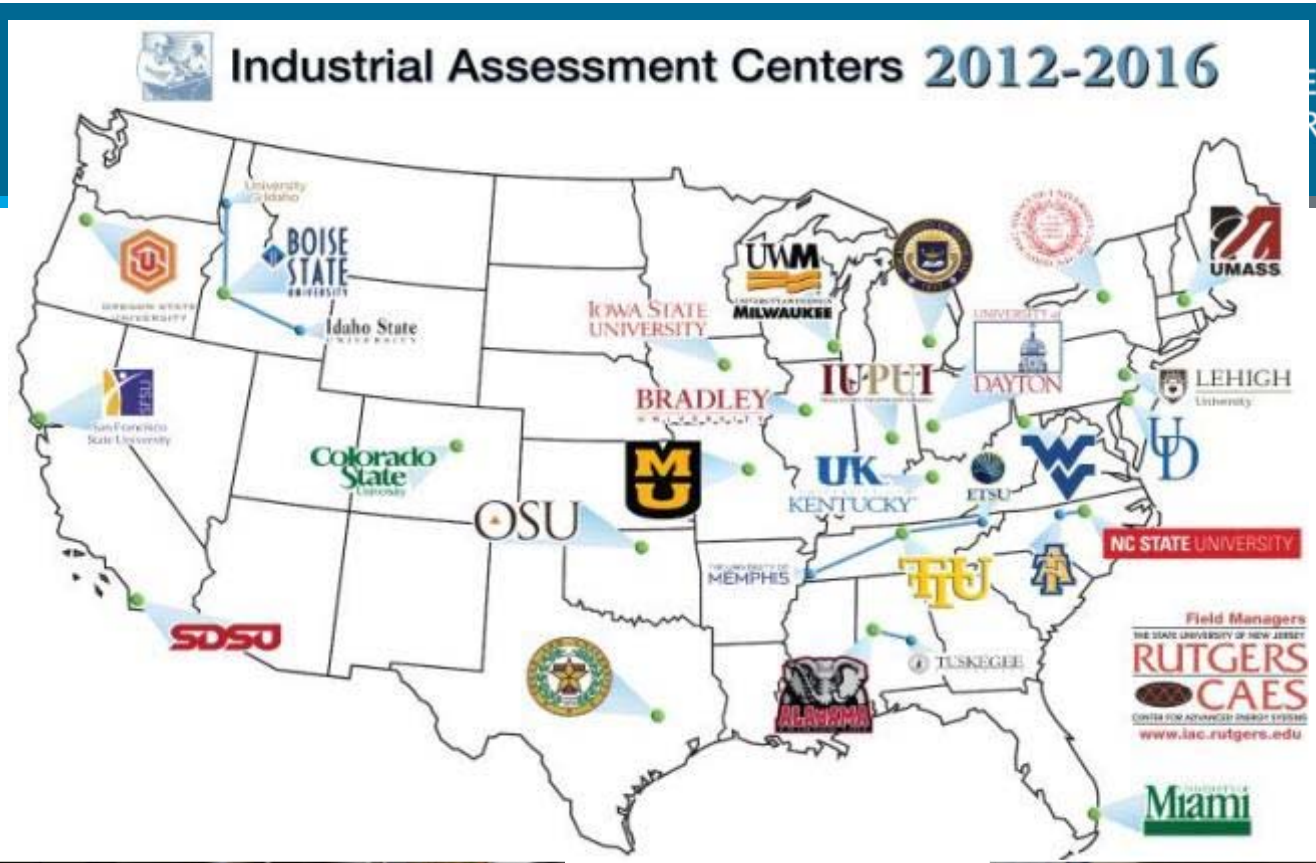
IAC Student Collaboration Webinar

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Thomas Wenning, PE
Oak Ridge National Laboratory

IAC Student Webinar Series
January 2015


Industrial Assessment Centers 2012-2016
BOISE STATE
Idaho State
Colorado State
OSU
SDSU
IOWA STATE UNIVERSITY
BRADLEY
UWM
MILWAUKEE
IUPUI
DAYTON
UMASS
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NC STATE UNIVERSITY
MEMPHIS
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RUTGERS
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www.iac.rutgers.edu
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IAC Student-Led Webinars Intro

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- Alternative to student meeting
- Monthly student-led webinars
- Proposed Structure:
  - 20 min student presentation
  - 40 minutes of Q&A/open dialogue
- Allow students to connect

Webinar Series Purpose

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- Mechanism for IAC-to-IAC student collaboration
- Possible topics:
  - Relevant items for day-to-day IAC operations (client recruitment, report writing, etc.)
  - New technologies and innovations
- Rotate speakers and topics each month
- Each center will lead or contribute a presentation to a future webinar

Possible Discussion Topics:

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1. Pre-Assessment Preparation
   a) What type of preparation does your center do to prepare for upcoming audits?
   b) How does your center connect-with/recruit companies prior to an assessment?
   c) How do you ensure you are thoroughly prepared to efficiently move through an assessment?
2. Assessment Practices & Procedures
   a) How is your center's assessment structured?
   b) How do you divide the workload among the IAC team?
   c) What measurements do you take and for how long?

Possible Discussion Topics:

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3. Reporting and Follow-up
   a) How are your assessment reports structured?
   b) Are "canned" ARs used, or are ARs written anew each time?
   c) Through what means and how often does your center follow-up with clients?
   d) What could be improved to help implementation results?
4. Tools and Resources
   a) What internal or external tools does your center utilize?
   b) What information resources does your center use?
   c) How can information be shared between centers?

Feedback

We want your feedback (date, time, topics, etc)!

Feedback

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Webinar Survey

1. Did you find this webinar helpful (1 being least helpful and 5 being most helpful) ?

   1 ○ 2 ○ 3 ○ 4 ○ 5 ○

2. What topic or topics would you like to see addressed in future IAC student-led webinars?

3. Would you be interested in leading a future webinar?

   ○ Yes

   ○ No

4. If interested in leading a future webinar, please list your name and contact email.

On to the Speakers…

- **Topic**: U of Miami's IAC approach to data collection and metering

- **Who**: Joel Zahlan & Ahmad Seyfi, University of Miami IAC

Data Collection Overview (Power Logging)

University of Miami Industrial Assessment Center

UNIVERSITY OF MIAMI

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Director, IAC
University of Miami
Coral Gables, Fl 33146

Outline

- Introduction to MIIAC
- Why Metering
- Power Metering
  - Capabilities
  - Our Strategy
  - Equipment
  - Software
- Electrical Safety
  - Overview
  - NFPA Safety Regulations
  - Safety Equipment

Power Metering

Why Metering?

- To understand directly how much a target piece of equipment is using
- To map energy flows in a building
- To achieve known and high precision

https://www.pce-instruments.com/english/slot/2/artimg/large/fluke-deutschland-gmbh-phase-power-meter-fluke-434-ii-3-404819_702287.jpg

Power Metering

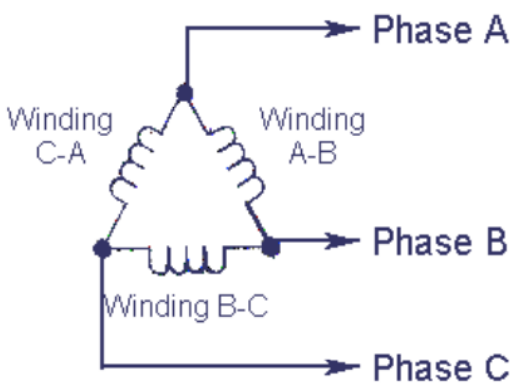
How to Calculate?

- AC single phase amps to kilowatts calculation
  - $P_{(kW)} = PF \times I_{(A)} \times V_{(V)} / 1000$
- AC three phase amps to kilowatts calculation
  - **Calculation with line to line voltage**
  - $P_{(kW)} = \sqrt{3} \times PF \times I_{(A)} \times V_{L\text{-}L\ (V)} / 1000$
  - **Calculation with line to neutral voltage**
  - $P_{(kW)} = 3 \times PF \times I_{(A)} \times V_{L\text{-}N\ (V)} / 1000$

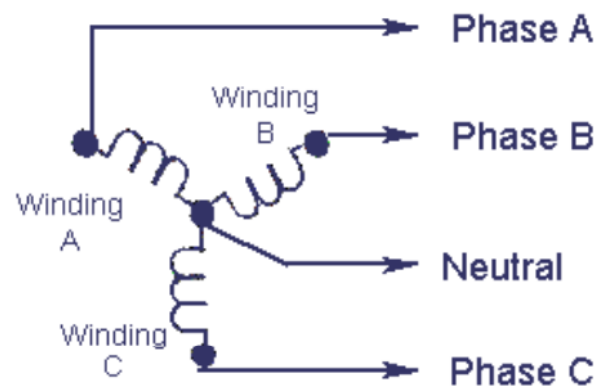
http://www.rapidtables.com/calc/electric/Amp_to_kW_Calculator.htm

Delta and Wye Power Systems

- Delta
  - 208 & 480 V only
  - Single- and three phase loads
  - No neutral conductor



- Wye
  - 120/208 V and 277/480 V
  - High and low voltages with neutral



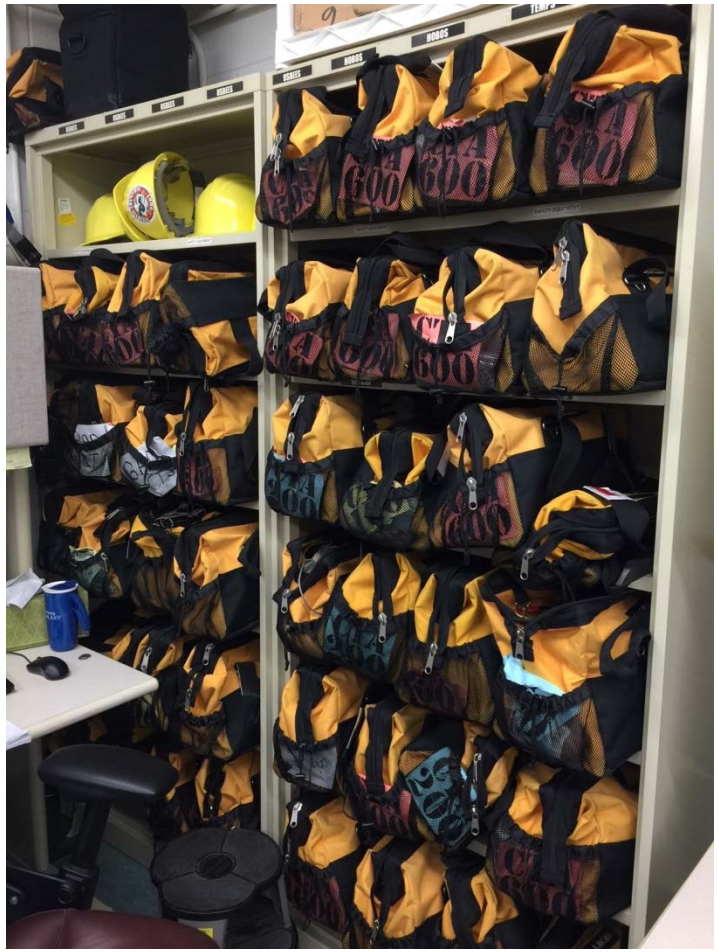
Metering Capabilities

- Over 1000 Data Loggers and Current Transducers (CT), this represents an investment of $200,000
- Various Different Fluke Meters for Power Logging representing an investment of $50,000

Note: Funds needed for the purchase of this equipment were raised by Dr. Asfour from outside sources.

Pre Assessment

- Request lists of large motors and any available electrical plans.
- Pre Assessment (When needed)
- Pre program any loggers of interest:
  - Air Compressors
  - Chillers
  - Main Service Entrances
  - Large Motors
  - Etc



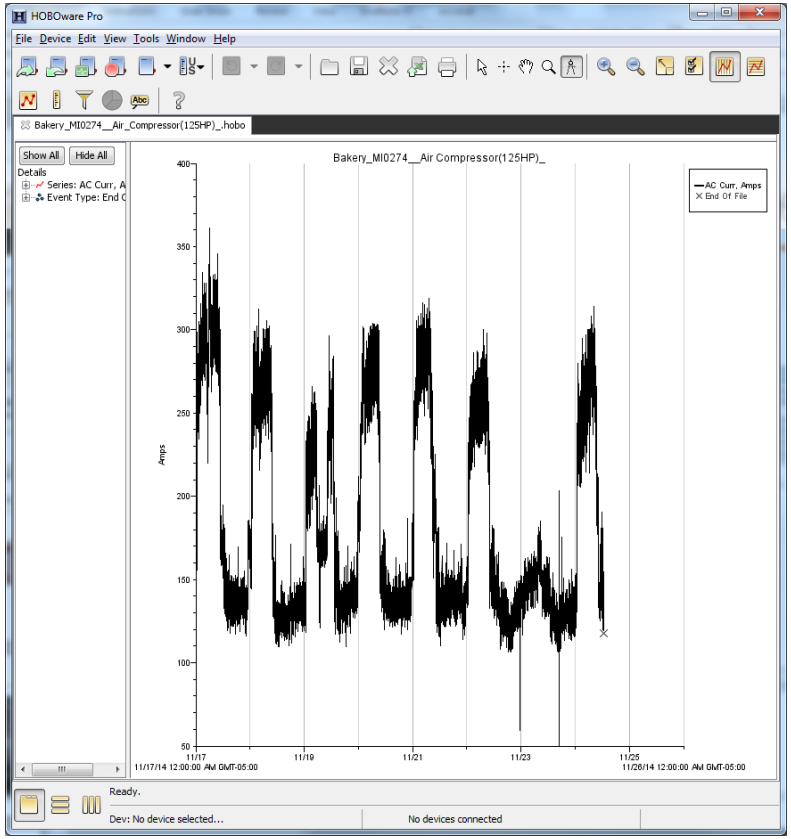
During Assessment

- Perform preliminary Walk-though
- Identify any additional areas of interest.
- Execute logging plan with facility personnel.
- Loggers are launched for 1 week to 1 month at either 15 sec or 1 min intervals.

https://www.pce-instruments.com/english/slot/2/artimg/large/fluke-deutschland-gmbh-phase-power-meter-fluke-434-ii-3-404819_702287.jpg

Post Assessment

- Loggers are picked up after 1 week to 1 month.
- Team returns to facility for pick-up (Normally 2 Members)
- Loggers are downloaded and backpacks are run.

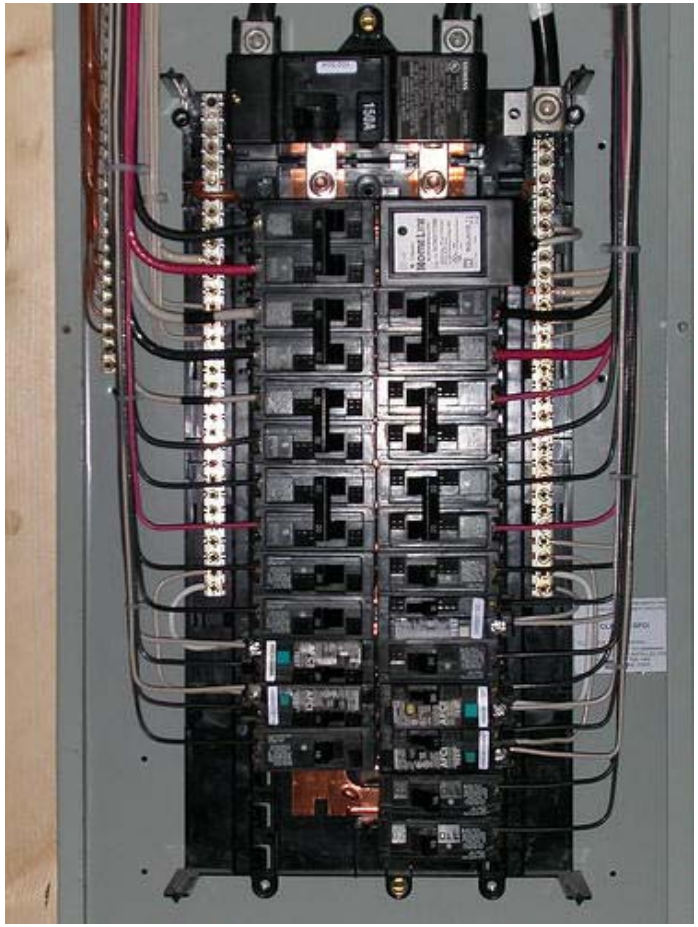


Power Metering: Planning

- Where are you metering?
  - Electrical closet
  - Rooftop (check local forecast!)
  - Office space
  - Residential
- What should you bring?
  - Extra meters (at least 1 of each if possible)
  - Ladder?
  - Proper tools for task
  - Coil of rope?
  - Extension cord?
  - Sunblock/sunglasses/bee spray/water?
- What is the local emergency number? (911/other?)

