Association of Energy Engineers
2013
Real World Results EE+ADR

PROJECT
8105 Irvine Center Dr.

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
366,000

LOBOS INSTALLATION
2012

SAVINGS
$71,019 Annual

AUTOMATED DEMAND RESPONSE CAPACITY
260 kW
Real World Results EE+ADR

PROJECT
Jamboree Center

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
1.6 Million

LOBOS INSTALLATION
2012

SAVINGS
$310,464 Annual

AUTOMATED DEMAND RESPONSE CAPACITY
1.1 mW
Real World Results EE

PROJECT
Inland Center Mall

FACILITY TYPE
Regional Mall

LOCATION
San Bernardino CA

SQUARE FEET
932,709

LOBOS INSTALLATION
2008

SAVINGS
$360,000 Annual
Real World Results ADR

PROJECT
Park Place

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
1,891,000

LOBOS INSTALLATION
2010

AUTOMATED DEMAND RESPONSE CAPACITY
1.4 mW
Real World Results ADR

PROJECT
The Michelson

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
531,000

LOBOS INSTALLATION
2010

AUTOMATED DEMAND RESPONSE CAPACITY
436 kW
Real World Results EE+ADR

PROJECT
The Irvine Company

FACILITY TYPE
Commercial Office Portfolio

LOCATION
Orange County CA

SQUARE FEET
7,000,000

LOBOS INSTALLATION
2010

SAVINGS
$1.2 Million Annual

AUTOMATED DEMAND RESPONSE CAPACITY
4.9 MW
Real World Results ADR

PROJECT
500 Newport Center Dr.

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
127,000

LOBOS INSTALLATION
2012

AUTOMATED DEMAND RESPONSE CAPACITY
125 kW

Enerliance
Real World Results EE+ADR

PROJECT
Irvine Towers

FACILITY TYPE
Commercial Office

LOCATION
Irvine CA

SQUARE FEET
1.1 Million

LOBOS INSTALLATION
2010

SAVINGS
$284,000 Annual

AUTOMATED DEMAND RESPONSE CAPACITY
903 kW
Important vs. Urgent...

For your clients:

Improving comfort in their facilities

Reducing energy use and costs

Shaping the AM and PM electrical demand profiles

Reducing energy waste and maintenance costs

For your firm:

Protecting your client base from erosion

Increasing revenue and profits
LOBOS Performance

LOBOS EE
- Annual cost savings of $0.12-$0.20 per SF (USD)
- Energy Efficiency gains of 30-50%
- Breakthrough Intelligence

LOBOS DR
- Annual DR monetization of $0.01-$0.03 per SF (USD)
- Auto Demand Response of ½ to 1 watt per SF
- The Last Mile

LOBOS FDD
- Indemnifies & amplifies investment in LOBOS
- Custom integration of SkySpark Fault Detection & Diagnostics
The Building Automation System (aka BAS, BMS, EMS) and LOBOS™ work together, adding DR and EE intelligence that take full advantage of the BMS system’s capabilities.

A simple way to think of the relationship: The BAS system serves as the nerves (gathering inputs) and muscles (exercising control) with the LOBOS™ system working as the brain (providing intelligence).

LOBOS™ is built on the Niagara platform, allowing it to seamlessly communicate with virtually any BMS system.
### Compelling ROI Possible for HVAC

