Monitoring and control of energy consumption in multi-site enterprises

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What are multisite facilities?

Centrally managed, similar locations

Sites 10,000+ sq ft, $15K yearly energy

Retail
Grocery
Restaurants
Theatres
Banks

50+ sites, 10+ new per year
What is the energy impact of multisite?

- 500,000 sites
- About 12% of US energy consumption
- Roughly 95GW peak load

*Source: DOE/EIA Annual Energy Review, 2008*
How does automation work in these buildings?

- A system at **each site**, made up of:
  - An executive controller
  - Unitary (equipment) controllers in each energy consuming device (lighting, refrigeration, HVAC)
  - A variety of sensors and other devices that provide input to the executive and unitary controllers (e.g. thermostats, sub-meters)

- A system that **spans the business**, made up of:
  - The BAS systems at each site
  - Supervisory control software
  - Data and Analytics tools

- An **integrated** Energy/Operational Efficiency and Demand Response Platform
  - Centralized management of site schedules, setpoints, alarms, etc
  - Predictive and analytic tools for tracking performance
  - OpenADR to enable DR programs
Challenges in managing multisite enterprises

- **Very large number** of geographically distributed assets to maintain
- **Tradeoff** between energy management and maintenance costs
- **No local support** -- local staff focused on sales operations
- For HVAC, **many zones**, malfunctioning equipment can be obscured because all supply same space
- **Volume** of data extracted from sites is very large
- **Context** is critical to interpreting data
Providing a big picture view of the enterprise

Executive Summary for March

The Novar team produced savings of $125,619 and the supply side efforts contributed $80,043. The demand side efforts cover 601 active Company XXX stores. The reduced consumption savings are a "cost avoidance" based on actual electricity and natural gas usage changes comparing March 06 with March 07. This includes making adjustments for weather normalizing, actual energy costs and rationalizing operational changes for the same stores.

Operational Status

Service Calls: For March, Novar team managed 231 HVAC and lighting service requests from the stores while handling an additional 483 service calls from on-site HVAC/electrical contractors requesting troubleshooting assistance. Of the 232 service requests, 123 were dispatched with Novar remotely fixing 111.

Alarms: Novar managed 20 alarms from the stores. 20 alarms required contractors being dispatched for service while 8 alarms were remotely fixed by Novar.

Demand Side (Consumption Optimization): Demand side savings for Mar 07 thru Feb 08 were $1,730,126 over the previous year. The electric reduction was 4,723,076 kWh and the natural gas reduction was 95,919 therms.
Details available on demand

**Daily Load Profiles**

**Site Information**
- Address: 
- Size: 164,608 ft²
- Occupied Hours: 101 hours/week

**Monthly Summary**
- Total Consumption: 399,559 kWh
- Max Daily Consumption: 15,116 kWh
- Min Daily Consumption: 11,754 kWh
- Median Daily Consumption: 13,436 kWh
- Average Daily Consumption:
  - Max Demand: 655 kW
  - Min Demand: 203 kW
  - Median Demand: 57.8 kW
  - Average Demand: 57.4 kW
- Max Intensity: 0.33 W/ft²
- Min Intensity: 0.11 W/ft²
- Median Intensity: 0.22 W/ft²
- Average Intensity: 0.22 W/ft²

**Monthly Consumption/Temperature Comparison**

**Relative Site Ranking - Unoccupied**
(Ranked 5 of 41, at 0.22 W/ft² average)

Date Run: 12/15/2008 6:00 PM
Implementing demand response in multisite

**Challenges**

- Need to balance participation with other energy management objectives
- Ability of energy management team to take on incremental work
- Differences across a portfolio of sites that has been built over years
- Security concerns drive I/T and communications decisions

**Benefits**

- Operational Efficiency achieved through automation of execution
- Integration of the ADR solution into the EMS/BAS reduces maintenance and support issues
- Full or partial funding of EMS/BAS upgrades
- Increased revenue potential through access to fast response programs
How OpenADR works for Multi-Site

DRAS (Demand Response Automation Server)

Internet

Commercial or Industrial Facility

Internet

Corporation HQ (BAS Server and OpenADR Gateway)

Corporation Network

Site 1  …  Site 2  …  Site N
Example loads and demand response strategies

**HVAC**
- Pre-cooling
- Fan to “auto” mode
- Lockout of second stage cooling
- Temperature setpoint adjustment

**Refrigeration**
- Pre-cooling
- Delay or cancel defrost cycle
- Adjust floating suction/head pressure

**Lighting**
- Employee-level lighting
- Cancel lighting in specific site zones
- Utilize dimmable lighting systems
# Case Study

## Situation

- Office Supply retailer
- 1,500+ sites
- Average of 20,000 sqft per site
- Typical site includes:
  - 6-8 roof-top HVAC units of 50-65 tons total capacity
  - 25-35kW of overhead and display lighting
  - Various plug loads

## Results

- Leveraged the utility incentive program to fully fund upgrade to Novar’s Opus BAS with OpenADR
- Implemented HVAC and Lighting shed strategies
- Average of 22kW per site of DR shed
  - 15kW from HVAC
  - 8kW from dimmable ballast lighting
- Ongoing rollout to 120+ sites in SCE and PG&E territories; also seeking other opportunities across the country

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Summary

Multi site is about 12% of US energy consumption, with a significant total peak load

Sites have an automation system and report up to central supervisory controls

Facility managers are highly resource constrained

Continuous monitoring with clear direction to key site actions needed to drive energy efficiency

Maintaining sites to standards, tracking exceptions, resolving is an ongoing process

OpenADR coordinated at the enterprise level and tied to utility programs