Power Meter: Basics

- Identify the panel or load to be metered
- Follow safety procedures
  - Ensure power is less than 480 V
  - Know how to shut it down in an emergency
- Remove cover(s) to gain access to conductors
- Note condition of enclosure and take photo
  - Any hazards
  - Breaker brand (Federal Pacific?)
  - Temperature (excessive heat?)
- Gain understanding power flow
- Measure and record the voltage, amperage, power, and power factor at this location



Source: http://roncoelectricnj.com/files/2014/05/electricalpanel1.jpeg

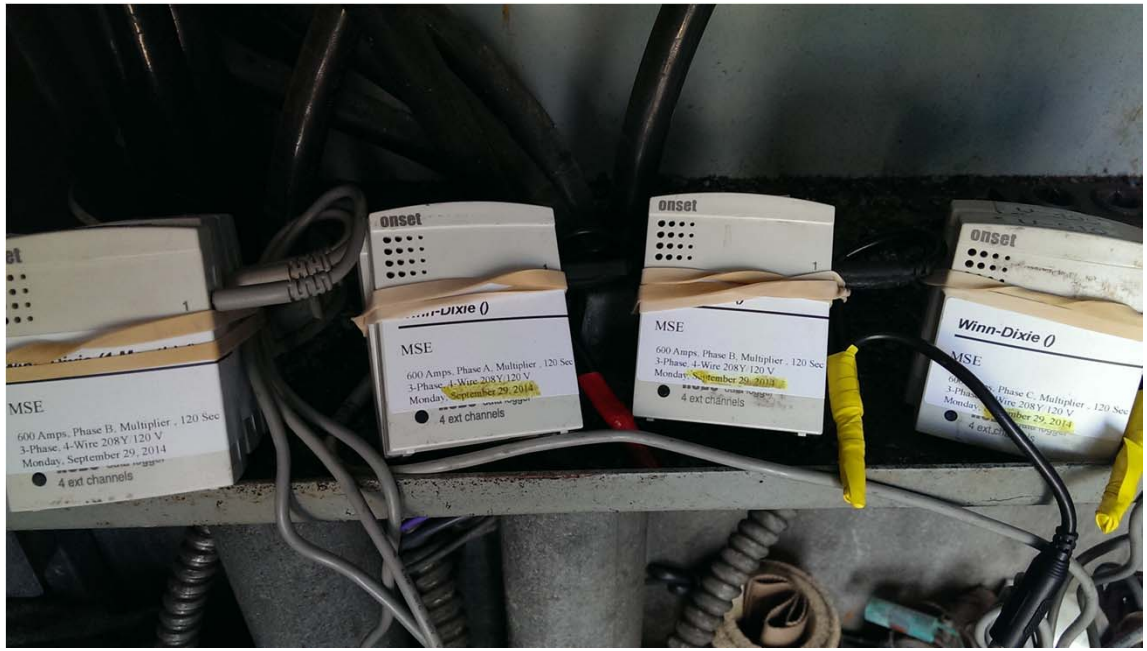
Voltage, Power Factor, and Power

- Voltage and power factor readings are taken using three methods:
  - Spot measurements using power meter (This is used along with amp meters)
  - 5 min readings using power meter (This is used along with amp meters)
  - Total Monitoring
  - 1 week to 1 month of data

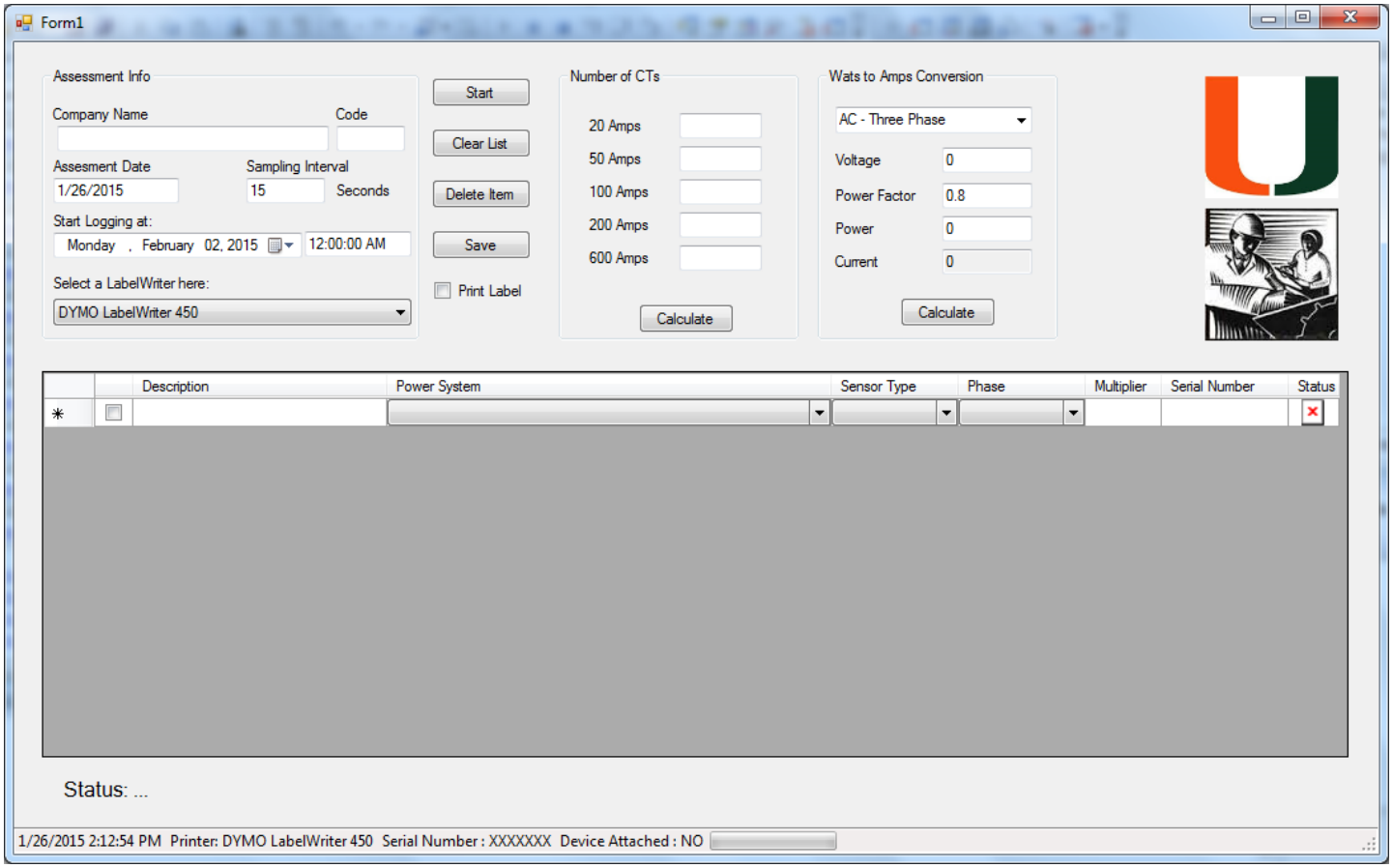
https://www.pce-instruments.com/us/measuring-instruments/meters/3-phase-power-meter-fluke-deutschland-gmbh-phase-power-meter-fluke-437-ii-3-det_2130389.htm

Logger Labeling

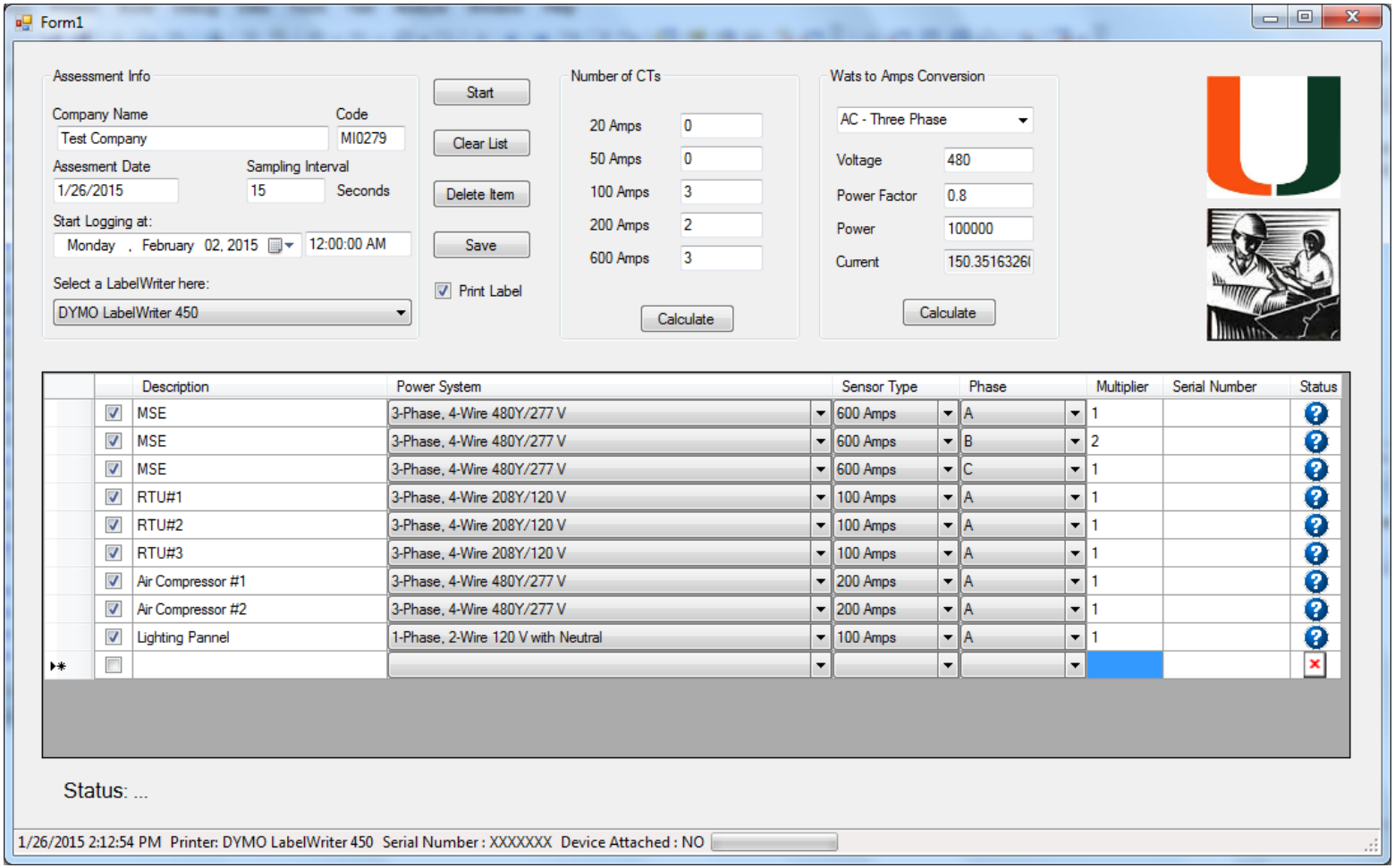
- Loggers are labeled using a software developed in-house.
- Name, voltage, phase, start date, CT amperage, and multiplier are all recorded on label.
- Pictures of panels, installations and loggers are taken.



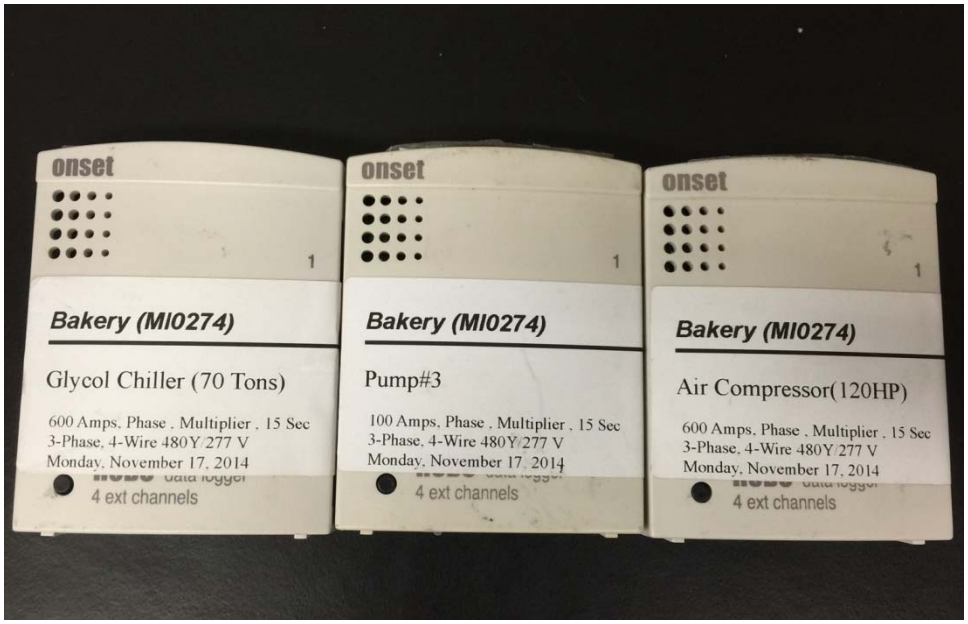
Logger Programming Software



Logger Programming Cont.



