:S16162 Savings Comparison

S17012

Electric Injection Molding Machine

Project S17012 received an incentive of $17,174 for installing a new, 300 ton all electric injection molding machine. The baseline for this measure was a variable volume hydraulic injection molding machine of equivalent capacity. The evaluation team verified the installation of the measure.

<u>Ex-Ante Gross Savings</u>

The ex-ante gross savings are calculated as comparing the baseline variable volume hydraulic injection molding machine with an electric injection molding machine. The ex-ante gross analysis estimates a total energy usage savings of 171,735 kWh/yr and a demand savings of 22.4 kW.

<u>Ex-Post Gross Savings</u>

A true power data logger was installed on the electric molding machine for period of four weeks in August and September of 2006. Raw data for a few days during the metering period is shown in Figure 120.

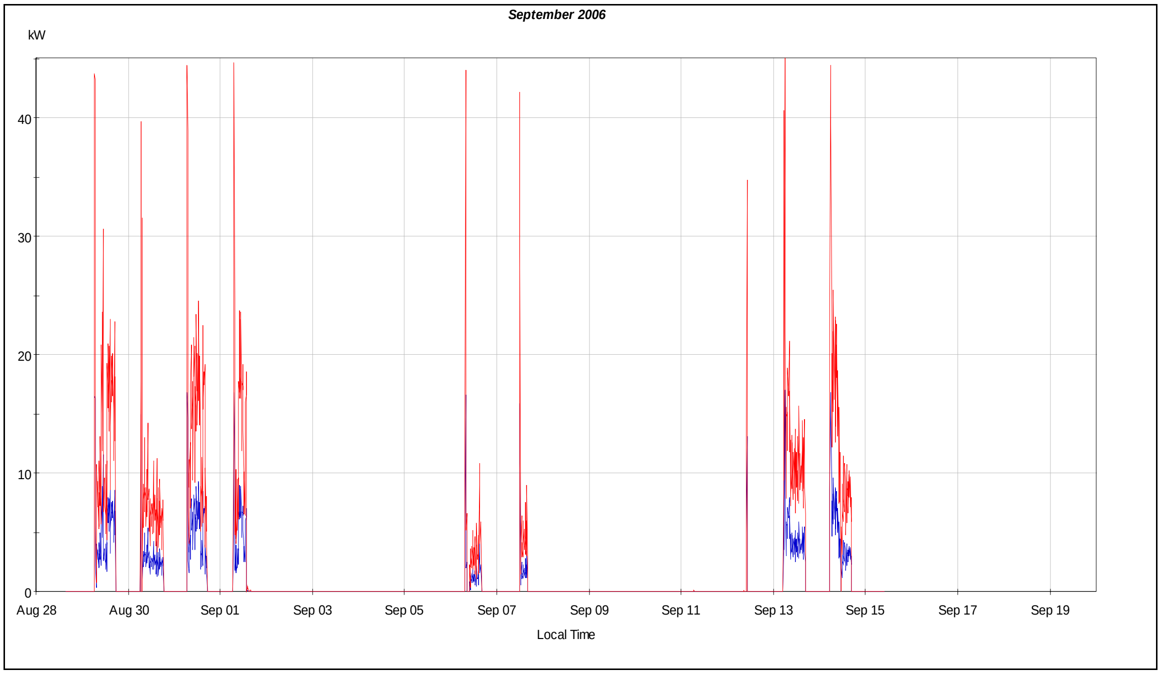


Figure 120: S17012 Metered Data

The logger data shows the machine runs 12 hours a day and four days a week (the machine is off on Saturday, Sunday, and Monday). The profiles for an average weekday (Tuesday through Friday) and weekend (Saturday, Sunday, Monday in this case) were created using Visualize-IT. The profiles for Thursday and Monday are shown in Figure 121. Note that red represents the baseline, while blue represents the metered power draw. The annual energy consumption was then calculated using the power profile and annual operating hours. This ex-post gross power and energy were compared to the baseline and ex-ante gross energy usage.

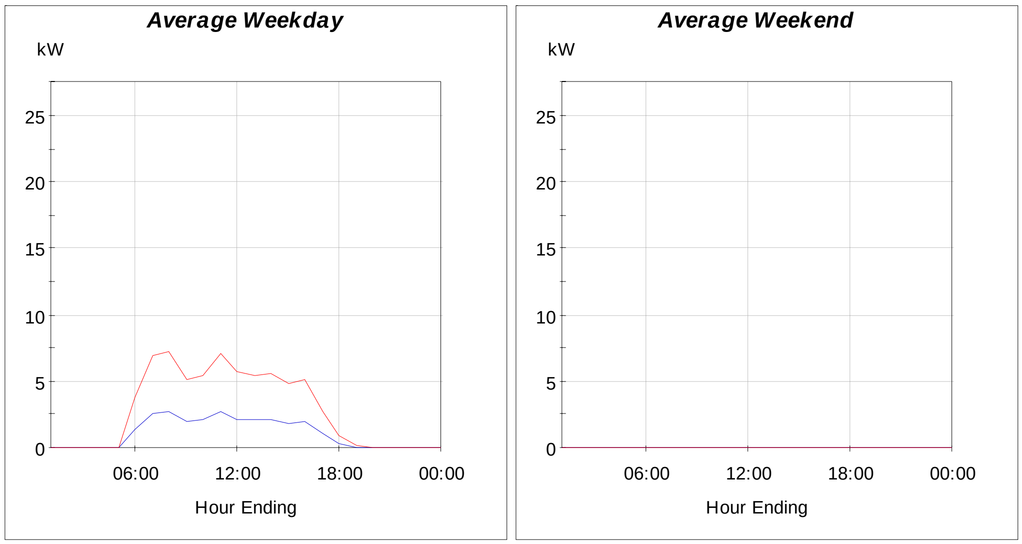


Figure 121: S17012 Weekday and Weekend Power Profiles

The estimated baseline demand was 5.0 kW and ex-post demand was 1.9 kW. The ex-ante gross demand was 13.6 kW. The ex-post gross savings were 9,934 kWh/yr with a demand reduction of 3.1 kW. The ex-post mass flow rate for this measure was 20.7 lbs/hr whereas the ex-ante mass flow rate was estimated to be 150 lbs/hr. Note that one of the primary factors affecting energy consumption of injection molding machines is the throughput of the machines. Table 126 shows estimated baseline, ex-ante gross and ex-post gross demand and energy consumption.

Incented Machines	300 T IMM
Annual Days	260
Ex-Ante Mass Flow Rate(lbs/hr)	150.0
Ex-Post Mass Flow rate(lbs/hr)	20.7
Baseline kWh	15,955
Baseline kW	5.0
Ex-Ante Gross Savings kWh	171,735
Ex-Ante Gross Savings kW	22.4
Ex-Post Gross Savings kWh	9,934
Ex-Post Gross Savings kW	3.1

Table 126: Comparison of Baseline, Ex-ante gross and Evaluated Energy Consumption

Ex-Post Net Savings

The facility representative could not be contacted for this program; therefore ex-post net savings are calculated on the program average freeridership score which is 2.5 out of 6, or freeridership ratio of 58%. Hence the ex-post net savings for this project is calculated as 42% of the ex-post net savings are shown in Table 127.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	22.4	3.1	14%	0.42	1.3
kWh	171,735.0	9,934.1	6%	0.42	4,139.2

Table 127: S17012 Savings Comparison

D60209

VFD Process Pumps

Project D60209 received an incentive of $75,000 for installing variable frequency drives to three (3) 400 hp secondary effluent pumps (23-P-03, 23-P-05, 23-P-07) and three (3) 10 hp reactivated sludge pumps (22-P-09, 22-P-12, 22-P-13). The baseline for this measure is constant speed pumps with valves to control flow rate. The evaluation team verified the installation of this measure during the site visit.

Ex-Ante Gross Savings

The ex-ante gross savings are calculated by comparing the baseline pump motors usage with a VFD retrofitted pump motors. The parameters used for the savings calculations are pump power, flow rate, pumping head and the pump efficiency.

Ex-Post Gross Savings

Data loggers were installed on all six pumps. Table 128 below shows the list of incented pumps and the incentive amount associated with each. The metering period lasted four weeks between August 8 and September 6 of 2006.

Incented Equipment	Metered	Incentive ($)
10 hp VFD Process Pumps(3)	3	2,245
400 hp VFD Process Pumps(3)	3	72,755
Total	**6**	**75,000**

Table 128: D60209 Incented Pumps

The metered data shows that all three 10 hp VSD pumps run at a constant load throughout the monitoring period. There was not much variation in kW power consumption during the monitoring period. The meter data shows that out of the three pumps two pumps are always in operation at any given time in a rotation.. For example, P09 and P12 operate in the first phase, P09 and P013 operate in the second phase, P12 and P13 operate in the third phase, P12 and P13 operate in the forth phase, and so on. Figure 122 shows the power draw and schedule of operation of all three 10 hp VSD pumps during the monitoring period. According to the facility personnel the schedule of operation during the metering period is indicative of the entire year. Based on the above assumptions and analysis of the metered data a yearly schedule was derived for all three 10 hp VSD pumps, which is tabulated in Table 129.

Incented Equipment	Hours/ yr
10 hp VFD Process Pump P09	6,675
10 hp VFD Process Pump P12	4,493
10 hp VFD Process Pump P13	6,351

Table 129: D60209 RAS Pump Annual Schedule

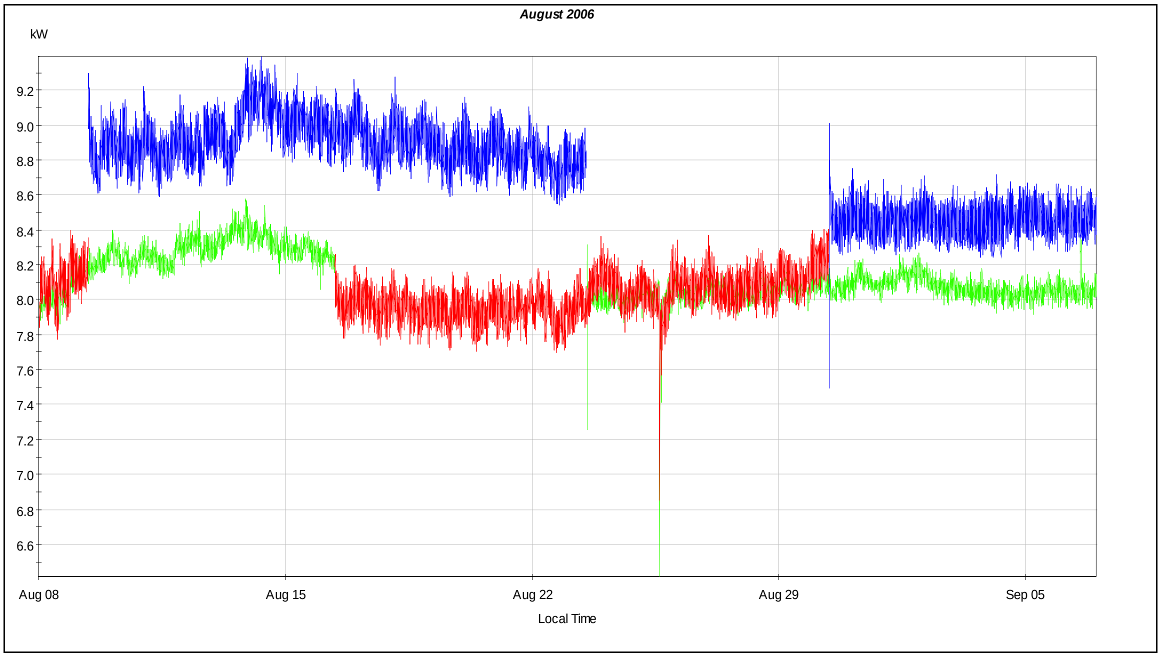


Figure 122:D60209 10 hp VSD Pump Power Profile for the Monitoring Period (P12-Red, P09- Green, P13- Blue)

The evaluated kW and annual operating hours are used to calculate the evaluated energy usage for a year. Then the ex-post gross savings were calculated by subtracting the evaluated energy consumption from the baseline energy consumption. The Table 130 below shows the ex-ante gross and ex-post gross savings for the above pumps.

Incented Equipment	Ex-Ante Gross Savings kWh/yr	Ex-Post Gross Savings kWh/yr
10 hp VFD Process Pump P09	31,312	3,143
10 hp VFD Process Pump P12	31,312	2,301
10 hp VFD Process Pump P13	31,312	458

Table 130 : D60209 Ex-ante gross and Ex-post gross Savings Comparison

Similarly the raw kW data for all three 400 hp VSD secondary effluent pumps were imported into Visualize-IT. The meter data shows that out of the three pumps one of the pumps (P-03) did not operating during the monitoring period. According to the plant personnel the P-03 pump is used as a stand-by pump. The metered data also shows that the pumps P-05 and P-07 were operating twenty four hours a day and seven days a week. Figure 123 below shows the meter data for the two pumps (P-05 and P-07) and Figure 124 shows the average day profile.

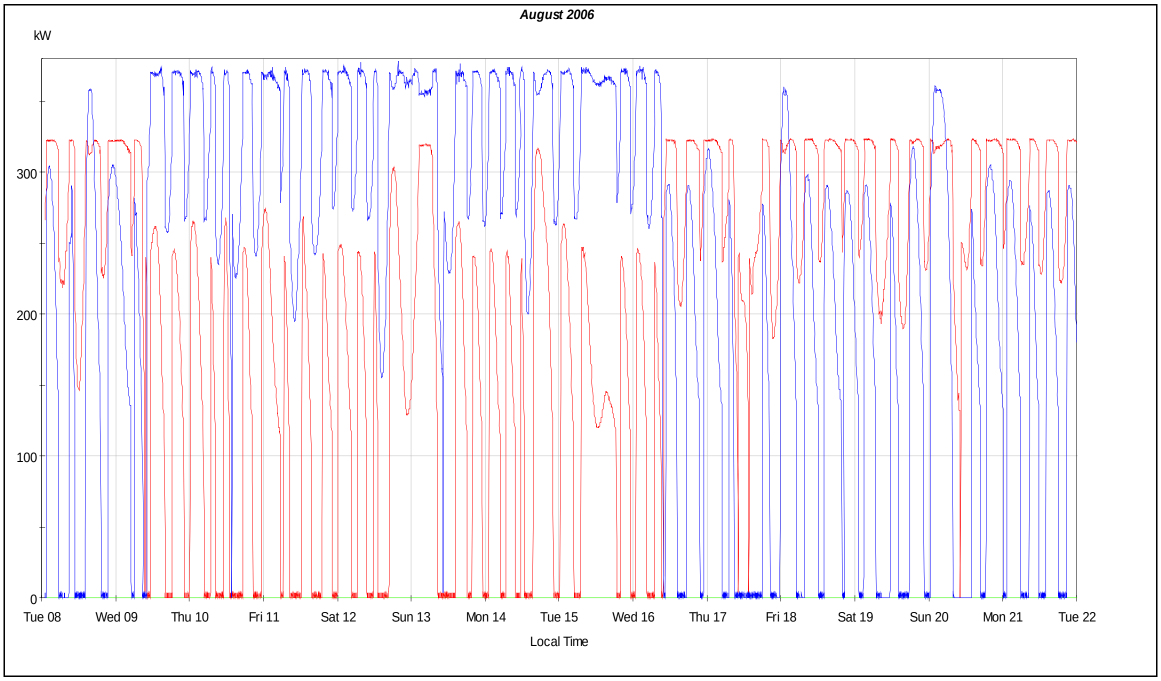


Figure 123 : D60209 400 hp VSD Secondary Effluent Pumps Power Profile (P03- Green, P05- Blue, P07- Red)

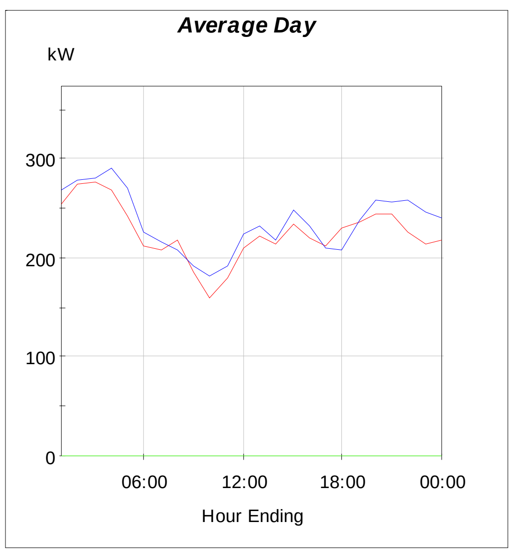


Figure 124: D60209 Average Day Profile (P03- Green, P05- Blue, P07- Red)

According to the facility personnel the schedule of operation during the metering period reflects the whole year. Based on the above assumptions and analysis of the metered data a yearly schedule was derived for all three 400 hp VSD pumps. The ex-post gross energy usage was calculated by using the evaluated annual operating hour and hourly kW. The methodology used in the program file was used to calculate the baseline power consumption for both the pumps. Then evaluated power consumption was subtracted from baseline power consumption to determine ex-post gross savings. Table 131 shows the comparison of ex-ante gross and ex-post gross savings for the three evaluated 400 hp VSD secondary effluent pumps.

Incented Equipment	Evaluated Hours/yr	Ex-Ante Gross Savings kWh/yr	Ex-Post Gross Savings kWh/yr
400 hp VFD Process Pump P03	0	1,014,213	0.0
400 hp VFD Process Pump P05	8760	1,014,213	774,110
400 hp VFD Process Pump P07	8760	1,014,213	675,527
Total		**3,042,639**	**1,449,637.2**

Table 131: D60209 Secondary Effluent Pump Ex-Ante Gross and Ex-Post Gross Savings Comparison

There is significantly less savings than expected because the ex-ante gross estimate was based on the three 400 hp pumps running continuously, whereas it was found that only two out of the three pumps were running during the evaluation. Lower savings were also found in the case of the 10 hp VSD RAS pumps because the above pumps were running at almost full load during the monitoring period, whereas ex-ante gross estimates shows it was running under lower loads.

Ex-Post Net Savings

The facility representative indicated that the program was somewhat influential in the implementation of these measures. The representative also stated that the SBD incentive made this measure an easier sell" to superiors. However, the respondent indicated that they would have probably installed the measure without the help from the SBD program. For the ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 2.5 out of 6, or 58% freeridership. Therefore, the ex-post net savings are evaluated at 42% of the ex-post gross savings as summarized in Table 132.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	513.8	29.2	6%	0.42	12.2
kWh	3,136,575	1,455,538	46%	0.42	606,474

Table 132: D60209 Savings Comparison

S12229

Premium Efficiency Motors and VSD Well Pumps

Project S12229 received an incentive of $11,839 for installing premium efficiency motors and VFDs on two well pumps (1-300 hp and 1-250 hp) at the new blending station #1. But the evaluation team found three pumps during the site visit. The new pumps include: 300 hp for Well#20; 300 hp for Well#22 and 250 hp for Well#23. Baseline for this measure is a constant volume standard efficiency 850 hp pump. The baseline power consumption calculation is based on the electricity used per acre-foot of water pumped (kWh/AF), which was assumed to be 451 kWh/AF. The evaluation team verified the installation of this measure.

Ex-Ante Gross Savings

Ex-ante gross savings are calculated by subtracting VFD retrofitted pump usage from the base case pump usage. The ex-ante gross calculation was based on the electricity used per acre-foot of water pumped (kWh/AF), and annual operating hours. Essentially, it was assumed that two (2) pumps, one at 250 hp and one at 300 hp, would have to operate 6,772 hours per year at 85% flow to produce the equivalent acre-foot of water pumped as in the base case. The program predicts this measure will operate at 389 kWh/AF. Note that the ex-ante gross savings are calculated based on two pumps.

Ex-Post Gross Savings

Data loggers were installed on all three pumps. Table 133 below shows the list of pumps on which data loggers were installed. The metering period lasted four weeks in the month of August.

Incented Equipment	Metered
Well # 20 300 hp Pump (1)	YES
Well # 22 300 hp Pump (1)	YES
Well # 23 250 hp Pump (1)	YES

Table 133 : S12229 Incented Equipment

The recorded data was then imported to Visualize-IT. Figure 125 shows raw data for all three pumps during the monitoring period. Figure 126 shows the average weekday and weekend profile for all three pumps. The Visualize-it output reflects the operating hours and load factors of all three pumps during the monitoring period. Metered data shows all three pumps run twenty four hours a day, seven days a week. According to the plant personnel the pumps have the same schedule throughout the year.