**Facility Address:** NREL CBECS Model, Golden Colorado

<table>
<thead>
<tr>
<th>1) Comprehensive EE &amp; DR Investment</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Total EE &amp; DR Turnkey Project Cost</td>
<td>$215,947</td>
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<tr>
<td>EPACT 2005 Benefit</td>
<td>$0</td>
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<tr>
<td>EE Utility Incentive</td>
<td>($45,664)</td>
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<tr>
<td>DR Utility Incentive</td>
<td>($18,375)</td>
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<td>Net Investment</td>
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<table>
<thead>
<tr>
<th>2) Annual EE Savings Summary</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Total Annual kWh Savings</td>
<td>$46,937</td>
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<tr>
<td>Annual Comfort Call Labor Savings</td>
<td>$3,750</td>
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<tr>
<td>Total Annual EE Savings</td>
<td>$50,687</td>
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<table>
<thead>
<tr>
<th>3) Annual DR Revenue &amp; Savings Summary</th>
<th>Amount</th>
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<tbody>
<tr>
<td>DR Capacity Payments</td>
<td>$2,940</td>
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<tr>
<td>DR Event Payments</td>
<td>$588</td>
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<td>DR Event kWh Savings, 6 Events</td>
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<tr>
<td>Opt-In Real Time Pricing Capacity Revenue</td>
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<tr>
<td>Tariff Optimization Savings</td>
<td>$0</td>
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<tr>
<td>Total Annual DR Revenue and Savings</td>
<td>$3,695</td>
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<table>
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<tr>
<th>4) Total Annual Savings</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Annual EE Cost Savings</td>
<td>$50,687</td>
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<tr>
<td>Annual DR, Capacity &amp; Tariff Revenue</td>
<td>$3,695</td>
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<tr>
<td>Total Annual EE &amp; DR Savings</td>
<td>$54,382</td>
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<tr>
<th>5) Financial Metrics</th>
<th>Value</th>
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<tbody>
<tr>
<td>Simple Payback (Years)</td>
<td>2.79</td>
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<tr>
<td>Internal Rate of Return (Ten Years)</td>
<td>33.9%</td>
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<tr>
<td>Valuation Increase at 8% Cap Rate</td>
<td>$679,781</td>
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<table>
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<tr>
<th>6) Environmental Metrics</th>
<th>Value</th>
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<tr>
<td>EE Annual Lbs CO2 Emissions Reduced</td>
<td>695,344</td>
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<td>kW DR Capacity, 2 Hour stage 10</td>
<td>123</td>
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<table>
<thead>
<tr>
<th>Site Information</th>
<th>Value</th>
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<tr>
<td>Square Feet</td>
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<tr>
<td>kWh Rate</td>
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<tr>
<td>Region</td>
<td>SW</td>
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<tr>
<td>Variable Speed Equipment</td>
<td>Yes</td>
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33 Billion = Square feet of commercial building space, a subset of 81 billion SF feet of commercial buildings

245,356 = Commercial Buildings > 50k Square Foot

25 GW = Auto DR capacity.

21 = Nuclear Power Plants. Auto DR capacity equivalent to the electricity generated by 21 nuclear power plants.

46,000 GWh = Annual electricity savings

$5 Billion = Annual energy cost savings

$14.4 Billion = LOBOS building intelligence, total addressable market and potential revenue.

$84.8 Billion = LOBOS + pull through equipment. Total addressable market and potential revenue.
Real World Results
The Irvine Company

The Project

• The Niagara Ax based LOBOS EE & DR platform and directly programmed LOBOS logic were successfully applied to a diverse base of existing Building Automation Systems.

• The common platform leverages a single integration effort to provide Energy Efficiency and Automated Demand Response

Results & Project Data

• Over $1 million in SCE incentives.

• 4.9 Megawatts (MW) of fully automated Demand Response. (.7 watts per SF)

• $1.2 million in annual energy savings. ($0.17 per SF)

• SCE DR test on 85 degree day in August, with only 8 comfort calls over 7 million square feet.

• 7 million square feet, type A multi-tenant commercial office space.

• Thirty buildings, 2009-10 Installation.
2009 Project

- Existing 3600 ton natural gas fired absorption plant.
- Installed 2400 ton Trane all-VFD all-electric plant.
- Added 1.4 mW of electrical load and saved 2,800,000 kWh.

LOBOS Control Sequences & Reset Strategies.

- Look at the AHU loads,
- Raise the CHW temperature as high as possible,
- Lower the CHW differential pressure as low as possible so that the worst case AHU load is met.

The Results

- Despite conversion from natural gas to electric plant, overall electricity consumption is reduced.
- In the example at right total plant operation at part load is just 0.24 kW per ton with 1200 ton Trane chiller serving 377 ton load.
The Project

- Early DCx strategies applied to a new variable speed chiller and a new “variable everything” chilled water pumping system working together with the existing BAS system.

- Overall annual efficiency running at 0.52 kWh per ton. At ~200 ton load the plant runs at around 0.36 kW/ton.

- The plant operation has been reduced by over 1,500 hours per year, due to “Thermal Flywheel” logic that shuts down chillers and uses the cold water that is in the pipes to meet small loads.

