C&I Energy Savings
Low Touch Continuous Monitoring

Presented to Illinois Stakeholder Advisory Group
March 2013

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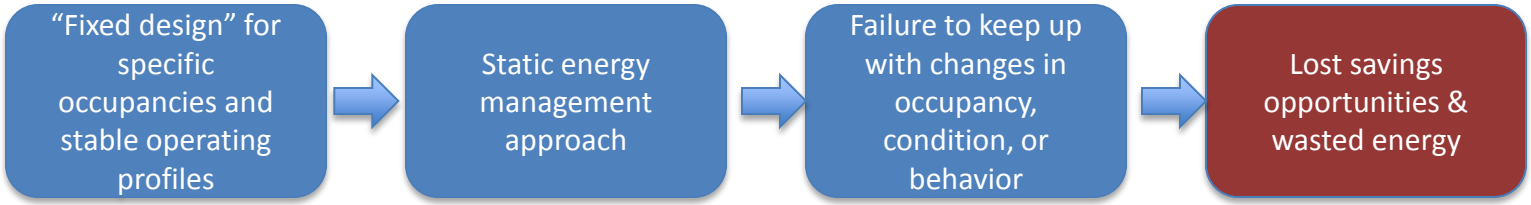
Traditional Approach to Building Energy Management

- Buildings treated as “static systems”



- Even with building automation:
  - Initial set-up for conditions that likely changed long ago
  - Short-term “bypasses” and other re-programming increase energy consumption
- Limited or no information to make decisions

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Importance to Utilities and Regulators

- Conventional program approaches reaching limits
- Higher standards make it more difficult to find and increase cost-effective savings
  - Most C&I efficiency programs focus on equipment
- Evaluation uncertainty increases risk of reducing claimed savings
  - Deemed savings, prescriptive algorithms, and even custom analysis assume fixed conditions that will eventually change

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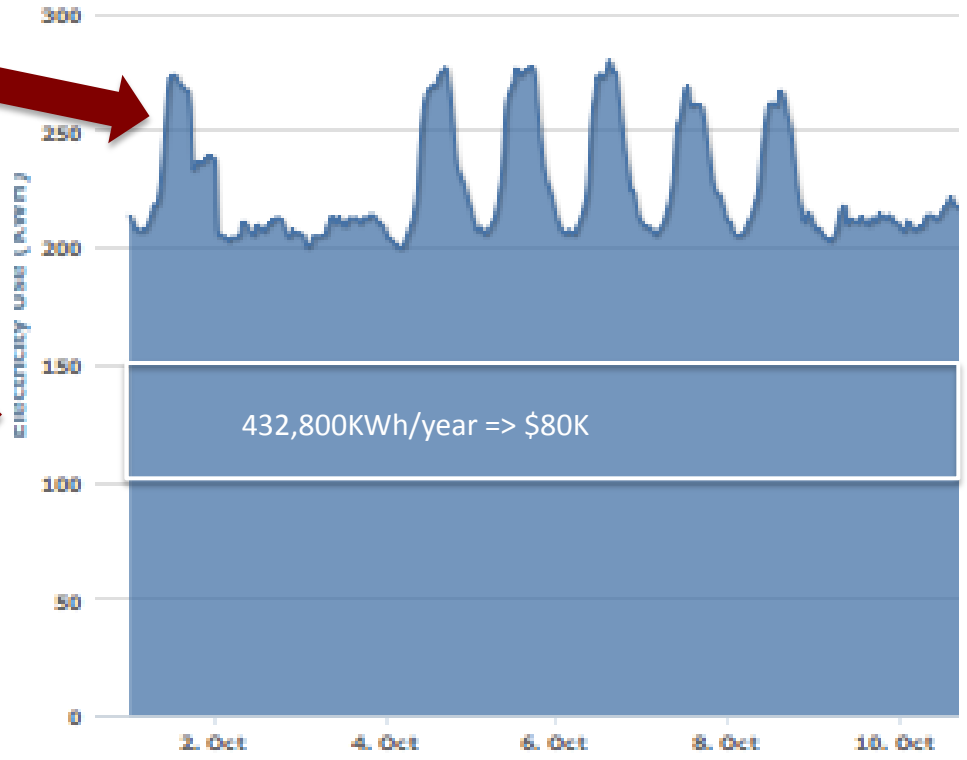
The Components of Consumption

Dynamic Properties
Information to duty cycle systems efficiently

Load Analysis & Disaggregation
Information to discover which loads should be duty-cycled and which ones could be improved through upgrades



Must know the state of loads and occupants and let information drive the decisions for savings

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What's Available Now?