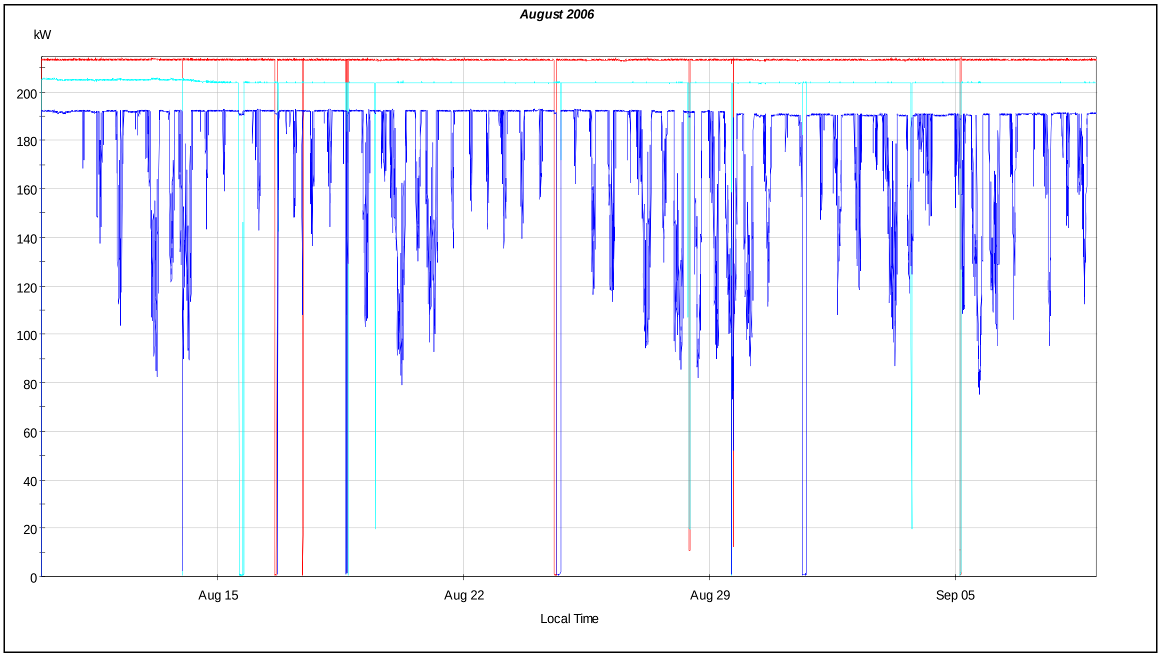


Figure 125:S12229 Raw Metered Data (P20- Red, P22-Lite Blue & P23- Navy)

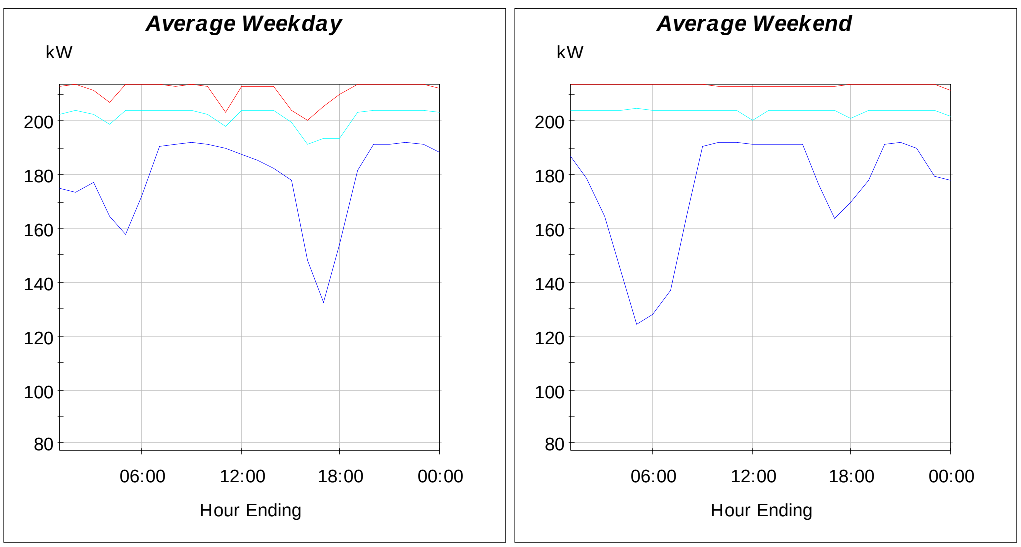


Figure 126: S12229 Average Weekday and Weekend Profile (P20- Red, P22-Lite Blue & P23- Navy)

During the monitoring period well pump #20 & #22 ran almost constantly at full speed. Well pump #23 ran almost constantly at a high load factor with some speed variation.

For the purpose of analysis the evaluated monthly kW data from each pump was used to determine hourly flow rate, corresponding monthly motor speed and total production in acre-feet. The total energy usage (kWh) is divided by the total production (gal/month) to determine production efficiency (kWh/AF) for the monitored month. This data was then extrapolated to a one year period to determine the annual kWh and annual flow rate (gal/yr). Table 134, Table 135 and Table 136 show the ex-post gross monthly kWh, gallons per month and kWh/AF.

Pump 20 5% kW Bin	5 Min Intervals	kWh	VFD Speed %	VFD Flow gpm	Total Gallons
0.0	36	0	0.0%	0	0
10.7	19	17	36.8%	1,105	104,995
21.5	3	5	46.4%	1,392	20,887
32.2	1	3	53.1%	1,594	7,970
42.9	1	4	58.5%	1,754	8,772
53.6	3	13	63.0%	1,890	28,348
64.4	0	0	66.9%	2,008	0
75.1	1	6	70.5%	2,114	10,571
85.8	0	0	73.7%	2,210	0
96.6	0	0	76.6%	2,299	0
107.3	2	18	79.4%	2,381	23,811
118.0	3	30	81.9%	2,458	36,869
128.7	3	32	84.3%	2,530	37,954
139.5	0	0	86.6%	2,599	0
150.2	1	13	88.8%	2,664	13,319
160.9	1	13	90.9%	2,726	13,628
171.6	0	0	92.8%	2,785	0
182.4	1	15	94.7%	2,842	14,209
193.1	0	0	96.5%	2,896	0
203.8	4	68	98.3%	2,949	58,983
214.6	8561	153,071	100.0%	3,000	128,415,000
Total	**8640**	**153,308**		**gal/month**	**128,795,317**
				AF/Year	**4,742**
				kWh/AF	**388**

Table 134: S12229 Evaluated Usage (Pump 20)

Pump 22	5 Min		VFD Speed	VFD Flow	Total
5% kW Bin	**Intervals**	**kWh**	**%**	**gpm**	**Gallons**
0.0	44	0	0.0%	0	0
10.3	3	3	36.8%	1,105	16,578
20.6	20	34	46.4%	1,392	139,248
30.9	2	5	53.1%	1,594	15,940
41.2	1	3	58.5%	1,754	8,772
51.5	2	9	63.0%	1,890	18,899
61.8	0	0	66.9%	2,008	0
72.1	0	0	70.5%	2,114	0
82.4	0	0	73.7%	2,210	0
92.7	1	8	76.6%	2,299	11,495
103.0	2	17	79.4%	2,381	23,811
113.3	3	28	81.9%	2,458	36,869
123.6	0	0	84.3%	2,530	0
133.8	2	22	86.6%	2,599	25,987
144.1	6	72	88.8%	2,664	79,911
154.4	3	39	90.9%	2,726	40,885
164.7	0	0	92.8%	2,785	0
175.0	6	88	94.7%	2,842	85,254
185.3	1	15	96.5%	2,896	14,482
195.6	3	49	98.3%	2,949	44,237
205.9	8541	146,564	100.0%	3,000	128,115,000
Total	**8640**	**146,956**		**gal/month**	**128,677,369**
				AF/Year	**4,738**
				kWh/AF	**372**

Table 135: S12229 Evaluated Usage (Pump 22)

Pump 23	5 Min		VFD Speed	VFD Flow	Total
5% kW Bin	**Intervals**	**kWh**	**%**	**gpm**	**Gallons**
0.0	81	0	0.0%	0	0
9.6	2	2	36.8%	1,105	11,052
19.3	0	0	46.4%	1,392	0
28.9	0	0	53.1%	1,594	0
38.6	2	6	58.5%	1,754	17,544
48.2	2	8	63.0%	1,890	18,899
57.9	2	10	66.9%	2,008	20,083
67.5	1	6	70.5%	2,114	10,571
77.2	19	122	73.7%	2,210	209,990
86.8	47	340	76.6%	2,299	540,248
96.5	96	772	79.4%	2,381	1,142,929
106.1	145	1,282	81.9%	2,458	1,782,024
115.8	185	1,785	84.3%	2,530	2,340,526
125.4	215	2,247	86.6%	2,599	2,793,621
135.1	227	2,555	88.8%	2,664	3,023,313
144.7	257	3,099	90.9%	2,726	3,502,500
154.4	243	3,126	92.8%	2,785	3,383,718
164.0	296	4,046	94.7%	2,842	4,205,871
173.7	322	4,660	96.5%	2,896	4,663,314
183.3	314	4,797	98.3%	2,949	4,630,154
193.0	6184	99,439	100.0%	3,000	92,760,000
Total	**8640**	**128,302**		**gal/month**	**125,056,356**
				AF/Year	**4,605**
				kWh/AF	**334**

Table 136: S12229 Evaluated Usage (Pump 23)

Also baseline power consumption was also calculated based on the annual operating hour and hourly power draw of the 850 hp pump (300+300+250). Then the evaluated power consumption was subtracted from the baseline usage to determine the ex-post gross savings for the project. Table 137 below shows the evaluated annual kWh , gallon per year and acre feet per year for all the evaluated pumps.

Pump #	Power (hp)	Evaluated kWh/yr	Gallons/yr	AF/yr
Well 20	300	1,839,691	1,545,543,804	388
Well 22	300	1,763,468	1,544,128,428	372
Well 23	250	1,539,618	1,500,676,275	334

Table 137 : S12229 Evaluated Data

Ex-Post Net Savings

The facility representative indicated that the program was slightly influential in the implementation of these measures. The representative also indicated that the nature of their operation lends itself to this kind of technology and the program didn't have to sell them on it. They also said they searched out the program because they were aware of the availability of incentives. For the ex-post net savings evaluation, this combination of answers yields a partial freeridership score of 0.25 out of 6, or 96% freeridership. Therefore, the ex-post net savings are evaluated at 4% of the ex-post gross savings as summarized in Table 138.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	N/A	79.33	N/A	0.04	3.31
kWh	394,644.00	254,317.73	64%	0.04	10,596.57

Table 138 :S12229 Savings Comparison

S13017

VFD Blowers

Project S13017 received an incentive of $6,544 for installing positive displacement blowers with premium efficiency motors and variable frequency drives at wastewater treatment facility. The blower flow rate is based on dissolved oxygen level in the aeration basins. Note that the ex-ante gross analysis on the project file was done for four VFD blowers, whereas the incentive was issued for only one blower. Therefore, our ex-post gross savings calculation was done for all four blowers. The evaluation team verified the installation of the measure.

Ex-Ante Gross Savings

The baseline for these blowers is constant speed centrifugal blowers with standard efficiency motors with inlet vane flow control. Ex-ante gross savings are estimated based on the difference in energy consumption between the existing basin and proposed basin. The basin consists of a blower, a mixer and a pump. Between the existing and proposed basin the only difference is that the existing basin consists of a centrifugal blower with inlet vane control whereas the proposed basin consists of a positive displacement blower with a premium efficiency motor and variable frequency drive control. The ex-ante gross model estimates a demand saving of 24.9 kW and annual energy consumption of 218,124 kWh.

Ex-Post Gross Savings

Data loggers were installed on the VFD blower for a period of three weeks in the month of October 2006 and November 2006. Table 139 below shows the incented blowers which was metered.

Incented Equipment	Metered
60 hp Blowers (4)	4

Table 139 : S13017 Incented Blower

The recorded data were imported into Visualize-IT. Figure 127 shows the raw data for all four blowers during the monitoring period. Also Figure 128 shows average weekday power profile for all four blowers. The Visualize-IT output reflects the operating hours and load factors of all four blowers during the monitoring period. Metered data shows all four blowers run twenty four hours a day, seven days a week. According to the plant personnel the pumps have the same schedule throughout the year.

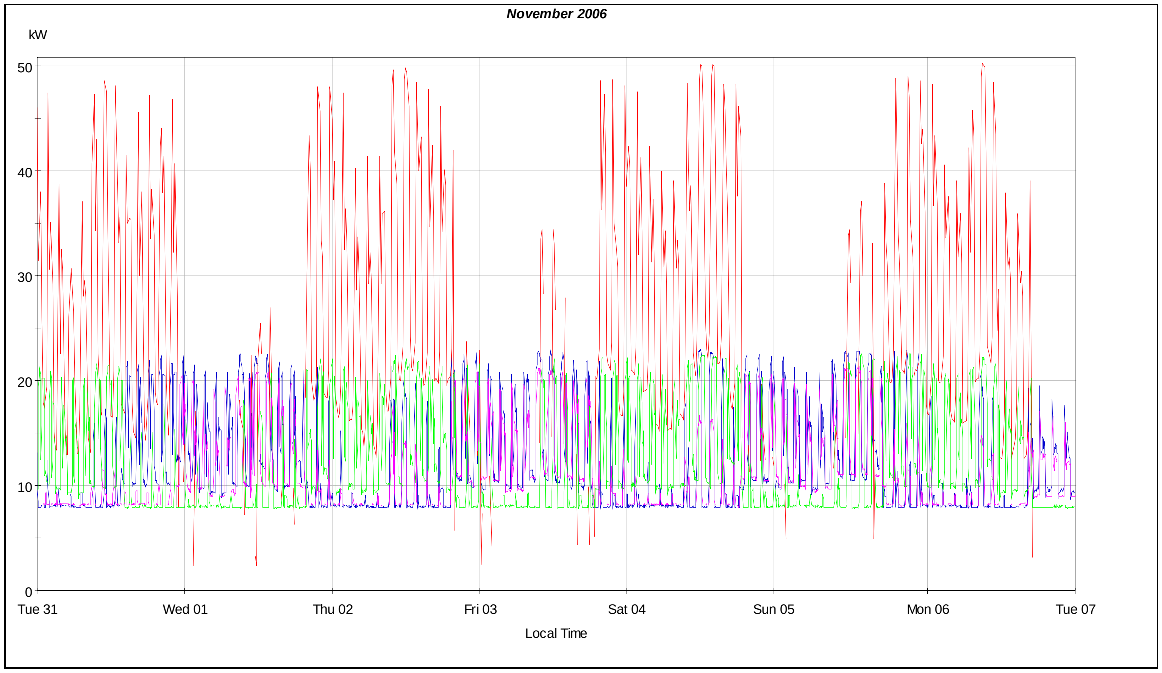


Figure 127 : S13017 Portion of Raw Metered Data (1A-Blue, 1B-Red, 2A-Green, 2B-Pink)

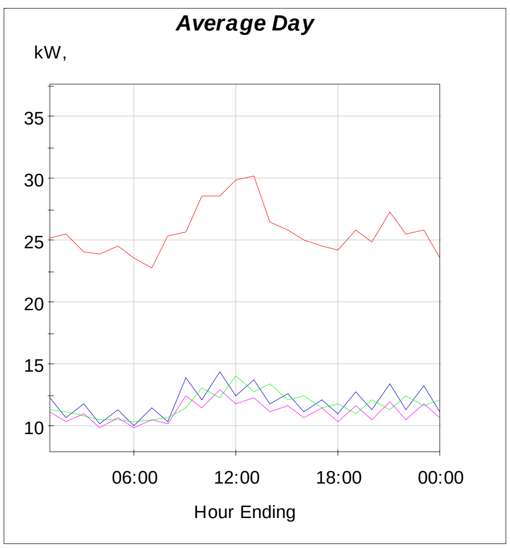


Figure 128 : S13017 Average Day Profile (1A-Blue, 1B-Red, 2A-Green, 2B-Pink)

The evaluation team was provided with a blower curve for the VFD positive displacement blower and the curves for the baseline centrifugal blower was obtained from EPRI's relative energy consumption of different fan control strategies. The blower curves were used to extrapolate from the metered VSD blower power to baseline blower power. Figure 129 illustrates the order in which the calculations occurred for the blowers.

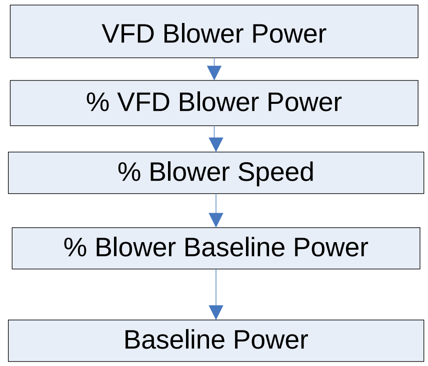


Figure 129 : S13017 Blower Baseline Power Consumption Calculation Sequence

First, the percent power that the VFD uses was calculated by dividing the metered power by the rated motor power. This was not done for the average power draw, but for every metered point which was taken at five minute intervals. Next, the VFD percent speed was calculated using the pump curve shown in Figure 130.

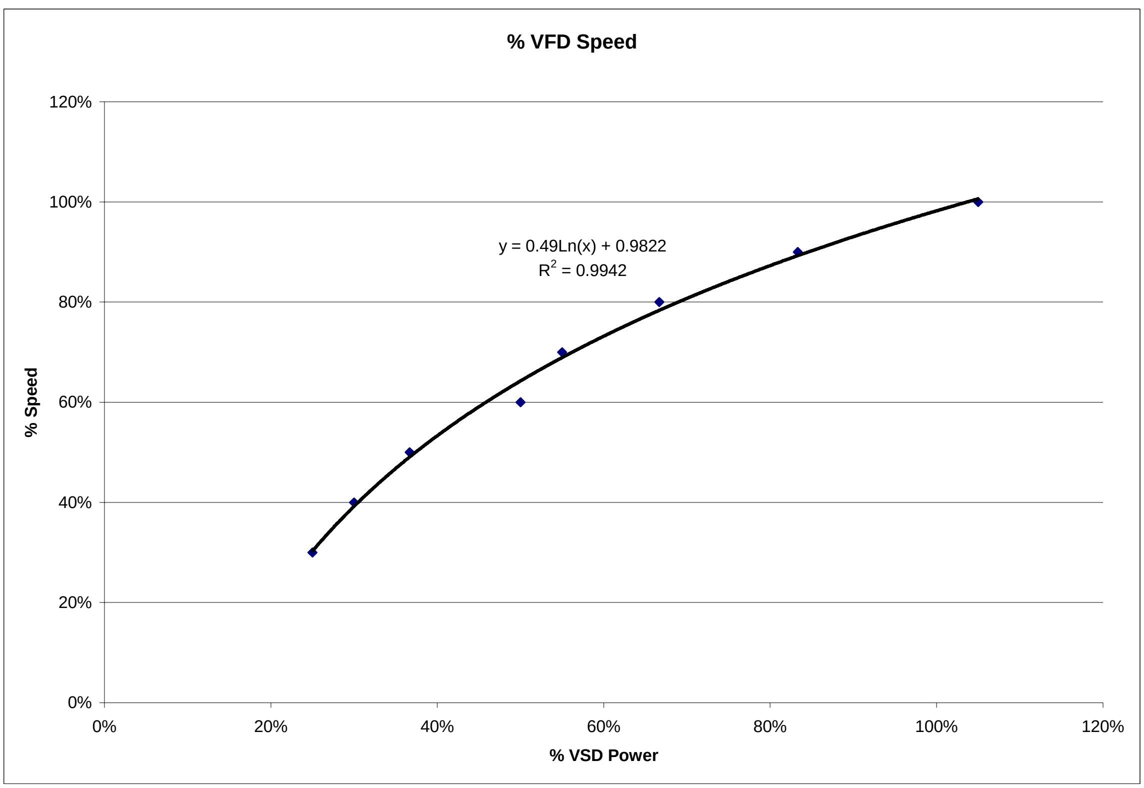


Figure 130 : S13017 %VFD Blower Power vs. % Speed Curve

The speed ratio is the same for the baseline and installed motor. This means the speed ratios calculated in the previous step could be used in the power/speed curve for the baseline. This curve is presented in Figure 131.

