

PowerCore ENGINEERING

Monitor - Control - Manage - Analyze



Power Monitoring and

Energy Management Solutions

Challenges configuring Metering and Reporting systems:
Effective Considerations



PowerCore Engineering

COMPANY INTRO

- ❖ PowerCore is a Power Distribution System Engineering Company and a turnkey Automated Systems Integrator based in London Ontario.
- ❖ We specialize in Power Systems Engineering and Design, Engineered Drive Systems, PQ solutions, Power Management and Energy & Demand Control Automation systems.
- ❖ PowerCore is a team of skilled Electrical Engineering specialist with experience in leading edge technology solutions that enable our clients to optimize their power distribution system assets and generate sustainable results in Energy Cost Reduction
- ❖ *We deliver services and products to commercial, institutional and industrial establishments and have the capacity to provide solutions ranging from limited scope to very complex projects*



Electrical Energy

– WHAT MAKES UP THE COST ?

Peak Demand charges

“Peak kW Draw”

- ❖ kW Demand (*“Rate or power flow”*) is typically calculated as the facility’s draw averaged over 15 min window (*SD: “Sliding Demand”*). The SD value changes every 15 minutes, and is typically synchronized on top of the hour
- ❖ The maximum 15min kW Demand throughout a month will be selected as a Peak Demand (*“Billing Demand”*)
- ❖ The kW charges for the entire month are derived from one 15min Peak Demand throughout the month.
- ❖ There are number of charges related to the kW on the electrical bill.

Consumed Energy charges

“Electricity kWh consumed”

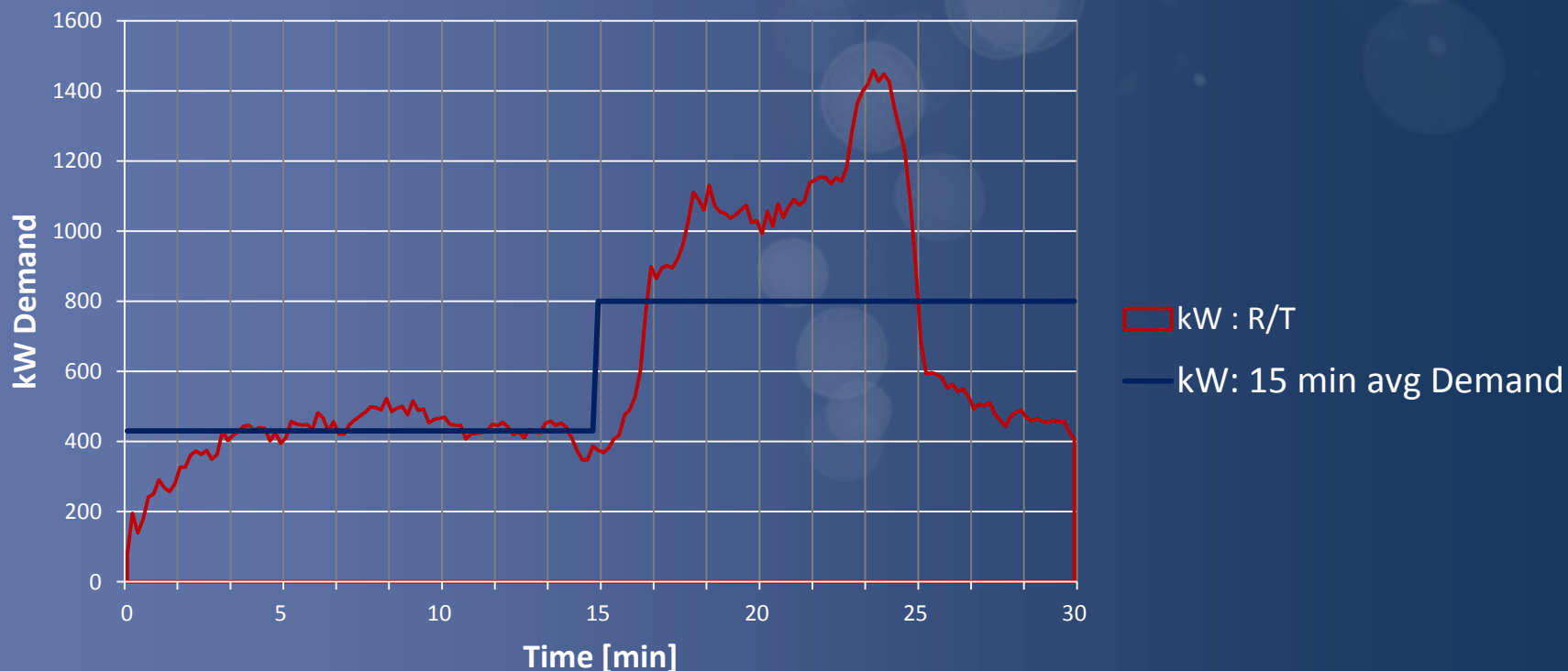
- ❖ kWh is the amount of Electrical Energy used in the facility.
- ❖ Energy is usually tied to the requirements of the bldg operation, processes, machinery, facilities req’s etc.
- ❖ The kWh is the kW demand integrated (i.e. totalized) over the course of the entire month.
- ❖ The kWh charges on the electrical bill are derived from the monthly Energy Total
- ❖ There are number of charges related to the kWh on the electrical bill.