The Results

- 1.25 million annual kWh reduction measured at the sub-meter.
- Greater than 58% Energy Efficiency savings
- Increased Occupancy Comfort
This Chart Illustrates the Potential of LOBOS and DCx Control Logic

**Legacy Strategies:** Energy savings related to new VFD and chiller equipment with traditional control strategies are 12% of baseline.

**New Paradigm:** The same VFD equipment with DCx control strategies produced a 70% savings during the first full year of operation.

1. **October.** During commissioning, energy savings with “Limited Reset” LOBOS logic were running at 45% compared to baseline.

2. **November.** The LOBOS system was intentionally disengaged. The new variable speed equipment and traditional control strategies produced a 12% savings compared to baseline.

3. **December-April.** The “Limited Reset” LOBOS logic was restarted, savings returned to the 45%-50% range through April.

4. **Ongoing.** When full DCx logic resets were released in June, savings climbed to 73%-75% per month.

% Central Plant and Air Handler Electricity Savings Compared to Baseline
**The Project**

- LOBOS control strategies optimize CHW supply temperature and CDW supply temperature, as well as AHU variables.
- Total chiller plant energy efficiency is **averaging less than 0.50 kW/ton, even on 100°F days.**
- Total Plant includes all chillers, chilled water pumps, condenser water pumps and cooling towers.

**Results & Customer Quotation**

“If we reduce usage anymore...we can turn everything off and go home! Overall usage down an amazing 55.89% from last year. **HVAC usage down 86.59% from last year**”

David Manley | Operations Manager
Inland Center Mall
500 Inland Center
San Bernardino, CA, 92408
EE System
Air Handler Overview

This screen provides an overview of all air handlers in a particular facility.

Note the wide variety of Speed Command, Supply Air (SAT), and Static combinations and the consistency in Return Air (RAT).

This illustrates how LOBOS ensures comfort (RAT) while saving energy by creating an optimal mix of system resources that is synonymous with efficiency.

All floors are not loaded alike.
Central Plant Optimization

LOBOS provides a very stable reset platform to enhance comfort and productivity, while using less energy at the same time – think of it as a “Cruise Control” for your HVAC system.

Typical HVAC system controls are more like you drove your car when you were 17 years old and wanted to impress your friends with how fast you could get to the next stoplight – lots of throttle and lots of brakes, but not very efficient or comfortable...
AHU Supply Temperature Tuning

The operator can tune and tweak each floor as desired without entering the code by using slide bars.

Self tuning loops adjust the system gains for each AHU every 15 minutes when needed to account for changes in the loads – occupancy, weather etc..

All the while LOBOS is delivering optimized setpoints every 60 seconds.
This page presents an overview of the information for each particular AHU. There is general information for site and central plant and a summary of the WCAH values being utilized to drive LOBOS.

On this page, the user can adjust the level of influence for each AHU to be monitored by LOBOS.
DR System
Automated Demand Response

- **Ten Stages, Automatic** The LOBOS DR fully automatic 10-stage controller takes the pain out of participating in Demand Response.

- **Set it and Forget It** The LOBOS™ DR system is programmed to duplicate the Utility Demand Response program requirements so that you don’t have to think about it. All you have to do is program in the desired demand reduction profile, enable the system in the Automatic Mode, and the LOBOS™ DR system will automatically follow the power curve, keeping you safely within the limits of your DR bid amount.

- **Safety Valves & Resource Allocation** Unlike typical DR control systems, the LOBOS™ DR control system is equipped with “safety valves.” For example, if the return air temperature for an individual AHU exceeds pre-specified limits for each stage of demand reduction, the LOBOS™ DR system will slowly start reducing the amount of demand reduction at that specific unit to increase cooling capacity, and reduce tenant issues, automatically. Depending on how close the measured demand reduction is to the DR bid amount, the LOBOS™ DR system will automatically increase the demand reduction at other AHUs and the chiller plant, to ensure that you stay within the DR program guidelines. With this logic, a single tenant who will not tolerate much deviation from the norm won’t limit the overall ability of the system to reduce demand.

- **User Friendly Adjustability** Each individual AHU is fully programmable to allow for system fine tuning.
DR AHU Configuration

Uses 10 day average return air temperatures as a safety valve to reduce client awareness of a DR event.
At the end of the day when people are headed out the door, you can save a lot of energy by allowing the HVAC system to “Coast to a stop” instead of running at full speed right up until the AHU’s shut off.
FDD System
LOBOS EE & DR provide intelligent control of the central plant and air handlers.