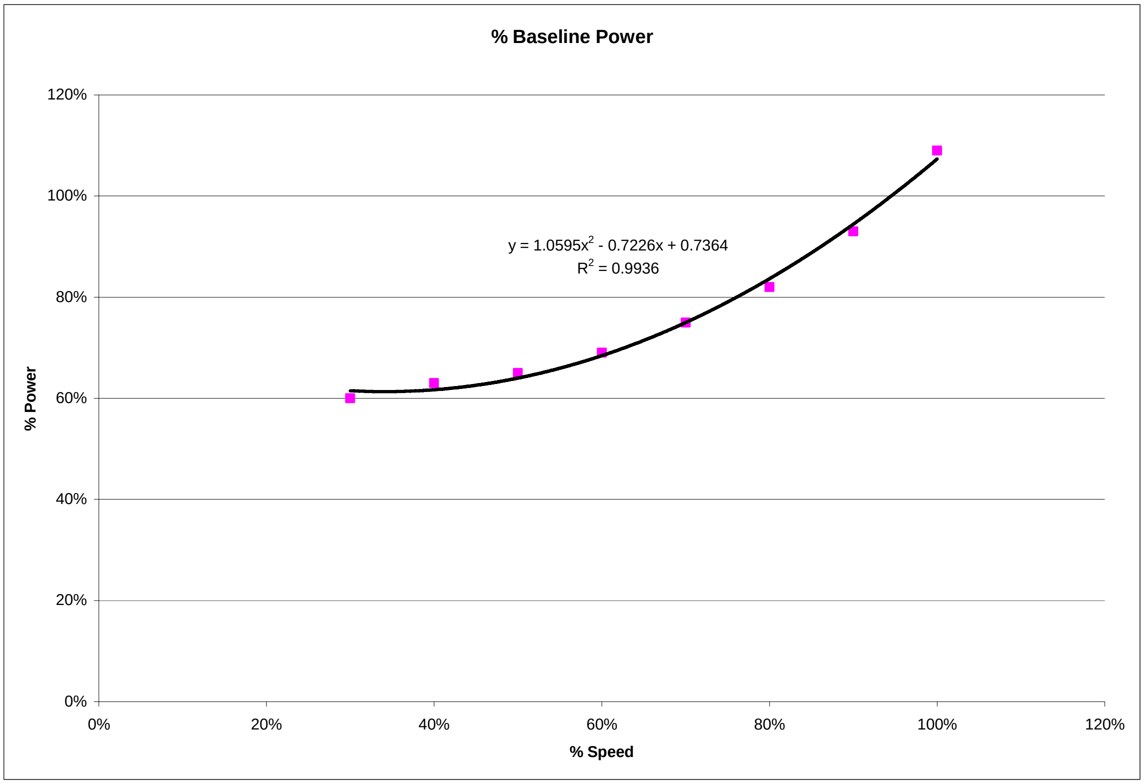


Figure 131: S13017 % Blower Speed vs. % Baseline Power

The final step in the blower analysis is simply converting the power ratio to actual baseline power by multiplying by the rated input power. Next, the difference in energy usage between the baseline and installed blower was calculated.

The savings were calculated using the operating schedule and comparing the power draw of the baseline and installed blowers. An hourly power profile for an average day was calculated with the visualization software, Visualize-IT.

The savings are a lot more than expected for this measure because the ex-ante gross kWh was only for one blower whereas the program was evaluated for four blowers.

<u>Ex-Post Net Savings</u>

The facility owner indicated that the program was somewhat influential in the implementation of this measure. The SBD incentive made this measure an easier sale. The respondent also stated that they would have installed the measure exactly the same without the help of the Savings by Design Program. For our ex-post net savings calculation, this combination of answers yields a partial freeridership score of 3.5 out of

6, or 42 % freeridership. There fore the ex-post net savings are evaluated at 58% of ex-post gross savings as summarized in Table 140.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	24.9	67.7	272%	0.58	39.5
kWh	218,124.0	590,234.2	271%	0.58	344,303.3

Table 140: S13017 Savings Comparison

S14236 – Non-metered Site

Whole Building

Project S14236 received an incentive of $49,500 to install condenser controls, efficient air unit motors, occupancy lighting sensors, and reduced lighting power density in an additional 34,000 square feet of refrigerated warehouse.

<u>Ex-Ante Gross Savings</u>

Ex-ante gross savings were estimated with DOE-2.2R simulation software. A variety of model parameters were estimated including the schedules, temperatures, and loads.

<u>Ex-Post Gross Savings</u>

DOE-2.2R was also used to produce ex-post gross savings. The evaluation team performed a field inspection at the site which showed no changes from the DOE-2.2R model. No equipment was monitored. Consequently, the savings are the same as the ex-ante gross estimates.

<u>Ex-Post Net Savings</u>

The free-rider scores were different for each measure at this facility. Therefore, the ex-post net savings were weighted by freeridership per measure. The lighting measures received scores of 6 out of 6 because they were highly influenced, suggested by an SBD representative, and definitely would not have been installed absent the program. The condenser controls measure was somewhat influenced by the program, were suggested by an SBD representative, and probably would have been installed absent the program. This yields a partial free-rider score of 3.5 out of 6, or 42% freeridership. The efficient motors measure was not influenced at all by the program and would have been installed exactly the same absent the program. This yields a free-rider score of 0, or 100% freeridership. The savings are shown in Table 141.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	22.00	22.00	100%	0.43	9.55
kWh	247,131.00	247,131.00	100%	0.67	164,594.56

Table 141: S14236 Whole Building Savings Comparison

S15099 –

Whole Building

Project S15099 received an incentive of $49,500 to install improved insulation, reduced lighting power density, VSDs, efficient fan motors, and condenser controls in an additional 32,000 square feet refrigerated warehouse.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated with DOE-2.2R simulation software. A variety of model parameters were estimated including the schedules, temperatures, and loads.

Ex-Post Gross Savings

DOE-2.2R was also used to produce ex-post gross savings. The evaluation team performed a field inspection at the site which showed no changes from the DOE-2.2R model. Consequently, the savings are the same.

Ex-Post Net Savings

Each measure for this facility received a different freeridership score. The overall freeridership was weighted by savings. The facility respondent indicated that the lighting and efficient motors were not influenced at all by the SBD program and they would have been installed exactly the same absent the program. Therefore there were no net savings associated with these measures. However, the VFD and insulation measures were highly influenced by the program, the measures were first suggested by an SBD representative, and definitely would not have been installed absent the program. Therefore, these measures are 0% free-riders. The LPD and insulation measures had the most peak savings, but one was a complete free-rider while the other was completely influenced by the program. The VFD measure saved the majority of the energy for the whole site which is why the net energy savings are much higher than the net peak savings. The overall savings are shown in Table 142.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	33	33	100%	0.48	15.9
kWh	873,611	873,611	100%	0.91	798438.8

Table 142: S15099 Whole Building Savings Comparison

S15125 –

Whole Building

Project S15125 received an incentive of $28,075 to install an oversized condenser, VFD air unit motors, low lighting power density, and improved insulation in an additional 13,500 square feet of refrigerated warehouse. They were also incented for condenser controls, VSD condenser motors, and efficient condenser motors, but a facility representative reported during the onsite that this equipment was installed before the SBD retrofit.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated with DOE-2.2R simulation software. A variety of model parameters were estimated including the schedules, temperatures, and loads.

Ex-Post Gross Savings

DOE-2.2R was also used to produce ex-post gross savings. The evaluation team performed a field inspection at the site which showed no changes from the DOE-2.2R model inputs. Therefore, the only changes to the model were turning off the measures described above which were installed before the other incented equipment. Of course, this lowered the savings.

Ex-Post Net Savings

Each measure received different free-rider scores for this facility. The freeridership was weighted by savings for each measure to compute the total freeridership. The oversized condenser received a score of 2.25 out of 6 because the facility representative indicated that the program was minimally influential, the SBD program made the measure an easier sell, and the measure probably would not have been installed absent the program. The VSD measure received a score of 2, while the LPD and insulation measures received scores of 4.5 out of 6. The LPD and insulation measures were somewhat influenced by the program, an SBD representative suggested the measures, and they probably would not have been installed absent the program. Altogether, the VSD measure had the most energy savings and therefore the most influence on net energy savings. Likewise, the LPD and insulation measures saved the most peak power and influenced the net peak savings the most. The savings are presented in Table 143.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	21	7.3	35%	0.89	6.5
kWh	350,939.0	334,450.0	95%	0.37	123,789.9

Table 143: S15125 Whole Building Savings Comparison

P15328 – **Whole Building**

Project P15328 received an incentive of $56,140 to install efficient condenser fan motors, VSD and floating head pressure condenser controls, and air-unit VSD controls in an additional 27,100 square feet of refrigerated warehouse.

Ex-Ante Gross Savings

Ex-ante gross savings were estimated with DOE-2.2R simulation software. A variety of model parameters were estimated including the schedules, temperatures, and loads.

Ex-Post Gross Savings

DOE-2.2R was also used to produce ex-post gross savings. The model was changed based on an onsite inspection. The evaluation team performed a field inspection at the site, however no monitoring occurred. The onsite showed that all of the measures were installed correctly. Therefore, the only change to the model was due to a variation in the saturated condensing temperature and the wet bulb temperature. The condenser controls were installed, but it was found in the post-field inspection that the temperature difference was approximately 10°F, not 5°F as originally estimated. Consequently, savings are slightly less than estimated in the ex-ante gross analysis.

Ex-Post Net Savings

A facility representative indicated that the program was somewhat influential. They indicated that the equipment representative suggested the upgrade, but the SBD program made the measures an easier sell. The facility would have installed less efficient equipment absent the program. This combination of answers gives a score of 3.5 out of 6, or 42% freeridership. Therefore, the ex-post net savings are evaluated at 58% of the ex-post gross savings. The savings are presented in Table 144.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	35	26	75%	58%	15
kWh	801,996	791,352	99%	58%	461,622

Table 144: P15328 Whole Building Savings Comparison

P25992

Process Systems

P25992 received an incentive of $35,000.00 for installing a 500 ton VSD chiller with condenser reset and installing VSDs on their four 50 hp cooling tower fan motors. The baseline of the VSD chiller was a 500 ton constant volume screw chiller and base case of the VSD retrofitted cooling tower fan is constant speed cooling tower fans. The evaluation team verified the installation of these measures during the site visit.

Ex-Ante Gross Savings

Ex-ante gross savings for both the measures are calculated by hourly bin analysis for the whole year.

Ex-Post Gross Savings

Data loggers were installed on the VSD chiller and all four cooling tower fans for period of three weeks in the month of July and August 2006. Temperature loggers were installed on chilled water supply and return and condenser water supply and return to monitor temperature and a weather station was stationed for three weeks to monitor ambient temperature and relative humidity. Figure 132 below shows raw data for the VSD chiller.

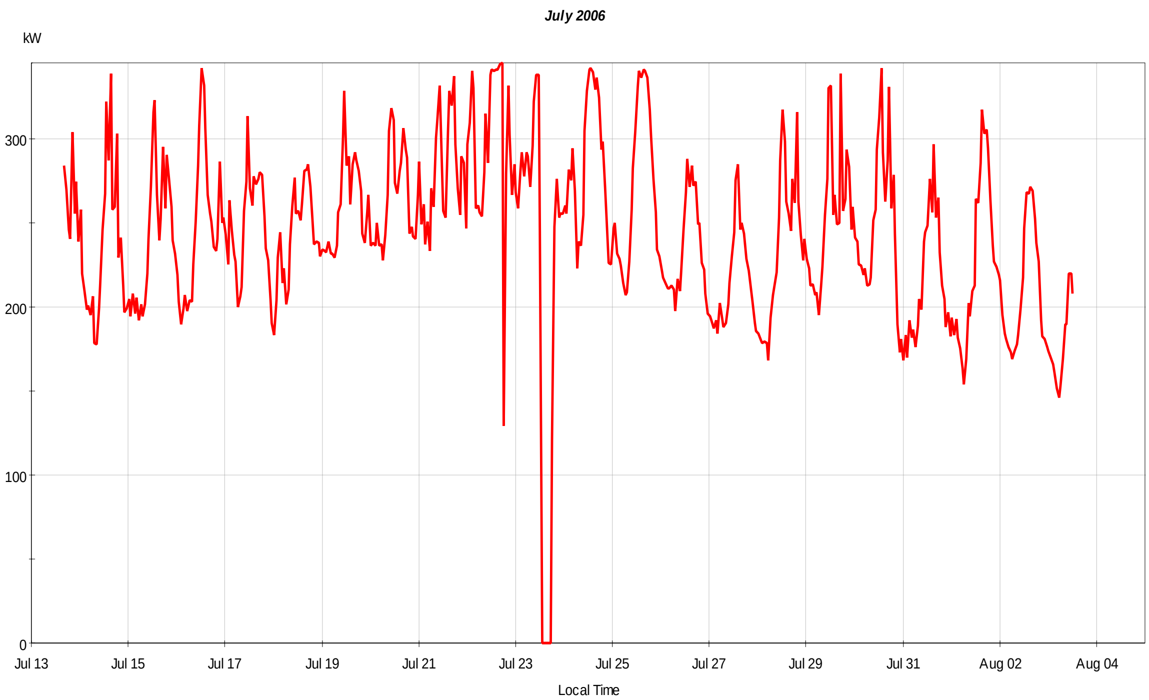


Figure 132 :P25992 VSD Chiller Metered Data

Ex-post gross savings analysis was done by building a model in Survey-It for the VSD chiller and performing simulations with DOE-2.2 with yearly weather data. The collected metered data was imported in to Visualize-IT to create an hourly profile. Then the meter data was calibrated with the DOE-2.2 model for the metering period. Once the calibration is established for the metering period, the calibrated model is used as the evaluation model. This evaluation model was the basis for our ex-post gross savings calculation. Then the annual kWh was compared with baseline kWh to determine the ex-post gross savings.

Ex-Post Net Savings

The facility representative indicated that the program was somewhat influential in the implementation of the VSD chiller measure. They indicated that the SBD representative first introduced this measured. They also stated that they may not have gone as far with the energy saving suggestions without the program. The design team implemented 100% of the SBD recommendations. The combination of all these answers yields a freeridership score of 4.5 out of 6, or 25% freeridership. Therefore ex-post net savings are evaluated at 75% of the ex-post gross savings as summarized in Table 145.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	177.0	117.1	66%	0.75	87.8
kWh	588,316	1,027,458	175%	0.75	770,594

Table 145: P25992 Savings Comparison

The facility representative indicated that the program was very influential in the implementation of the VSD cooling tower measure. They indicated that the SBD representative first introduced this measured. They also stated that without the program they would have let the designers give them their recommendations regardless of how efficient the system was. The combination of these answers yields a freeridership score of 5 out of 6, or 17% freeridership. Therefore, ex-post net savings are evaluated at 83% of the ex-post gross savings as summarized in Table 146

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	24.0	24.0	100%	0.83	20.0
kWh	100,961	100,961	100%	0.83	84,134

Table 146: P25992 Savings Comparison

Total Site Savings

The energy savings for both measures combined are shown in Table 147.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to Gross Ratio	Ex-Post Net Savings
peak kW	201.0	141.1	70%	0.76	107.8
kWh	689277	1128419	164%	0.76	854728

Table 147 : P25992 Total Savings Comparison

P17655

Measure Overview

Project P17655 received an incentive of $75,000 to install an efficient proprietary gas fired candy dryer and high volume low speed fans for worker comfort. The baseline of the gas fired dryer is a batch process tunnel dryer and the baseline of the high volume low speed fans are standard speed fans. . The ex-ante gross savings assumes that the plant operates 300 days a year. The site contact reported the same annual days of operation.

Ex-Ante Gross Savings

Gas Savings

Gas savings of the Custom Dryer = (Proposed therms / million pieces) x (number of millions a day) x (number of days a year)

Gas savings of the Spiral Dryer = 423 therms /year x 2 millions a day x 300 days a year

Gas savings of the Spiral Dryer = 253,000 therms / year

Electric Savings

Fan savings = kWh difference / million pieces) x (number of millions a day) x (number of days a year)

Dryer Savings = 96 x 2 x 300 kWh/yr

= 57,600 kWh/yr

Fan Savings = 4,120 kWh/yr

Ex-Post Gross Savings

The ex-post gross savings were assumed to be the same as the ex-ante gross savings. All assumptions seemed reasonable.

Ex-Post Net Savings

The facility representative indicated that the program was somewhat influential in the implementation of these measures. He also indicated that the SBD had no influence on this measure and they would have installed the measure exactly the same without the presence of the Savings by design program. The combination of these answers yields a freeridership score of 0.5 out of 6, or 92% freeridership. Therefore ex-post net savings are evaluated at 8% of ex-post gross savings as summarized in Table 148 and Table 149.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	2.1	2.1	100%	0.08	0.2
kWh	61,760.0	61,760.0	100%	0.08	5146.7

Table 148: P17655 Electric Savings Comparison

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
Therms	253,000	253,000	100%	8%	21,083

Table 149: P17655 Gas Savings Comparison

S17052

Measure Overview

Project S17052 received an incentive of $65,037 for installing three high efficiency Flottweg decanter centrifuges with SIMP mechanical drives in their ethanol plant. The baseline of this measure is Alfa Laval centrifuges with conventional back drives. The energy savings comes from the reduction in losses from using SIMP drive versus conventional back drive.

Due to superior efficiency of the SIMP centrifuges savings of 30 hp per unit are achieved. By assuming full load motor efficiency as 0.88 (same as the ex-ante gross calculation) the input power savings will be 25.43 kW per unit. According to plant personnel these units run 8,520 hours per year.

Ex-Post Gross Savings

Total Ex-post gross kW Savings = (Input Power /unit) x no. of units x 0.96[1]

= 25.43 x 3 x 0.96 = 73.23 kW

Total Ex-post gross kWh Savings = (Input Power /unit) x no. of units x 0.96[1] x Annual Operating Hours

= (25.43) x 3 x 0.96 x 8520 = 624,036 kWh/ yr

Ex-Post Net Savings

The facility representative indicated that the program was not at all influential in the implementation of these measures. He also indicated that the SBD had no influence on this measure and it probably would have been installed exactly the same without the presence of the Savings By Design program. The combination of these answers yields a freeridership score of 1 out of 6, or 83% freeridership. Therefore, ex-post net savings are evaluated at 17% of the ex-post gross savings as summarized in Table 150.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	0.0	73.2	N/A	0.17	12.2
kWh	650,037.0	624,035.5	96%	0.17	104005.9

Table 150: S17052 Savings Comparison

[1] Is the load factor of the unit as per plant personnel

P12691

Measure Overview

Project P12691 received an incentive of $24,126.00 for installing a VSD on a 600 hp booster pump with a premium efficiency motor. The baseline of this system is a 600 hp constant volume pump with a standard efficiency motor. The evaluation team visited the site and found out that the VSD was not working and the booster pump was running at constant speed. According to the technician the VSD had some design issues and was supposed to be repaired within 2 weeks of the visit from the evaluation team. Monitoring equipment was installed on the pump for a period of 8 weeks on the assumption that the VSD would be functioning by that time. At the time of retrieval of the monitoring equipment the pump was still running without the VSD. This results in ex-post gross savings of zero for this measure.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of this measure. He also indicated that the SBD incentive made this an easier sell and they probably would not have installed the measure exactly the same without the presence of the Savings By Design program. The combination of these answers yields a freeridership score of 4 out of 6, or 33% freeridership. Therefore ex-post net savings are evaluated at 67% of the ex-post gross savings. However, since no gross savings were realized, there are consequently no net savings.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	70	0.0	0%	0.0	0.0
kWh	804,211	0.0	0%	0.0	0.0

Table 151: P12691 Savings Comparison

P18087 X

P26189

Fine Bubble Aerator – Gas Savings

P26189 received an incentive of $75,000.00 for installing a gas driven engine fined bubble aerator system. The baseline for this system is a coarse bubble aeration system of the same capacity. A PG&E representative performed a post field visit and verified the installation of the above two measures. Therefore, the only verification that the evaluation team could perform is the verification of operating hours.

Ex-Ante Gross Savings

The energy savings are a result of the selection of fine bubbles over coarse bubbles in the secondary treatment aeration process and were calculated as follows:

1. The reduction in air flow estimated as 4000 cfm/tank was confirmed during the conversation with the plant personnel.
2. The reduction in gas consumption in Btu/tank = 4000 cfm/tank ÷ 0.19[2]cf/Btu

   = 21,053 Btu/m/tank

By confirming the annual operating hours of the aerator the annual gas savings in therms per tank are estimated as follows:

21,053 Btu/m/tank x 60m/hr x 8,760 ÷ 100,000 Btu/therms

= 110,655 therms/year/tank

Annual savings for all four tanks = 110,655 x 4 = 442,620 therms/ year

Ex-Post Gross Savings

The ex-post gross savings were assumed to be the same as the ex-ante gross savings. All assumptions seemed reasonable.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of this measure. He also indicated that the SBD incentive made it an “easier sell” and they probably would not have installed the measure without the presence of the Savings by Design Program. The combination of all these answers yields a freeridership score of 5 out of 6 or 17 % freeridership. Therefore ex-post net savings are evaluated at 83% of ex-post gross savings as summarized in Table 152.

[2] Assumed value is 0.19cf/BTU

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
Therms	442,620	442,620	100%	0.83	368,850

Table 152 : P26189 Savings Comparison

P18087

Fine Bubble Aerator – Electric Savings

P18087 received an incentive of $75,000.00 for installing an electric driven fine bubble aerator system. The baseline for this measure is a coarse bubble system with the same capacity. A PG&E representative performed a post field visit and verified the installation of the above two measures. Therefore, the only verification that the evaluation team could perform is the verification of operating hours.