- More sophisticated analysis
  - Algorithms now capable of disaggregating consumption data with high degrees of precision
- Inexpensive, low touch wireless data collection
  - Allows real-time monitoring of key end uses, occupancy, and building conditions
- Software-as-a-Service (SaaS)
  - Provides effective, continuous feedback for taking action

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Building Dynamic Data Collection and Uses: Three Steps

BENCHMARK AND REMOTE AUDIT

Interval Data Analysis*
Identify Opportunities
Track Progress
Measurement and Verification

CONSUMPTION PROFILING

Wireless Sub-metering
Occ. , Temp. & Humidity Sensing
Hours of Operation
Detailed Load Analysis
Savings Recommendations

AUTOMATED SAVINGS

Simple Controls to realize savings
Intelligent Thermostats
Custom Controllers
Interface to existing EMS

Identify and implement operational savings at high cost-effectiveness

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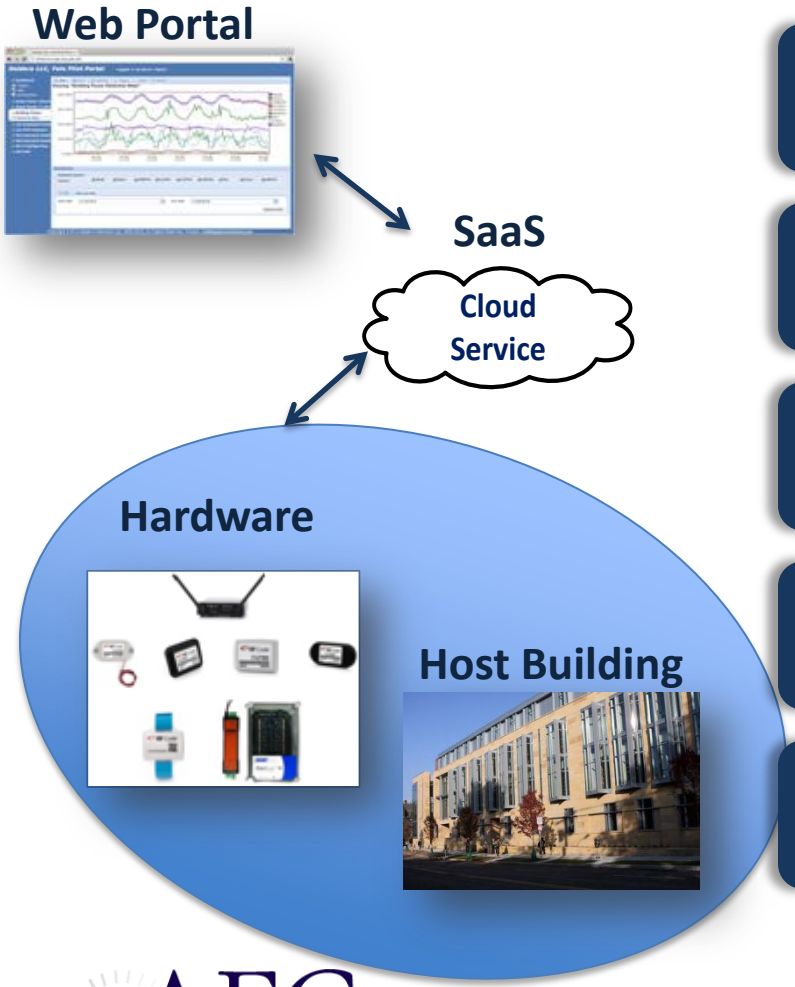
*Can achieve meaningful results with historical billing data

How Does It Work?