LOBOS FDD utilizes the Industry leading Skyspark by SkyFoundry database engine and LOBOS specific rules to go beyond control.

1. LOBOS FDD automatically looks for costly performance issues.
   - Across a wide range of data with different sources and formats.
   - Processes rules to generate “sparks”, notices of items needing corrective measures.
   - Easily add new rules without re-programming controllers or end devices.

2. LOBOS FDD turns operational data into correctable issues with minimal intervention.

3. LOBOS FDD allows you to identify problems and take corrective action before you suffer increased expense, and decreased comfort.
Typical sparks report showing AHU on and the building is unoccupied or on outside of lease time and NO call for afterhours air has been requested by tenant.
Typical sparks report showing temperature sensor failure, chiller plant NOT running when called for or running when NOT called for.
Allows you to quickly view the following analysis for site equipment maximum runtime, kW for each site and kWh for each site for selected time frame.
Report Application

Designate individual customized folders for each report for individual staff members to view.

Name the folders specific to a portfolio or site.
Why Load Based Optimization Works
We reduce chiller lift thru chilled water and condenser water temperature and flow optimization – using the end use AHU loads to drive the entire process. AHU’s are also Optimized for comfort and energy efficiency improvements.

**Refrigerant Lift vs Chiller Efficiency**

Greater refrigerant lift (relative difference between CDWS and CHWS) equates to much worse system efficiency.

- 4 degrees of differential = 0.16 kW/ton
- 40 degrees of differential = 0.69 kW/ton
Real World Example

Effects of Changing CDW Temp Setpoint on VFD Chiller Efficiency

LOBOS takes advantage of increased chiller efficiency with reduced CDWS temperatures.

Shutting off LOBOS cooling optimization hurt overall plant performance by over 30%.
“Poor controls can waste more energy than great equipment can save.”

11.9 MPG on the Prius

Prius with “Efficient” HVAC Control Strategies
16 MPG

Prius with “Load Based” HVAC Control
99 MPG
Previous Plant Operation was between 1.5 and 2 kW per ton under similar loads. Averaging over 70% savings in the first 18 months post-installation.

Note the OSA humidity at 105% - previously existing sensor, and why we do not use RH in any of our code...
Many existing loads still have 3-way valves, so secondary flow and pump energy is still higher than it needs to be. Low CHW temperature differential from 3-ways also drives primary pump energy higher than it needs to be, so we could eventually get down to 0.22 to 0.25 kW/ton for the entire plant under similar conditions.
Multiple CT control loops to optimize the chiller plant while protecting the chillers...
Total chiller plant (chillers, pumps, cooling towers) at less than 0.50 kWh/ton-hour, delivering 35°F fluid.

This is a TES charge cycle, making really cold water with the entire chiller plant using less energy than the chiller typically uses by itself. This is a sample of what can be done during chiller plant upgrade/retrofit projects.
LOBOS in operation at an AHU – Running very warm Supply Air Temps in the morning to minimize reheat energy waste and chiller energy waste, then, as the loads increase later in the day, the SAT drops to keep the loads under control. SAT was 73F in the morning and 63F in the afternoon, still saving chiller plant energy.
Market, Challenges, Opportunities
Increased Occupant Comfort

- It is well documented that comfort is directly tied to tenant retention, increased occupancy, and increased rental rates.
- Increased occupant comfort has been directly shown to result in increased building valuations.

Reduced Operating Costs

- Improved energy efficiency leads directly to reduced operating expenses.
- Reduced comfort calls leads to reduced stationary engineer payroll expense, conservative estimates suggest 2.5 cents per square foot annual savings.
- Longer service life. Efficient equipment lasts longer.
Opportunities....

Avoidance of Punitive Peak Energy Costs

- Automated Demand Response allows **precise control of peak loads**, and the looming punitive on-peak energy tariffs related to FERC order 745.
- Current DR programs can **produce revenue of 1 to 3 cents per square foot** annually. Future programs will yield far greater amounts.

Energy Efficiency Savings

- Typical LOBOS™ EE savings for commercial office space are **10 cents to 25 cents per square foot annually**, with 24/7 facilities yielding far greater savings.
Increased Asset Valuations

• It is well documented that energy efficient buildings have increased valuations and cap rates.