Ex-Ante Gross Savings

The energy savings are a result of the selection of fine bubbles over coarse bubbles in the secondary treatment aeration process and were calculated as follows:

1. The reduction in air flow was estimated as 4000 cfm/tank was confirmed with during the conversation with the plant personnel.
2. The demand reduction in kW/tank = 4000 cfm/tank x 40[3]w/cfm ÷ 1000w/kW = 160 kW/tank

By confirming the annual operating hours of the aerator the annual electric savings in kWh per tank are estimated as follows:

Annual kWh savings per tank = 160 kW x 8,760 hrs = 1,401,600 kWh

Annual savings for two incented tanks = 1,401,600 x 2 = 2,803,000 kW-hrs/year

Ex-Post Gross Savings

The ex-post gross savings were assumed to be the same as the ex-ante gross savings. All assumptions seemed reasonable.

Ex-Post Net Savings

The facility representative indicated that the program was very influential in the implementation of this measure. He also indicated that the SBD incentive made it an "easier sell" and they probably would not have installed the measure without the presence of the Savings by Design Program. The combination of all these answers yields a freeridership score of 5 out of 6 or 17 % freeridership. Therefore ex-post net savings are evaluated at 83% of ex-post gross savings as summarized in Table 153.

[3] Assumed 40w/cfm

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Site Net-to-Gross Ratio	Ex-Post Net Savings
peak kW	320	320	100%	0.83	267
kWh	2,803,000	2,803,000	100%	0.83	2,335,833

Table 153: P18087 Savings Comparison

P25949

P25949 received an incentive of $75,000.00 for installing a new plate and frame heat exchanger system as part of a production expansion effort to improve its preheating efficiency. The baseline for this measure is no heat exchanger installed as the production was using fan coil units to reject heat to the ambient air prior to the production expansion. A utility representative performed a post field visit and verified the installation of the measure.

During the evaluation team's phone interview with the facility representative, it was found that the incented heat exchanger failed prematurely. The heat exchanger could not tolerate the thermal cycling of this application. Essentially, the heat exchanger was incorrectly specified by the facility engineering team, and consequently was not covered under warranty. An additional $450K was then spent on modification and controls for a shell and tube heat exchanger, which is a more suitable design for the installation.

<u>Ex-Ante Gross Savings</u>

The gross savings for the site is the natural gas usage avoided through installation of the heat exchanger. The feed stream was heated solely by a direct-fired gas heater prior to the production expansion. Therefore, any heat supplied to the feed stream saved natural gas energy by reducing the load for the heater.

The ex-ante calculations assumed a production rate 10,000 Barrels per day, a 239F degree rise across the heat exchanger and downtime of 5%

The anticipated heat flux during was calculated at 17.249 MMBtu/hr. The annual therm savings were calculated as follows:

therm/yr savings = (heat flux [MMBtu/hr]) (10 therms/MMBtu)*(1 – downtime) * (8760 hr/yr)

= 17.249*10*(1-0.5)* (8760)

=1,435,462 therms/yr

<u>Ex-Post Gross Savings</u>

Based upon facility supplied production data, the average temperature rise of the feed stream across the heat exchanger was 251F, and the average flow rate (during operation) was 8000 Barrels per day or 14 million gallons per hour. Given the fluid heat capacity of 4.078 Btu/Gallon, the average heat flux across the heat exchanger was 14.33 MMBtu/hr. Coupled with the facility downtime fraction derived from production data, 0.325, the annual savings were estimated at 847,841 therms per year

(14.33/10)*(1-0.325) = 847,841 therms/yr

The deviation between the realized savings and the anticipated savings can be attributed to an overestimation of production in the ex ante calculations. The predicted increase in overall facility production rate that was factored into the ex ante calculations was not realized. The flow rate through the heat exchanger was 20% less than anticipated. Additionally, the facility downtime was underestimated, actually facility downtime, as calculated from the most recent 1 and 2/3 years of facility data, was 6 and a half times greater than anticipated.

Ex-Post Net Savings

According to project decision-makers, the utility representative was very influential in implementation of this measure. He influenced the implementation by verifying the savings calculations at the beginning of the project and being in regular communication with the project manager through the course of the project. The decision-maker stated that in the absence of utility representative influence, the project would have been installed, but with a less efficient heat exchanger. Under the approved net savings methodology this combination of answers yields a measure net-to-gross ratio of 0.667[4].

Site results are summarized below.

	Ex-Ante Gross Savings	Ex-Post Gross Savings	Gross Realization Rate	Measure Net-to-Gross Ratio	Ex-Post Net Savings
therms	1,435,462.0	847,841	59%	0.667	565,227

Table 154 : P25949 Savings Comparison

[4] For the purposes of the TRC calculation, the project cost should include the total installation cost of the first installation plus two-thirds of the second installation, ~$300,000 since the cost of the second heat exchanger was necessary to realize any savings for this site. By rule, participant free-ridership costs are not included the TRC.

Utility Specific Savings by Measure Category

The following tables show the measure category components of savings used to calculate the utility totals in the ex-post gross analysis section of the report. In the utility specific measure category savings section, due to small sample sizes, mean per unit estimation was used on categories where ratio estimation was not possible. As a result relative precisions and error bounds could not be calculated for those sites. The high relative precisions are a result budget constraints and sample design being performed to optimize optimal relative precision statewide level, as stated in the approved research plan.

Annual Ex-Post Gross Energy Savings

	Measure Category	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	360	419	116.5%	NA
	LPD	13,209	4,974	37.7%	36.6%
	Daylighting Controls	1,750	1,726	98.6%	4.9%
	Other Lighting Controls	973	911	93.7%	2.7%
	HVAC + Motors	2,935	2,174	74.1%	6.6%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	49,541	5,946	12.0%	13.8%
	Combined Commercial Total	**68,768**	**8,593**	**12.5%**	**13.4%**
	Industrial	34,454	5,171	13.5%	NA

Table 155: PGE Ex-Post Gross Energy Savings

	Measure Category	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	483	781	161.6%	NA
	LPD	3,628	2,771	76.4%	25.2%
	Daylighting Controls	1,766	2,246	127.2%	12.3%
	Other Lighting Controls	800	550	68.7%	5.6%
	HVAC + Motors	12,443	4,716	37.9%	32.4%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	48,309	7,437	15.4%	29.9%
	Combined Commercial Total	**67,429**	**9,665**	**14.3%**	**21.2%**
	Industrial	3,399	3,756	61.8%	NA

Table 156: SDGE Ex-Post Gross Electrical Energy Savings

	Measure Category	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	815	1,591	195.2%	NA
	LPD	42,284	18,912	44.7%	30.2%
	Daylighting Controls	14,504	10,807	74.5%	10.4%
	Other Lighting Controls	3,167	1,730	54.6%	2.3%
	HVAC + Motors	25,633	15,819	61.7%	21.5%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	(9)	14	154.6%	0.0%
	Whole Building	30,921	3,879	12.5%	14.8%
	Combined Commercial Total	**117,316**	**28,113**	**24.0%**	**17.4%**
	Industrial	47,224	12,309	22.3%	NA

Table 157: SCE Ex-Post Gross Electrical Energy Savings

	Measure Category	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	134	464	346.1%	NA
	LPD	1,321	1,367	103.5%	10.1%
	Daylighting Controls	-	-	0.0%	0.0%
	Other Lighting Controls	89	106	119.6%	0.7%
	HVAC + Motors	3,490	2,160	61.9%	22.1%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	10,210	2,468	24.2%	13.0%
	Combined Commercial Total	**15,244**	**3,005**	**19.7%**	**13.1%**
	Industrial	1,618	1,808	115.3%	NA

Table 158: SoCalGas Ex-Post Gross Electrical Energy Savings

Annual Ex-Post Gross Demand Reduction

	Measure Category	Ex-Post Gross Demand Reduction (MW)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	0.2	0.2	75.2%	NA
	LPD	1.9	1.1	57.7%	22.9%
	Daylighting Controls	0.5	0.5	99.9%	6.2%
	Other Lighting Controls	0.2	0.1	67.3%	2.2%
	HVAC + Motors	1.4	0.9	61.2%	8.8%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	8.0	2.1	26.3%	16.1%
	Combined Commercial Total	**12.2**	**2.6**	**22.6%**	**9.4%**
	Industrial	6.8	1.3	19.3%	NA

Table 159: PGE Ex-Post Gross Demand Reduction

	Measure Category	Ex-Post Gross Demand Reduction (MW)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	0.1	0.1	130.6%	NA
	LPD	0.4	0.4	86.8%	28.1%
	Daylighting Controls	0.4	0.5	122.7%	28.9%
	Other Lighting Controls	0.1	0.1	67.2%	5.0%
	HVAC + Motors	1.4	0.6	39.9%	26.7%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	8.4	1.5	18.3%	27.7%
	Combined Commercial Total	**10.8**	**1.6**	**16.4%**	**22.1%**
	Industrial	0.1	0.6	76.4%	NA

Table 160: SDGE Ex-Post Gross Demand Reduction

	Measure Category	Ex-Post Gross Demand Reduction (MW)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	0.7	0.5	65.5%	NA
	LPD	5.6	3.3	59.2%	30.4%
	Daylighting Controls	2.6	2.1	79.2%	14.0%
	Other Lighting Controls	0.1	0.4	349.9%	0.6%
	HVAC + Motors	3.9	2.6	68.2%	15.9%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	(0.1)	0.1	-156.6%	-0.6%
	Whole Building	6.7	1.3	19.1%	17.4%
	Combined Commercial Total	**19.6**	**5.7**	**33.8%**	**19.1%**
	Industrial	4.1	1.8	55.7%	NA

Table 161: SCE Ex-Post Gross Demand Reduction

	Measure Category	Ex-Post Gross Demand Reduction (MW)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	(0.0)	0.1	-416.4%	NA
	LPD	0.2	0.1	87.9%	9.8%
	Daylighting Controls	-	-	0.0%	0.0%
	Other Lighting Controls	0.0	0.0	98.1%	0.9%
	HVAC + Motors	0.5	0.3	61.5%	13.2%
	Refrigeration	-	-	0.0%	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%
	Whole Building	1.7	0.3	17.9%	14.1%
	Combined Commercial Total	**2.4**	**0.5**	**21.1%**	**10.3%**
	Industrial	0.4	0.4	123.3%	NA

Table 162: SoCalGas Ex-Post Gross Demand Reduction

Annual Ex-Post Gross Gas Savings

	Measure Category	Ex-Post Gross Energy Savings (therms)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	305,728	245,055	80.2%	NA
	LPD	(100,053)	NA	NA	-8.0%
	Daylighting Controls	(25,293)	NA	NA	-2.0%
	Other Lighting Controls	(5,812)	NA	NA	-0.5%
	HVAC + Motors	(31,511)	NA	NA	-2.5%
	Refrigeration	24,789	26,689	107.7%	0.7%
	Domestic Hot Water	6,282	5,672	90.3%	1.1%
	Whole Building	44,666	35,055	78.5%	7.1%
	Combined Commercial Total	**218,796**	NA	NA	**-5.2%**
	Industrial	4,412,558	360,296	14.1%	NA

Table 163: PGE Ex-Post Gross Gas Savings

	Measure Category	Ex-Post Gross Energy Savings (therms)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	6,016	10,008	166.4%	NA
	LPD	(14,530)	NA	NA	-1.4%
	Daylighting Controls	(5,615)	NA	NA	-0.5%
	Other Lighting Controls	(4,676)	NA	NA	-0.4%
	HVAC + Motors	850,176	508,544	59.8%	53.9%
	Refrigeration	754	1,261	167.1%	4.3%
	Domestic Hot Water	10,098	9,576	94.8%	832.2%
	Whole Building	1,331,147	201,477	15.1%	60.7%
	Combined Commercial Total	**2,173,369**	NA	NA	**27.9%**
	Industrial	-	-	0.0%	NA

Table 164: SDGE Ex-Post Gross Gas Savings

	Measure Category	Ex-Post Gross Energy Savings (therms)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	119,878	250,710	209.1%	NA
	LPD	(90,894)	NA	NA	-3.8%
	Daylighting Controls	(42,891)	NA	NA	-1.8%
	Other Lighting Controls	(7,560)	NA	NA	-0.3%
	HVAC + Motors	3,987,617	5,494,330	137.8%	74.1%
	Refrigeration	11,038	12,211	110.6%	0.2%
	Domestic Hot Water	6,167	7,260	117.7%	0.3%
	Whole Building	99,021	43,831	44.3%	49.4%
	Combined Commercial Total	**4,082,376**	NA	NA	**-2.1%**
	Industrial	-	-	0.0%	NA

Table 165: SCE Ex-Post Gross Gas Savings

	Measure Category	Ex-Post Gross Energy Savings (therms)	Error Bound	Relative Precision	Savings as % of End Use Baseline
Systems Approach	Shell	6,369	NA	NA	NA
	LPD	(1,156)	NA	NA	-2.1%
	Daylighting Controls	(5,119)	NA	NA	-9.1%
	Other Lighting Controls	(228)	NA	NA	-0.4%
	HVAC + Motors	3,772	NA	NA	6.7%
	Refrigeration	893	NA	NA	294.9%
	Domestic Hot Water	2,397	NA	NA	118.9%
	Whole Building	7,849	16,195	206.3%	1.3%
	Combined Commercial Total	**14,777**	NA	NA	**2.0%**
	Industrial	-	-	0.0%	NA

Table 166: SoCalGas Ex-Post Gross Gas Savings

Incented Measures Analysis

The following tables show the impacts of the program solely for measures that have explicitly received incentives. In essence, these results include all whole building approach project savings and the system project savings for the incented systems only. Any savings for systems projects with above baseline equipment that was not incented are not included here.

It has been a long standing policy to include whole building savings for new construction projects in California, even for those using the systems or prescriptive incentive path. Under the Title 24 performance approach, the credit for one building system being above baseline can be "traded off" in order to install another building system that is below baseline resulting in a building that is minimally compliant, or near minimally compliant in overall performance. The logic behind reporting the whole building saving as project savings is that the program will not benefit from providing incentives to the efficient part of a near baseline building. This policy also reflects the theory that projects should be evaluated as comprehensively and holistically as possible.

The measures only tables shown below are shown for informational purposes only. The measures only results provide insight to the relative impacts between system approach measure categories and system approach versus whole building approach categories.

Ex-Post Gross Energy Savings Incented Measures

Ex-Ante Gross Energy Savings (MWh)	Sampled Energy Savings (MWh)	% Energy Savings Sampled	Ex-Post Gross Energy Savings (MWh)	Realization Rate
344,748	144,339	41.9%	317,392	92.1%

Table 167: Annual Ex-Post Gross Energy Savings – Incented Measures Only

	Measure Category	Ex-Post Gross Energy Savings (MWh)	Error Bound	Relative Precision	Savings as % of End Use Baseline	Ex-Ante Gross Energy Savings (MWh)	Gross Realization Rate
Systems Approach	Shell	25	27	110.6%	NA	55	45.0%
	LPD	50,355	19,526	38.8%	24.9%	51,512	97.8%
	Daylighting Controls	14,638	10,880	74.3%	7.2%	10,557	138.7%
	Other Lighting Controls	-	-	0.0%	0.0%	-	0.0%
	HVAC + Motors	22,458	7,889	35.1%	10.7%	28,733	78.2%
	Refrigeration	-	-	0.0%	0.0%	-	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%	-	0.0%
	Whole Building	136,500	13,663	10.0%	17.5%	151,002	90.4%
	Combined Commercial Total	**224,254**	**26,654**	**11.9%**	**16.4%**	**228,003**	**98.4%**
	Industrial	93,138	16,808	18.0%	NA	102,839	90.6%

Table 168: Annual Ex-Post Gross Energy Savings and Realization Rates by

Measure Category – Incented Measures Only

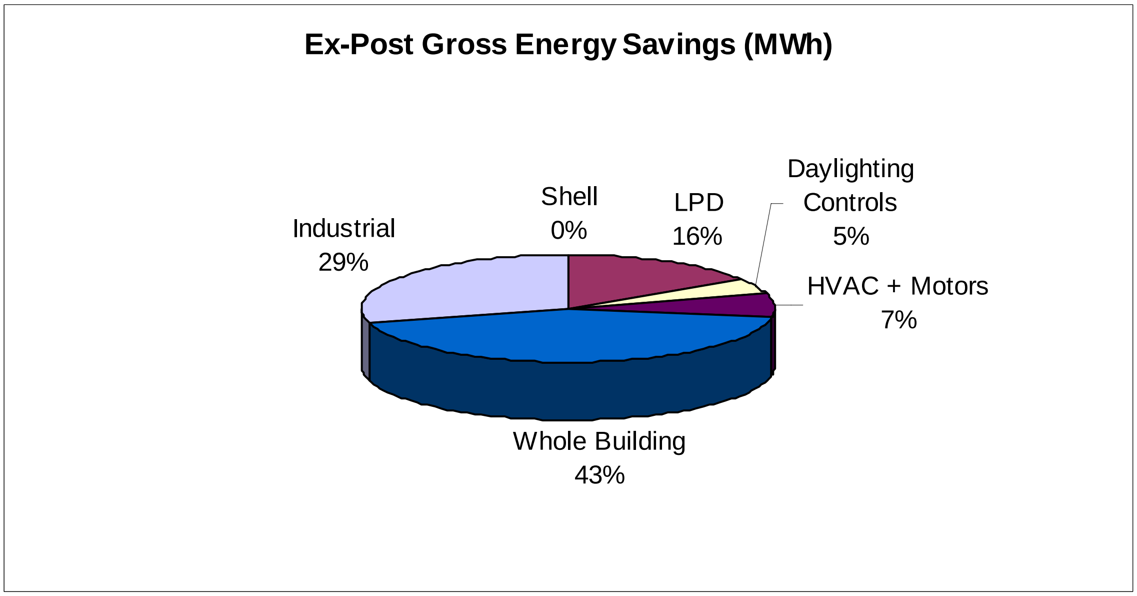


Figure 133: Composition of Estimated Annual Ex-Post Gross Energy Savings – Incented Measures Only

Ex-Post Gross Demand Reduction Incented Measures

Ex-Ante Gross Demand Reduction (MW)	Sampled Demand Reduction (MW)	% Demand Reduction Sampled	Ex-Post Gross Demand Reduction (MW)	Realization Rate
68.7	27.3	40%	52.5	76.4%

Table 169: Summer Peak Ex-Post Gross Demand Reduction – Incented Measures Only

	Measure Category	Ex-Post Gross Demand Reduction (MW)	Error Bound	Relative Precision	Reduction as % of End Use Baseline	Ex-Ante Gross Demand Reduction (MW)	Gross Realization Rate
Systems Approach	Shell	0.003	0.004	124.3%	NA	0.0	10.9%
	LPD	8.0	3.8	46.8%	25.8%	8.3	96.6%
	Daylighting Controls	3.2	2.3	71.5%	10.2%	2.3	135.2%
	Other Lighting Controls	-	-	0.0%	0.0%		0.0%
	HVAC + Motors	5.5	2.2	39.6%	11.2%	10.8	50.9%
	Refrigeration	-	-	0.0%	0.0%	-	0.0%
	Domestic Hot Water	-	-	0.0%	0.0%	-	0.0%
	Whole Building	25.2	3.1	12.5%	18.8%	37.1	67.9%
	Combined Commercial Total	**41.9**	**6.9**	**16.5%**	**17.1%**	**58.5**	**71.7%**
	Industrial	10.6	3.7	34.9%	NA	10.1	105.0%

Table 170: Summer Peak Ex-Post Gross Demand Reduction and Realization Rates by Measure Category – Incented Measures Only

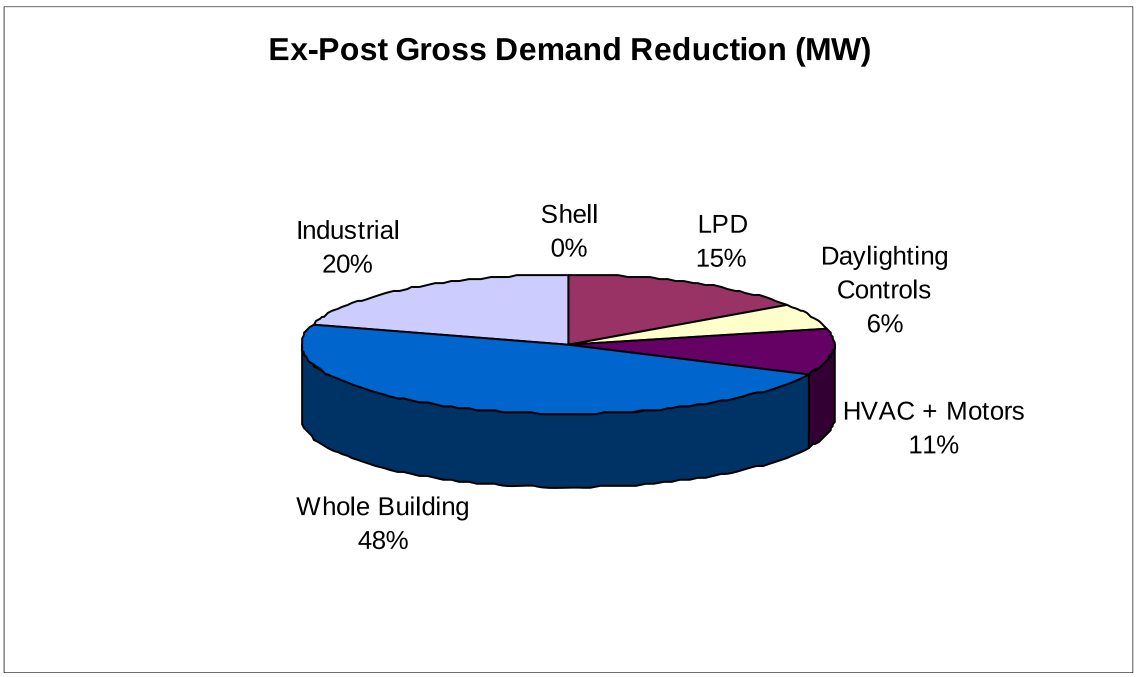


Figure 134: Composition of Summer Peak Ex-Post Gross Demand Reduction – Incented Measures Only