Peak Demand Calculation

— EXAMPLE

15 min kW Average Calculation



kW Demand calculated as an average value of Real Time kW over 15 minute period

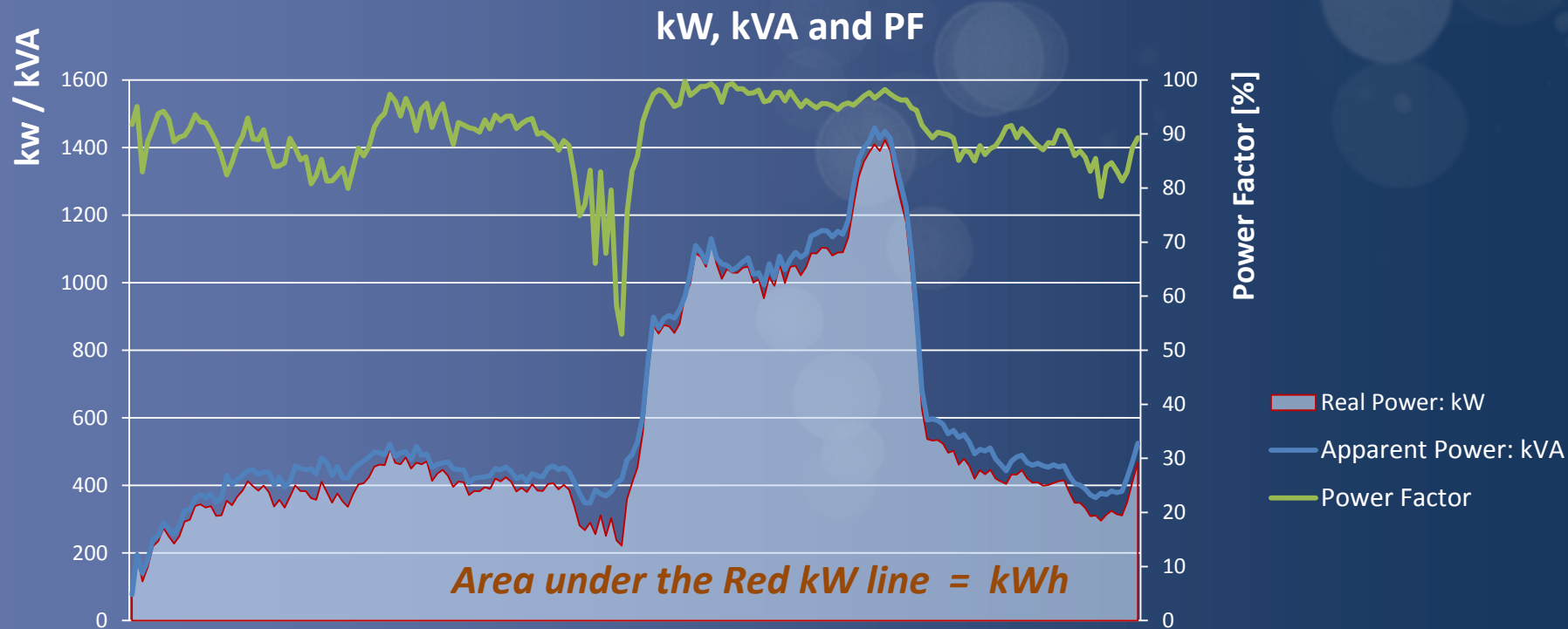
NOTE 1: Instantaneous peaks have negligible effect on the 15min Demand

NOTE 2: a term "Sliding Demand" is used where the kW demand is calculated across 15 min window that continuously "slides" along the Time axis in defined increments (e.g. 15 or 5 minute "jumps")



kWh, kW & kVA Demand

– DAILY PROFILE EXAMPLE



Power Factor : $\text{kW} / \text{kVA} \Rightarrow$ a measure of Real Power vs. the Reactive Power ;
the closer to one the better \Rightarrow 100% PF means no reactive energy is drawn

NOTE 1: Only PF at peak demand is taken into consideration for utility billing purposes

NOTE 2: PF of less than 90% results in low PF penalty

Load Factor : $\text{Total kWh} / (\text{kW}_{\text{PEAK}} \times \# \text{ of Days} \times 24 \text{ Hours}) \Rightarrow$ a measure of “flatness” of the demand curve

the closer to one the better \Rightarrow 100% LF means perfectly flat demand

NOTE: Low load factor results in higher kW Peak Demand Charges.



What makes up Electrical Bill

– ELECTRICITY CHARGES COMPONENTS - EXAMPLE

	Fixed	kW based	kWh based
<i>Electricity Charge</i>			2.058 ¢/kWh
<i>Global Adjustment Charge</i>			8.718 ¢/kWh
<i>Distributon Fixed</i>	\$150.00		
<i>Distributon Variable</i>		1.6995 \$/kW	
<i>Transmission Connection Charge</i>		2.3902 \$/kW	
<i>Transmission Network Charge</i>		2.9550 \$/kW	
<i>Regulatory Charges</i>			0.560 ¢/kWh
<i>Debt Retirement Charge</i>			0.700 ¢/kWh
<i>Trfm Discount</i>		-0.6000 \$/kW	
<i>Interval Meter Charge</i>	\$5.50		



Energy Efficiency Strategies

– HOW CAN ELECTRICITY COST BE REDUCED?

Reduce Peak Demand

=> decrease kW charges

❖ Improve Power Factor



❖ Reduce the Peak Demand



- *Control Monthly Peak Demand through implementation of Peak Demand Control system*

❖ Demand Response Program (DR3 - "SaveOnEnergy")



- *through implementation of Peak Demand Control*

Reduce Consumed Energy

=> decrease kWh charges:

❖ Increase efficiency



❖ Reduce losses



❖ Shift energy consumption



Some of the Strategies:

- ✓ Lighting retrofits
- ✓ VFD retrofits
- ✓ Equipment efficiency improvements



Power Monitoring and Energy Management Systems

– WHAT'S THE PURPOSE ?

Real Time Monitoring

- R/T WAGES
- System Load Demand
- Power Quality
- Abnormal Events

Energy / Usage Reporting

- WAGES *Cost*
- Energy Usage trends
- Energy usage Transparency
- Cost Allocation
- Cost-per-occupant (*commercial & institutional*) or Cost-per-unit (*Industrial*)
- Baseline for Energy *efficiency* retrofit programs (*e.g. "SaveOnEnergy"*)

Shared Infrastructure

Bill Verification



Power Monitoring and Energy Management Systems

– WHO BENEFITS ?