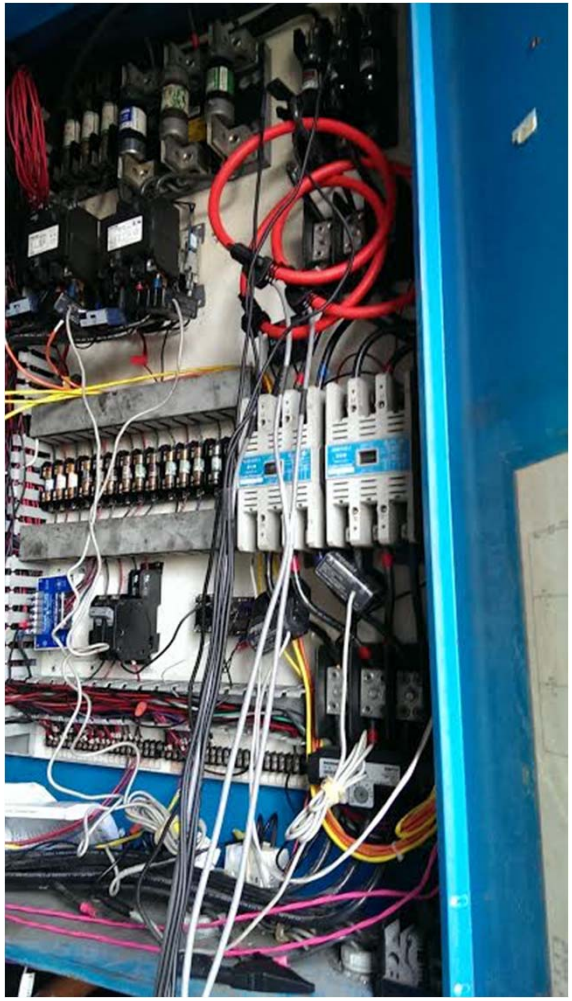
Logger Software Output



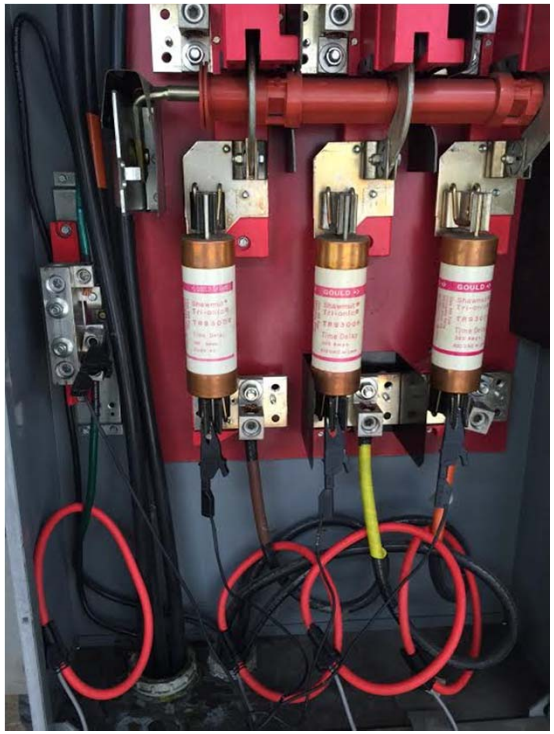
CT and Logger Installation

- CT's are first connected and loggers attached.
- For motors, only one line is captured as the load should be balanced.
- For main service entrances and panels feeding more than one piece of equipment, all lines are captured.
- Multipliers in the circuit are either captured as a whole or individually.

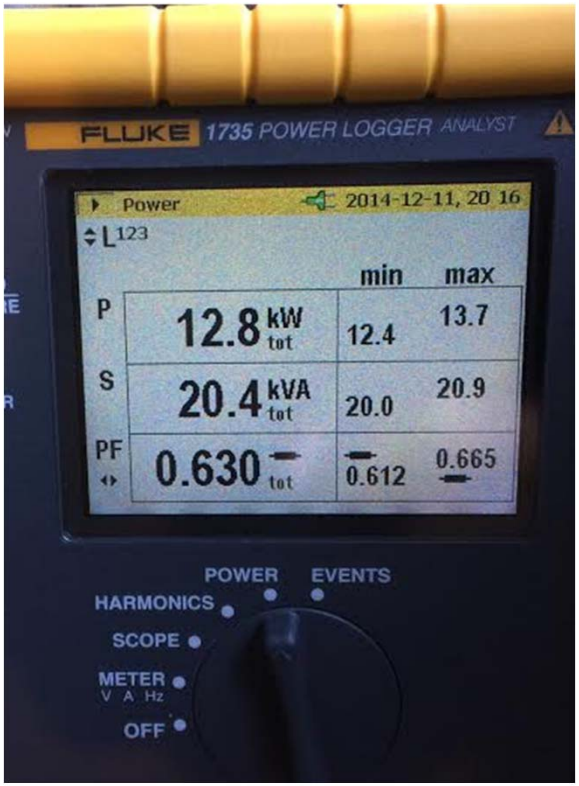
Note: All lines are tested to ensure loads are balanced.

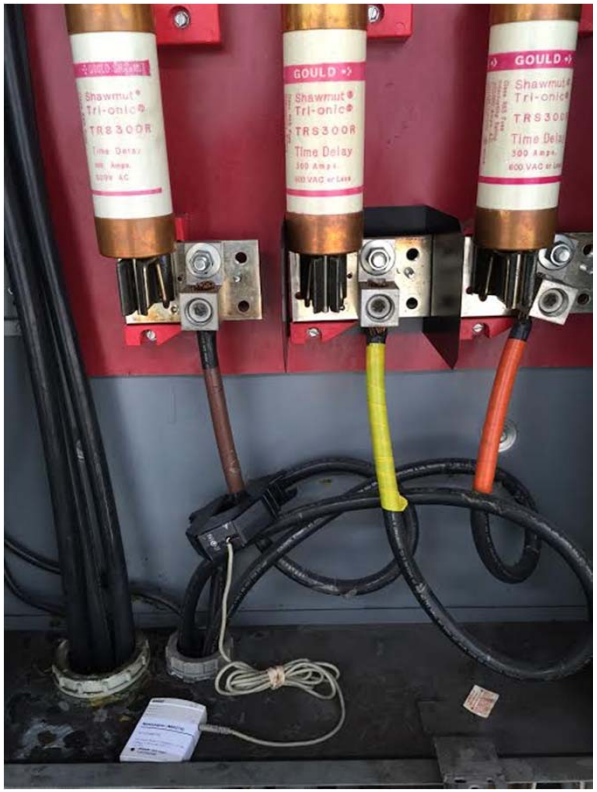


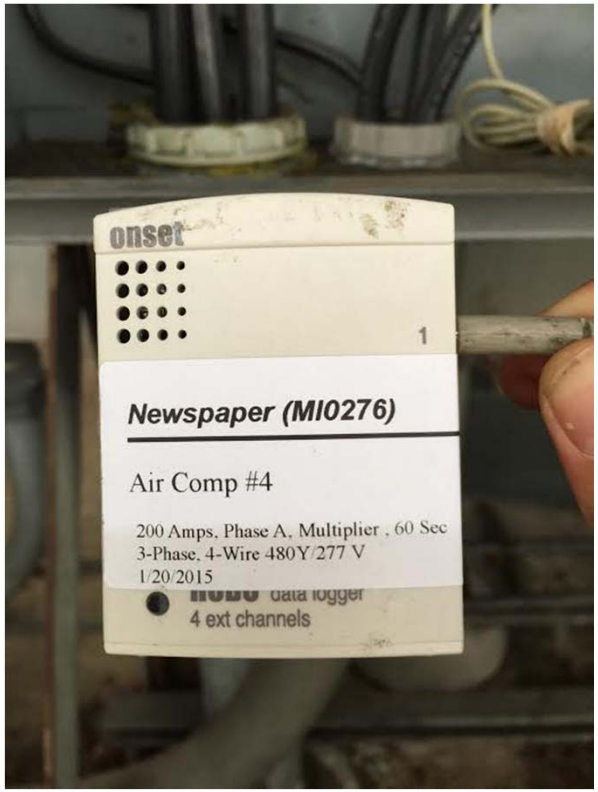
Sample Installations



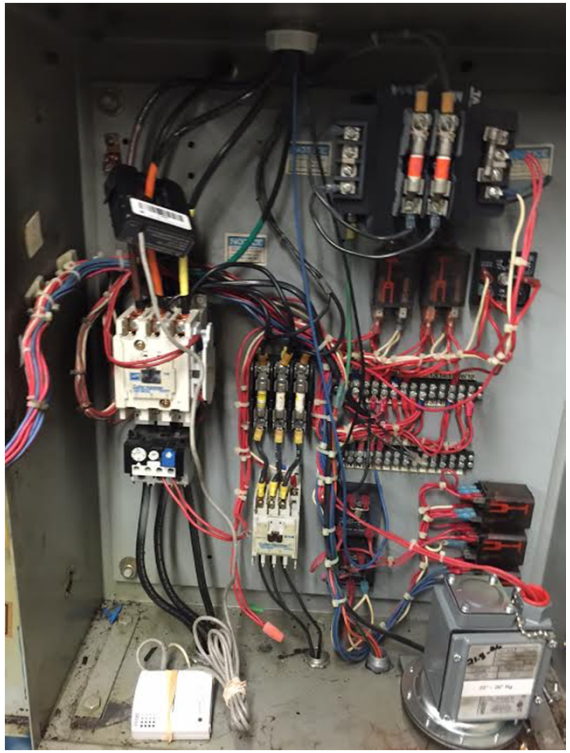
Sample Installations

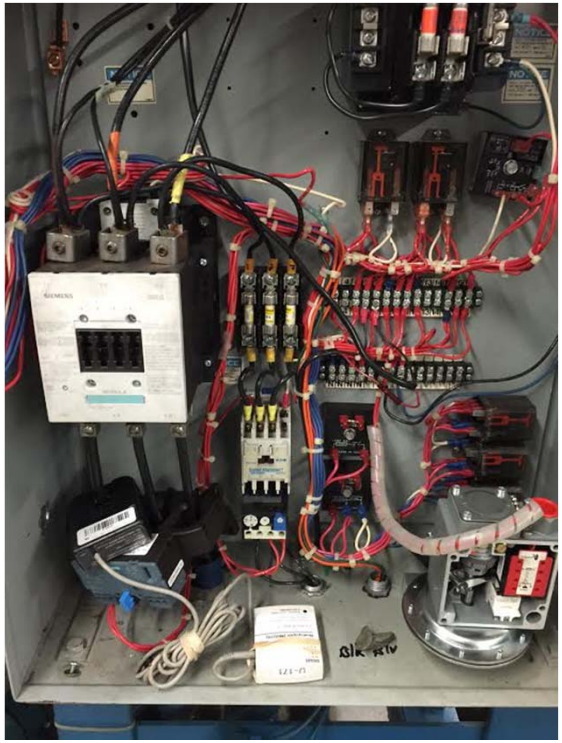


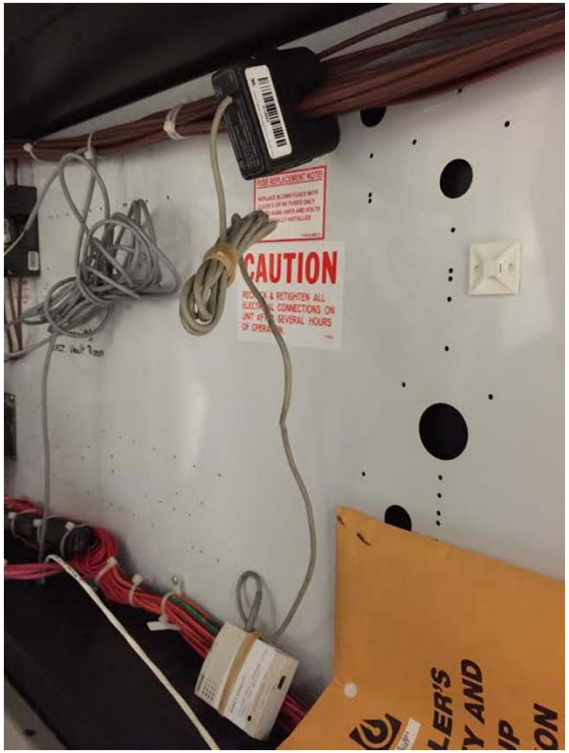




Sample Installations

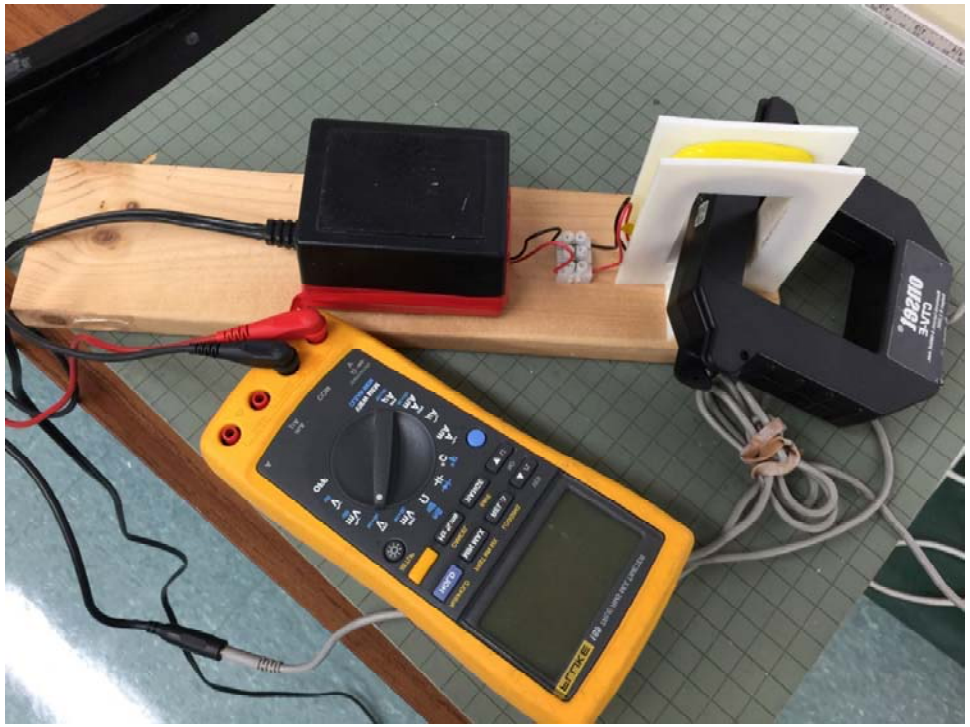






Equipment Maintenance

- All CT's and Data loggers are regularly tested and maintained.
- Battery tests on data loggers are done every time loggers return to the lab.
- A method for testing CT's was developed in house.
- Power loggers and amp meters are regularly calibrated and maintained.



Equipment Inventory

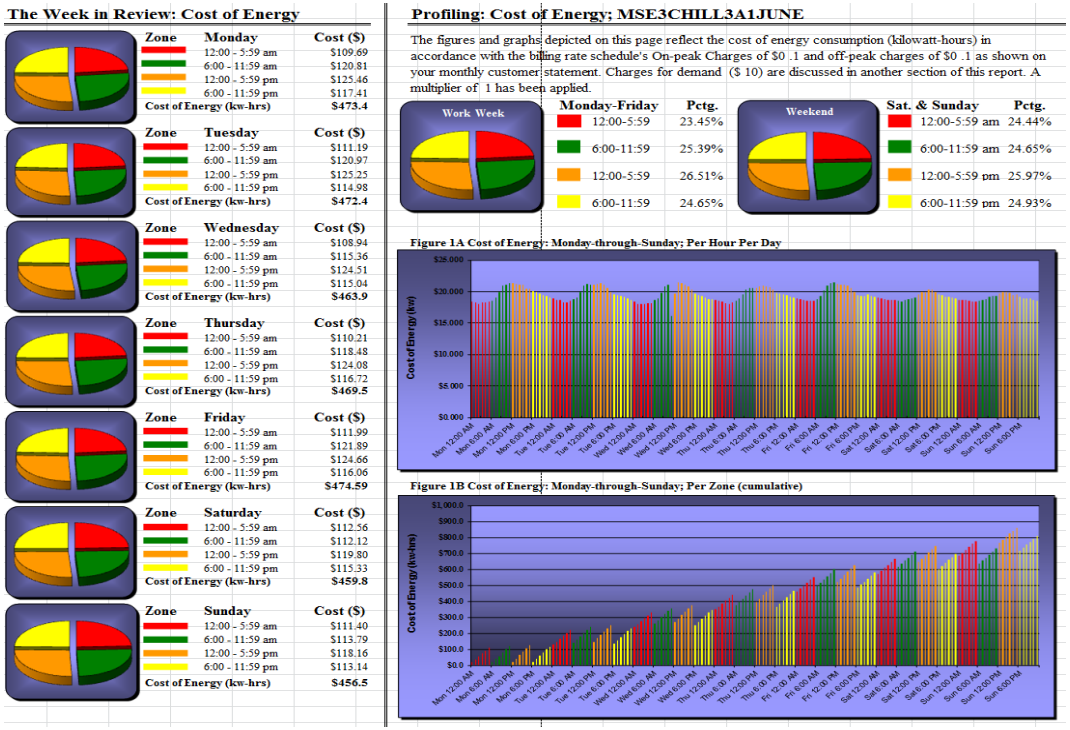
- Equipment inventory is taken before and after an assessment is conducted.
- Bar code system is being developed to track loggers and CT's.
- Process of checking out loggers and CT's, tracking loggers, and returning loggers into inventory.