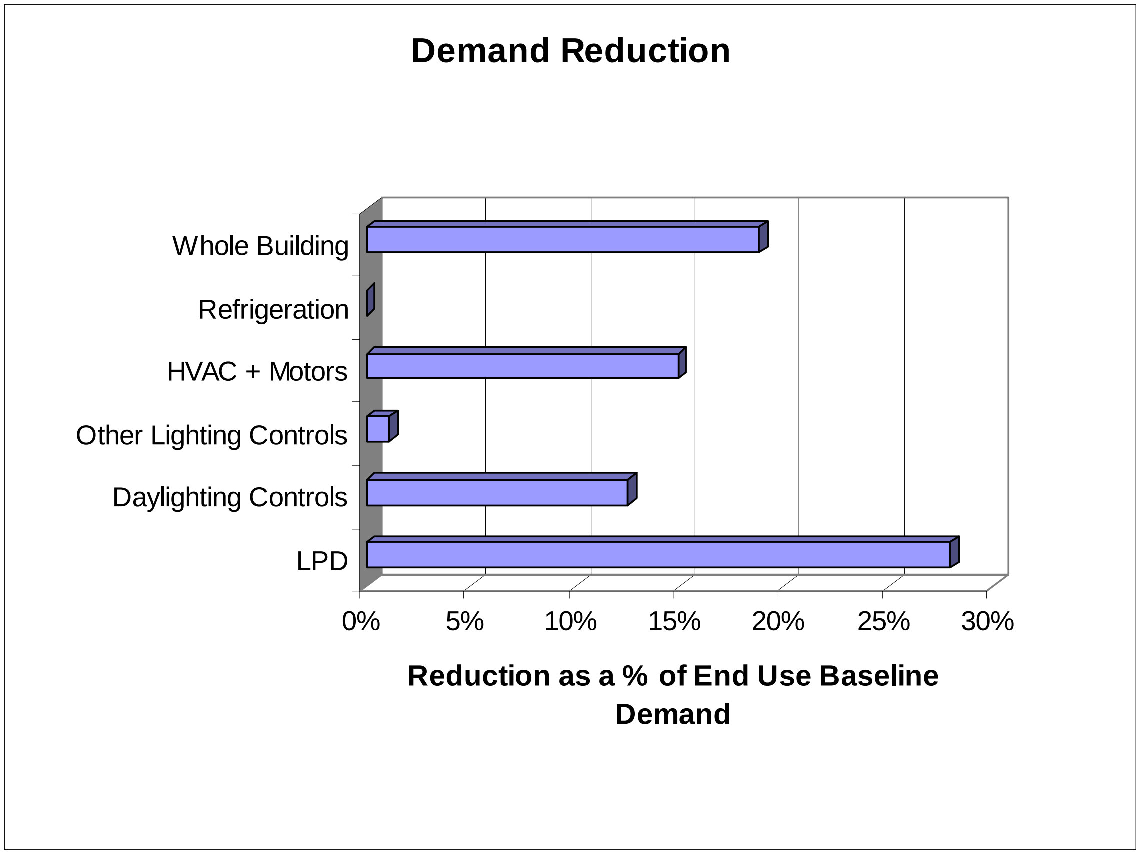


Figure 135: Demand Reductions as Percentages of End Use Baseline – Incented Measures Only

Ex-Post Gross Gas Savings Incented Measures

Ex-Ante Gross Energy Savings (Therms)	Sampled Energy Savings (Therms)	% Energy Savings Sampled	Ex-Post Gross Energy Savings (Therms)	Realization Rate
8,662,541	4,194,603	48.4%	5,684,204	65.6%

Table 171: Incented Measure Gas Savings

Ex-Post Net Energy Savings Incented Measures

	Measure Category	Ex-Post Net Energy Savings (MWh)	Ex-Post Gross Savings (MWh)	Net-to-Gross Ratio	Ex-Ante Gross Energy Savings (MWh)
Systems Approach	Shell	37	25	150.8%	53
	LPD	35,117	50,355	69.7%	50,269
	Daylighting Controls	14,307	14,638	97.7%	10,302
	Other Lighting Controls	-	-	NA	-
	HVAC + Motors	17,615	22,458	78.4%	28,040
	Refrigeration	-	-	NA	-
	Domestic Hot Water	-	-	NA	-
	Whole Building	95,831	136,500	70.2%	151,002
	Combined Commercial Total	**163,024**	**224,254**	**72.7%**	**231,036**
	Industrial	59,209	93,138	63.6%	105,033

Table 172: Net and Gross Savings Rates by Measure Category – Incented Measures Only

Ex-Post Net Demand Reduction Incented Measures

	Measure Category	Ex-Post Net Demand Reduction (MW)	Ex-Post Gross Demand Reduction (MW)	Net-to-Gross Ratio	Program Estimated Demand Reduction (MW)
Systems Approach	Shell	0.003	0.003	100.0%	0.03
	LPD	5.3	8.0	65.8%	8.3
	Daylighting Controls	3.2	3.2	100.6%	2.3
	Other Lighting Controls	-	-	NA	-
	HVAC + Motors	3.6	5.5	65.9%	10.8
	Refrigeration	-	-	NA	-
	Domestic Hot Water	-	-	NA	-
	Whole Building	18.3	25.2	72.7%	37.1
	Combined Commercial Total	**30.4**	**41.9**	**72.6%**	**58.5**
	Industrial	7.0	10.6	65.9%	10.1

Table 173: Participant Gross and Net Demand Savings by Measure Category – Incented Measures Only

Ex-Post Net Gas Savings Incented Measures

	Measure Category	Ex-Post Net Energy Savings (Therms)	Ex-Post Gross Savings (Therms)	Net-to-Gross Ratio	Ex-Ante Gross Energy Savings (Therms)
Systems Approach	Shell	(8,303)	(8,304)	100.0%	(163.70)
	LPD	(143,810)	(197,264)	72.9%	(145,933)
	Other Lighting Controls	-	-	NA	-
	Daylighting Controls	(16)	(16)	100.0%	(20,141)
	HVAC + Motors	651,352	709,749	91.8%	1,701,315
	Refrigeration	-	-	NA	-
	Domestic Hot Water	-	-	NA	-
	Whole Building	1,393,582	1,213,583	114.8%	1,343,315
	Combined Commercial Total	**1,928,259**	**1,625,113**	**118.7%**	**2,878,393**
	Industrial	2,512,685	4,059,091	61.9%	5,784,148

Table 174: Participant Net and Gross Therm Savings by Measure Category – Incented Measures Only

Onsite Survey Instrument

General Information

Site ID # [ ]

Surveyor Name:		Building Name:
Date:	Primary Contact:	Phone:
Building Address:		
City		Zip

Start Time:	Finish Time:

Interview Questions

The following interview questions will be used to help us identify unobservable aspects of your building. These aspects include occupancy history, schedules, and heating and cooling controls. Answers to these questions will be coupled with data collected from our walk-through audit to produce a computer model which simulates the annual energy use of the building.

Building Overview

Q1. What is the overall building floor area? ____________SF

Q2. How many floors? ____________

Q3. What is the floor area of the new construction?

- o same as overall building floor area
- o ____________SF

Q4. Characterize the site by circling the appropriate description:

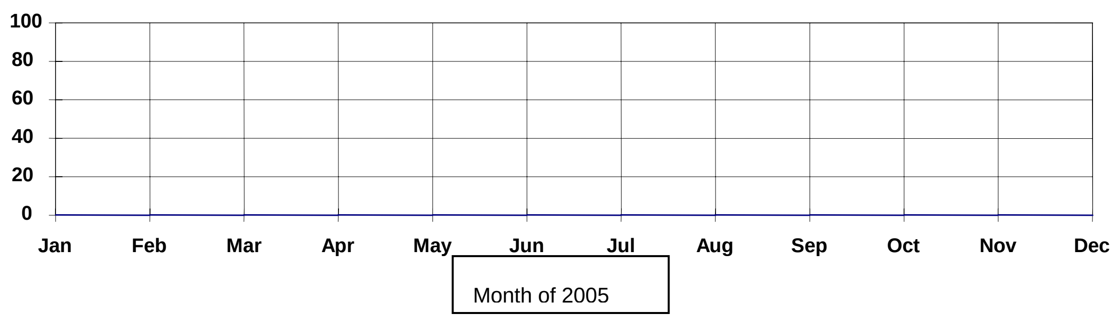
1. New building ("green field")
2. Alteration of existing building
3. Addition to existing building
4. Alteration of existing building and addition to existing building

Q5. Circle the appropriate building type description:

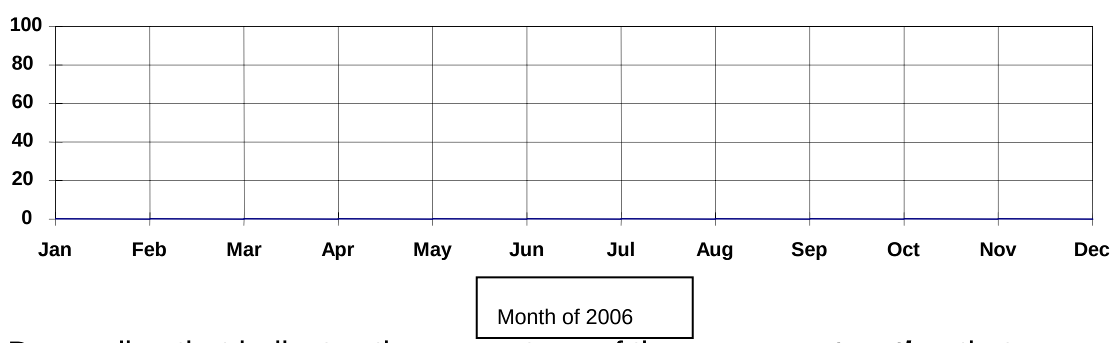
1	Small office	11	Hotel
2	Large office	12	Small school
3	Small retail	13	Large school
4	Multi-story large retail	14	Community college
5	Single story large retail	15	Large university
6	Grocery	16	Assembly
7	Quick service restaurant	17	Hospital
8	Full-service restaurant	18	Lt. Manufacturing
9	Conditioned warehouse	19	Bio/Tech Manufacturing
10	Uncond. warehouse		

Building Start-up

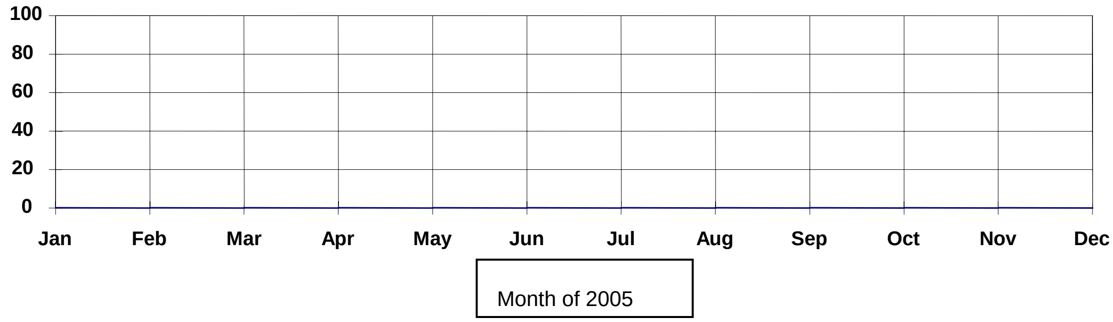
Q6. Draw a line that indicates the percentage of the ***new construction*** that was occupied (% of floor area) for 2005.



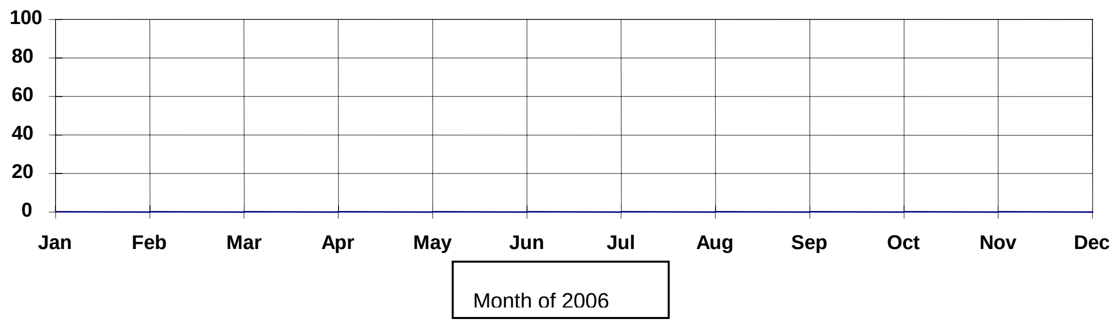
Q7. Draw a line that indicates the percentage of the ***new construction*** that was occupied (% of floor area) for 2006.



Q8. Draw a line that indicates the percentage of the ***new construction*** that was conditioned (% of floor area) during 2005.



Q9. Draw a line that indicates the percentage of the ***new construction*** that was conditioned (% of floor area) during 2006.



Building Areas

Q10. How many individual tenants (businesses) occupy this building?

____

Q11. Do the majority of tenants have their own electric meter? Y N

Q12. Which statement best describes the operation of the building?

( ) The entire building operates on *basically* the same schedule

( ) There are areas of the building (departments, tenants, etc.) that have *substantially* different operating schedules

Q13. If different areas of the building (departments, tenants, etc.) have *substantially* different operational schedules, divide the building into up to five areas with differing schedules, and provide a name for each area:

1. ________________________

2. ________________________

3. ________________________

4. ________________________

5. ________________________

Notes:

o **Building-Wide - or -**	**Area #___ and Area Name** ________________________
(fill out only one page)	(fill out one page per area)

Schedules

The following questions will help us establish schedules for the building.

Q14. What would be the best way to group the days of the week to describe the operation of this area? One of the three operation levels must be assigned to each day of the week.

	M	Tu	W	Th	F	Sa	Su	Holiday
Full operation:	o	o	o	o	o	o	o	o
Light operation:	o	o	o	o	o	o	o	o
Closed:	o	o	o	o	o	o	o	o

Q15. Are there any months that this area has higher or lower than normal operating hours? Indicate months of increased or decreased operating hours. Normal (100%) is assumed for blank entries.

	Lighting	HVAC	Equip and Process
	% of Normal	% of Normal	% of Normal
Jan	____%	____%	____%
Feb	____%	____%	____%
Mar	____%	____%	____%
Apr	____%	____%	____%
May	____%	____%	____%
Jun	____%	____%	____%
Jul	____%	____%	____%
Aug	____%	____%	____%
Sep	____%	____%	____%

Oct	____%	____%	____%
Nov	____%	____%	____%
Dec	____%	____%	____%

Q16. Which holidays are observed (check all that apply)

o New Years day o MLK day o Presidents' day o Easter ______ days

o Memorial day o July 4th o Labor day o Columbus day

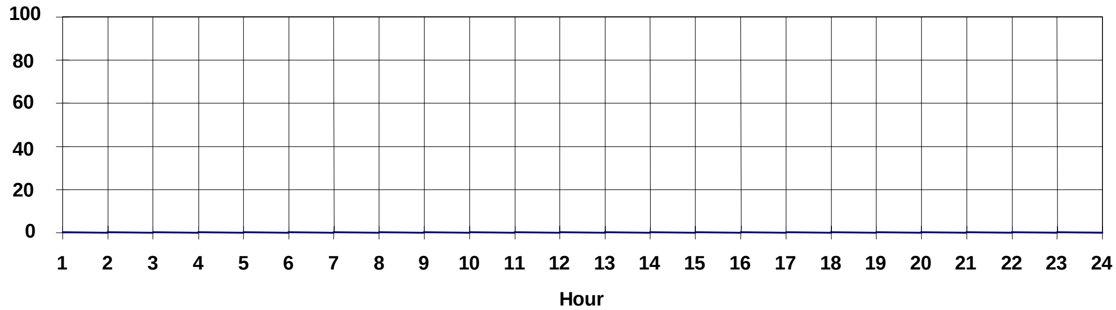
o Veteran's day o Thanksgiving ____ days o Christmas _____ days

Note: Holidays for 2004

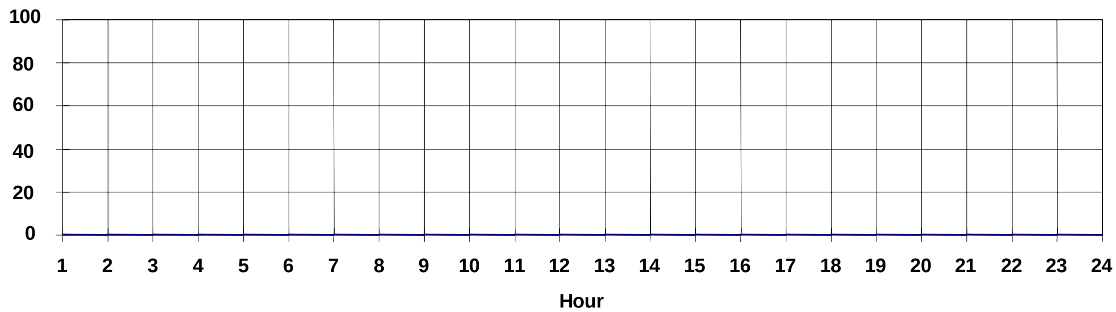
Holiday	Day/Date	Holiday	Day/Date
New Years day	Thur Jan 1	Labor day	Mon Sep 6
MLK day	Mon Jan 19	Columbus day	Mon Oct 11
Presidents' day	Mon Feb 16	Veteran's day	Sun Nov 11
Easter	Sun Apr 11	Thanksgiving	Thur Nov 25
Memorial day	Mon May 31	Christmas	Sat Dec 25
July 4th	Sun Jul 4		

ο **Building-Wide** **- or -**	**Area #___ and Area Name** ________________________
(fill out only one page)	(fill out one page per area)

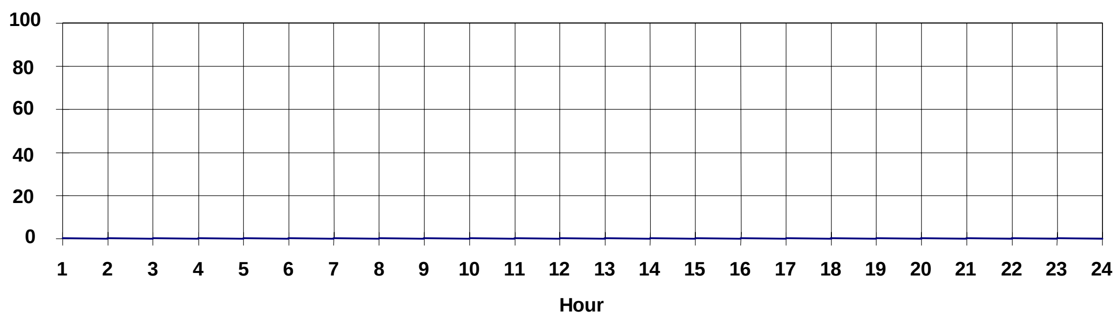
Q17. Draw a line that describes the ***occupancy*** schedule for a ***full operation day***.



Q18. Draw a line that describes the ***occupancy*** schedule for a ***light operation day***.

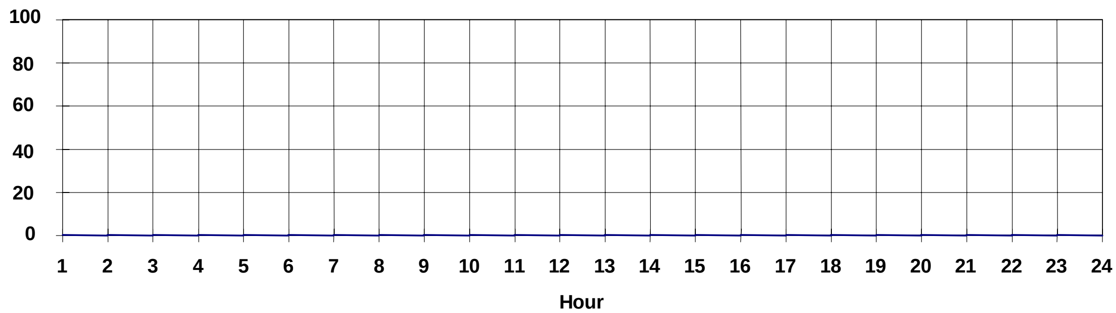


Q19. Draw a line that describes the ***occupancy*** schedule for a ***closed operation day***.