Real Time Monitoring

Facility Managers, Engineers and Operators

☐ Real Time Data

- **Dashboard Overview** (via local or remote PC or Mobile App)
- **Instant information** on loading and capacity.
- **Alarms and Warnings**
- Feedback on **Demand Control performance** (*for Peak Demand control or DR3 Events*)
- Remote **System Control**

☐ Logs and Historic Data Analysis

- **loading** and **power quality trends**
- **Analyze disturbances**
- **Root cause Analysis** for abnormal events affecting operation or production

Energy/Usage Reporting

Cost Centers & Energy Managers

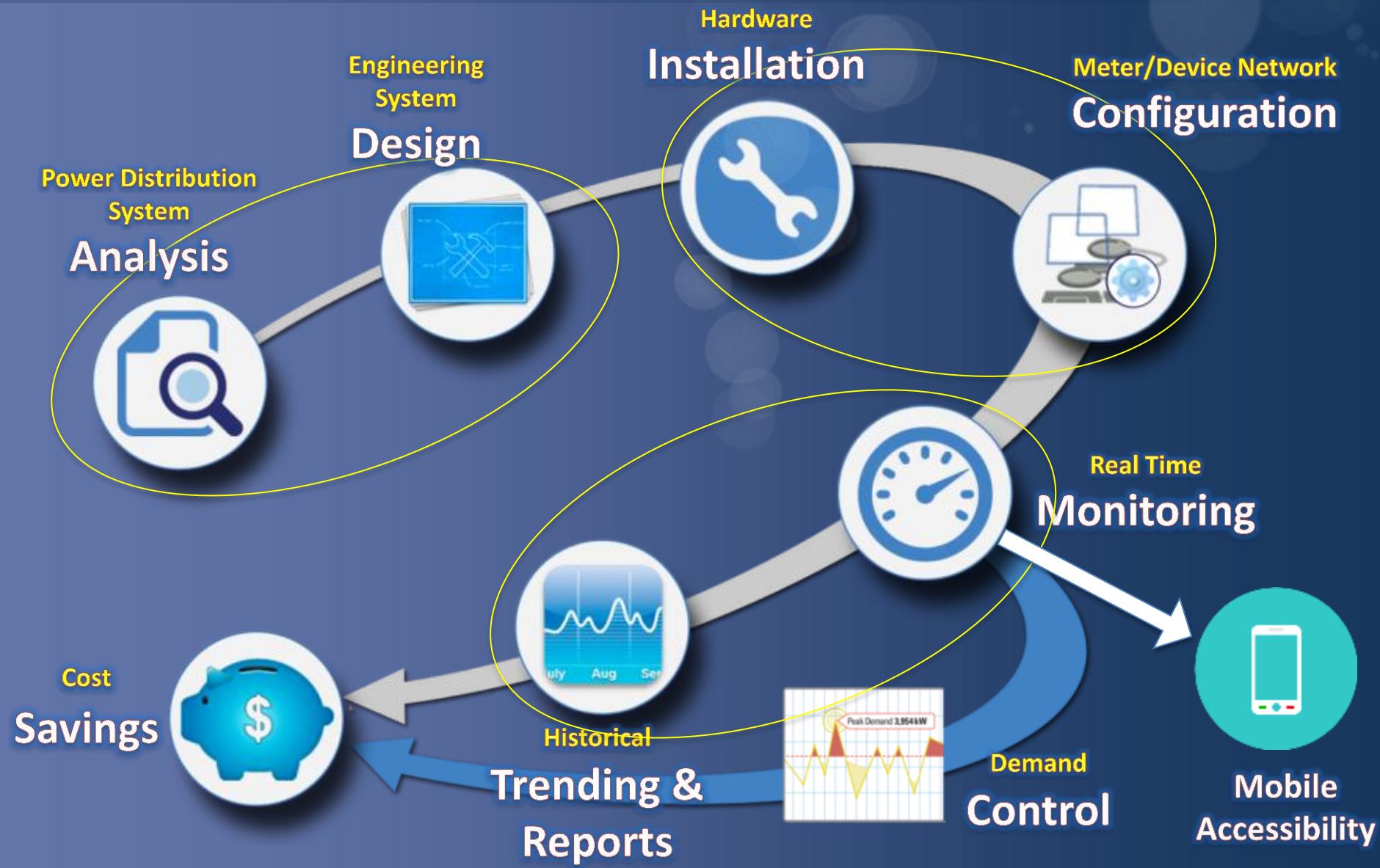
☐ Energy usage Reports & Logs

- **Energy Usage and Cost Reports** in form of
 - **Profile Charts**
 - **Usage Tables**
- **Cost-per-unit** analysis, cost allocation
- Utility **billing verification**
- Baseline & Usage data logs to **monitor performance** following energy saving retrofits
- **Energy usage transparency to drive conservation**