Other Loggers

- Temperature and humidity loggers
- Light loggers
- Motor runtime loggers
- Occupancy sensors
- Etc

Data Analysis

- In-house software "Backpack" used to analyze the data from the loggers.
- Other software's such as air master and excel models also used.
- Weather, utility bills and production data all used to normalize the 1 week trend data collected.



The Week in Review: Cost of Energy

Zone	Monday	Cost ($)
	12:00 - 5:59 am	$109.69
	6:00 - 11:59 am	$120.81
	12:00 - 5:59 pm	$125.46
	6:00 - 11:59 pm	$117.41
Cost of Energy (kw-hrs)		$473.4

Zone	Tuesday	Cost ($)
	12:00 - 5:59 am	$111.19
	6:00 - 11:59 am	$120.97
	12:00 - 5:59 pm	$125.25
	6:00 - 11:59 pm	$114.98
Cost of Energy (kw-hrs)		$472.4

Zone	Wednesday	Cost ($)
	12:00 - 5:59 am	$108.94
	6:00 - 11:59 am	$115.36
	12:00 - 5:59 pm	$124.51
	6:00 - 11:59 pm	$115.04
Cost of Energy (kw-hrs)		$463.9

Zone	Thursday	Cost ($)
	12:00 - 5:59 am	$110.21
	6:00 - 11:59 am	$118.48
	12:00 - 5:59 pm	$124.08
	6:00 - 11:59 pm	$116.72
Cost of Energy (kw-hrs)		$469.5

Zone	Friday	Cost ($)
	12:00 - 5:59 am	$111.99
	6:00 - 11:59 am	$121.89
	12:00 - 5:59 pm	$124.66
	6:00 - 11:59 pm	$116.06
Cost of Energy (kw-hrs)		$474.59

Zone	Saturday	Cost ($)
	12:00 - 5:59 am	$112.56
	6:00 - 11:59 am	$112.12
	12:00 - 5:59 pm	$119.80
	6:00 - 11:59 pm	$115.33
Cost of Energy (kw-hrs)		$459.8

Zone	Sunday	Cost ($)
	12:00 - 5:59 am	$111.40
	6:00 - 11:59 am	$113.79
	12:00 - 5:59 pm	$118.16
	6:00 - 11:59 pm	$113.14
Cost of Energy (kw-hrs)		$456.5

Profiling: Cost of Energy; MSE3CHILL3A1JUNE

The figures and graphs depicted on this page reflect the cost of energy consumption (kilowatt-hours) in accordance with the billing rate schedule's On-peak Charges of $0 .1 and off-peak charges of $0 .1 as shown on your monthly customer statement. Charges for demand ($ 10) are discussed in another section of this report. A multiplier of 1 has been applied.

Work Week

Monday-Friday	Pctg.
12:00-5:59	23.45%
6:00-11:59	25.39%
12:00-5:59	26.51%
6:00-11:59	24.65%

Weekend

Sat. & Sunday	Pctg.
12:00-5:59 am	24.44%
6:00-11:59 am	24.65%
12:00-5:59 pm	25.97%
6:00-11:59 pm	24.93%

Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day

Figure 1B Cost of Energy: Monday-through-Sunday; Per Zone (cumulative)

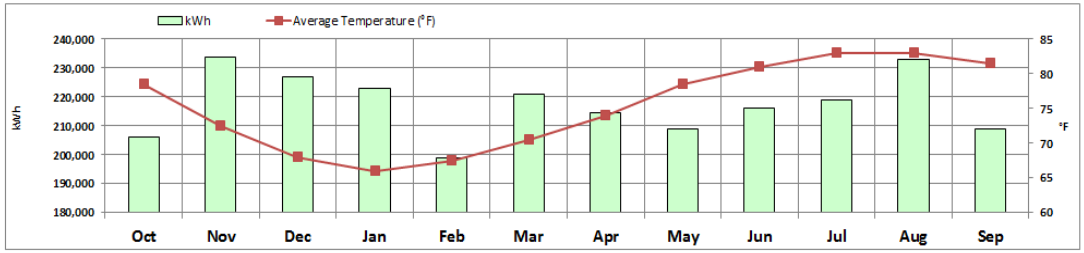
Backpack

FIX THE GRAPH - Average Temp values are incorrect

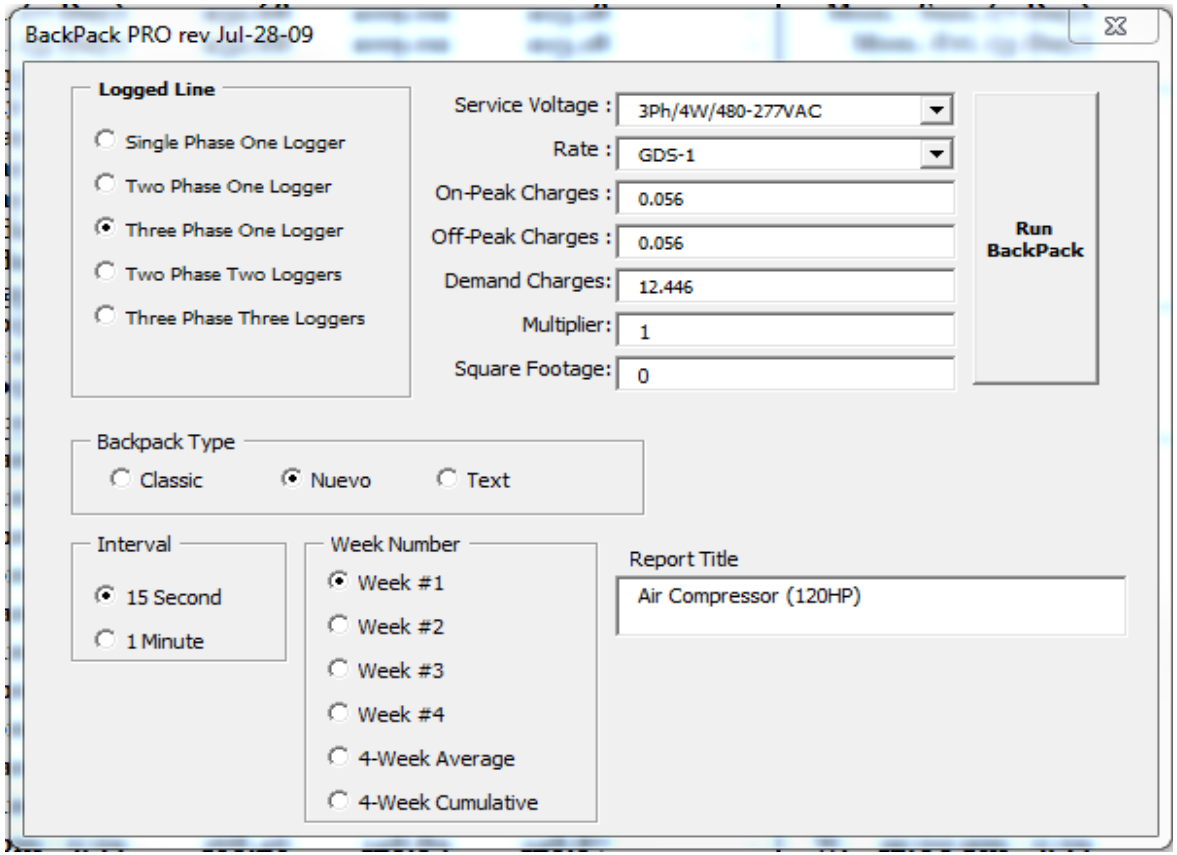
Electric Bill Summary (Oct 2013 - Sep 2014)													Acct # 18151-72265
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Service Days	10/8/2013	11/6/2013	12/6/2013	1/8/2014	2/7/2014	3/7/2014	4/7/2014	5/7/2014	6/6/2014	7/8/2014	8/7/2014	9/8/2014	10/8/2013
	11/6/2013	12/6/2013	1/8/2014	2/7/2014	3/7/2014	4/7/2014	5/7/2014	6/6/2014	7/8/2014	8/7/2014	9/8/2014	10/7/2014	10/7/2014
Days	1/29/1900	1/30/1900	33	30	1/28/1900	31	30	1/30/1900	32	30	2/1/1900	29	364
Consumption kWh	**206,160**	**233,760**	**226,800**	**222,720**	**198,960**	**220,800**	**214,560**	**209,040**	**216,000**	**218,880**	**233,040**	**208,800**	**2,609,520**
Avg. $/kWh (Non-Fuel)	$0.014790	$0.014790	$0.014680	$0.014680	$0.014680	$0.015280	$0.015280	$0.015280	$0.015280	$0.015280	$0.015280	$0.015280	
Avg. $/kWh (Fuel)	$0.031305	$0.031305	$0.038120	$0.038120	$0.038120	$0.036765	$0.036765	$0.036765	$0.036765	$0.036765	$0.036765	$0.036765	
Total kWh Cost	**$9,502.95**	**$10,775.17**	**$11,975.04**	**$11,759.62**	**$10,505.09**	**$11,491.54**	**$11,166.78**	**$10,879.49**	**$11,241.72**	**$11,391.61**	**$12,128.57**	**$10,867.00**	**$133,684.55**
Demand kW	**431**	**436**	**436**	**436**	**436**	**436**	**436**	**436**	**436**	**436**	**456**	**463**	**5,274**
Demand Charge	**$5,223.72**	**$5,284.32**	**$5,341.00**	**$5,341.00**	**$5,341.00**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,754.72**	**$5,843.06**	**$65,640.42**
Demand $/kW*	$12.12	$12.12	$12.25	$12.25	$12.25	$12.62	$12.62	$12.62	$12.62	$12.62	$12.62	$12.62	
Total kW Cost	**$5,223.72**	**$5,284.32**	**$5,341.00**	**$5,341.00**	**$5,341.00**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,502.32**	**$5,754.72**	**$5,843.06**	**$65,640.42**
Total Electric Cost	**$14,726.67**	**$16,059.49**	**$17,316.04**	**$17,100.62**	**$15,846.09**	**$16,993.86**	**$16,669.10**	**$16,381.81**	**$16,744.04**	**$16,893.93**	**$17,883.29**	**$16,710.06**	**$199,324.97**
Customer Charge	$100.48	$100.48	$100.48	$100.48	$100.48	$108.20	$108.20	$108.20	$108.20	$108.20	$108.20	$108.20	$1,259.80
Storm Charge	$136.06	$154.29	$117.94	$115.81	$165.14	$183.27	$178.09	$175.59	$181.44	$183.86	$165.46	$148.25	$1,905.20
Gross Receipt Tax	$345.06	$375.04	$383.77	$381.96	$352.69	$380.06	$368.71	$360.47	$366.07	$375.26	$397.47	$367.49	$4,454.05
Franchise Charge	$759.14	$825.09	$844.29	$840.32	$818.24	$881.73	$855.41	$893.96	$907.86	$930.65	$985.74	$911.38	$10,453.81
Utility Tax	$985.11	$1,055.74	$1,035.02	$1,027.64	$972.38	$1,059.65	$1,010.59	$998.22	$1,013.25	$1,033.77	$1,096.70	$1,026.25	$12,314.32
Florida Sales Tax	$1,019.32	$1,107.87	$1,133.65	$1,128.32	$1,044.81	$1,125.88	$1,092.27	$1,071.89	$1,080.79	$1,107.91	$14.88	$0.00	$10,927.59
Service Charge	$14.88	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Services and Taxes	**$3,259.57**	**$3,518.03**	**$3,514.67**	**$3,494.05**	**$3,353.26**	**$3,630.59**	**$3,505.07**	**$3,500.13**	**$3,549.41**	**$3,631.45**	**$2,660.25**	**$2,453.37**	**$40,054.97**
Total Charges	**$17,986.24**	**$19,577.52**	**$20,830.71**	**$20,594.67**	**$19,199.35**	**$20,624.45**	**$20,174.17**	**$19,881.94**	**$20,293.45**	**$20,525.38**	**$20,543.54**	**$19,163.43**	**$239,394.82**
Total amount per Qtr	**$58,394.46**			**$60,418.46**			**$60,349.55**			**$60,232.34**			
Percent of each quarter	24.39%			25.24%			25.21%			25.16%			100.00%

*The kW and kWh charges may deviate from the actual amounts because we did not have copies of the actual utility bills since the company receives them in electronic format, however, the final values are close to what the company actually pays

Storm Charge Rate ($/kWh)
Gross Receipts Tax Rate ($/$)
Franchise charge rate ($/$)



Backpack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Single Phase One Logger
Two Phase One Logger
Three Phase One Logger
Two Phase Two Loggers
Three Phase Three Loggers
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3Ph/4W/480-277VAC
Rate :
GDS-1
On-Peak Charges :
0.056
Off-Peak Charges :
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Demand Charges:
12.446
Multiplier:
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Square Footage:
0
Run BackPack
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Classic
Nuevo
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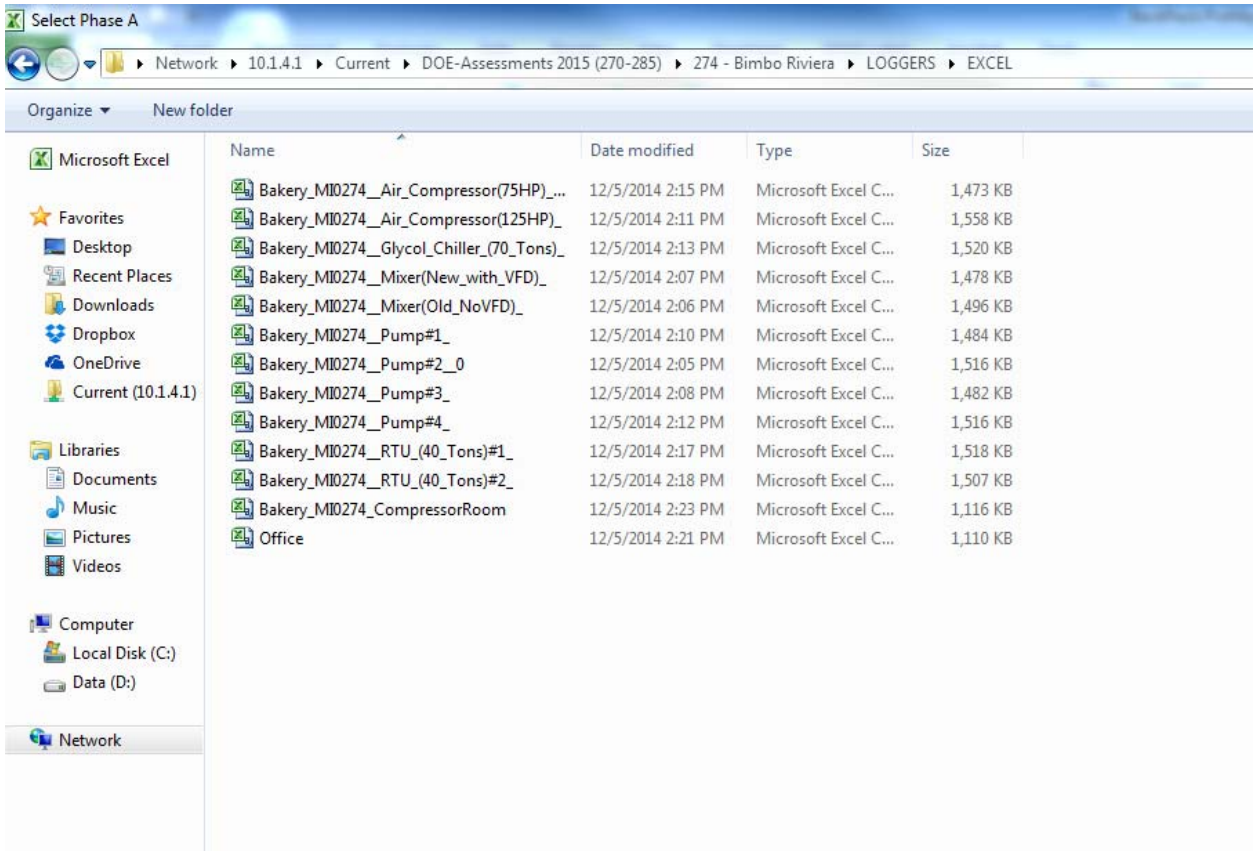
Week #2
Week #3
Week #4
4-Week Average
4-Week Cumulative
Report Title
Air Compressor (120HP)