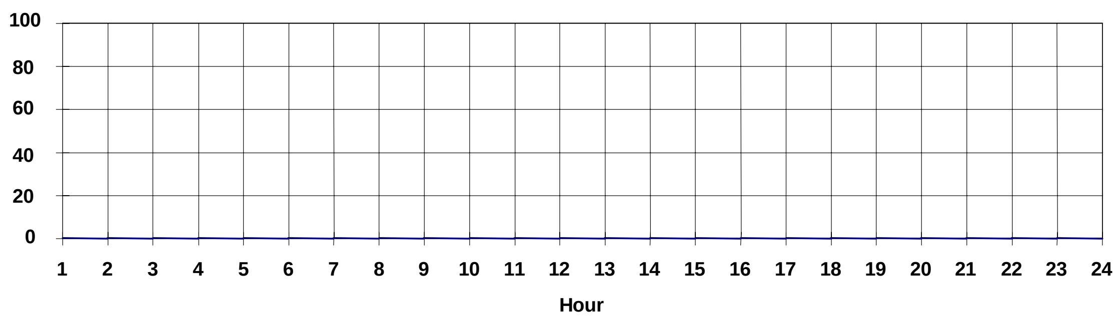


ο **Building-Wide - or -**	**Area #___ and Area Name**
(fill out only one page)	(fill out one page per area)

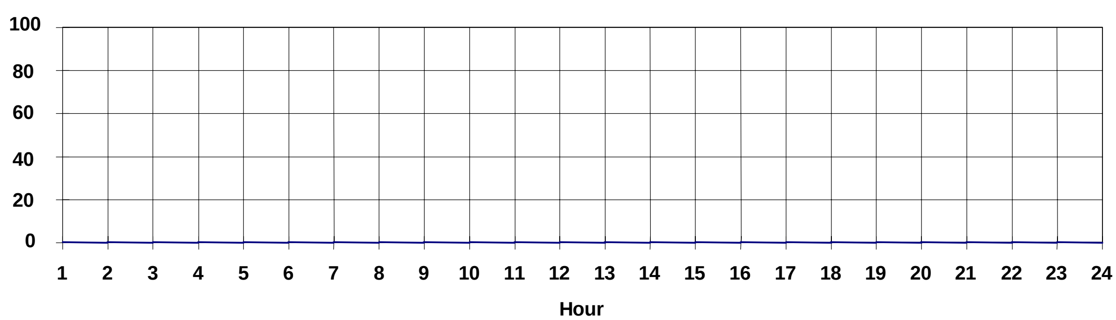
Q20. Draw a line that describes the schedule of use for ***interior lighting*** for a ***full operation day***.



Q21. Draw a line that describes the schedule of use for ***interior lighting*** for a ***light operation day***.



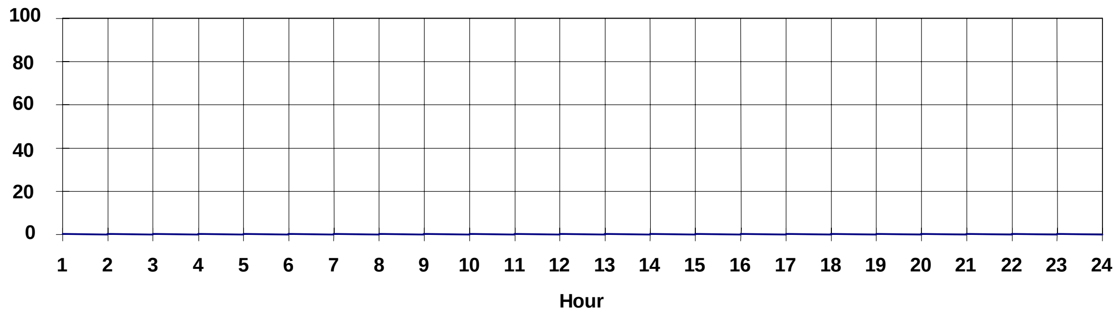
Q22. Draw a line that describes the schedule of use for ***interior lighting*** for a ***closed operation day***.



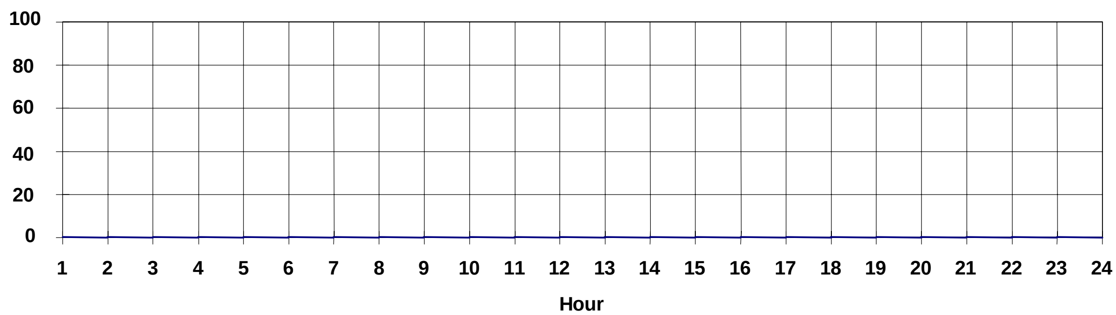
o **Building-Wide - or -**	**Area #___ and Area Name** ______________________
(fill out only one page)	(fill out one page per area)

Miscellaneous equipment and plug loads refer to any electrical equipment located in the conditioned space which is not lighting or HVAC

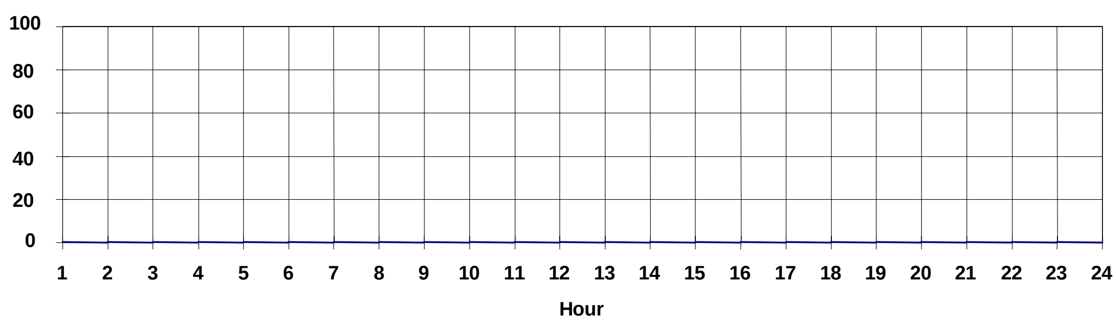
Q23. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***full operation day***.



Q24. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***light operation day***.



Q25. Draw a line that describes the schedule of use for ***miscellaneous equipment and plug loads*** for a ***closed operation day***.

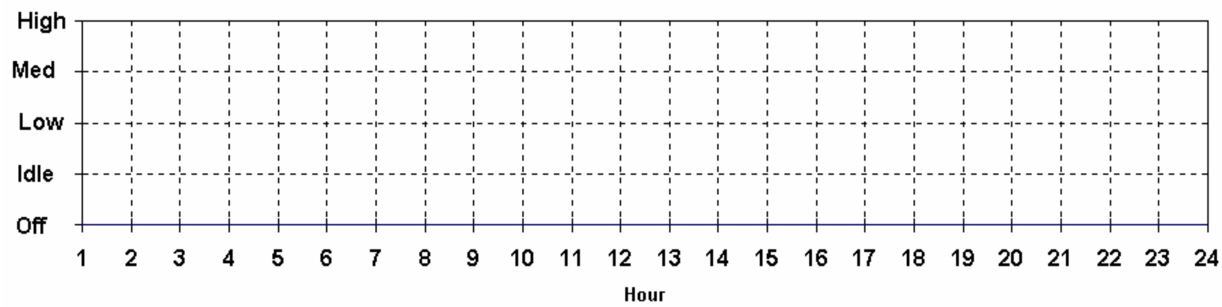


ο **Building-Wide - or - Area #___ and Area Name ________________________**

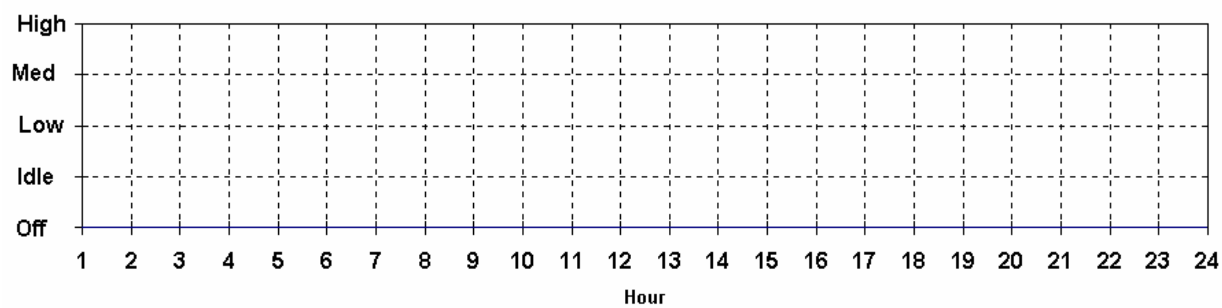
(fill out only one page) (fill out one page per area)

Kitchen Operation

Q26. If the area has a commercial kitchen, draw a line that describes the schedule of use for ***kitchen equipment*** for a ***full operation day***.



Q27. If the area has a commercial kitchen, draw a line that describes the schedule of use for ***kitchen equipment*** for a ***light operation day***.



o **Building-Wide** **- or -**	**Area #___ and Area Name** ________________________
(fill out only one page)	(fill out one page per area)

Room Thermostat Setpoints

Q28. Enter the values for heating and cooling thermostat setpoints during normal (occupied) and setback (unoccupied) periods

Period	**Heating Setpoint**	**Cooling Setpoint**
Occupied		
Unoccupied		

Set CSP to 99 for "off," set the HSP to 45 for "off"

Q29. Are room temperatures in this area controlled by the building EMS? Y N DK

Q30. Does the setback schedule in this area follow the fan on/off schedule? Y N DK

If the answer is N or DK, define the setback schedule below:

Q31. Draw a line that defines the occupied and unoccupied mode for a ***full operation day***. DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q32. Draw a line that defines the occupied and unoccupied mode for a ***light operation day***. DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q33. Draw a line that defines the occupied and unoccupied mode for a ***closed operation day***. DK

Occupied																								
Unoccupied																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

HVAC Fan System Operation

This section is used to establish the fan system schedule. List the hours that the fans are "on" or "off." "On" indicates occupied mode, where the fans run continuously. "Off" indicates unoccupied mode, where the fans cycle on only if needed to satisfy space temperature needs, or are shut off regardless of space temperature.

Q34. Draw a line that describes the fan system operation for a ***full operation day***:

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q35. Draw a line that describes the fan system operation for a ***light operation day***.
DK

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q36. Draw a line that describes the fan system operation for a ***closed operation day***.
DK

on																								
off																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

Q37. Is the fan system described above controlled by the building EMS? Y N DK

Q38. Is the fan system described above controlled using an optimum start algorithm?
Y N DK

Note: For fans with optimal start/stop, indicate the building occupancy schedule - e.g. the time when the building needs to be at normal operating temperature.

Q39. List the nighttime (off cycle) control strategy for the fan system described above:

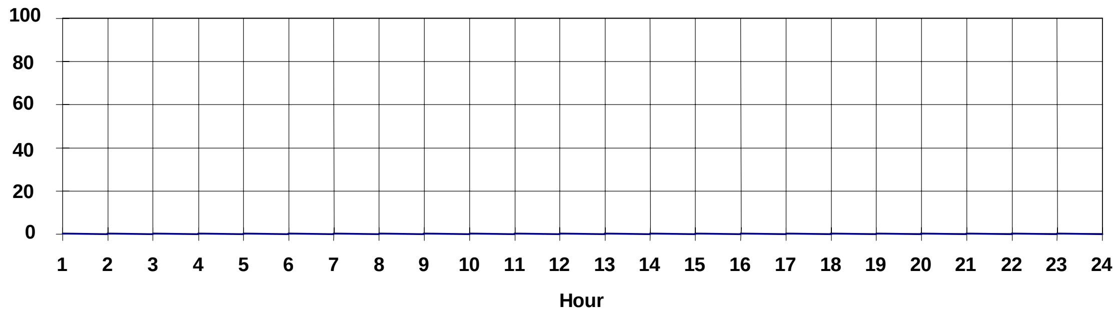
- o Stay off regardless of room temperature
- o Cycle on if any room requires heating or cooling
- o DK

List all air handling units, building areas, and/or packaged HVAC systems that run on this schedule below:

Exterior Lighting

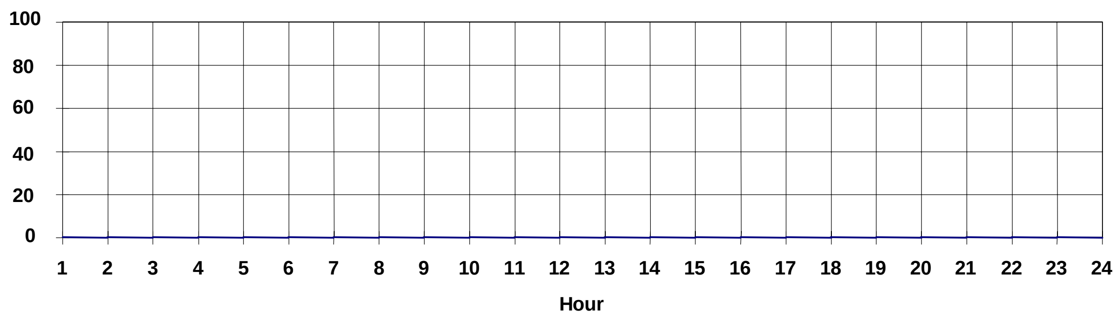
Q40. How are the exterior lights controlled? o Time clock o Photocell o DK

Q41. If the exterior lights are controlled with a time clock, draw a line that describes the schedule

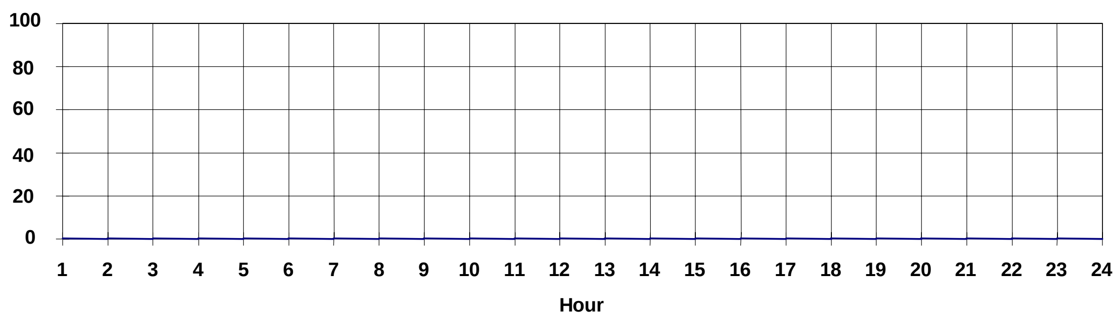


Exterior Miscellaneous Equipment

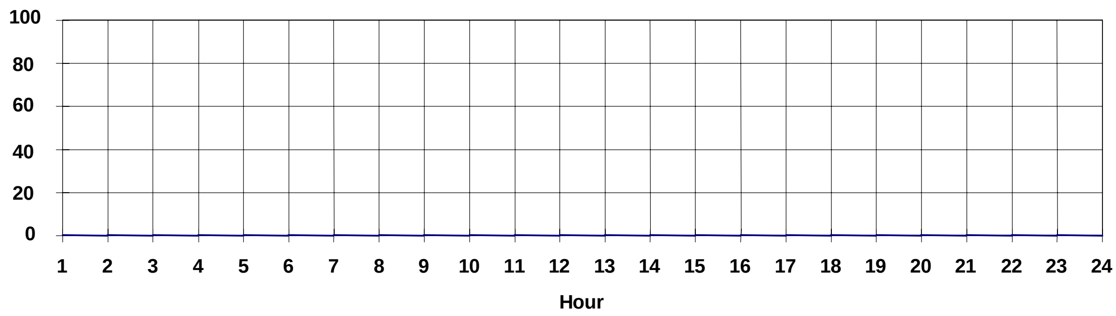
Q42. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***full operation day***



Q43. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***partial operation day***



Q44. Provide a schedule for miscellaneous equipment ***not*** in the conditioned space for a ***closed operation day***


100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour

Central HVAC Design and Control

The following questions will help us to understand how the HVAC systems operate in the building. (These questions are designed to be answered by someone familiar with the operation of the building mechanical and control systems.)

Q45. Does the building have a central energy management system (EMS)? Y N DK

Q46. If the answer above is yes, did you receive a rebate from your utility company to cover any part of the cost of the EMS? Y N DK

In each question below, indicate if the control action specified is initiated by the central EMS.

Q47. What is the minimum cooling supply air temperature setpoint ______°F DK

Q48. How is the supply air temperature controlled?

- o EMS?
- o Fixed
- o Reset based on outside air temp
- o Reset based on zone temp
- o DK

Q49. What is the condenser water setpoint temperature? ______°F DK

Q50. How is the condenser water setpoint temperature controlled?

- o EMS?
- o Fixed
- o Reset based on outside temp
- o DK

Q51. If the system is VAV, how is the flow rate determined?

- o EMS?
- o Duct static pressure
- o Measured air flow at the zone VAV boxes
- o DK

Q52. Are CO_2 sensors used to control outdoor air quantities? Y N DK

oM? o EMS?

Q53. Does the system utilize a humidistat to maintain space humidity? Y N DK
o EMS?

Q54. If yes, indicate minimum and maximum relative humidity: Min RH(%)______ Max RH(%)_______

Q55. Is the heating system turned off (locked out) on a seasonal basis? Y N DK

Q56. If yes, indicate the months when the heating system is typically available:

J F M A M J J A S O N D DK

Q57. If the building has chillers and cooling towers, is the system equipped with a water-side economizer? Y N DK

Q58. If yes, what type of water-side economizer is used?

o Strainer cycle o Thermosyphon o Plate-frame heat exchanger o DK

Q59. Circle the months of the year when the water-side economizer system is typically used:

J F M A M J J A S O N D DK

Refrigeration System

Q60. Does the building have a refrigeration system with remote condensers? Y N DK

If no or DK, skip the remaining questions pertaining to refrigeration systems.

Q61. What refrigerants are used in each circuit of the system?

a. Low temp (Ice cream) R-_____________ DK

b. Med temp (Frozen food) R-_____________ DK

c. High temp (All others) R-_____________ DK

Q62. What is the minimum condensing temperature setpoint? ______°F, DK

Q63. What is condenser fan control strategy? o Fixed temp o wet bulb offset ____°F DK

Q64. For each circuit temperature, what type of defrost cycle and defrost control are typically used?

a. Low temp (Ice cream) defrost o electric o hot gas o time off o DK

defrost control o time clock o demand o DK

b. Med temp (Frozen food) defrost o electric o hot gas o time off o DK

defrost control o time clock o demand o DK

c. High temp (All others) defrost o electric o hot gas o time off o DK

defrost control o time clock o demand o DK

Q65. Are the anti-sweat heaters controlled on store humdity? Y N DK

Q66. If Q56 is yes, list setpoints: RH off _____ % RH on_____ % DK

Q67. List the name and phone number of the refrigeration system service company

Name:____

Phone:________________

Shades and Blinds

Q68. If there are shades or blinds on windows, which ***best*** describes their general use?

- o Always open
- o Always closed
- o Operated by occupants to control comfort
- o Open when space is occupied, closed otherwise

Swimming Pools

Q69. If the building has a heated swimming pool, what water temperature is maintained? ______°F DK

Q70. If the building has a heated swimming pool, is a pool cover used? Y N DK

Q71. If a cover is used, at what time is it normally put on the pool? _____ (military time, blank if DK)

Q72. If a cover is used, at what time is it normally removed from the pool? _____ (military time)

Spas

Q73. If the building has a spa, what water temperature is maintained? ________°F DK

Q74. If the building has a spa, is a cover used? Y N DK

Q75. If a cover is used, at what time is it normally put on the spa? _____ (military time, blank if DK)

Q76. If a cover is used, at what time is it normally removed from the spa? _____ (military time)

Building-Wide Power Generation

Q77. Do you have an emergency back-up generator or cogeneration system? Y N DK

If yes, fill out the supplemental on-site power form

Thermal Energy Storage

Q78. Does the building have a thermal energy storage (TES) system? Y N DK

If yes, fill out the supplemental TES form.