Power Monitoring System

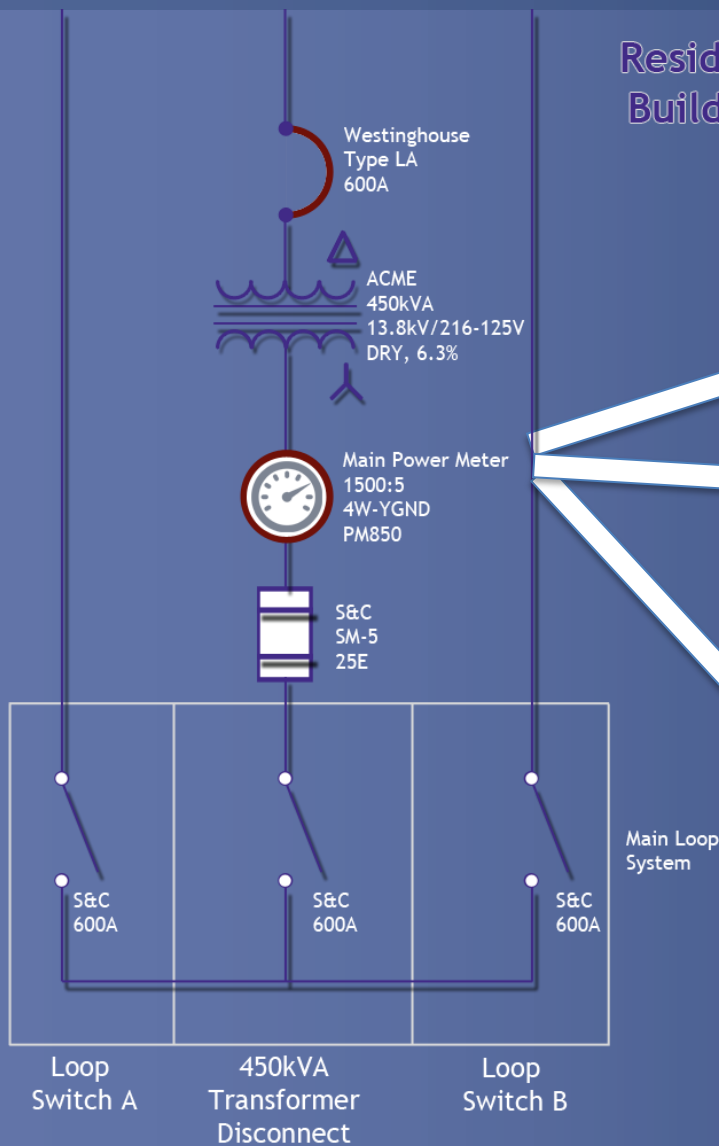
– Successful Implementation Strategy





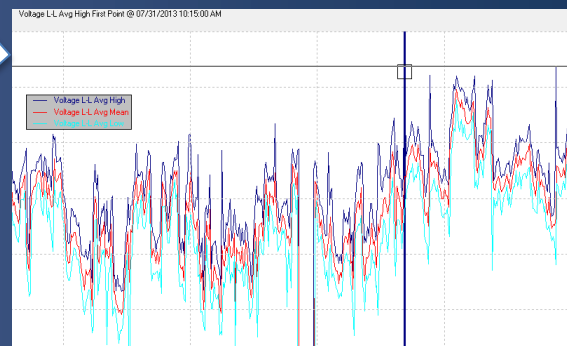
EXAMPLE:

Simple Power Monitoring System

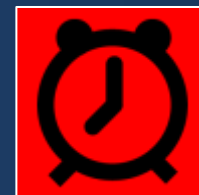


Residence
Building A

IA	138 A	V A-B	603 V
IB	124 A	V B-C	602 V
IC	118 A	V C-A	601 V
I Avg	128 V	V L-L Avg	602 V
kW Total		201 kW	
kVA Total		207 kVA	
PF Total		-99.1%	



ALARM: V L-L Unbalance
9:15AM August 13th, 2013
Phase A-B -> **8.4% Over Voltage**





EXAMPLE:

Full Scale PM Application

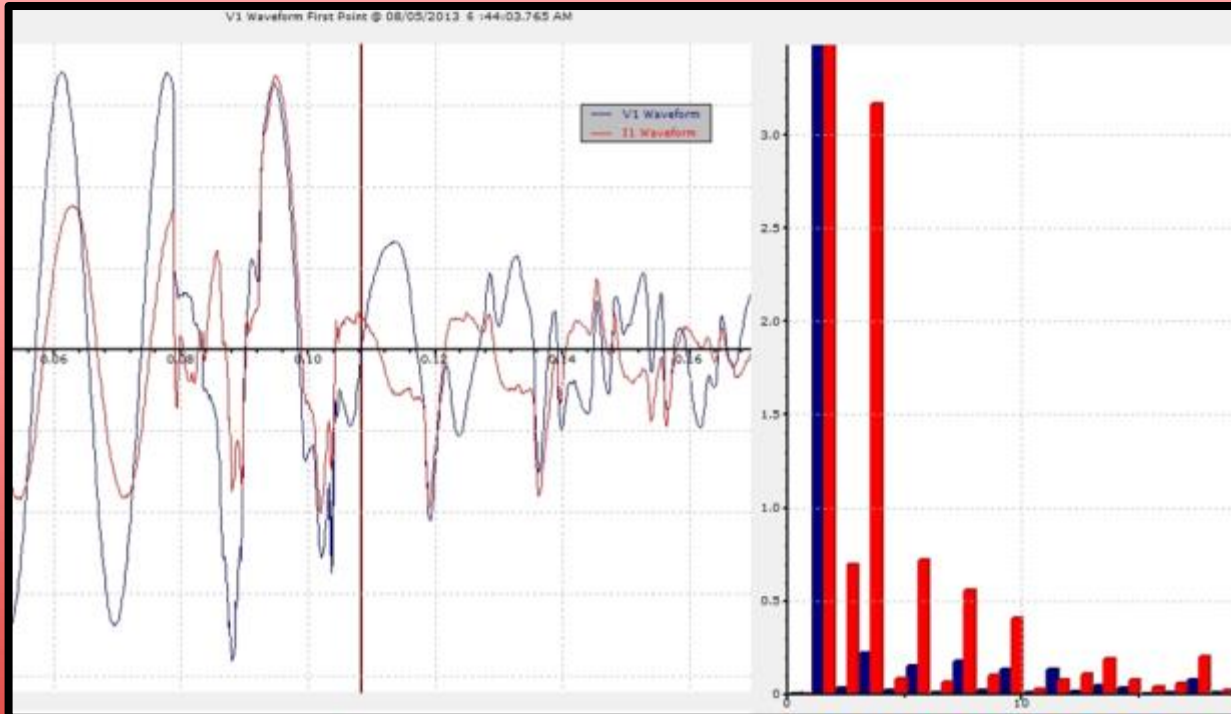
GM Lodon - Facilities

Incident 1

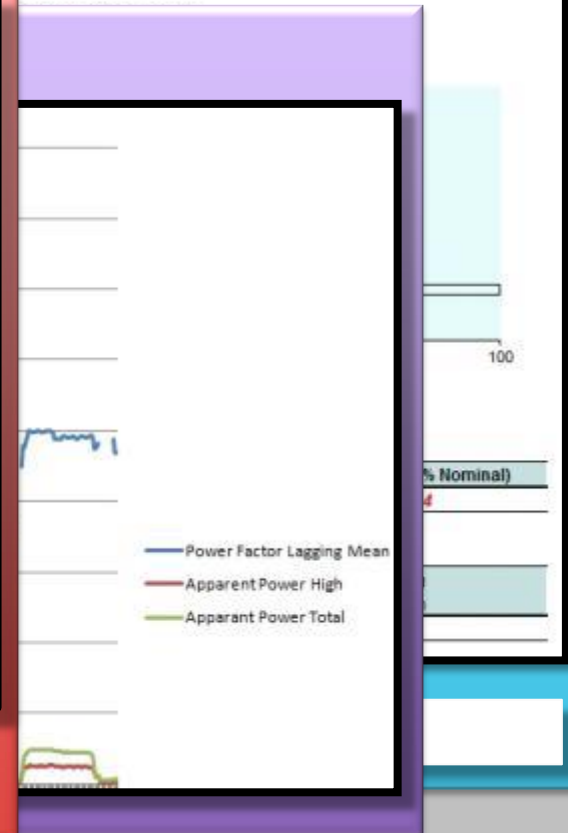
PowerCore Engineering

From: 2010-Nov-10 07:25:23.000

To: 2010-Nov-10 07:25:23.000



Transient Waveform Capture in Time and Frequency Domain



Time : 8/19/2004 03:32:43.346 PM

Billing Rates



Min/Max Details



Help



Resets

EXAMPLE:

Energy Reporting

Load Profile Trending

ELECTRIC MOTIVE

Aggregate Monthly E

EMC London, Ontario

ENERGY

Tariff
London Hydro General Rates
DRC
WMSR
EC
Total Per Tariff

DEMAND

Tariff	Time
London Hydro General R 27-Sep-06 12	
NSR	
DC	
LTCSR	
TD	
Total Per Tariff	

* NOTE: Demand kWmax may be kVAmx*0

TLF	Total Loss Fact
IMR	Interval Meter R
MCC	Monthly Custom
DRC	Debt Retirement
WMSR	Wholesale Marke
EC	Electricity Char
NSR	Network Serv
DC	Distribution Cha
LTCSR	Line and Trans
TD	Transformer Di

EMC London - Plant Total Load Profile - Oct-12

EMC Canada

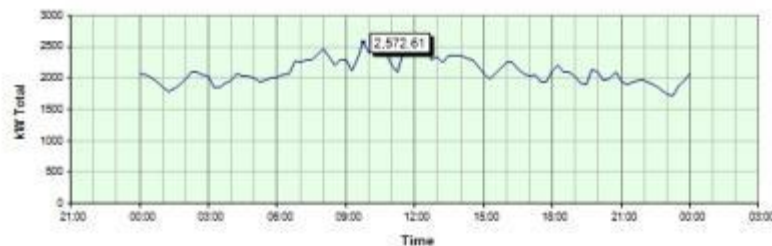
London, Ontario

From: October 12, 2006 00:00:00

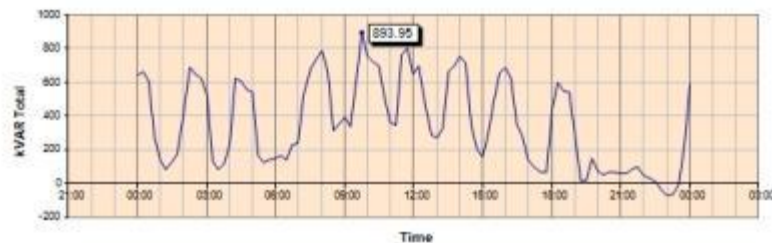
To: October 13, 2006 00:00:00

ELECTRIC MOTIVE

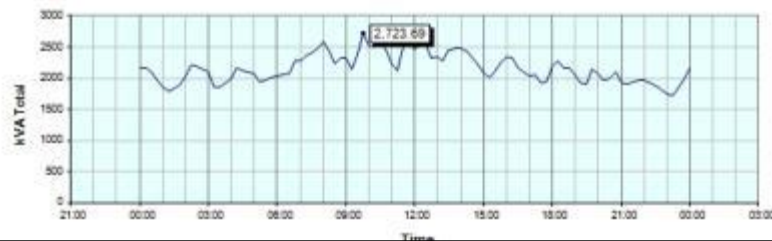
kW Load Profile



KVAR Load Profile



kVA Load Profile



ELECTRIC MOTIVE

ulation | Help |

ions

Show Billing

Aggregate

Multiple Meters

Save Automatically

Title

File Name

Author

Manager

Company

Save To

Suppliers

Aggregate Sheet Title

Multiple Sheet Titles

Apply

Apply

Apply

Apply

Apply

Apply



Fully Integrated Commercial/Institutional Power Monitoring System



LAURIER
Inspiring Lives.