Backpack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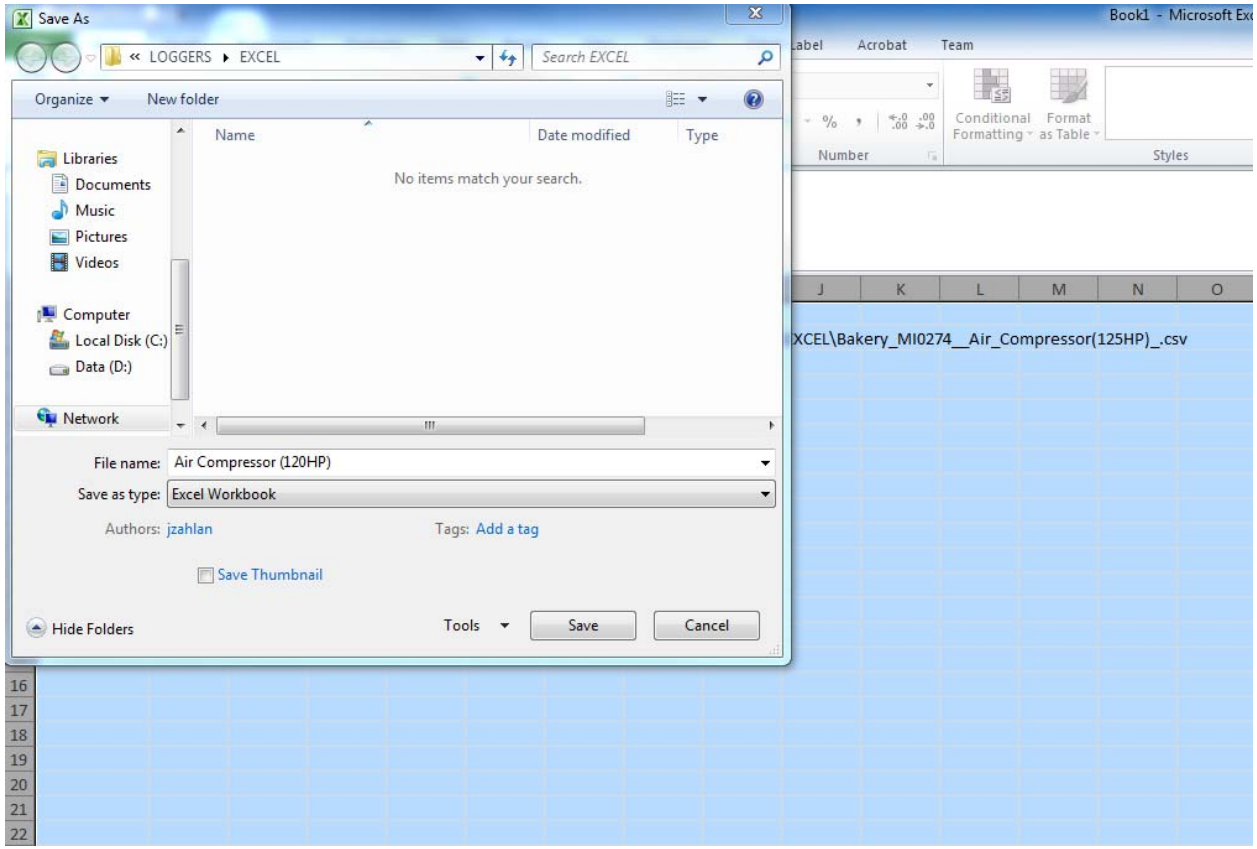
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New folder
Name
Date modified
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Videos
Computer
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Data (D:)
Network
File name: Air Compressor (120HP)
Save as type: Excel Workbook
Authors: jzahlan
Tags: Add a tag
Save Thumbnail
Hide Folders
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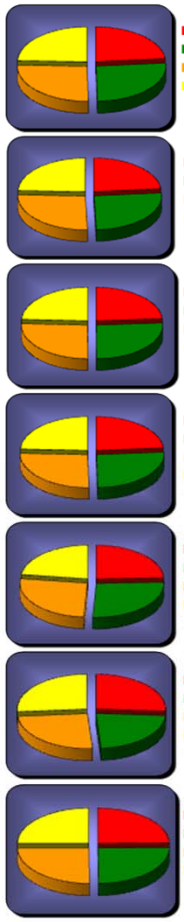
The Week in Review: Cost of Energy



Zone	Monday	Cost ($)
	12:00 - 5:59 am	$113.70
	6:00 - 11:59 am	$126.11
	12:00 - 5:59 pm	$124.46
	6:00 - 11:59 pm	$118.16
Cost of Energy (kw-hrs)		$482.4

Zone	Tuesday	Cost ($)
	12:00 - 5:59 am	$115.60
	6:00 - 11:59 am	$127.16
	12:00 - 5:59 pm	$127.82
	6:00 - 11:59 pm	$119.97
Cost of Energy (kw-hrs)		$490.5

Zone	Wednesday	Cost ($)
	12:00 - 5:59 am	$116.95
	6:00 - 11:59 am	$127.12
	12:00 - 5:59 pm	$125.84
	6:00 - 11:59 pm	$118.70
Cost of Energy (kw-hrs)		$488.6

Zone	Thursday	Cost ($)
	12:00 - 5:59 am	$114.93
	6:00 - 11:59 am	$125.33
	12:00 - 5:59 pm	$125.25
	6:00 - 11:59 pm	$117.58
Cost of Energy (kw-hrs)		$483.1

Zone	Friday	Cost ($)
	12:00 - 5:59 am	$114.72
	6:00 - 11:59 am	$124.31
	12:00 - 5:59 pm	$123.75
	6:00 - 11:59 pm	$107.55
Cost of Energy (kw-hrs)		$470.32

Zone	Saturday	Cost ($)
	12:00 - 5:59 am	$116.05
	6:00 - 11:59 am	$102.13
	12:00 - 5:59 pm	$111.45
	6:00 - 11:59 pm	$117.24
Cost of Energy (kw-hrs)		$446.9

Zone	Sunday	Cost ($)
	12:00 - 5:59 am	$115.18
	6:00 - 11:59 am	$116.61
	12:00 - 5:59 pm	$116.57
	6:00 - 11:59 pm	$116.31
Cost of Energy (kw-hrs)		$464.7

Profiling: Cost of Energy;

The figures and graphs depicted on this page reflect the cost of energy consumption (kilowatt-hours) in accordance with the billing rate schedule's On-peak Charges of $0 .1 and off-peak charges of $0 .1 as shown on your monthly customer statement. Charges for demand ($ 10) are discussed in another section of this report. A multiplier of 1 has been applied.

Monday-Friday	Pctg.
12:00-5:59	23.85%
6:00-11:59	26.09%
12:00-5:59	25.97%
6:00-11:59	24.10%

Sat. & Sunday	Pctg.
12:00-5:59 am	25.37%
6:00-11:59 am	24.00%
12:00-5:59 pm	25.01%
6:00-11:59 pm	25.62%

Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day

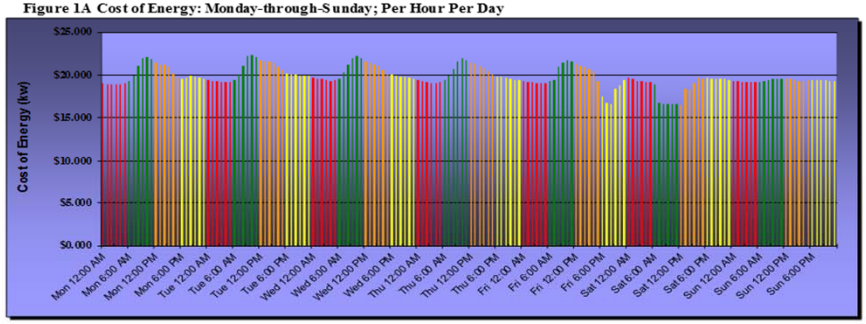


Figure 1B Cost of Energy: Monday-through-Sunday; Per Zone (cumulative)

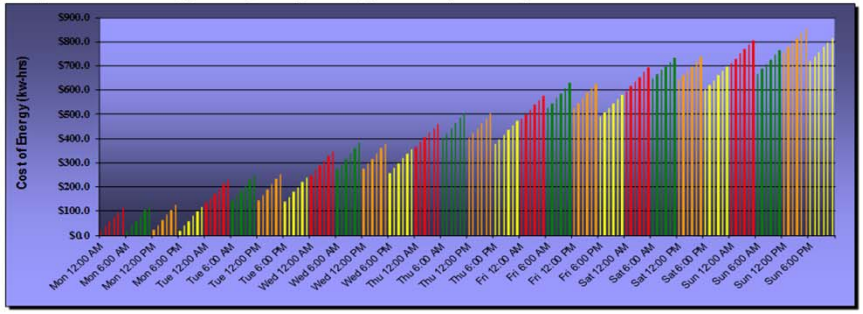


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Table 1 Vertical Cross Analysis

		Vertical Cross Analysis			
#	Day	Cost ($)	Kw-Hrs	P ctg	Cumu %
1-	Monday	$482.4	4824.2	14.50%	14.50%
2-	Tuesday	$490.5	4905.5	14.75%	29.25%
3-	Wednesday	$488.6	4886.0	14.69%	43.94%
4-	Thursday	$483.1	4830.9	14.52%	58.46%
5-	Friday	$470.3	4703.2	14.14%	72.60%
6-	Saturday	$446.9	4468.7	13.43%	86.03%
7-	Sunday	$464.7	4646.7	13.97%	100%
8-	Work Week	$2,415.0	24149.9	72.6%	72.6%
9-	Week End	$911.5	9115.4	27.4%	100%
10-	Total Week	$3,327	33265.3	100%	100%

Table 2 Cost of Energy; Per Time Zone Per Day

	Ghost Power: 12:00 To 05:59 AM				Gate Power: 06:00 To 11:59 AM				Stretch Power: 12:00 To 05:59 PM				Phantom Power: 06:00 To 11:59 PM			
Day	Cost ($)	Kw-Hrs	V-P ctg	H-P ctg	Cost ($)	Kw-Hrs	V-P ctg	H-P ctg	Cost ($)	Kw-Hrs	V-P ctg	H-P ctg	Cost ($)	Kw-Hrs	V-P ctg	H-P ctg
Monday	$113.70	1137.01	14.09%	23.57%	$126.11	1261.06	14.86%	26.14%	$124.46	1244.58	14.55%	25.80%	$118.16	1181.59	14.49%	24.49%
Tuesday	$115.60	1155.99	14.32%	23.57%	$127.16	1271.57	14.98%	25.92%	$127.82	1278.19	14.95%	26.06%	$119.97	1199.73	14.71%	24.46%
Wednesday	$116.95	1169.46	14.49%	23.93%	$127.12	1271.17	14.98%	26.02%	$125.84	1258.40	14.72%	25.76%	$118.70	1187.00	14.56%	24.29%
Thursday	$114.93	1149.33	14.24%	23.79%	$125.33	1253.27	14.77%	25.94%	$125.25	1252.49	14.65%	25.93%	$117.58	1175.80	14.42%	24.34%
Friday	$114.72	1147.17	14.21%	24.39%	$124.31	1243.09	14.65%	26.43%	$123.75	1237.47	14.47%	26.31%	$107.55	1075.52	13.19%	22.87%
Saturday	$116.05	1160.53	14.38%	25.97%	$102.13	1021.29	12.03%	22.85%	$111.45	1114.45	13.03%	24.94%	$117.24	1172.44	14.38%	26.24%
Sunday	$115.18	1151.81	14.27%	24.79%	$116.61	1166.10	13.74%	25.10%	$116.57	1165.70	13.63%	25.09%	$116.31	1163.11	14.26%	25.03%
Work Week	$576	5759	71.4%	23.8%	$630	6300	74.2%	26.1%	$627	6271	73.3%	26.0%	$582	5820	71.4%	24.1%
Week End	$231	2312	28.6%	25%	$219	2187	25.8%	24%	$228	2280	26.7%	25%	$234	2336	28.6%	26%
Total Week	$807	8071.3	100%	24.26%	$849	8487.6	100%	25.51%	$855	8551.3	100%	25.71%	$816	8155.2	100%	24.52%

Table 3 Cost of Energy; Per Hour Per Day For Seven Days

		12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM
Monday	Cost ($)	$19.064	$18.958	$18.898	$18.883	$18.900	$18.997	$19.313	$19.965	$21.055	$21.916	$22.076	$21.782
	Kw-Hrs	190.64	189.58	188.98	188.83	189.00	189.97	193.13	199.65	210.55	219.16	220.76	217.82
	%	3.95%	3.93%	3.92%	3.91%	3.92%	3.94%	4.00%	4.14%	4.36%	4.54%	4.58%	4.52%
	Cumu %	3.95%	7.88%	11.80%	15.71%	19.63%	23.57%	27.57%	31.71%	36.07%	40.62%	45.19%	49.71%
Tuesday	Cost ($)	$19.455	$19.350	$19.296	$19.205	$19.151	$19.142	$19.439	$20.084	$21.071	$22.195	$22.304	$22.063
	Kw-Hrs	194.55	193.50	192.96	192.05	191.51	191.42	194.39	200.84	210.71	221.95	223.04	220.63
	%	3.97%	3.94%	3.93%	3.91%	3.90%	3.90%	3.96%	4.09%	4.30%	4.52%	4.55%	4.50%
	Cumu %	3.97%	7.91%	11.84%	15.76%	19.66%	23.57%	27.53%	31.62%	35.92%	40.44%	44.99%	49.49%
Wednesday	Cost ($)	$19.709	$19.545	$19.492	$19.394	$19.352	$19.453	$19.604	$20.280	$21.147	$21.960	$22.158	$21.968
	Kw-Hrs	197.09	195.45	194.92	193.94	193.52	194.53	196.04	202.80	211.47	219.60	221.58	219.68
	%	4.03%	4.00%	3.99%	3.97%	3.96%	3.98%	4.01%	4.15%	4.33%	4.49%	4.54%	4.50%
	Cumu %	4.03%	8.03%	12.02%	15.99%	19.95%	23.93%	27.95%	32.10%	36.43%	40.92%	45.46%	49.95%
Thursday	Cost ($)	$19.429	$19.235	$19.125	$19.044	$18.998	$19.103	$19.393	$19.924	$20.733	$21.561	$21.984	$21.733
	Kw-Hrs	194.29	192.35	191.25	190.44	189.98	191.03	193.93	199.24	207.33	215.61	219.84	217.33
	%	4.02%	3.98%	3.96%	3.94%	3.93%	3.95%	4.01%	4.12%	4.29%	4.46%	4.55%	4.50%
	Cumu %	4.02%	8.00%	11.96%	15.90%	19.84%	23.79%	27.81%	31.93%	36.22%	40.68%	45.24%	49.73%
Friday	Cost ($)	$19.305	$19.173	$19.145	$19.070	$18.990	$19.034	$19.312	$19.401	$20.884	$21.464	$21.707	$21.540
	Kw-Hrs	193.05	191.73	191.45	190.70	189.90	190.34	193.12	194.01	208.84	214.64	217.07	215.40
	%	4.10%	4.08%	4.07%	4.05%	4.04%	4.05%	4.11%	4.13%	4.44%	4.56%	4.62%	4.58%
	Cumu %	4.10%	8.18%	12.25%	16.31%	20.34%	24.39%	28.50%	32.62%	37.06%	41.63%	46.24%	50.82%
Saturday	Cost ($)	$19.710	$19.487	$19.292	$19.228	$19.149	$19.186	$18.847	$16.799	$16.585	$16.668	$16.608	$16.623
	Kw-Hrs	197.10	194.87	192.92	192.28	191.49	191.86	188.47	167.99	165.85	166.68	166.08	166.23
	%	4.41%	4.36%	4.32%	4.30%	4.29%	4.29%	4.22%	3.76%	3.71%	3.73%	3.72%	3.72%
	Cumu %	4.41%	8.77%	13.09%	17.39%	21.68%	25.97%	30.19%	33.95%	37.66%	41.39%	45.10%	48.82%
Sunday	Cost ($)	$19.318	$19.235	$19.207	$19.170	$19.121	$19.130	$19.218	$19.309	$19.407	$19.535	$19.578	$19.563
	Kw-Hrs	193.18	192.35	192.07	191.70	191.21	191.30	192.18	193.09	194.07	195.35	195.78	195.63
	%	4.16%	4.14%	4.13%	4.13%	4.11%	4.12%	4.14%	4.16%	4.18%	4.20%	4.21%	4.21%
	Cumu %	4.16%	8.30%	12.43%	16.56%	20.67%	24.79%	28.92%	33.08%	37.26%	41.46%	45.67%	49.88%