- Sensors monitor building conditions and occupancy
- System identifies wasted and unoptimized energy usage
- System drives BMS controls (or provides real-time feedback to facility managers)
- System tracks actions and quantifies savings
- Generates reports and alerts

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Continuous Commissioning and Evaluation Now Possible

- Continuously monitor the building and make changes as you go
- Identify the changes related to occupant behavior
  - Where is the redundant usage?
  - Are the schedules and zones properly defined?
- Monitor consumption per end-use class
  - HVAC, lights, occupant-loads, water-heaters, etc.
- Use intensity metrics at the sub-load level to refine the operation
- EMS system interaction – read the sensors, pass control decisions
- Regular evaluation reports against benchmarks
  - Can see effects of behavioral and equipment changes nearly in real time

What Does This Look Like in Practice?

Office Building Case Study

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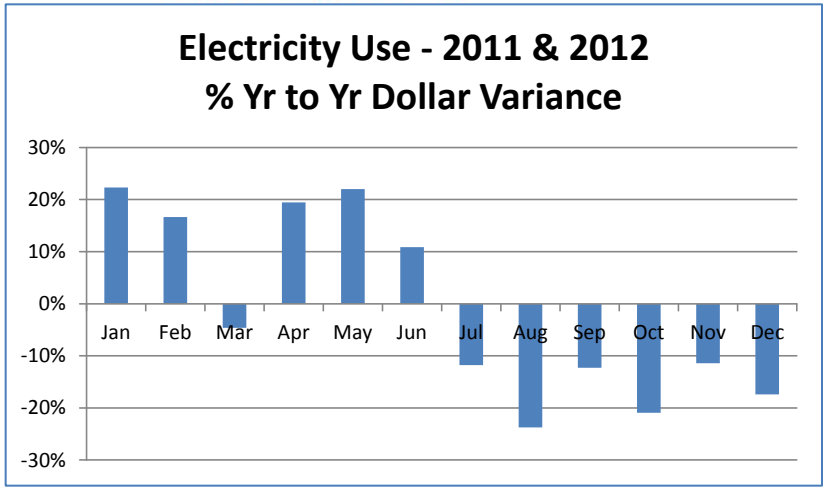
Case Study: Office Building

Customer:	New London County Insurance Co.
Address:	101 High Street
City:	Norwich
State:	CT
Building Size:	46,612 Square Feet

Energy Efficiency Measures	
Electricity Consumption - kWh Monthly	71,112
Electricity Cost - $ / kWh	$0.16
Energy Efficiency Target	15%
Target Reduction - kWh Annual	128,002
Target Reduction - $ Annual	$20,480



Building analytics data collection began in July 2011 and resulted in a reduction of 69,848kWh over the same period in 2012

- HVAC optimizations, light schedule optimizations extracted from occupancy analysis

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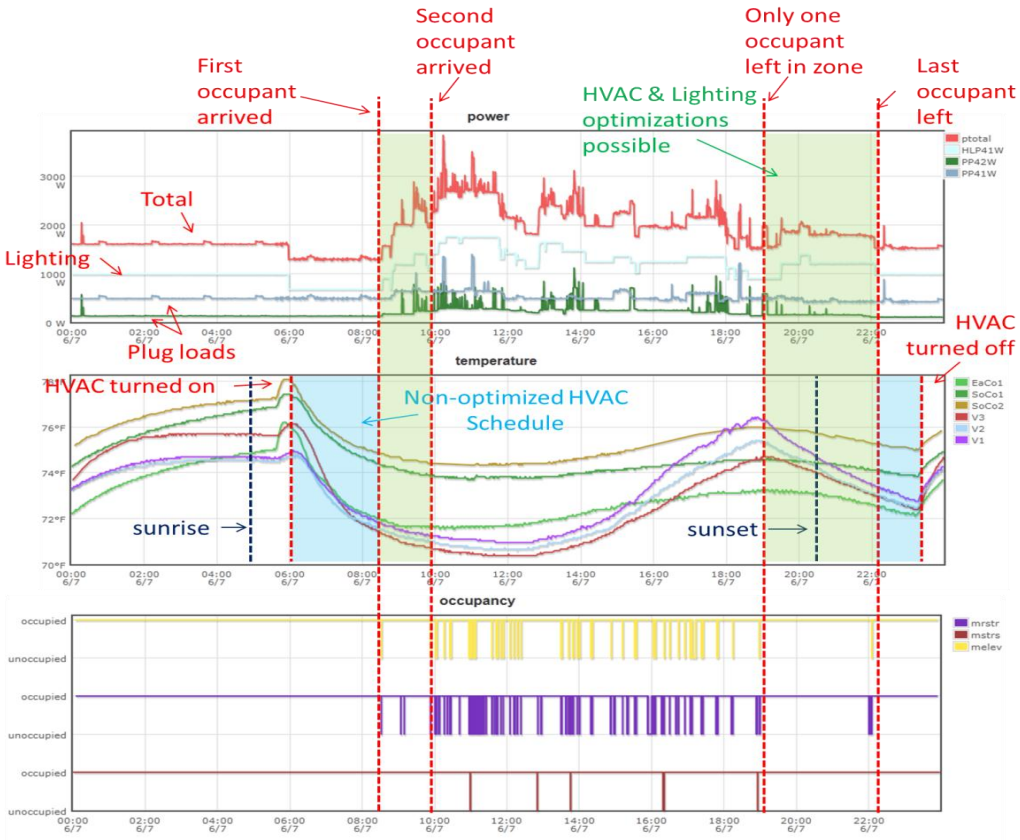
Baseline: Behavior De-Coupled from Consumption