Operations and Maintenance

Q79. Please list any equipment or system operating problems that cause thermal discomfort or excessive energy consumption?

Problem	Equipment and/or Systems Affected
System under or oversized	
Insufficient or excess air flow	
Faulty control sensors	
Improper control sensor installation or location	
Insufficient sensor points for control and/or monitoring	
Improper EMS or control system programming	
Control systems “locked out” (left in manual position)	
Faulty valve or damper linkage or actuator	
Loose fan belts and / or improper alignment	
Improper ductwork installation or leakage	
Leaky valves, pipes, or fittings	
Defective major components (compressors, pumps, fans, etc.)	
Refrigerant leakage	
Fouled evaporative cooler media	
Water treatment problems (corrosion or bacterial growth)	

Other (list)

Code	Equipment/system
1	Air distribution
2	Boiler

Code	Equipment/system
6	Cooling towers
7	Daylight control(s)

Code	Equipment/system
11	Lighting
12	Occupancy sensor(s)

3	Chilled water
4	Chillers
5	Condenser water

8	Fans
9	Hot water
10	HVAC

13	VSDs
14	Other

Built-Up HVAC Systems

(Do not enter backup or stand-by equipment)

Chillers/ Large Split DX

o Serves more than the surveyed area

	CH-	CH-	CH-
Equipment Name	o old? o M?	o old? o M?	o old? o M?
Location			
Quantity			
Manufacturer			
Model Number			
Serial Number			
Size (tons)			
Chiller Type			
Full-load efficiency	kW/ton COP	kW/ton COP	kW/ton COP
Condenser Type	Air / Water	Air / Water	Air / Water
Air-Cooled Cond. Fan hp			

Enter condenser fan hp only if not included in equipment efficiency rating

Chiiller type: 1=recip; 2=screw/scroll; 3=cent; 4=sngl eff absorp; 5=dbl eff ind fired absorp; 6=dbl eff dir fired absorp; 7=gas eng

Towers/ Evaporative Condensers

	T-	T-	T-
Equipment Name	o old? o M?	o old? o M?	o old? o M?
Location			
Quantity			
Manufacturer			
Model Number			
Rated Capacity (kBtuh)			
Out WB Temp @ rating			
Lv Cond Temp @ rating			
Fan Control	1-Sp / 2-Sp / o M? Pony / VSD	1-Sp / 2-Sp / o M? Pony / VSD	1-Sp / 2-Sp / o M? Pony / VSD
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump
Quantity			
Hp			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	o M?	o M?	o M?
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump
Quantity			
Hp			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	o M?	o M?	o M?

Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump
Quantity			
Hp			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	o M?	o M?	o M?
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump
Quantity			
Hp			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	o M?	o M?	o M?

Enter each fan and pump motor surveyed.

Heating System

	HS-	HS-	HS-
Equipment Name	o old? o M?	o old? o M?	o old? o M?
Location			
Quantity			
Capacity	KW / kBtuh	KW / kBtuh	KW / kBtuh
Type	Steam / HW / Duct Htr	Steam / HW / Duct Htr	Steam / HW / Duct Htr
Fuel	Electric / Other	Electric / Other	Electric / Other
Efficiency (%)			

Pumps

Pump	**Name**	**Old Const ?**	**HP**	Phase	RPM	Motor effic %	**M?**	**Control**	**M?**	**EMS ?**	**Location**	**Loop**	**Use**
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec
P-		o					o	CV / VSD	o	o		CHW / Cond / HW	Pri / Sec

Central Air Handlers

Name	AH-	AH-	AH-
Equipment Name	o old? o M?	o old? o M?	o old? o M?
Location			
Quantity			
Type (circle one)	Single Duct Dual Duct Multi-Zone	Single Duct Dual Duct Multi-Zone	Single Duct Dual Duct Multi-Zone
Evaporative System Type (circle one)	None / Direct oM? Ind / Ind-Dir	None / Direct oM? Ind / Ind-Dir	None / Direct oM? Ind / Ind-Dir
Supply Fan Type (circle one)	CV / VAV	CV / VAV	CV / VAV
Supply Fan Control (circle one)	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?
EMS control of supply fan?	o	o	o
Supply Fan Flow Rate (cfm)			
Fan motor type (circle)	Supply / Return	Supply / Return	Supply / Return
Motor HP			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	oM?	oM?	oM?
Fan motor type (circle)	Supply / Return	Supply / Return	Supply / Return
Motor HP			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	oM?	oM?	oM?

Fan motor type (circle)	Supply / Return	Supply / Return	Supply / Return
Motor HP			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	oM?	oM?	oM?
Fan motor type (circle)	Supply / Return	Supply / Return	Supply / Return
Motor HP			
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	oM?	oM?	oM?
OA Control (circle one)	Fixed / Temp / Enth oM?	Fixed / Temp / Enth oM?	Fixed / Temp / Enth oM?
EMS control of OA?	o	o	o
Min OA Fraction	DK	DK	DK

Packaged HVAC Systems

	AC-	AC-	AC-
Equipment Name	o old?	o old?	o old?
Location			
Quantity			
Type Code			
Manufacturer			
Model No. (outdoor - all)			
Model No (indoor if split)			
Cooling Capacity (ton)			
Cooling Efficiency (circle units)	EER oM? SEER	EER oM? SEER	EER oM? SEER
Supply CFM			
Heating Fuel (circle one)	Elec / Other	Elec / Other	Elec / Other
Heating Capacity (kBtuh) (heating capacity for heat pumps is for compressor only)			
Heating Efficiency (circle COP or HSPF for heat pumps, AFUE for gas heat)	COP oM? HSPF AFUE	COP oM? HSPF AFUE	COP oM? HSPF AFUE
Condenser Type (circle one)	Dry Coil / Evap. Cond. oM? Pad pre-cooler	Dry Coil / Evap. Cond. oM? Pad pre-cooler	Dry Coil / Evap. Cond. oM? Pad pre-cooler
Evaporative System Type (circle one)	None / Direct oM? Ind / Ind-Dir	None / Direct oM? Ind / Ind-Dir	None / Direct oM? Ind / Ind-Dir
System Type (circle one)	CV / VAV	CV / VAV	CV / VAV
Supply Fan Control (circle one)	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?	CV: Constant / Cycles VAV: VSD / Inlet/ Disch oM?
EMS control of Supply Fan?	o	o	o

Supply Fan HP			
Return/Relief Fan HP			
OA Control	Fixed / Temp / Enth oM?	Fixed / Temp / Enth oM?	Fixed / Temp / Enth oM?
EMS control of OA?	o	o	o
Min OA Fraction	DK	DK	DK

Type Code	Description	Type Code	Description	Type Code	Description
1	Single Package Rooftop AC	5	PTAC	9	Water Loop Heat Pump
2	Single Package Rooftop Heat Pump	6	PTHP	10	Dual Fuel Heat Pump
3	Split System AC	7	Window/Wall AC Unit	11	Evaporative System
4	Split System Heat Pump	8	Window/Wall HP		

Ducts Outside Conditioned Space

Virtual System ____________

Use default area o Stories served ___________

Type	Location	Dia or L x W (in)	Lineal Ft	% total default area	Construction	R-Value	Notes
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		
o Supply o Return	o Plenum o Outside				o Sheet Metal o Flex o Duct Board		

Fill out one table per virtual system

Zone _____

Name ____________________ Zone Multiplier ______ HVAC zoning by exposure? Y N

Exterior Walls

Assembly Name	**Old Const?**	**Type Code**	Insul R or U-value	HC	**M?**	**Orientation** (N, NE, E, ,NW)	**H (ft)**	**W (ft)**
	o		R U		o			
	o		R U		o			
	o		R U		o			
	o		R U		o			
	o		R U		o			

Height and width are gross dimensions, including windows

Enter "0" for R-value if uninsulated, leave blank if unknown

	Wall Construction Type
1	Face Brick + Brick
2	Face Brick + Poured Concrete
3	Face Brick + Concrete Block

	Wall Construction Type
4	Poured Concrete + Finish
5	Concrete Block + Finish
6	Wood Frame Wall

	Wall Construction Type
7	Metal Frame Wall
8	Curtain Wall
9	Open

Interior Walls

Assembly Name	**Type**	**Area**	**H (ft)**	**W (ft)**	**Next to Zone**	**Notes**
	Solid Air					
	Solid Air					

Survey only if non-adiabatic

Roof

Assembly Name	**Old**	**Type Code**	**Surf Code**	**Surf Color**	Aged Reflec	Aged Emitt	**M**	**Ceil Insul**	**Roof Insul**	**M**	**H (ft)**	**W (ft)**	Plen H (ft)	Plen Wall R	Ret Air
	o						o	R U	R U	o					o
	o						o			o					o
	o						o			o					o
	o						o			o					o

Height and width are gross dimensions, including skylights

Enter “0” for R-value if uninsulated, leave blank if unknown

	Roof Construction Type
10	Concrete Deck Roof.
11	Wood Frame Roof
12	Metal Frame Roof

	Roof Surface
1	Paint
2	Elastomeric coating
3	Single ply membrane

	Roof Surface
4	Metal roofing
5	Asphalt shingles or roll
6	Gravel (ballast)

Zone _____ (contd)

Window/Skylight Types

Ref. No.	Assembly Name	**No. Panes**	**Glazing Type**	**Frame Type**	**Features (circle)**	**Meas.Trans.**	SHGC	U- value
1	o old? o M?				Low e / gas fill			
2	o old? o M?				Low e / gas fill			
3	o old? o M?				Low e / gas fill			
4	o old? o M?				Low e / gas fill			
5	o old? o M?				Low e / gas fill			
6	o old? o M?				Low e / gas fill			
7	o old? o M?				Low e / gas fill			
8	o old? o M?				Low e / gas fill			
9	o old? o M?				Low e / gas fill			
10	o old? o M?				Low e / gas fill			

	Glass Type
1	Clear
2	Tinted
3	Reflective
4	Fritted (diffusing)

	Plastic Type
5	Clear Plastic
6	Tinted Plastic
7	White Plastic
8	Translucent

	Window Frame Type
1	Standard Metal Frame
2	Thermally Broken Frame
3	Wood/Vinyl Frame

	Skylight Frame Type
4	Standard Metal Frame w/ Curb
5	Thermally Broken Frame w/ Curb
6	Standard Metal Frame w/o Curb
7	Thermally Broken Frame w/o Curb

Window/Skylight Geometry

Ref No. (from above)	**Orient** (N, NE, .. H)	**H (ft)**	**W (ft)**	**Qty**	Int. Shade Type	Otr Ex Shd%	Window OH Offset	Window OH Proj	Skylight Shape

Otr Ex Shd% refers to exterior shading from adjacent buildings, building self-shading, thick vegetation, hillsides etc.

Interior Shade Type: 1 = Blinds; 2 = Light Shades or Drapes; 3 = Dark Shades or Drapes

Skylight Shape: 1 = Domed; 2= Flat; 3= Pyramid; 4= Ridge; 5= Vault

Zone _____ (contd)

Zone-Level HVAC Equipment (Not Central, Not Packaged)

Name	Type Code	Qty	Fan Hp	CFM	Heat Source	Make	Model	Capacity	M?
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				
					None / Elec. / Other				

Zone-Level HVAC Equipment

Type Code	Zone-Level HVAC Equipment Description	Type Code	Zone-Level HVAC Equipment Description

1	Baseboard or radiant heater
2	Two-pipe fan coil
3	Four-pipe fan coil
4	Two pipe induction terminal
5	Four pipe induction terminal
6	Unit heater

7	Unit ventilator
8	Non-powered VAV terminal
9	Series fan-powered VAV terminal
10	Parallel fan-powered VAV terminal
11	Computer equipment cooler
12	Exhaust fan

Space _____

Name ___________________ Floor Area__________SF

Corridor/Restroom/Support Area______% Space Multiplier______

Circle appropriate occupancy code: LPD Measure o

1	Auditorium	14	Office - Other	26	Hotel function	39	Gymnasium
2	Church /chapel	15	Computer center	27	Hotel guest room	40	Library
3	Convention, meeting	16	EEG/EKG/MRI/Radiation	28	Hotel lobby	41	Locker room
4	Courtroom	17	Hospital - Emergency	29	Barber, beauty shop	42	School shop
5	Exhibit	18	Hospital general area	30	Bowling alley	43	Swimming pool
6	Main entry lobby	19	Hospital laboratory	31	Coin op laundry	44	Aircraft hanger
7	Motion picture theater	20	Hosp.patient rm/ nursery	32	Comm'l dry cleaners	45	Auto repair workshop
8	Performance theater	21	Hosp. therapy (OT, PT)	33	Grocery	46	General C&I work
9	Bars, lounge, casino	22	Hospital Pharmacy	34	Mall, arcade, atrium	47	Precision C&I work
10	Dining	23	Hospital Radiology	35	Retail, whlse sales flr	48	Storage, warehouse
11	Kitchen	24	Hospital Recovery	36	Classroom	49	Other (Describe)
12	Bank/financial institution	25	Hosp. Surgical & OB suite	37	Day care		
13	Medical / clinical office			38	Dormitory		

Note: Codes 16 – 25 are for hospitals only

Lighting

Name	**Fixture Code**	**Fixture Count**	**Mount. Type**	**Track Length**	**Controls** (circle all that apply)		**% fix ctrl**	**% ctrl oper**
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		

					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		
					1 / 2 / 3 / 4	o EMS? o M?		

Lighting Control Codes

1 = Occupancy sensor 2 = Daylight - contin. dimming 3 = Daylighting - stepped 4 = Lumen maintenance

Fixture Mounting Type Codes

1 = Rec 2 = Dir 3 = Ind 4 = Ind-Dir 5 = Plug-in Task 6 = Furn. Int. Task. 7 = Track 8 = Exempt

Miscellaneous Equipment and Plug Loads

o Use typical value: 1 2 3 4 o Define additional or unique loads (use next page)

Space _____ contd

Miscellaneous Equipment and Plug Loads

o Use typical value: 1 2 3 4 plus additional loads listed below:

o Define unique loads for this space only

Name	**Equip. Code**	**Count**	kW/ Unit or	Motor HP or	kBtuh Input	Under Hood?
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N

Equipment

Record kW for equipment without default or if default is not appropriate

	Equipment Description	Equip Code	Defaul t kW
General	Personal Computer w/ Monitor	1	0.5
	Terminal	2	0.15
	Laser Printer	3	0.85
	Copier	4	1.4
	Fax Machine	5	0.1

	Equipment Description	Equip Code	Default kW
Grocery	Meat Grinder	19	7.
	Meat Saw	20	2.5
	Meat Slicer	21	0.25
	Wrapper	22	0.9
	Check stand	23	1.5

	Mini-Computer + Periph	6	1.0
	Main Frame Computer + Periph	7	
	Microwave	8	1.7
	Misc. Appliance	9	
	Television	10	0.15
	Washer	11	0.5
	Dryer	12	4.
	Cash Register	13	0.15
	Box Crusher	14	10.
	Gasoline pump	15	0.7
	ATM	16	.5
	Video game	17	.5
	Exercise equipment	18	.5

Hospital	Laboratory Equipment	24	
	Monitoring, Life Support	25	1.1
	EEG	26	1.1
	EKG	27	1.1
	MRI	30	26.
	X-ray machine	31	5.
	Radiation Therapy Machine	32	10.
Indust	Air Compressor	33	
	Welder	34	
	Battery Charger	35	1.5
	Machine Tools	36	
	Motor	37	
Misc.	Other	38	

Space _____ contd

Light level measurements

Test Area Description	Floor Area Percentage Represented	FC Under fixture	FC Between fixtures	Fixture Code

Average value____________ Min ________________ Max___________________-

Notes:

Typical Miscellaneous Equipment and Plug Loads 1 2 3 4

Floor area surveyed ___________________ SF

Name	**Equip. Code**	**Count**	kW/ Unit or	Motor HP or	kBtuh Input	Under Hood?
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N
						Y / N

Equipment

Record kW for equipment without default or if default is not appropriate

	Equipment Description	Equip Code	Defaul t kW
General	Personal Computer w/ Monitor	1	0.5
	Terminal	2	0.15
	Laser Printer	3	0.85
	Copier	4	1.4
	Fax Machine	5	0.1
	Mini-Computer + Periph	6	1.0
	Main Frame Computer + Periph	7	

	Equipment Description	Equip Code	Default kW
Grocery	Meat Grinder	19	7.
	Meat Saw	20	2.5
	Meat Slicer	21	0.25
	Wrapper	22	0.9
	Check stand	23	1.5
Hospital	Laboratory Equipment	24	
	Monitoring, Life Support	25	1.1

	Microwave	8	1.7
	Misc. Appliance	9	
	Television	10	0.15
	Washer	11	0.5
	Dryer	12	4.
	Cash Register	13	0.15
	Box Crusher	14	10.
	Gasoline pump	15	0.7
	ATM	16	.5
	Video game	17	.5
	Exercise equipment	18	.5

	EEG	26	1.1
	EKG	27	1.1
	MRI	30	26.
	X-ray machine	31	5.
	Radiation Therapy Machine	32	10.
Indust	Air Compressor	33	
	Welder	34	
	Battery Charger	35	1.5
	Machine Tools	36	
	Motor	37	
Misc.	Other	38	

Refrigerated Cases

Zone: ____

Name	Type	Qty	Unit Dim. (ft, CF)	Walk-in SF	Product	Comp Loc	Door type (Reach-in)	Lights	EE Mtr	LSHX
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ
						Int / Rem	ρ	ρ	Y / N ρ	Y / N ρ

Enter SF for walk-in or walk-in/reach-in only

Type Code	Case Description	Unit Dim.	Default kW/unit
1	Island, open, single-level narrow	ft	0.1
2	Island, open, single-level wide	ft	0.1

Product Code	Product
1	Ice Cream
2	Frozen Food

3	Island, open, island, single level double	ft	0.2
4	Island, closed, single-level narrow	ft	0.1
5	Island, closed, single-level wide	ft	0.1
6	Island, closed, single level double	ft	0.2
7	Open Single-deck	ft	0.3
8	Open Multi-deck	ft	0.3
9	Reach-in Multi deck	ft	0.3
10	Closed rear-entry multi-deck	ft	0.03
11	Curved glass rear entry multi deck	ft	0.06
12	Walk-in / Reach-in	ft	0.3
13	Walk-in	ft	0.015
14	Under counter Reach-in	CF	0.03
15	Blast Chiller	CF	0.03
16	Ice Maker	CF	0.04
17	Residential Reach-in Refrigerator	CF	0.03
18	Residential Reach-in Freezer	CF	0.03
19	Residential Closed Coffin Freezer	CF	0.03
20	Refrigerated Vending Machine	CF	0.03
21	Water cooler	each	0.5
22	Slurpee, frappaccino machine	each	
23	Other	kBtuh	

3	Fresh Meat
4	Deli
5	Dairy/Beverage
6	Produce

Door Code	Door Type
1	Single glazed
2	Double glazed
3	Triple glazed, no heater controls
4	Triple glazed, w/ heater controls
5	Triple glazed, no heaters
6	Quadruple glazed, no heater controls
7	Quadruple glazed, w/ heater controls
8	Quadruple glazed, no heaters

Light Code	Lighting Type
1	None
2	T-12 w/ magnetic ballast
3	T-12 w/ electronic ballast
4	T-8

Refrigeration Plant

Compressors / Compressor Racks

Name	Make	Model	Old Const?	Comp Code	Circuit	AHU Ht. Rec	M?	Mech Subcool
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o
CR-			o		LT / MT / HT	Y / N	o	o

LT circuit is for ice cream cases (product code 1), MT is for frozen food cases (product code 2) and HT is for all others

Supply evaporator tons and rack suction temperature (SST) if known

Comp Code	Compressor type	Comp Code	Compressor type
1	Stand-alone	3	Parallel equal multiplex
2	Stand-alone w/ VSD	4	Parallel unequal multiplex

Refrigeration Condenser

	RC-	RC-	RC-	RC-
Equipment Name				
Old Construction?	o	o	o	o
Location				
Type	Air / Water	Air / Water	Air / Water	Air / Water
Manufacturer				
Model Number				
Compressors served				
Rated Cap (kBtuh)	M?o	M?o	M?o	M?o
Outdoor Temp @ rating	WB DB	WB DB	WB DB	WB DB
Cond Temp @ rating				
Fan Control	1-Sp / 2-Sp / Pony VSD M?o	1-Sp / 2-Sp / Pony VSD M?o	1-Sp / 2-Sp / Pony VSD M?o	1-Sp / 2-Sp / Pony VSD M?o
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump	Fan / Pump
Quantity				
Hp				
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	M?o	M?o	M?o	M?o
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump	Fan / Pump
Quantity				

Hp				
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	M?o	M?o	M?o	M?o
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump	Fan / Pump
Quantity				
Hp				
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	M?o	M?o	M?o	M?o
Aux motor type (circle)	Fan / Pump	Fan / Pump	Fan / Pump	Fan / Pump
Quantity				
Hp				
Phase / RPM (circle)	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600	1 3 / 1200 1800 3600
Motor efficiency	M?o	M?o	M?o	M?o

Foodservice

Zone: _______

Kitchen Equipment

Appliance Name	**Qty**	**Type Code**	**Fuel**	KW ***or***	Volts / Amps ***or***	kBtuh Input ***or***	**Trade Size**	**Hi-Effic**	**Hood**	**M**
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o

			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o
			Elec. / Other		/			Y / N	Y / N	o

Hoods

Name	**Type**	**Size (SF)**	Flow (cfm)	Fan hp	**Makeup Air Source**
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond
	Canopy / Island Canopy / Backshelf				Cond / Uncond

Type Code	Description	Trade size	Default kW/unit
1	Broiler (include cheesemelter)	ft	1.7
2	Char Broiler	ft	3.7
3	Griddle, single sided	ft	4.5
4	Griddle, clam shell	ft	7.5
5	Fryer, countertop	lb	0.3

Type Code	Description	Trade size	Default kW/unit
15	Oven, convection, combi, or retherm	doors	3.8
16	Food warmer	ft	0.6
17	Heated display case	ft	0.5
18	Microwave oven		1.7
19	Toaster, pop-up		1.8

6	Fryer, free-standing	lb	0.3
7	Fryer, pressure	lb	0.3
8	Fryer, donut	lb	0.3
9	Kettle, Pasta cooker	qt	0.25
10	Heat lamps	lamps	0.5
11	Range top	ft	5.
12	Oven, pizza or bake	decks	7.
13	Oven, conveyor	decks	13.
14	Oven, range	ft	2.

