Welcome to:

It's About Customers

2014 AFEC

ADVANCED FACILITIES MANAGEMENT AND ENGINEERING CONFERENCE
AUTOMATED DEMAND RESPONSE AND OPTIMIZATION IN ACTION
Agenda

• Identifying demand reduction potential
• How to implement and what tools exist
• Utility programs and rebates
• Case studies

Learning objective: how to start paying attention to your building’s demand reduction potential and your options
Identifying Demand Reduction Potential

How to analyze your data
Utility and Metered Data

• What resolution is your utility/metered data?
Monthly Data

- Monthly data shows seasonal peaks
Weekly Data

- Weekly profiles show day of week peaks

![Demand Peaks (15 min intervals)](image.png)
Interval Data

- Interval data will show time of day peaks
Weather Influence

• Electric reheat load influenced by temp

- Higher AM demand peaks caused by colder temp
- Afternoon load less affected by temp
Weather Influence

• AC load influenced by temp

Afternoon AC load affected by temp
Building Load Factor

- Base load vs peak loads

Demand Peaks (15 min intervals)

Peaks 100-200 kW

Base 30-40 kW
Building Energy Disaggregation

- Understand the associated load with major end uses

Graph courtesy of Brad Queen, Cube Resources
Building Energy Disaggregation

- Monitor load of major equipment

Graph courtesy of Brad Queen, Cube Resources
How “Spikey” is the Data?

• Are demand peaks getting set by a couple occurrences?
How “Spikey” is the Data?

The top 119 kW of load occurs for just 30 minutes over the entire year.

Graph courtesy of Brad Queen, Cube Resources
How Much Can I Save?

• Demand rates are typically 40-60% of total electric charges!

Xcel Energy Rate Structure:
Secondary General (2014 – Approximate Rates)

<table>
<thead>
<tr>
<th></th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Use ($/kWh)</td>
<td>$0.038 /kWh</td>
</tr>
<tr>
<td>Demand – Summer ($/peak kW each month)</td>
<td>$21.63 /kW</td>
</tr>
<tr>
<td>Demand – Winter ($/peak kW each month)</td>
<td>$18.17 /kW</td>
</tr>
</tbody>
</table>
How Much Can I Save?

• What is the typical daily peak
How Much Can I Save?

<table>
<thead>
<tr>
<th>Load Clipping Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>25 kW Limit</strong></td>
</tr>
<tr>
<td><strong>55 kW reduced</strong></td>
</tr>
<tr>
<td><strong>118 kWh over a period of:</strong></td>
</tr>
<tr>
<td><strong>7.5 Hours</strong></td>
</tr>
<tr>
<td><strong>$1,007 Demand Savings Over 1 months</strong></td>
</tr>
<tr>
<td><strong>$6 Energy Savings Over 1 months</strong></td>
</tr>
</tbody>
</table>

Graph courtesy of Brad Queen, Cube Resources
Demand Reduction & Tools

How to reduce demand and the tools to help
Why Demand Reduction

- Demand costs can amount to 40-60% of your utility bill
- USGBC LEED Credits for AutoDR implementation (pilot)
- Growth in renewable generation driving need for fast acting DR to balance markets
- AutoDR technologies are being utilized to also manage dynamic price response
Types of Demand Reduction

**Demand Optimization:** Make equipment or operational change that reduces peak at all times

**Demand Response (DR):**
- **Manual** – Manually turn off lights and equipment for DR event
- **Semi-Manual** – Turn on pre-programmed BAS control strategy for DR event
- **Automatic** - External price, reliability, or event signal automatically triggers a BAS control sequence; no human intervention needed
Efficiency versus Demand Reduction

- Reducing demand for short period has minimal impact on energy use.
- Energy Use Intensity (EUI) and Energy Star are based on energy use (kBtu/SF), not affected by peak.
- Many efficiency measures impact non-peak times.
Reducing Demand

- Reset space temp set points
- Reset discharge air temp set points
- Reset chilled water supply temp set points
- Limit motor (fan, pump) speeds
- Limit equipment operation/staging
  - 2nd stage of compressor
  - Electric reheat stages
  - Demand limiting features on chillers
  - #s of motors or chillers on
Reducing Demand

- Dim lights or lighting sweeps
- Shut equipment off (don’t operate industrial equipment during demand window)
- Pre-cool the building
- Thermal energy (ice) storage

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*Average value of peak electricity consumption during the same time period for the most recent 30 weekdays prior to the date of DR issuance on which DR was not issued.*
Demand Reduction Challenges

- Comfort compromise is a myth
  - Duration of demand event changes impact; might only be able to drop 10% of the kW in a 4 hour event that you could drop in a ½ to 1 hour event due to thermal lag
- Education critical to understand rates/benefits and how to drop load
- Uncertain results – measure what would have been?
- Financial incentives worth the risk and hassle?
Tools - Demand Notification (Dashboards)

- Alert if threshold has been exceeded
Tools - Fault Detection Diagnostics (FDD)/ SkySpark

- A database of building operating data - ANY data!
- View/Analyze data
- “Rules” identify data behavior across all data
- Makes use of the data we used to throw away
Tools – FDD/ SkySpark