9/12/2013 1:42:05.000 PM

13:42



Campus
Single-Line

lucid

Building
Dashboard



ION EEM

Physical
Resources

Wilfrid Laurier University Energy Monitoring System

Brantford
Campus

Kitchener
Campus

Waterloo
Campus



System Overview

V: 1.0.1

Updated By: ayaz@powercoreeng.com

Updated: Sept-2013

PHYSICAL RESOURCES



Utility Monitoring System Mobile Application

Real-Time

Interactive
Dashboard

Responsive



Daily Consumption



Comprehensive R/T



Location Details



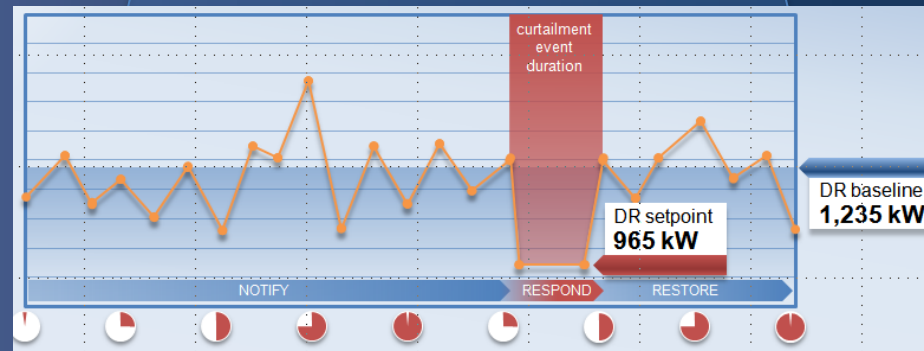
System Alerts



Demand Control Basics

**Demand
Control**

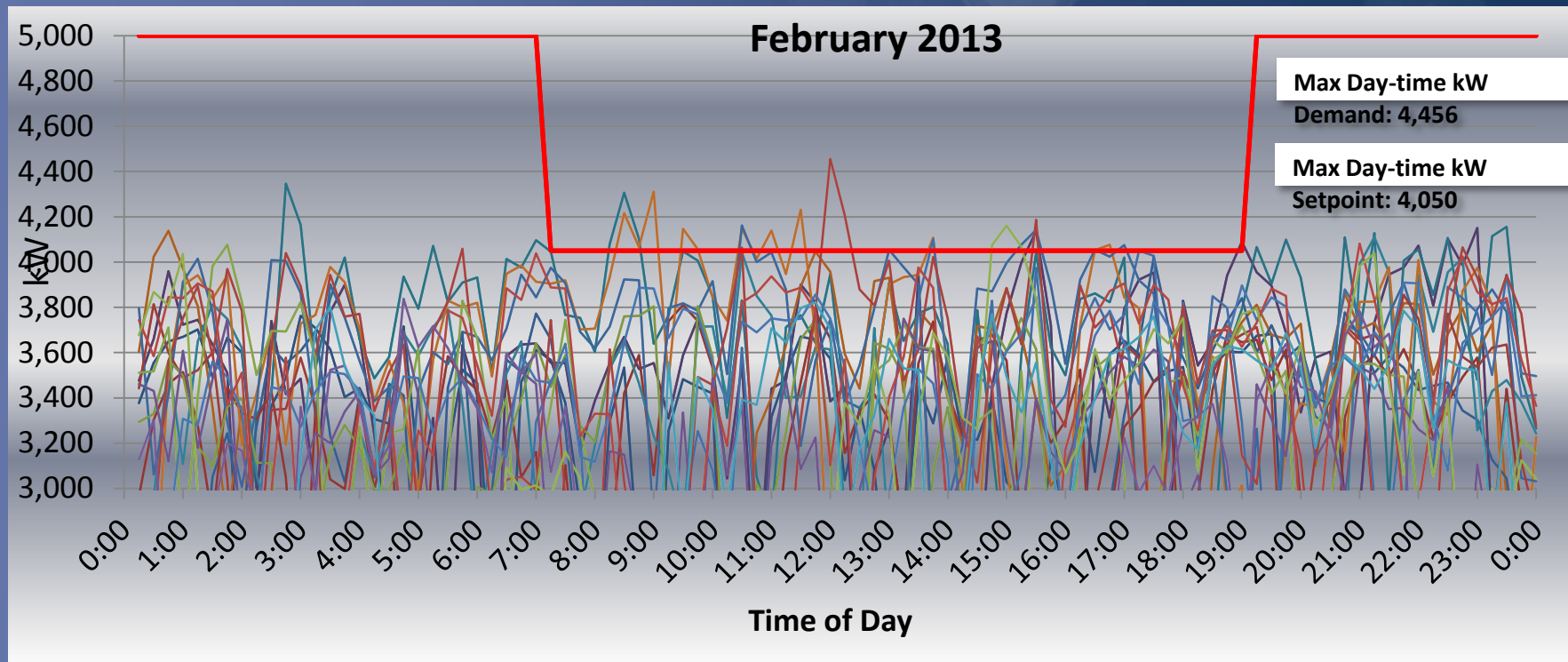
- ❖ **Demand Control** is a process of understanding **where, when and why** high cost kW demand spikes occur and **taking measures to reduce them**.
- ❖ The goal is to **reduce the kW Peak Demand** and thereby:
 - **Reducing Billable kW Demand** charges which can make up to 40% of the total Electricity bill
 - **Allowing participation in Ontario's Demand Response Program (DR3) for maximum sustainable payoffs**
- ❖ Demand Control can be **problematic** to manage **manually** in facilities with **multiple equipment types** and process demands.