• Roll up LOBOS™ conservative savings values to 13.5 cents per square foot annual, apply an 8% cap rate to a 500k square foot facility, and the result is more than $800,000 in increased building valuation.
Opportunities....

Rent and Valuation Premiums

• According to a March 2008 CoStar Study, LEED buildings command rent premiums of $11.33 per square foot over their non-LEED peers and have 4.1 percent higher occupancy. Rental rates in Energy Star buildings represent a $2.40 per square foot premium over comparable non-Energy Star buildings and have 3.6 percent higher occupancy.

• And, in a trend that could signal greater attention from institutional investors, Energy Star buildings are selling for an average of $61 per square foot more than their peers, while LEED buildings command a remarkable $171 more per square foot.
Opportunities....

Utility Incentives
• Most utilities offer cash incentives to help pay for the installation of Energy Efficiency software and hardware.
• Many utilities now offer cash incentives for the installation of Automated Demand Response capabilities.

Environmental Benefits
• The energy use reduction associated with a 460k SF Lobos EE deployment example (found later in this presentation) results in a reduction of more than 560,000 pounds of CO2 emissions annually. That’s the equivalent of removing 90 passenger cars from the road for one year, or enough to offset the emissions related to electricity use at 53 households for one year.
Market Challenges...

1. **Grid Congestion** - The utility industry, driven by the compelling need to manage peak load on an aging grid, must create large scale automated demand response.

2. **Inability to Effectively Control Aggregated Loads** - Conceptually, it seems a manageable task to aggregate and automate loads for Demand Response. In reality, it has been a complex challenge to automate large lighting and mechanical loads, without costly and negative impacts to an operating facility.

3. **Unfulfilled Promise** - DR aggregators and Curtailment Service Providers have emerged, aggregating loads and building enormous market capitalizations in anticipation of monetizing those loads, but have yet to deliver the automated DR that the Smart Grid needs.
Market Challenges...

1. **Less Low Hanging Fruit** - While demand for Energy Efficiency has been booming since the late 1980s. Most of this activity has been centered on so called “low hanging fruit” such as lighting equipment. These opportunities have been highly commoditized and harvested.

2. **Deeper Retrofits have Longer Paybacks** – HVAC systems, which consume up to 35% of a typical commercial facility’s electricity, have been relatively untouched during the energy efficiency boom due to the complexity, high cost, and uncertain savings characteristics of available solutions.

3. **Hard to Reach Opportunities** – This translates to an enormous backlog of unrealized savings opportunities, and an unmet demand for user friendly, comfort-focused, HVAC and controls-based energy efficiency projects.
1. **Hard Coded Solutions** – While HVAC and controls professionals know what should be done to optimize central plant performance, until now, most solutions have required programming static sequences of operations into their existing controls systems. Even for technology OEMS customizing their own solutions, consistent results are elusive.

2. **Savings Dilution** - Due to the static nature of hard coded optimization strategies, and difficulty of future modification or adjustments, these hard coded strategies tend to get over-ridden in the name of occupant comfort. The savings do not persist.

3. **Increased Expectations** – With the proliferation of user friendly consumer electronics, buyers of energy efficiency technologies are increasingly conditioned to expect a similar experience.
Playing Together with Analytics
Technology Opportunity

LOBOS – EE & ADR
Real time resets require live data trends

Analytics Partner
Analytics utilize CSV data trends

User Interface
Market Opportunity

Analytics Partner
Energy Analytics
Benchmarking
Automated Fault Detection

LOBOS – EE & ADR
EE - Real Time HVAC Optimization
DR - Strategic Curtailment

Analytics Partner
Energy Solutions

ENERLIAACE
Building Efficiency Solutions
Thank You!

**Big Opportunities**
Substantial energy efficiency, demand response, and investment opportunities exist within commercial, industrial, and institutional real estate facilities, specifically those with central chiller plants.

**Facilities Need It**
The LOBOS™ DR and EE software platform unlocks the backlog of savings potential allowing facility owners and operators to harvest these opportunities.

**Utilities Want It**
Breakthrough technology that delivers integrated EE & DR, proven in the real world, and validated by $10M in R&D and $7M in utility incentives.

**We Can Deliver It**
This product requires skill to deploy. With our combined skills, experience and relationships, we can deliver it together.