• Data visualization – meter and equipment detail
• Identify & quantify opportunities – get to the source of operational improvements
• Automate detection through “rules”
Tools - FDD/ SkySpark

Identifies “Sparks” when kW exceeds target (220 kW)
Tools - Building IQ

- Cloud-based software communicates with your building management system (BMS)
- Results in lower energy use as well as reduced demand during demand response events
- Predictive Energy Optimization™ uses advanced algorithms to automatically fine tune and control HVAC systems
Tools - Building IQ

• Software automatically learns and models the building’s thermal characteristics and usage patterns
• Then system uses predictive thermal modeling to maintain occupant comfort by optimizing set points and schedules based on weather forecasts, unique building characteristics, energy prices, and demand response signals.
Tools – LOBOS (Load Based Optimization System)

- Tool that combines energy reduction control strategies, automated demand response, and fault detection and diagnostics
- Built on Niagara platform
- Connects to BAS through JACE
- Adaptive learning to optimize controls (load based control)
- Automatic demand control
Utility Demand Programs
Utility Demand Programs

• Turning off demand has essentially the same effect as turning on additional generation
• Triggers: changes in the price of electricity or utility is reaching peak capacity
• Many different demand response program types
  • Direct load control
  • Interruptible load
  • Spinning/non-spinning reserves
  • Critical peak pricing and other pricing programs

www.DemandResponseDirectory.com
Nevada Energy Demand Pilot Program

mPowered™ Energy Optimization for Commercial Buildings

• The program is designed to help building owners lower energy costs and allow NV Energy to initiate demand response events during times of peak load – all without impacting occupant comfort.

• The mPowered program offers participating facilities advanced software technology provided by Building IQ that communicates with the BAS.

• Program Value: 15% annual energy savings, up to $20k in equipment or meter upgrades, free software subscription.
Nevada Energy Demand Pilot Program

- Control shifts usage outside peak times.
- Building IQ’s software predicts how much energy is required to maintain comfort during the scheduled demand event. Then automatically pre-cools the building to maintain occupant comfort thresholds.
Xcel Energy

Interruptible Service Option Credit (ISOC)

- Tariff for large industrial customers – larger than 300 kW
- Two options: 1 hour notice and less than 10 minute notice
  - 1 hour notice: Xcel contacts client, they are responsible for load drop (however that happens)
  - Less 10 min: Xcel puts hardware in the field and the hardware automatically drops load. Typically this is put on pumps, motors, and industrial loads
- Substantial rate decrease but penalties if don’t drop to the previously agreed upon load
Xcel Energy

Peak Savings Business Program

• Medium to large commercial/industrial program
• Run by EnerNOC
• They have a 40 MW capacity agreement
• EnerNOC does customer recruitment, incentive determination based on agreed load drop
• Xcel calls EnerNOC they call their clients (~200 clients)
• Drop is accomplished through hardware controls, BAS control language, and manual control (with coaching/advise ment)
Xcel Energy

Saver Switch

• 175,000 switches in CO
  • CO is just residential, MN also has light commercial
• Automatic switch control to limit compressor operation
• $40 rebate

Smart Thermostat (Residential Pilot)

• Wifi enabled thermostat
• Performance incentives during DR events
• Xcel provides incentives to buy Tstat
Fort Collins Utility

Hot Shot / AC Load Control

- Remote devices installed on electric water heaters or air conditioners
- Devices turn off heaters for short periods during demand events
- Residential program
- Annual rebate
- Program only for existing enrollment

Advanced Smart Meters

- Program to be developed
Case Studies
Examples - Banking/Office Building

- Monthly peak 240 kW
- Peak daily demand was typically around 170-180 kW except for that one day
Examples - Banking/ Office Building (cont)

- Electric reheat caused an additional 100 kW from 6a-8a on that one peak day.
- That day was the coldest day of the month (max 76, avg 52, low 32).
Examples - School w/ Community Use

Church group uses 591 kWh more than Saturday (~$30 energy charge), but chiller induces 99 kW spike above rest of curve. On Sunday July 7th this effect added 80 kW above any other point in July, adding $1,465 to the demand charge.

Graph courtesy of Brad Queen, Cube Resources
Case Study - Denver Office

- 437,000 SF, 17 story office building located in Denver
- Two large built-up variable air volume (VAV) air handling units
- VAVs with electric reheat

Cost/Yr of Electric Use and Demand

- Electric Use (kWh): $218,683
- Electric Demand (kW): $348,053
Denver Office - Demand Profile

• Highest demand costs in winter
Denver Office - Demand Profile

- SkySpark graph – winter demand (high peak) vs. summer
Denver Office - Demand Profile

- Peak demand occurs during morning warm up during winter months
Denver Office - Demand Optimization

- Analyzed AHU through data visualization and rules
- New morning warm-up sequence: discharge air temp at 110°F (electric heat disabled) until 10 zones below setpoint, then step DAT down 5°F every 10 min
Denver Office - Results

- Significant savings of almost $58,000/yr through demand reduction alone

Previous year (1,300 kW morning peak) vs. this year (500 kW peak)
HERE TO ANSWER YOUR QUESTIONS

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Thank you!

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