Coupling occupant behavior to consumption to provide accountability of expenditure



1. Data Collection

Sensing Infrastructure

Scalable Sensing Network

2. Behavior Algorithm

Couple Energy Consumption Behavior Savings via Behavior Change

3. Reporting

Monitor Time, Occupancy & Energy Control Future Loads

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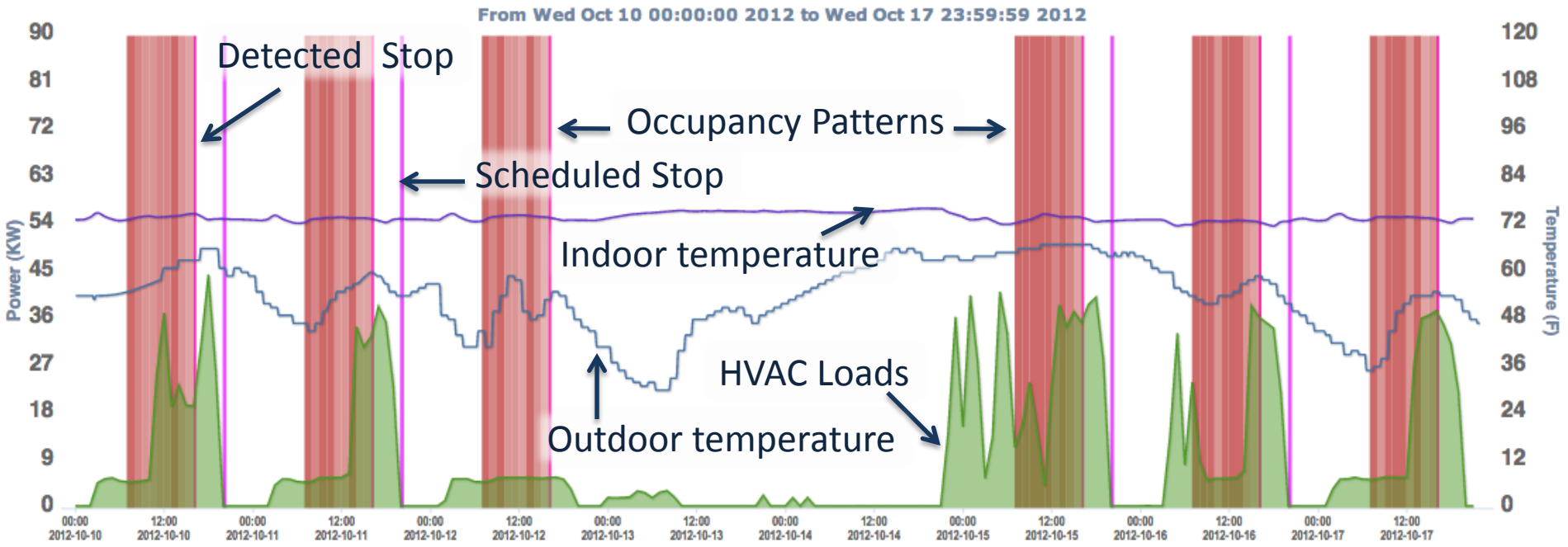
Savings projection from pilot deployment