20	Toaster, conveyor		4.6
21	Coffee pot	burners	1.
22	Steam table	ft	0.6
23	Dishwasher, single tank	racks/hr	0.3
24	Dishwasher, conveyor	racks/hr	0.1
25	Steam jacketed kettle	qt	0.4
26	Braising pan/skillet	qt	0.1
27	Other	kW	

Hot Water

Conventional Water Heating Equipment

Name	**Location**	**Type Code**	**Old Cost?**	Storage Cap (gal)	**Fuel**	**Effic**	Pump hp	M?
			o		Elec / Other			o
			o		Elec / Other			o
			o		Elec / Other			o
			o		Elec / Other			o

Solar Water Heating Equipment

Name	Location	System Type Code	Collector Area (SF)	Tilt (deg, horiz =0)	Storage Cap (gal)	M ?
						o
						o
						o

Pools/ Spas

Name	Location	Surface Area (SF)	**Filter Motor hp**	**Heating System**
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___
	Outside / Inside			None / PH-___

Pool/Spa Heating System

Name	Location	**Fuel Code**	**Effic**	Solar Collector Type	Collector Area (SF)	Tilt (deg, horiz =0)	Heat Recovery	M ?

PH-1		Elec / Other		Glazed / Unglazed			Y / N	o
PH-2		Elec / Other		Glazed / Unglazed			Y / N	o
PH-3		Elec / Other		Glazed / Unglazed			Y / N	o
PH-4		Elec / Other		Glazed / Unglazed			Y / N	o

WH Type Code	Water Heater Description
1	Storage
2	Instantaneous
3	Heat Pump

SWH Type Code	Solar Water Heater Description
1	Active flat plate
2	Passive flat plate
3	Integral Collector/Storage
4	Active evacuated tube
5	Active concentrating E-W tracking
6	Active concentrating N-S tracking

Miscellaneous

Interior Transformers

Name	**Location**	**Qty**	Manuf.	Model No.	**kVA**	**Temp Rise (°C)**	**Cooling Fan?**
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N
							Y / N

Survey only if measure

Vertical Transportation

				Elevator		Escalator	
Name	**Type**	**Qty**	Motor hp	**Number of Floors**	**Width (ft)**	**Rise (ft)**	**Run (ft)**
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						
	Elev / Esc						

	Elev / Esc						
	Elev / Esc						

Exterior Lighting

Name	Old Const?	Fixture Code	Count	Application	Allowed Area	M ?
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot Auto sales Gas station canopy Other		o
	o			Parking lot		o

				Auto sales Gas station canopy Other		
	O			Parking lot Auto sales Gas station canopy Other		O
	O			Parking lot Auto sales Gas station canopy Other		O
	O			Parking lot Auto sales Gas station canopy Other		O

Collect only if connected to electric meter serving occupied space

Miscellaneous Exterior Electric Loads

Name	**Equip Code**	**Quantity**	kW/unit or	Hp/unit

Collect only if connected to electric meter serving occupied space

Equipment Description	Equipment Code	Defaul t kW
Misc. Appliance	1	
Washer	2	0.5
Dryer	3	4.
Cash Register	4	0.15
Box Crusher	5	10.
Gasoline pump	6	0.7
Air Compressor	7	

Equipment Description	Equipment Code	Default kW
Welder	8	
Battery Charger	9	1.5
Machine Tools	10	
Motor	11	
Refrig vending machine	12	
Ice merchandizer	13	
Other	14	

Incidents

Circle any incidents as applicable:

1 None to report
2 Complaint about rates
3 Complaint about energy costs or lack of savings
4 Complaint about outages or power quality
5 Complaint about technology reliability
6 Complaint about utility customer service
7 Contact person unavailable or unaware of survey appointment
8 Customer expressed dissatisfaction with survey (list reason(s))
9 Property damage occurred during on-site survey
10 Personal injury occurred during on-site survey
11 Other (list)

Title 24

Circle the method used for Title 24 compliance?

Envelope (ENV):	o Component	o Overall envelope	o Performance	o DK	
Mechanical (MECH):	o Prescriptive	o Performance	o DK		
Lighting (LTG):	oComplete building	o Area category	o Tailored	o Performance	o DK

- If new construction complied using the ***performance method***, or ***tailored lighting*** approach, copy the PERF or LTG compliance reports, or obtain the name and phone number of the firm that did the compliance analysis:

  Name:

  Phone:

Meters

Meter Number	Surveyed Space / Metered Space (%)	Type	Meter Location
		Electric / Gas	
		Electric / Gas	
		Electric / Gas	
		Electric / Gas	
		Electric / Gas	
		Electric /	

		Gas	

o Some or all meter information not available

Notes:

System / Zone Association Checklist

DOE-2 "Virtual" System ----→	1	2	3	4	5	6	7	8	9	Zonal HVAC only	Uncond
Packaged HVAC											
AC-1											
AC-2											
AC-3											
AC-4											
AC-5											
AC-6											
AC-7											
AC-8											
AC-9											
AC-10											
AC-11											
AC-12											
AC-13											
AC-14											
AC-15											
AC-16											
AC-17											
AC-18											
AC-19											
AC-20											
Air Handlers											
AH-1											
AH-2											
AH-3											
AH-4											

AH-5											
AH-6											
AH-7											
AH-8											
AH-9											
AH-10											
AH-11											
AH-12											
AH-13											
AH-14											
AH-15											
AH-16											
AH-17											
AH-18											
AH-19											
AH-20											
Zone 1											
Zone 2											
Zone 3											
Zone 4											
Zone 5											
Zone 6											
Zone 7											
Zone 8											
Zone 9											
Zone 10											

Check 'Zonal HVAC only' if zone is conditioned only by baseboard, radiant, or unit heaters, or unit ventilators.

Plant / System Association Checklist

DOE-2 "Virtual" System ----→	1	2	3	4	5	6	7	8	9
Chillers / AC Compressors									
CH-1									
CH-2									
CH-3									
CH-4									
CH-5									
CH-6									
CH-7									
CH-8									
CH-9									
CH-10									
Towers / Evap. Condensers									
T-1									
T-2									
T-3									
T-4									
T-5									
T-6									
T-7									
T-8									
T-9									
T-10									
Heating Systems									
HS-1									
HS-2									
HS-3									
HS-4									

HS-5									
HS-6									
HS-7									
HS-8									
HS-9									
HS-10									
Pumps									
P-1									
P-2									
P-3									
P-4									
P-5									
P-6									
P-7									
P-8									
P-9									
P-10									
P-11									
P-12									
P-13									
P-14									
P-15									
P-16									
P-17									
P-18									
P-19									
P-20									

Interview "Area" / Audit "Zone" Association Checklist

Areas	1	2	3	4	5
Zone 1					
Zone 2					
Zone 3					
Zone 4					
Zone 5					
Zone 6					
Zone 7					
Zone 8					
Zone 9					
Zone 10					

Space/Zone Association

Zone

Space	Z 1	Z 2	Z 3	Z 4	Z 5	Z 6	Z 7	Z 8	Z 9	Z 10
1										
2										
3										
4										
5										
6										
7										
8										

9										
10										
11										
12										
13										
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20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

Sketch of Building Floor Plan

Be sure to include dimensions, North arrow, and zone and HVAC equipment locations

Recruiting & Decision Maker Survey

Contact and Project Info	**Owner Info**
Site ID:	Owner Company:
Contact Person:	Owner Address:
Business Name:	Contact Email:
Address:	Contact Fax:
Phone:	Bldg Type:
Program Delivery Type:	Sample: Special Team? Commit Date:
Square Footage: **(VERIFY)**	Level :2 Metering? :

Contact Log

	Date	**Time**	**Contacted**			**Comments**
1						
2						
3						
4						
5						
6						
7						

Num of Calls ______________Num of Contacts: ______________

Scheduled Yes/No Survey Completed Yes/No

Hello, my name is <<surveyor>> and I am calling on behalf of <utility>. I would like to speak with **<participant name>** regarding participation in <utility> New Construction Program, Savings by Design.

Q1. Are you the owner or the owner's representative for the building at **<participant address >.**?

01 Yes

02 No (Get contact info) Name:____________________
98 DK (Get contact info) Phone:____________________
Refused (Thank and terminate)

Hello <participant name>, this is Amber Watkins calling on behalf of <utility> with regard to **<business name>** located at **<participant address>.**. I am contacting you today regarding your past participation in <utilitly> Non-residential New Construction program, Savings by Design. Our records show that your project received financial incentives for installing high performance energy efficiency features in the building. We are working with <utility> to verify the installed energy efficiency measures and the energy savings resulting from them.

Q2. Do you recall participating in **<utility>** Savings By Design program?

01 Yes
02 No (Confirm Building Address, ask for someone else, Thank and Terminate)
98 DK (Get contact info)
99 Refused (Thank and Terminate)

Name: ____________________

Phone: ____________________

As you may be aware through Savings By Design program materials, <utility> regularly performs independent evaluation of the Savings By Design program to ensure the anticipated energy savings are actually being realized. Participants in the program are asked to participate in the evaluation so that program design can be improved and program energy savings results can be documented. In order to complete the evaluation we have been asked to conduct site surveys at a sample of participant sites to independently measure and verify the energy savings <utility> reported. Our independent evaluation is strictly confidential and can in no way effect the incentive you were already paid.

The purpose of the on-site visit is to collect information and data that is required to build an engineering model of your project, which in turn allows us to estimate the energy savings for each building or site we visit.

The on-site survey usually begins with a 30 minute meeting between our engineer/surveyor and your facility manager. During this meeting information such as building schedules and control schemes will be discussed and documented. The engineer/surveyor will then ask to review building plans, if available, and conduct a walk through of the facility to obtain specific measurements and equipment inventories needed for the model. The on-site visit is non-intrusive and normally takes between 3 and 8 hours, depending upon the size and complexity of the building and availability of building plans. Other than the introductory meeting, our engineer does should not need any further assistance, other than access to the building systems.

The on-site can be scheduled at your convenience, when would be a good time for you? *(Continue with Pg 3 "Scope of Work" if needed)*

1. Appointment Date and Time

Screener

Before we finish I would like to ask you just a few question about the building. We understand that designing and building new commercial properties is a long and difficult process that includes the decisions and input of many different decision makers, such as architects, engineers and building owners. If at anytime you feel someone else is more qualified to answer the following questions, please notify me and we will skip the question.

Q3. Our information shows that this building is a Grocery Store , is this correct?

01 Yes
02 No

(If no, Ask what type of building and primary occupancy type)

If mixed Occupancy please describe:

____
____
____
____
__

Q4. How would you describe the project (at <participant address>.), is it a…….

01 New building (brand new construction)
02 First Tenant improvement or newly conditioned space in an existing shell building
03 Renovation or remodel of an existing building
04 Addition to an existing building (Go to Q4a)
05 Renovation and addition (Go to Q4a)
06 Gut Rehabilitation of existing building
98 DK (Get contact info) Name: ______________________
99 Refused (Get contact info) Phone: ______________________

Q4a. Where in the building was the addition built? (Describe)

____
____
____
____

Q5. When was the building completed and opened for occupancy? (Month and Year)

Completed:

Opened for Occupancy: _______________ (If different from completed date)

Q6. Is the building completely built out?

01 Yes (Skip to Q7)
02 If No, % Complete________ Expected Completion Date_________

Q7. Is the building completely occupied?

01 Yes
02 If No, % Occupied________

Q7a. If no, what work remains?

____
____
____
____
____

Building Classification

Q8. Was this building constructed and is it owned by a private company or a public agency?

01 Private company
02 Public agency
98 DK
99 Refused

Q9. Was this building constructed to be occupied by the owner of the building, or built by a developer with the intent to lease space?

01 Built to be Owner Occupied
02 Built by a developer with the intent to lease space

03 Built and occupied by developer with intent to lease remaining space
98 DK
99 Refused

Q10. Do you have as-built building plans available at the site for review?

01 Yes
02 No
98 DK
99 Refused

Building Owner Questions

Q11. How did you first become aware of the SBD program, services, and owner incentives that were available to you?

01 Utility Representative
02 Previous Utility Program Participation
03 Marketing Material
04 Architect
05 Engineer
06 Web Site
07 Manufacturer Rep.
08 Construction Manager
09 Energy Manager
10 Previous Tenant
11 Utility Seminar PEC or CTAC
50 Other: ___________
98 DK
99 Refused

Q12. Did you work directly with the Savings By Design representative or consultant on this project?

01 Yes
02 No **(**Get name and contact info of person that did)
98 DK
99 Refused (Thank and Terminate)

Name: ____________________

Phone: ____________________

Q13. At which stage of the design and construction process did you become actively involved with the Savings By Design Representative? (READ LIST)

01 Project Conception
02 Project Development Phase
03 Schematic Design Phase
04 Design Development Phase

05 Construction Documents Phase

06 During Construction

07 Following Completion of Construction

08 Following Facility Occupancy

50 Other: ___________

98 DK

99 Refused

Q14. Which member of your project team, including yourself, was the single biggest advocate for participating in the program? **DO NOT PROMPT, ACCEPT ONLY ONE RESPONSE**

01 Owner/Developer

02 Architect

03 Lighting Designer

04 Electrical Engineer

05 Mechanical Engineer

06 Energy Manager

07 Manufacturer Rep.

06 Construction Manager

50 Other: ___________

98 DK

99 Refused

Q15. How important was the dollar incentive paid to the owner, in motivating the organization to participate in the SBD program?

01 Very important

02 Somewhat important

03 Neither important nor unimportant

04 Somewhat unimportant

05 Very unimportant

98 DK

99 Refused

Project Approach: Whole Building

Design Assistance: Yes or No

If no design assistance or analysis, skip Q16.

READ:

Design assistance is available to building owners and their design teams and typically includes recommendations for efficient equipment and consultation on enhanced design strategies. Design analysis is typically computer simulations to estimate building energy *savings for energy conservation measures being considered. A goal of design assistance is to provide building owners with the tools and skills to apply on future projects*

Q16. How important was the design assistance and design analysis provided by SBD in motivating your organization to participate in the SBD program?

01 Very important
02 Somewhat important
03 Neither important nor unimportant
04 Somewhat Unimportant
05 Very Unimportant
98 DK
99 Refused

Q17. Has participation in any component of SBD influenced you to change your standard building practice that would lead to more energy efficient buildings in the future?

01 Yes
02 No, Why? (Skip to Q19)
03 No Plans to build any more buildings.
98 DK (Skip to Q19 and ask who would know and get their name and phone) **Name:**______________________
99 Refused (Skip to Q19) **Phone:**______________________

Why:

Q18. What changes have you made, or do you foresee making, to your standard practice that would lead to a more energy efficient building design?

Record Answer Verbatim:

Q19. On a scale of 1 to 5, with 1 being very valuable and 5 being not at all valuable, how would you rate the value of the following SBD components for this project?

	Rating	DK	NA (Not Provided)	
a. Incentive	1 2 3 4 5	98	99	100
b. Design Assistance	1 2 3 4 5	98	99	100
c. Design Analysis	1 2 3 4 5	98	99	100

Q20. If any, what recommendations would you have to change the SBD program to improve its delivery to customers such as yourself? **(DO NOT READ)**

01 No changes needed
02 Utility reps need to present benefits more clearly
03 Increase incentives
04 More marketing to increase awareness of program
05 Review and response from utility needs to be more timely
06 More interaction with design team
07 Utilities should try to get involved earlier in projects
08 Less paperwork and red tape
09 Increase post project feedback, better “closure”
50 Other: ____

98 DK
99 Refused

Read:

"Either you or another member of the design team can answer the next questions. As I read through these questions, If you feel someone else is more qualified to respond please specify whom that person is."

Q21. Did this building use a set of prototype plans?

01 Yes (Skip to Prototype Module)
02 No
98 DK
99 Refused

Read:

The following questions address the influence of the Savings By Design program on specific measures. Please bear in mind that when we refer to Savings By Design, we mean all aspects of the program; financial incentives, design assistance, design analysis or any other interaction with SBD representatives or consultants.

ASK THESE 3 QUESTIONS FOR EACH MEASURE LISTED, RECORD RESPONSES ON THE BELOW MATRIX

Q22. How influential was the Savings By Design, including the incentives, design assistance, design analysis and interactions with SBD representatives and consultants in the implementation of the measuer?

READ LIST

1 = Very Influential	1 point
2 = Somewhat Influential	0.5 point
3 = Slightly or minimally Influential	0.25 point
4 = Not at all Influential	0 point (skip to Q24)

Q23. How did Savings By Design influence the implementation of <<***the measure***>> (choose all that apply) (**maximum of 2 points**)

DO NOT PROMPT

1 = SBD had no influence on this measure	0 point
2 = SBD representative first suggested/introduced measure	2 points
3 = SBD performed simulations and/or design analysis	2 points
4 = SBD incentive made this measure an "easier sell"	1 point
5 = SBD incentive helped the measure meet investment criteria	2 points
6 = Prior SBD projects have had success with this measure	1 points
7 = DK, Not Certain, Can't Remember	0 points
50= other	individually assessed

Q24. If you had no interaction with Savings By Design regarding this project, do you think **<<*the measure*>>….**

READ LIST

1 = Definitely would not have been installed 3 points (ask Why)
2 = Probably would not have been installed 2 points (ask Why)
3 = Probably would have been installed 1 point (ask Why)
4 = Would have been installed exactly the same 0 points (ask Why)
5 = Would have been installed with less efficient equipment and/or materials 2 points (ask Why)
98 = DK, Not certain if it would have been installed 1 point

#	Measure	Q22	Q23	Q24	Q25=, Why?
1	Mechanical Subcooling of systems A, S1A, & B				
2	----				
3	**----** Floating suction pressure as opposed to fixed				
4	**----** Display case lighting & reach-in freezer display lights (off from 5pm-6am)				
5	**----**				
6	**----**				
7	**----**				
8	**----**				
9	**----**				
10	**----**				
11					
12					
13					
14					

Q25. Why? (Ask for each Measure that gets a 1,2 3, or 5 for **Q24**)

Measure#(__)____
________________________________Measure#(__)____________________
____

Measure#(__)____
________________________________Measure#(__)____________________
____

Measure#(__)____
________________________________Measure#(__)____________________
____

Q26. Why? (Ask for each Measure that gets a 4 for **Q24**) **USE CODES FROM BELOW**

Measure#(__)____
________________________________Measure#(__)____________________
____

Measure#(__)____
________________________________Measure#(__)____________________
____

DO NOT PROMPT

1. As a result of what was learned through previous SBD program participation (**2 points)**
2. As a result of what was learned in past utility efficiency programs, (0 points)
3. Because it is our standard practice (0 points)
4. Because we have had positive prior experience with the same measure (0 points)
5. Because we would have funded design analysis through the project budget (0 points)
6. Measure already met financial criteria without the program incentive (0 points)
7. Other____(individually assessed)

Q27. Mitigating factors scoring documented by surveyor, or project file reviewer.

Measure#(__) FR Score ____; Surveyor or Project file reviewer ______;

Project Manager _______; Date _____

Explanation:

____

____

____

____

Measure#(__)FR Score ____; Surveyor or Project file reviewer ______;

Project Manager _______; Date _____

Explanation:

____

____

____

____

Measure#(__) FR Score ____; Surveyor or Project file reviewer ______;
Project Manager _______; Date _____

Explanation:

____

____

____

____

Measure#(__) FR Score ____; Surveyor or Project file reviewer ______;

Project Manager _______; Date _____

Explanation:

____

____

____

____