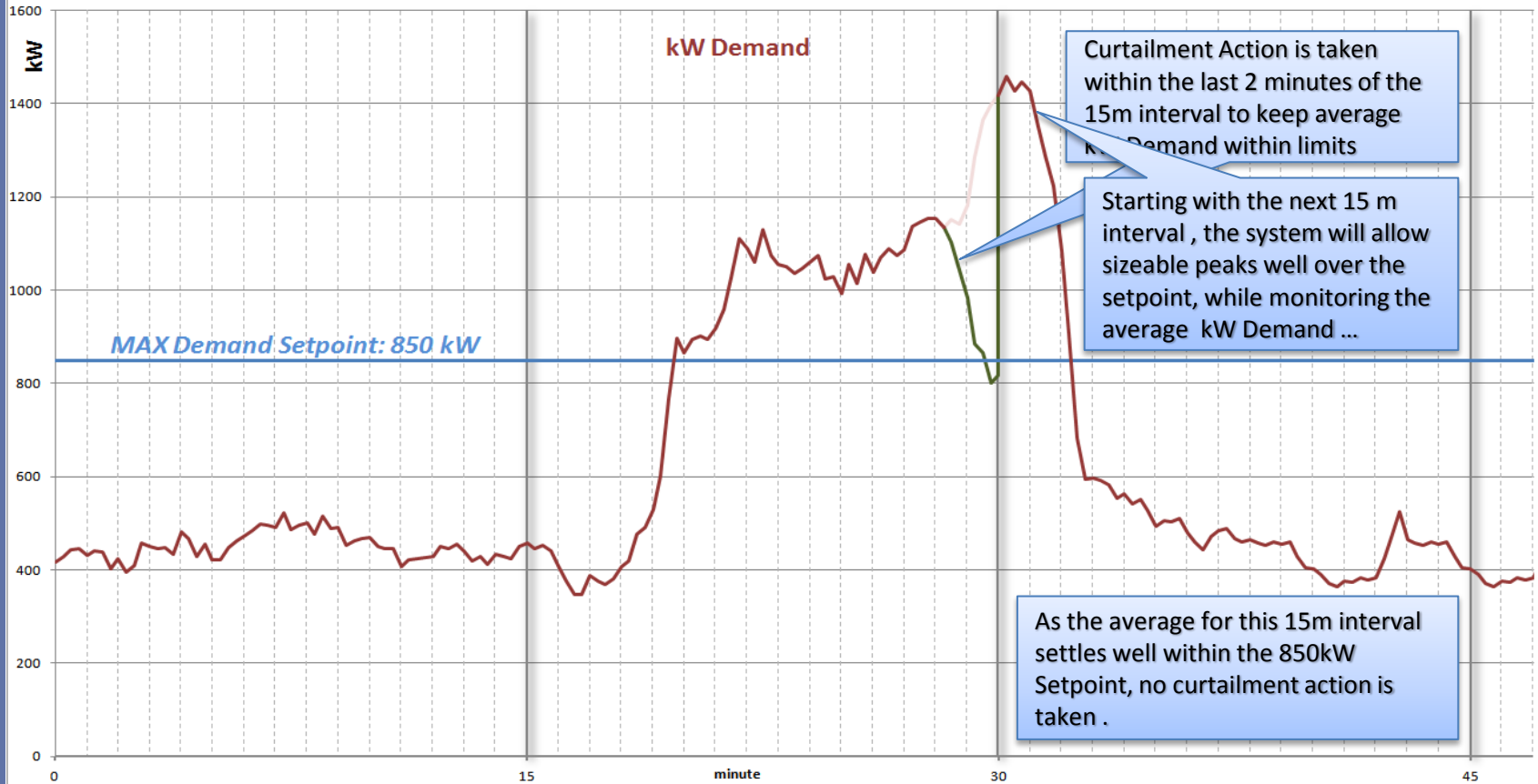
Automated Demand Control EXAMPLE

Establishing Demand Control Setpoints :





Demand Control Strategy





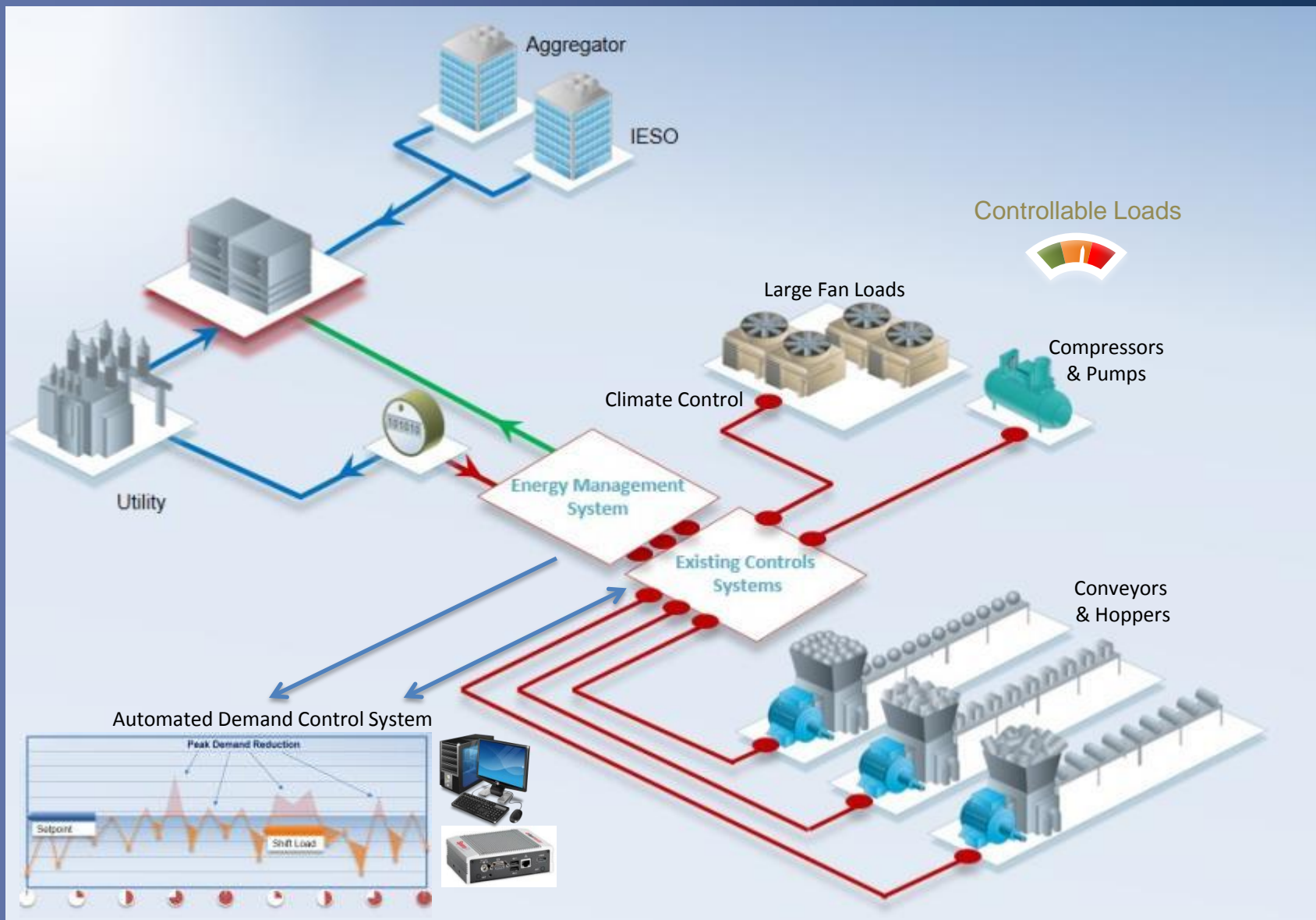
Demand Control Challenges

Demand Control Solution must address these concerns:

- ❖ **Load Shedding** can be **risky** (*or non-feasible*)
- ❖ **Manual Load Control** may be **unreliable** (*or non-feasible*)
- ❖ **Ability to determine exact curtailment needs**
- ❖ **Intuitive End User control**
- ❖ **Adaptive setpoints**
- ❖ **Tap into existing Control and Automation** infrastructure
- ❖ **Prioritize loads**
- ❖ Provide **Tools for performance Analysis**
- ❖ **Achieve savings large enough to justify the investment**



Demand Control Targets





Intelligent Operator Interface

Time: Mon Nov 14 11:27:55 2011

Lead Furnace: F1 ☐ F2 ☐ F3 ☐ F4 ☒

Energy Dashboard

DC Off Peak ☐ Alarm ☒

Power

Setpoint: 11500 kW
Power: 3450 kW
Projected Diff: 137199.6 kW
Reduction: 0 kW

Energy Consumption

Setpoint: 5750 kWh
Current Period: 140 kWh
Previous Period: 0 kWh
Daily: 140 kWh
Weekly: 140 kWh
Monthly: 140 kWh