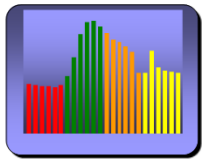
		12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Monday	Cost ($)	$21.416	$21.175	$21.131	$20.882	$20.178	$19.676	$19.594	$19.681	$19.873	$19.760	$19.686	$19.565
	Kw-Hrs	214.16	211.75	211.31	208.82	201.78	196.76	195.94	196.81	198.73	197.60	196.86	195.65
	%	4.44%	4.39%	4.38%	4.33%	4.18%	4.08%	4.06%	4.08%	4.12%	4.10%	4.08%	4.06%
	Cumu %	54.15%	58.54%	62.92%	67.25%	71.43%	75.51%	79.57%	83.65%	87.77%	91.86%	95.94%	100%
Tuesday	Cost ($)	$21.736	$21.577	$21.627	$21.443	$20.927	$20.509	$20.213	$20.032	$20.052	$19.945	$19.869	$19.862
	Kw-Hrs	217.36	215.77	216.27	214.43	209.27	205.09	202.13	200.32	200.52	199.45	198.69	198.62
	%	4.43%	4.40%	4.41%	4.37%	4.27%	4.18%	4.12%	4.08%	4.09%	4.07%	4.05%	4.05%
	Cumu %	53.92%	58.32%	62.72%	67.10%	71.36%	75.54%	79.66%	83.75%	87.83%	91.90%	95.95%	100%
Wednesday	Cost ($)	$21.558	$21.419	$21.231	$21.017	$20.531	$20.085	$20.035	$19.941	$19.791	$19.739	$19.642	$19.551
	Kw-Hrs	215.58	214.19	212.31	210.17	205.31	200.85	200.35	199.41	197.91	197.39	196.42	195.51
	%	4.41%	4.38%	4.35%	4.30%	4.20%	4.11%	4.10%	4.08%	4.05%	4.04%	4.02%	4.00%
	Cumu %	54.36%	58.75%	63.09%	67.39%	71.60%	75.71%	79.81%	83.89%	87.94%	91.98%	96.00%	100%
Thursday	Cost ($)	$21.480	$21.328	$21.076	$20.865	$20.490	$20.009	$19.804	$19.761	$19.659	$19.530	$19.400	$19.425
	Kw-Hrs	214.80	213.28	210.76	208.65	204.90	200.09	198.04	197.61	196.59	195.30	194.00	194.25
	%	4.45%	4.41%	4.36%	4.32%	4.24%	4.14%	4.10%	4.09%	4.07%	4.04%	4.02%	4.02%
	Cumu %	54.18%	58.60%	62.96%	67.28%	71.52%	75.66%	79.76%	83.85%	87.92%	91.96%	95.98%	100%
Friday	Cost ($)	$21.300	$21.076	$20.935	$20.746	$20.397	$19.293	$17.551	$16.742	$16.639	$18.408	$18.760	$19.453
	Kw-Hrs	213.00	210.76	209.35	207.46	203.97	192.93	175.51	167.42	166.39	184.08	187.60	194.53
	%	4.53%	4.48%	4.45%	4.41%	4.34%	4.10%	3.73%	3.56%	3.54%	3.91%	3.99%	4.14%
	Cumu %	55.35%	59.83%	64.28%	68.69%	73.03%	77.13%	80.86%	84.42%	87.96%	91.88%	95.86%	100%
Saturday	Cost ($)	$16.518	$18.392	$18.274	$19.067	$19.626	$19.568	$19.672	$19.538	$19.560	$19.538	$19.494	$19.441
	Kw-Hrs	165.18	183.92	182.74	190.67	196.26	195.68	196.72	195.38	195.60	195.38	194.94	194.41
	%	3.70%	4.12%	4.09%	4.27%	4.39%	4.38%	4.40%	4.37%	4.38%	4.37%	4.36%	4.35%
	Cumu %	52.52%	56.64%	60.73%	64.99%	69.38%	73.76%	78.17%	82.54%	86.91%	91.29%	95.65%	100%
Sunday	Cost ($)	$19.497	$19.550	$19.472	$19.342	$19.318	$19.392	$19.411	$19.418	$19.466	$19.372	$19.349	$19.294
	Kw-Hrs	194.97	195.50	194.72	193.42	193.18	193.92	194.11	194.18	194.66	193.72	193.49	192.94
	%	4.20%	4.21%	4.19%	4.16%	4.16%	4.17%	4.18%	4.18%	4.19%	4.17%	4.16%	4.15%
	Cumu %	54.08%	58.29%	62.48%	66.64%	70.80%	74.97%	79.15%	83.33%	87.51%	91.68%	95.85%	100%

		Ghost Power: 12:00 To 05:59 AM						Gate Power: 06:00 To 11:59 AM					
Summary	Cost ($)	$135.990	$134.984	$134.454	$133.993	$133.661	$134.047	$135.124	$135.762	$140.881	$145.300	$146.415	$145.273
	Kw-Hrs	1,359.9	1,349.8	1,344.5	1,339.9	1,336.6	1,340.5	1,351.2	1,357.6	1,408.8	1,453.0	1,464.2	1,452.7
	%	16.85%	16.72%	16.66%	16.60%	16.56%	16.61%	15.92%	16.00%	16.60%	17.12%	17.25%	17.12%
	Cumu %	16.85%	33.57%	50.23%	66.83%	83.39%	100%	15.92%	31.92%	48.51%	65.63%	82.88%	100%

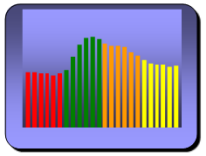
		Stretch Power: 12:00 To 05:59 PM						Phantom Power: 06:00 To 11:59 PM					
Summary	Cost ($)	$143.505	$144.517	$143.746	$143.362	$141.468	$138.532	$136.281	$135.113	$135.041	$136.292	$136.199	$136.592
	Kw-Hrs	1,435.0	1,445.2	1,437.5	1,433.6	1,414.7	1,385.3	1,362.8	1,351.1	1,350.4	1,362.9	1,362.0	1,365.9
	%	16.78%	16.90%	16.81%	16.76%	16.54%	16.20%	16.71%	16.57%	16.56%	16.71%	16.70%	16.75%
	Cumu %	16.78%	33.68%	50.49%	67.26%	83.80%	100%	16.71%	33.28%	49.84%	66.55%	83.25%	100%

Backpack

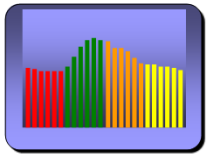
The Week in Review: Peak Demand



Zone	Monday	Cost ($)
	5:34:35 PM	$1,942.8
	12:57:18 PM	$2,245.3
	2:03:00 AM	$2,190.5
	1:31:47 AM	$2,103.3
Peak Demand		$2,245



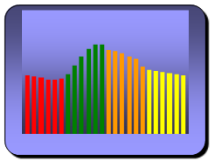
Zone	Tuesday	Cost ($)
	9:54:53 PM	$1,968.3
	7:42:24 PM	$2,267.2
	6:30:29 AM	$2,211.8
	11:04:24 AM	$2,070.8
Peak Demand		$2,267



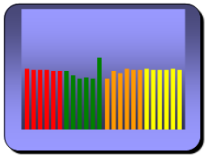
Zone	Wednesday	Cost ($)
	9:04:56 PM	$2,001.8
	9:57:18 PM	$2,260.5
	12:15:45 AM	$2,232.9
	9:08:23 PM	$2,034.9
Peak Demand		$2,261

Profiling: Cost of Energy;

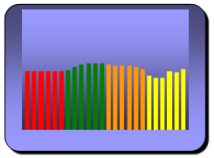
Data Collection: Peak demand is the kw (kilowatt) to the nearest whole kw as determined from the company's time of use metering equipment for the Customer's greatest use for the designated on-peak periods during the month adjusted for power factor. The figures and graphs depicted on this page reflect the peak demand cost of energy (kilowatts) in accordance with the billing rate schedule ($ 10/peak-kilowatt demand) and applicable taxes as shown on your monthly customer statement. for a detailed breakdown of peak demand costs per hour per day, please refer to the accompanying tables following this page. A multiplier of 1 has been applied.



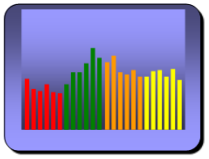
Zone	Thursday	Cost ($)
	4:52:53 PM	$1,977.1
	11:02:26 AM	$2,227.4
	5:42:22 PM	$2,181.2
	3:56:31 PM	$2,018.9
Peak Demand		$2,227



Zone	Saturday	Cost ($)
	6:10:09 AM	$2,009.1
	5:10:30 AM	$2,393.0
	10:22:36 PM	$2,014.0
	8:07:30 PM	$2,014.2
Peak Demand		$2,393

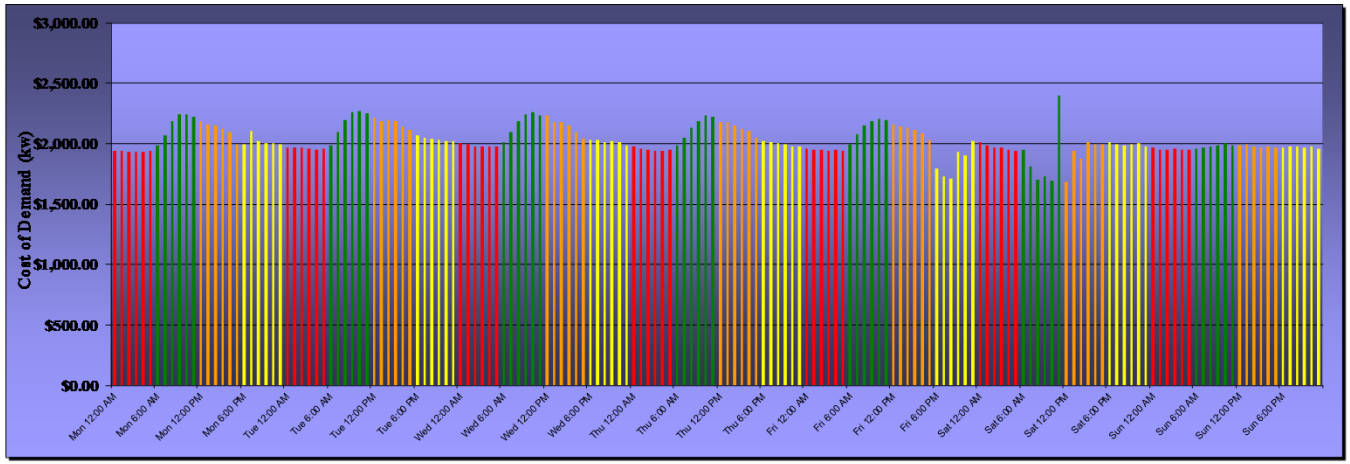


Zone	Friday	Cost ($)
	9:12:37 AM	$1,958.7
	10:29:03 AM	$2,205.5
	10:16:50 PM	$2,161.9
	4:03:46 PM	$2,021.7
Peak Demand		$2,206



Zone	Sunday	Cost ($)
	9:12:37 AM	$1,962.7
	3:43:02 PM	$2,001.5
	4:54:05 PM	$1,992.5
	12:16:13 AM	$1,976.1
Peak Demand		$2,001

Figure 1A Cost of Energy: Monday-through-Sunday; Per Hour Per Day



Backpack

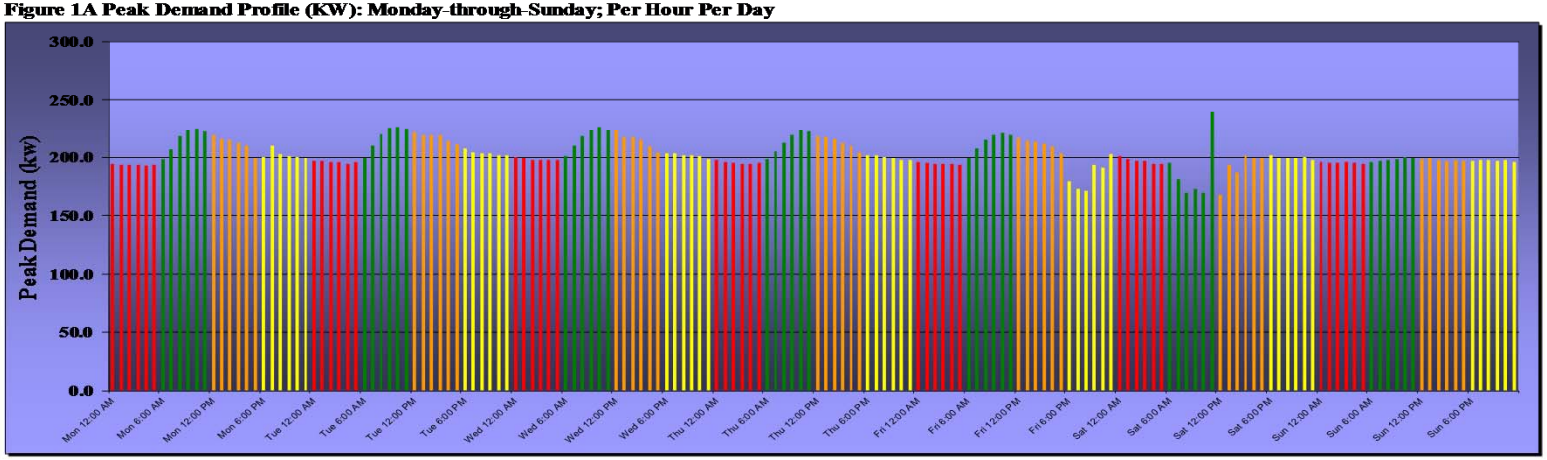
Profiling: Cost of Energy:

Data Collection: The team implements a data logging session aimed to capture the company's lump sum cost of energy-peak demand (kilowatt, kw) and consumption (kilowatt hours, kw-hrs). The data collection strategy consist of the installation of a minimum of 18 and up to a maximum of 500 data loggers for seven consecutive days. Each logger is preset to capture electrical demand inputs according to the preset configuration. For example, if the data loggers are set to capture data every 15 seconds, then the total number of points captured by one logger is equal to 40,320 data points. The tables shown below reflect the cost of energy- peak demand (kilowatt). All calculations reflect the billing rate schedule shown on the company's customer monthly billing statment.