Relationship Between Consumption & Behavior



Building Energy Performance

Total Consumption	1855 KWH
Total Consumption Cost	$296.94
Achieved Savings (selected time window)	418 KWH
Achieved Savings (selected time window)	$66.94
Projected Annual Savings	56077 KWH
Projected Annual Savings	$8972.47
Savings to Date	14128 KWH
Savings to Date	$2260.53

Report Parameters

Start Date: 2012-10-10 Start Time: 00:00:00
End Date: 2012-10-17 End Time: 23:59:59
Regenerate Report

NLC Building Information

Address
NLC Building
101 High Street
Norwich, CT 06360
Area: 46612 Sq. Ft.

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Using Data for Multiple Functionalities

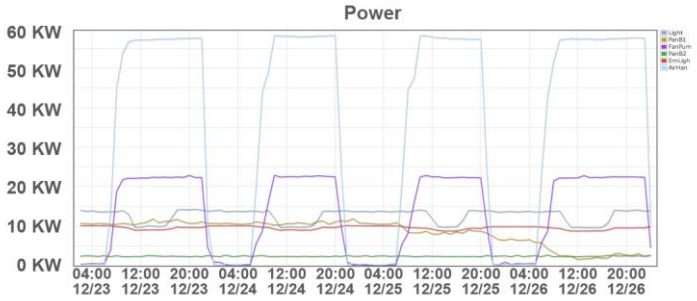
Cloud Service

Electric Load Disaggregation

Intelligent Control based on Behavior Patterns

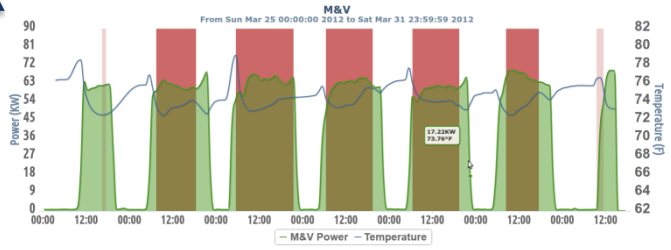
Reporting

Awareness



Visibility into Internal Load Patterns

Immediate Savings



Continuous Performance Reporting

Social norms and behavior modification to conserve

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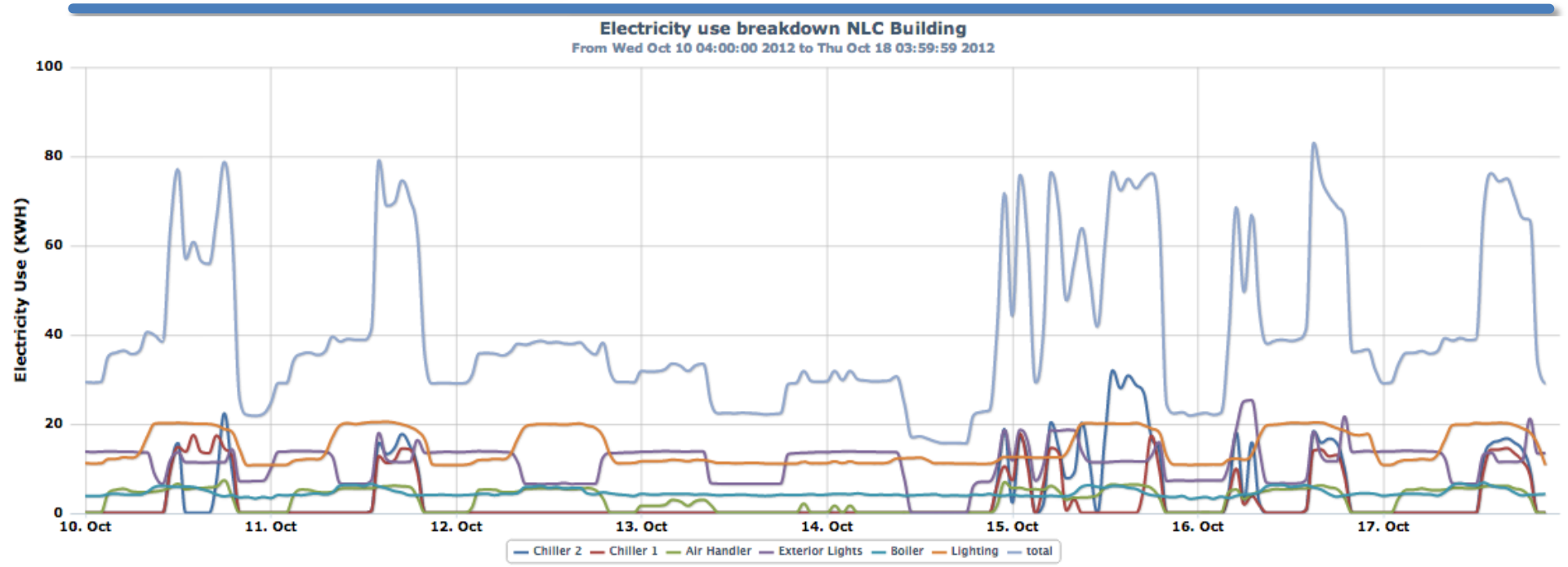
Detailed Load Analysis