Previous Period

Length: 30 min
Time Left: 150 sec
Subinterval: 55
Subintervals: 60

Shed Furnace 1 ☐ Shed Furnace 3 ☐
Shed Furnace 2 ☐ Shed Furnace 4 ☐

Loads

Load Configuration

Update Rate: 60 s

Update

Submit

Manufacturing

Load: RTU #1



Status: Running

Priority: 1

Base power

75 kW

100 %

Current power

75 kW

100 %

Constraints:



Settings

Demand:



Load: Air Comp #1



Status: Reduced

Priority: 1

Base power

94 kW

62 %

Current power

94 kW

62 %

Constraints:



Settings

Demand:



Load: Evap. #1



Status: Running

Priority: 1

Base power

15 kW

100 %

Current power

15 kW

100 %

Constraints:



Settings

Demand:



Load: Furnace #1



Status: Running

Priority: 1

Base power

4000 kW

94 %

Current power

4000 kW

94 %

Constraints:



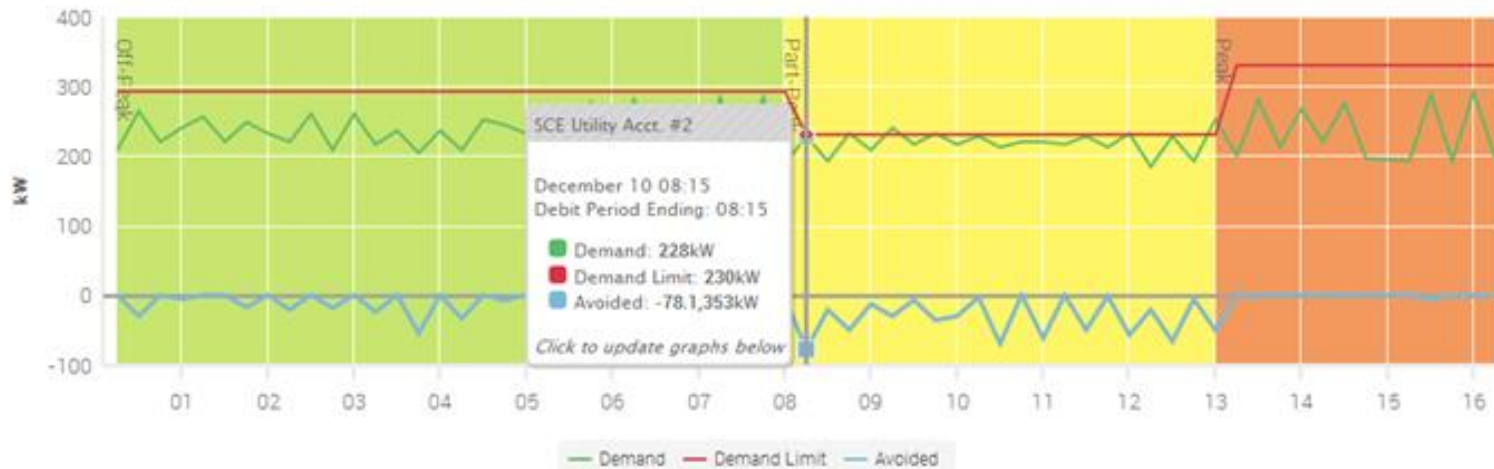
Settings

Demand:





“Post-mortem” Performance Analysis



Demand Power Distribution by Load



- Warehouse Lighting
- Ripening Room #1
- Ripening Room #2
- Ripening Room #3
- Ripening Room #4
- Ripening Room #5
- Ripening Room #6
- Ripening Room #7
- Ripening Room #8
- Ripening Room

▲ 1/2 ▼





Demand Control Impact

	Impact of kW Demand Reduction		
Strategy	Monthly Billable Peak Demand Reduction	DR3 Program Participation	Global Adjustment Class A - PDF Reduction
\$ / kW Savings	\$6 /kW /month	\$38 /kW /year	\$63 /kW /year
Pros	<ul style="list-style-type: none">- No Contract required- Payoff is immediate	<ul style="list-style-type: none">- Open to Class A & B customers- Contract can be tailored	<ul style="list-style-type: none">- No Contract required
Cons	<ul style="list-style-type: none">- Payoff is low in many instances	<ul style="list-style-type: none">- Contract is required- Payoff is several months away	<ul style="list-style-type: none">- Payoff is a year away
Notes	<i>If the load Factor is close to 1.0, Payoff may not justify the cost of Demand Control Measures.</i>	<i>Proper analysis should be done to determine the optimum level of DR commitment.</i>	<i>___Every kW counts___</i>
DR 3 Assumes 5 DR Events a year, OPA DR3 Program Option C (Call Hour Window: 12:30 PM - 6:30 PM)			



An effective and responsive *Peak Demand Control System* is crucial to maximize the Demand Reduction impact while maintaining Facility Priorities !

Additional INFO



Global Adjustment Strategies

\$ /kW

Reducing the Peak Demand Factor – the \$ IMPACT:

❖ If the customer is able to reduce the demand during the Coincidental Peaks, It will directly impact the PDF for next year

✓ Example: Base Period 2012 – Customer ABC - Reducing Demand:

✓ Customer ABC reduces the demand during the 5 Coincidental Peaks by 100 kW in each instance to:

5.9 , 6.9, 7.9, 6.9 & 4.9 [MW] (Combined demand reduction of 500 kW)

✓ The Provincial Load during 5 Coincidental Peaks was: 24.46, 23.8, 23.87, 23.81, 23.47 [GW]
**

✓ Customer's reduced PDF will be:
$$\frac{\sum(5.9, 6.9, 7.9, 6.9, 4.9)}{\sum(24.46, 23.8, 23.87, 23.81, 23.47) \times 1000} = 0.0272172\%$$

✓ The IESO Set GA cost for October 2013: \$ 634.3M ***

✓ Customer's Reduced GA Cost for Oct 2013 will be: $0.0272172\% \times \$634.3M = \underline{\$172,611.17}$

✓ Resulting in monthly savings of : \$ 2,655

✓ Projected yearly savings: \$ 31,866

✓ **Savings per kW reduced:**
$$\frac{\$31,866}{500kW} = \underline{\$ 63.73/kW / year}$$