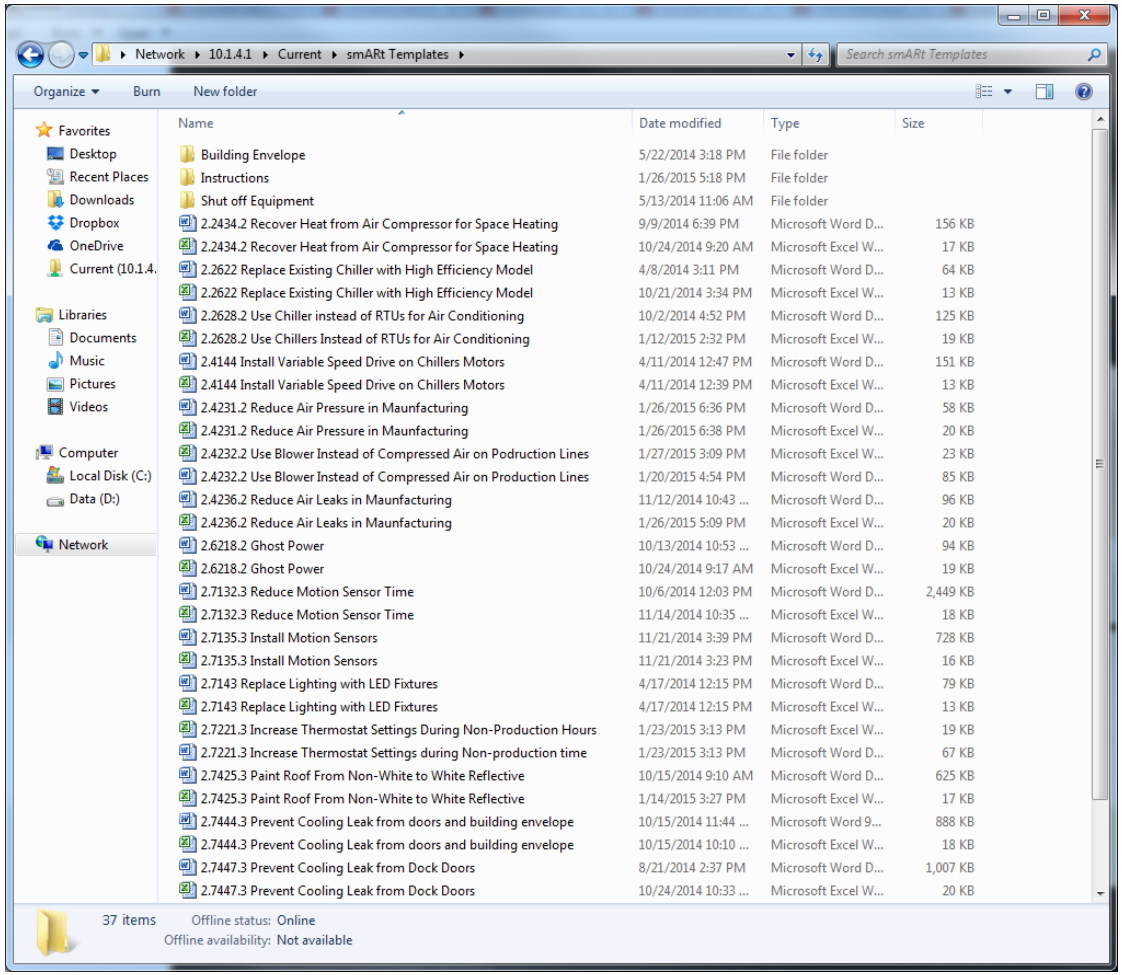
The Week in Review: Peak Demand Profile; Highest 15-second interval Kilowatt Demand, Time of Day Recorded, and Cost of Peak

		12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Mon	Cost ($)	$1,942.8	$1,937.9	$1,929.8	$1,933.8	$1,926.9	$1,935.7	$1,981.8	$2,069.4	$2,184.2	$2,241.8	$2,245.3	$2,219.7	$2,190.5	$2,156.6	$2,146.5	$2,123.3	$2,098.4	$1,995.5	$1,995.9	$2,103.3	$2,022.9	$2,005.7	$2,001.8	$1,995.4
	Kw d	194.3	193.8	193.0	193.4	192.7	193.6	198.2	206.9	218.4	224.2	224.5	222.0	219.1	215.7	214.6	212.3	209.8	199.6	199.6	210.3	202.3	200.6	200.2	199.5
	Time	12:13 AM	1:47 AM	2:20 AM	3:00 AM	4:45 AM	5:51 AM	6:51 AM	7:57 AM	8:58 AM	9:32 AM	10:38 AM	11:14 AM	12:00 PM	1:03 PM	2:22 PM	3:00 PM	4:00 PM	5:17 PM	6:22 PM	7:59 PM	8:07 PM	9:03 PM	10:42 PM	11:34 PM
Tue	Cost ($)	$1,968.3	$1,963.3	$1,962.0	$1,955.9	$1,943.8	$1,956.2	$1,988.2	$2,095.8	$2,196.6	$2,259.1	$2,267.2	$2,245.5	$2,211.8	$2,190.3	$2,192.7	$2,186.1	$2,138.8	$2,109.2	$2,070.8	$2,044.5	$2,036.1	$2,034.1	$2,018.7	$2,020.5
	Kw d	196.8	196.3	196.2	195.6	194.4	195.6	198.8	209.6	219.7	225.9	226.7	224.5	221.2	219.0	219.3	218.6	213.9	210.9	207.1	204.4	203.6	203.4	201.9	202.0
	Time	12:20 AM	1:23 AM	2:58 AM	3:08 AM	4:44 AM	5:42 AM	6:58 AM	7:48 AM	8:58 AM	9:23 AM	10:34 AM	11:44 AM	12:03 PM	1:28 PM	2:39 PM	3:04 PM	4:09 PM	5:06 PM	6:11 PM	7:38 PM	8:22 PM	9:02 PM	10:49 PM	11:23 PM
Wed	Cost ($)	$2,001.8	$1,994.4	$1,976.5	$1,972.2	$1,972.0	$1,975.5	$2,009.9	$2,095.3	$2,182.8	$2,236.8	$2,260.5	$2,233.9	$2,232.9	$2,177.1	$2,176.7	$2,146.9	$2,090.1	$2,038.2	$2,029.4	$2,034.9	$2,015.0	$2,016.8	$2,008.1	$1,984.0
	Kw d	200.2	199.4	197.6	197.2	197.2	197.5	201.0	209.5	218.3	223.7	226.1	223.4	223.3	217.7	217.7	214.7	209.0	203.8	202.9	203.5	201.5	201.7	200.8	198.4
	Time	12:44 AM	1:59 AM	2:55 AM	3:30 AM	4:09 AM	5:34 AM	6:53 AM	7:54 AM	8:59 AM	9:40 AM	10:12 AM	11:17 AM	12:04 PM	1:34 PM	2:02 PM	3:01 PM	4:06 PM	5:12 PM	6:29 PM	7:00 PM	8:32 PM	9:19 PM	10:07 PM	11:42 PM
Thur	Cost ($)	$1,977.1	$1,961.4	$1,951.9	$1,938.7	$1,941.8	$1,950.1	$1,982.3	$2,049.3	$2,126.6	$2,190.1	$2,227.4	$2,225.8	$2,181.2	$2,172.7	$2,153.2	$2,125.4	$2,102.9	$2,044.4	$2,018.9	$2,012.8	$2,001.8	$1,994.3	$1,979.3	$1,972.0
	Kw d	197.7	196.1	195.2	193.9	194.2	195.0	198.2	204.9	212.7	219.0	222.7	222.6	218.1	217.3	215.3	212.5	210.3	204.4	201.9	201.3	200.2	199.4	197.9	197.2
	Time	12:03 AM	1:01 AM	2:04 AM	3:19 AM	4:47 AM	5:36 AM	6:54 AM	7:59 AM	8:58 AM	9:51 AM	10:58 AM	11:04 AM	12:03 PM	1:09 PM	2:18 PM	3:07 PM	4:02 PM	5:03 PM	6:25 PM	7:07 PM	8:21 PM	9:29 PM	10:02 PM	11:17 PM
Fri	Cost ($)	$1,958.7	$1,948.3	$1,943.6	$1,941.4	$1,944.4	$1,937.1	$1,991.3	$2,073.4	$2,147.3	$2,187.7	$2,205.5	$2,192.8	$2,161.9	$2,140.4	$2,130.5	$2,114.8	$2,088.3	$2,031.2	$1,791.8	$1,725.7	$1,708.5	$1,931.6	$1,906.3	$2,021.7
	Kw d	195.9	194.8	194.4	194.1	194.4	193.7	199.1	207.3	214.7	218.8	220.6	219.3	216.2	214.0	213.0	211.5	208.8	203.1	179.2	172.6	170.8	193.2	190.6	202.2
	Time	12:01 AM	1:02 AM	2:19 AM	3:50 AM	4:40 AM	5:42 AM	6:51 AM	7:26 AM	8:57 AM	9:50 AM	10:26 AM	11:31 AM	12:13 PM	1:24 PM	2:00 PM	3:12 PM	4:06 PM	5:10 PM	6:28 PM	7:02 PM	8:33 PM	9:21 PM	10:13 PM	11:28 PM
Sat	Cost ($)	$2,009.1	$1,986.8	$1,969.4	$1,967.1	$1,946.2	$1,942.8	$1,947.7	$1,811.1	$1,697.3	$1,728.5	$1,693.0	$2,393.0	$1,678.7	$1,935.9	$1,871.8	$2,014.0	$1,990.3	$1,992.9	$2,014.2	$1,994.7	$1,988.4	$1,995.1	$2,000.6	$1,971.4
	Kw d	200.9	198.7	196.9	196.7	194.6	194.3	194.8	181.1	169.7	172.9	169.3	239.3	167.9	193.6	187.2	201.4	199.0	199.3	201.4	199.5	198.8	199.5	200.1	197.1
	Time	12:01 AM	1:46 AM	2:00 AM	3:02 AM	4:36 AM	5:28 AM	6:36 AM	7:01 AM	8:58 AM	9:14 AM	10:13 AM	11:31 AM	12:31 PM	1:55 PM	2:00 PM	3:26 PM	4:09 PM	5:42 PM	6:08 PM	7:05 PM	8:12 PM	9:18 PM	10:07 PM	11:42 PM
Sun	Cost ($)	$1,962.7	$1,950.9	$1,947.7	$1,956.6	$1,946.4	$1,945.0	$1,956.8	$1,971.0	$1,971.6	$1,982.0	$2,001.5	$1,988.9	$1,984.6	$1,992.5	$1,971.6	$1,968.3	$1,973.8	$1,965.9	$1,966.3	$1,973.2	$1,974.4	$1,966.7	$1,976.1	$1,961.7
	Kw d	196.3	195.1	194.8	195.7	194.6	194.5	195.7	197.1	197.2	198.2	200.1	198.9	198.5	199.2	197.2	196.8	197.4	196.6	196.6	197.3	197.4	196.7	197.6	196.2
	Time	12:20 AM	1:15 AM	2:48 AM	3:19 AM	4:39 AM	5:52 AM	6:51 AM	7:05 AM	8:47 AM	9:20 AM	10:26 AM	11:25 AM	12:16 PM	1:09 PM	2:16 PM	3:58 PM	4:42 PM	5:29 PM	6:18 PM	7:16 PM	8:39 PM	9:50 PM	10:24 PM	11:34 PM

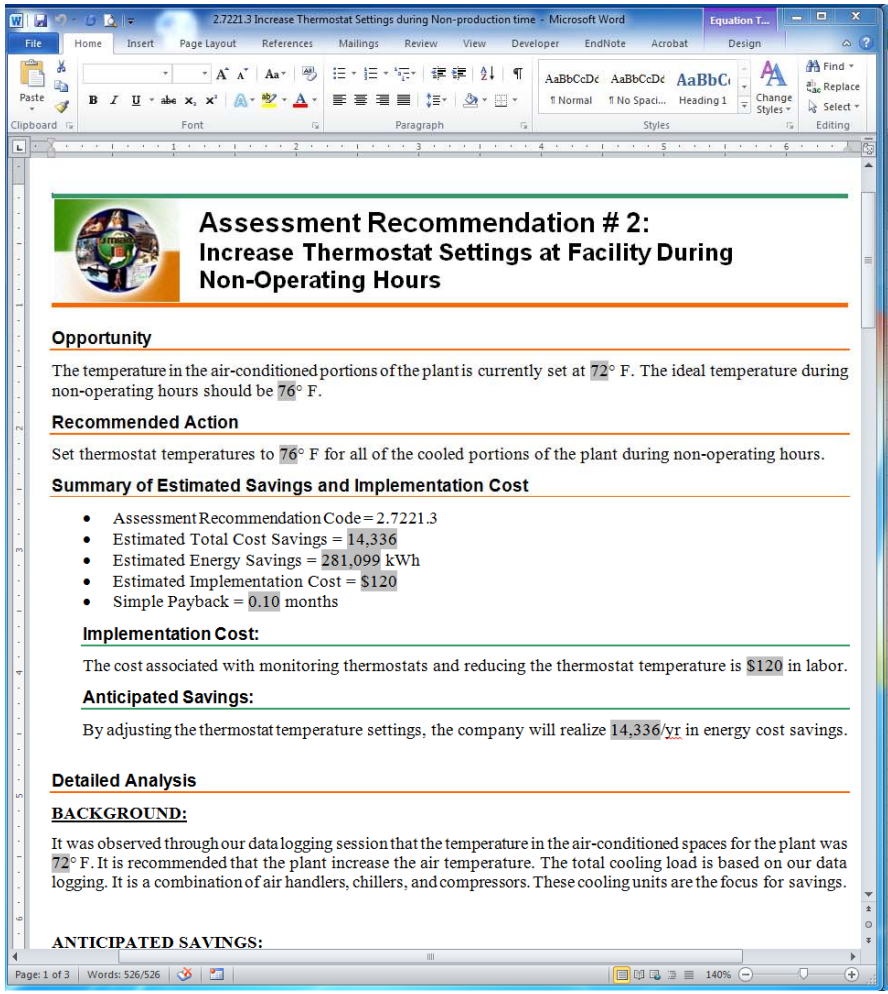
Figure 1A Peak Demand Profile (KW): Monday-through-Sunday; Per Hour Per Day



smARt© Templates



smARt© Templates



Assessment Recommendation # 2:
Increase Thermostat Settings at Facility During Non-Operating Hours

Opportunity

The temperature in the air-conditioned portions of the plant is currently set at 72° F. The ideal temperature during non-operating hours should be 76° F.

Recommended Action

Set thermostat temperatures to 76° F for all of the cooled portions of the plant during non-operating hours.

Summary of Estimated Savings and Implementation Cost

- Assessment Recommendation Code = 2.7221.3
- Estimated Total Cost Savings = 14,336
- Estimated Energy Savings = 281,099 kWh
- Estimated Implementation Cost = $120
- Simple Payback = 0.10 months

Implementation Cost:

The cost associated with monitoring thermostats and reducing the thermostat temperature is $120 in labor.