Building Energy Performance

Chiller 2	733 KWH (9.5%)
Chiller 1	517 KWH (6.7%)
Air Handler	604 KWH (7.8%)
Exterior Lights	2152 KWH (27.9%)
Boiler	877 KWH (11.4%)
Lighting	2820 KWH (36.6%)
Total Consumption	7706 KWH
Proj. Annual Consumption	319308 KWH
Proj. Annual Cost	$51089

Report Parameters

Start Date: 2012-10-10 Start Time: 00:00:00
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stacked
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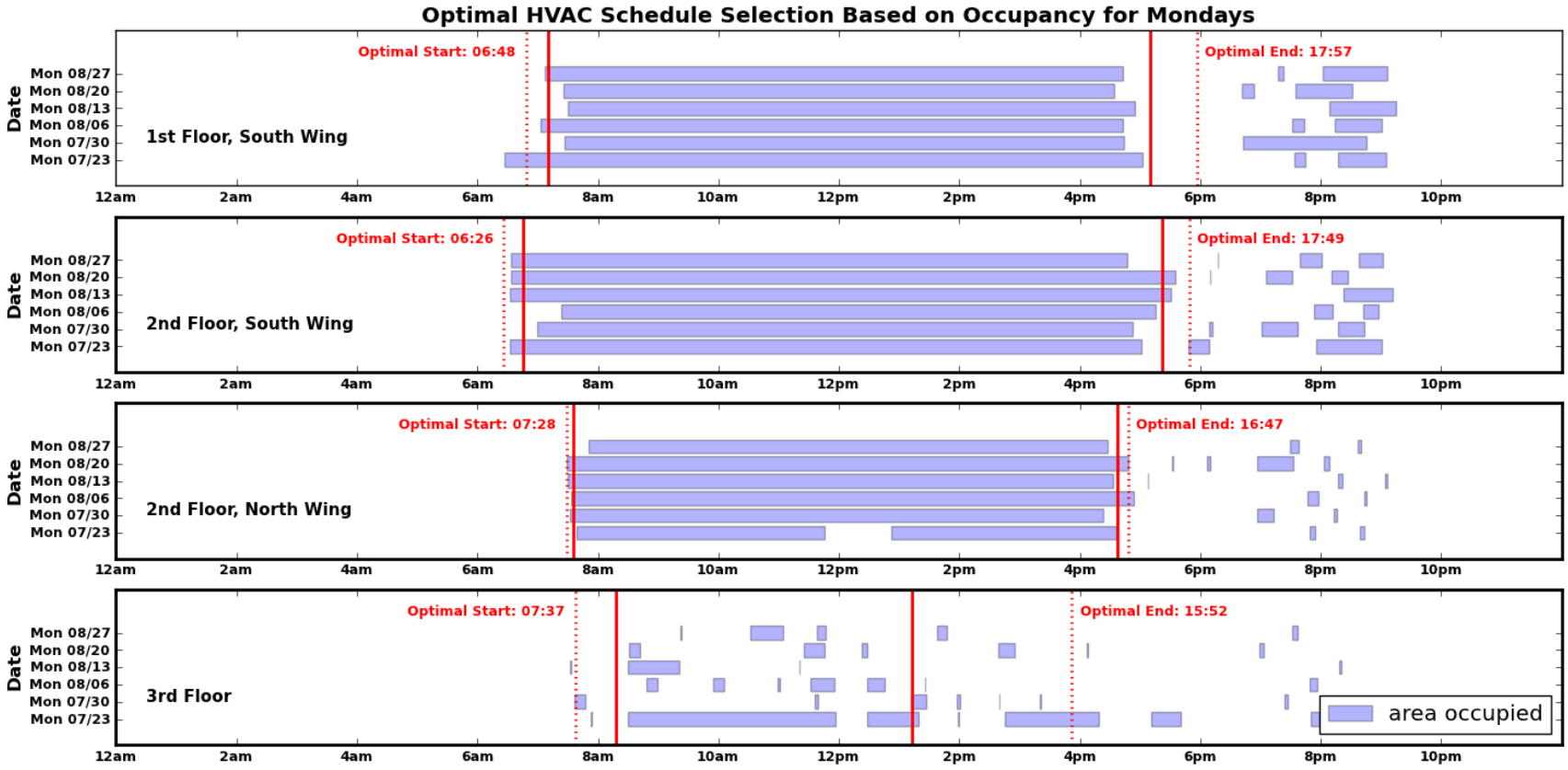
Automated Schedule Discovery