Anticipated Savings:

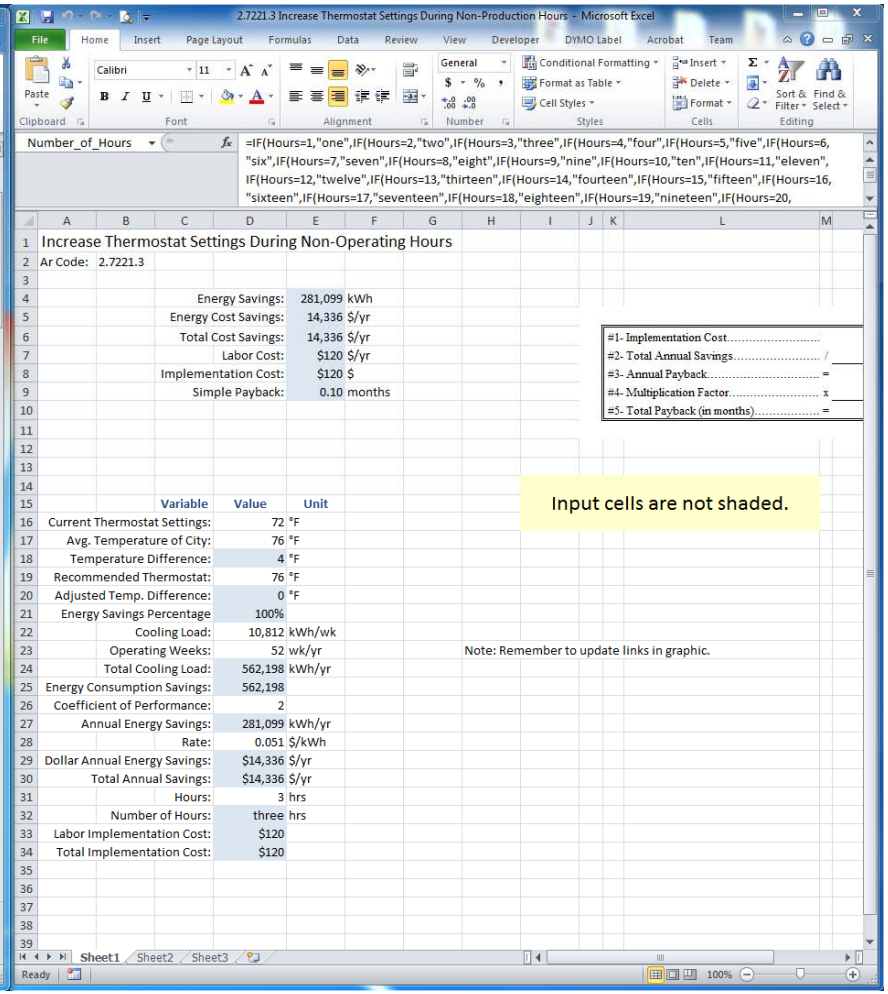
By adjusting the thermostat temperature settings, the company will realize 14,336/yr in energy cost savings.

Detailed Analysis

BACKGROUND:

It was observed through our data logging session that the temperature in the air-conditioned spaces for the plant was 72° F. It is recommended that the plant increase the air temperature. The total cooling load is based on our data logging. It is a combination of air handlers, chillers, and compressors. These cooling units are the focus for savings.

ANTICIPATED SAVINGS:



Number_of_Hours =IF(Hours=1,"one",IF(Hours=2,"two",IF(Hours=3,"three",IF(Hours=4,"four",IF(Hours=5,"five",IF(Hours=6,"six",IF(Hours=7,"seven",IF(Hours=8,"eight",IF(Hours=9,"nine",IF(Hours=10,"ten",IF(Hours=11,"eleven",IF(Hours=12,"twelve",IF(Hours=13,"thirteen",IF(Hours=14,"fourteen",IF(Hours=15,"fifteen",IF(Hours=16,"sixteen",IF(Hours=17,"seventeen",IF(Hours=18,"eighteen",IF(Hours=19,"nineteen",IF(Hours=20,

Increase Thermostat Settings During Non-Operating Hours

Ar Code: 2.7221.3

Energy Savings:	281,099	kWh
Energy Cost Savings:	14,336	$/yr
Total Cost Savings:	14,336	$/yr
Labor Cost:	$120	$/yr
Implementation Cost:	$120	$
Simple Payback:	0.10	months

#1- Implementation Cost.....
#2- Total Annual Savings..... /
#3- Annual Payback..... =
#4- Multiplication Factor..... x
#5- Total Payback (in months)..... =

Input cells are not shaded.

Variable	Value	Unit
Current Thermostat Settings:	72	°F
Avg. Temperature of City:	76	°F
Temperature Difference:	4	°F
Recommended Thermostat:	76	°F
Adjusted Temp. Difference:	0	°F
Energy Savings Percentage	100%	
Cooling Load:	10,812	kWh/wk
Operating Weeks:	52	wk/yr
Total Cooling Load:	562,198	kWh/yr
Energy Consumption Savings:	562,198	
Coefficient of Performance:	2	
Annual Energy Savings:	281,099	kWh/yr
Rate:	0.051	$/kWh
Dollar Annual Energy Savings:	$14,336	$/yr
Total Annual Savings:	$14,336	$/yr
Hours:	3	hrs
Number of Hours:	three	hrs
Labor Implementation Cost:	$120	
Total Implementation Cost:	$120	

Note: Remember to update links in graphic.

Electrical Safety

Source: http://orbittechnologiesinc.com/wp-content/uploads/2013/08/Arc_Flash.jpg

Safety Statistics

- Average of 30,000 electrical contact injuries annual in US
- Electrocutions (deaths) account for about 10% of construction-related deaths
- >50% of these occurred on less than 600 V
- 4th leading cause of industrial death
- 7.5 watts @ 120V is more than enough to kill.

https://www.ecmag.com/?fa=articleID=7552
http://www.osha.gov/Publications/3075.html

Reaction of Human Body to Electric Current

Effect of Current (Milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions.
5 mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6-16 mA	Painful shock, begin to lose muscular control. Commonly referred to as the freezing current or "let-go" range.
17-99 mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible.
100-2,000 mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death is likely.
>2,000 mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

Source: https://www.osha.gov/SLTC/etools/construction/electrical_incidents/eleccurrent.html

University of Miami Policy

- Energized greater than 120 Volts
  - All NFPA 70E Hazard/Risk Category 2* gear
- Energized up to 120 Volts
  - Insulated gloves
  - Safety glasses
- De-energized enclosures
  - Must test power wearing appropriate safety gear
  - After confirmation of no power, minimum of safety glasses

    ONLY IF the disconnect switch/fuse is WITHIN SIGHT or LOCKED OUT
- Energized greater than 240 V
  - Must first qualify on (10) 208, or 240 V Installations energized and receive appropriate training
- Never wear
  - Synthetic clothing (including undergarments)
  - Open-toed shoes
  - Jewelry/loose clothing
- Always wear safety glasses

NFPA 70E

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Hazard/Risk Category 2*

FR Clothing Minimum Arc Rating of 8	• Arc-rated long-sleeve shirt • Arc-rated pants • Arc-rated coverall (instead of pants and shirt) • Arc-rated arc flash suit hood (or face shield system with arc-rated balaclava) • Arc-rated jacket, parka, or rainwear (As needed)
FR Protective Equipment	• Hard hat • Safety glasses or safety goggles • Hearing protection (ear canal inserts) • Leather gloves • Leather work shoes

Safety Equipment

- Face shield system
- Balaclava
- Arc Flash Jacket
- Flame-resistant shirt
- Rubber Insulating Gloves
- Leather Protective Gloves
- Leather Working Boots
- Flame-resistant pants

Safe Work Practices

- BEFORE opening an electrical enclosure, know how to shut down equipment in an emergency
- Resist "hurry-up" pressure
- Never try to attempt something you are not comfortable with
- Use properly electrically insulated tools
- De-energize equipment before installing or removing loggers or performing work (whenever possible)
- Use a voltage tester to verify presence of voltage
- Remain in visual and audible contact with the workers performing the work unless safety is not compromised by doing so

Questions

Contact

Dr. Shihab Asfour
Professor & Associate Dean of Engineering
Director, Industrial Assessment Center

University of Miami
Department of Industrial Engineering
1251 Memorial Drive
268 McArthur Engineering Building
Coral Gables, FL 33146 USA

Phone : (305) 284-2367
Fax : (305) 284-4040
E-mail : sasfour@miami.edu

LinkedIn IAC Group

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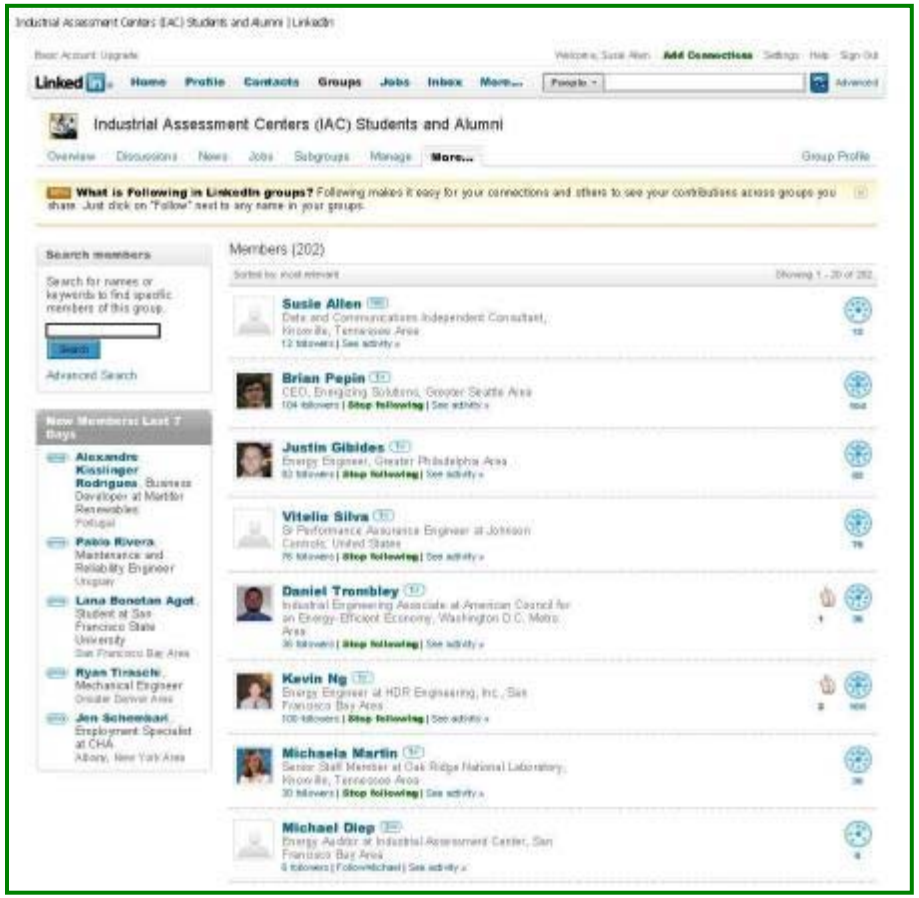
- Established in year 2008
- Professional networking site for IAC students and alumni
- 520+ members
- News items, professional profiles, discussions
- **Want to utilize more heavily for ongoing collaboration**



www.IACForum.org

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Student Registry and Exit Interviews

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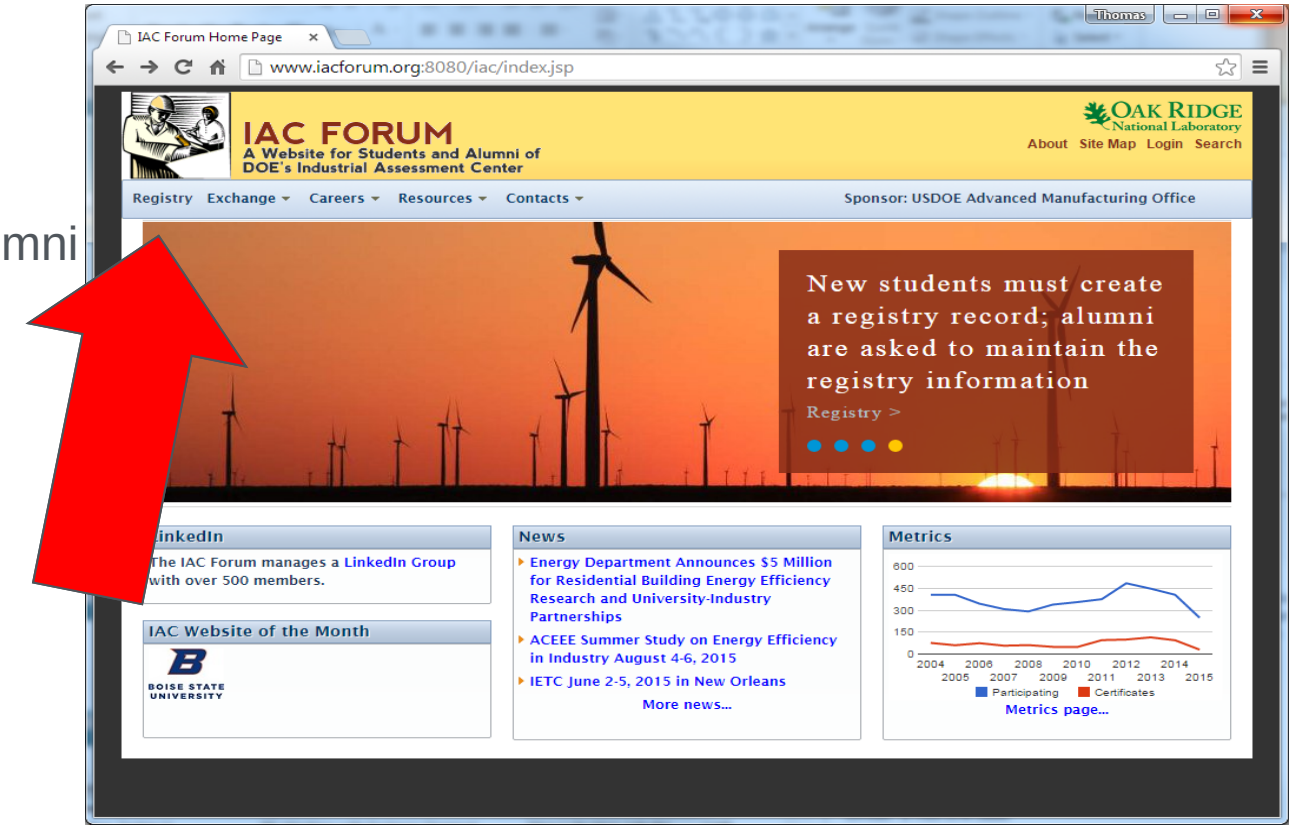
- **Lead Student Responsibilities**
  - Ensure all students complete registry entry
  - Ensure all students complete exit interview
  - Ensure that lead/active/inactive status is current
- Exit Interviews
  - Identify new lead students
  - Update contact information for alumni
  - Capture alumni career data



http://www.iacforum.org/

Student Certificates

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- On-line requests are processed through the certificates link on www.iacforum.org
- **Students and alumni must be in the IAC registry to receive certificates**
- Deadlines occur 3 times per year:
  - October 1, March 1, and July 1
- Certificate process
  - Student initiates request online,
  - Director/AD receives email notification with link
  - He/she completes the request online
  - Certificates arrive
- Certificates are mailed to the Directors within 30 days of deadline

Certificate of Participation
presented to
Name
For the completion of requirements mandated by the
U.S. Department of Energy's
Industrial Assessment Center Program at
Texas A & M University

Looking ahead…February

- **Topic**: Effectively Preparing for an Assessment

- **Who**: University of Dayton IAC

Thank You!

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Thomas Wenning, PE

IAC Student Activities Coordinator

Oak Ridge National Laboratory

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