Snapshot from automated schedule extraction based on occupancy



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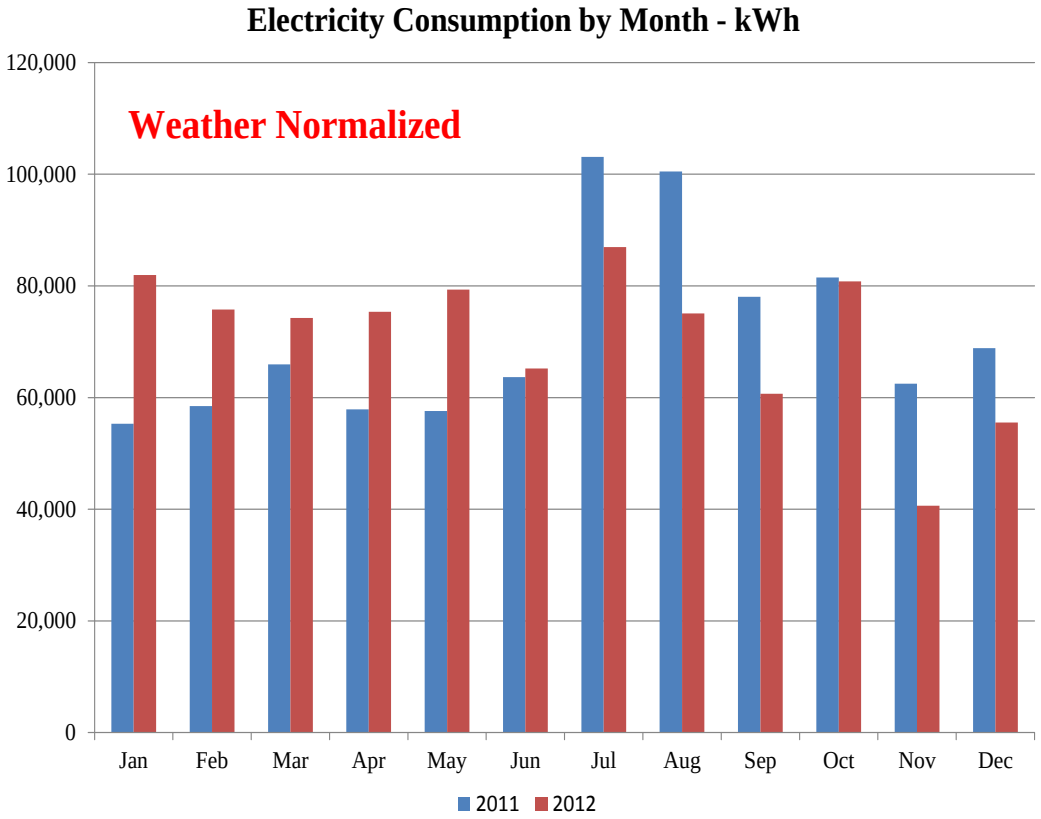
Achieved Savings

- Further HVAC optimization
- Integration of occupancy models in decisions
- Interior light controls and exterior light replacements
- Chiller optimization



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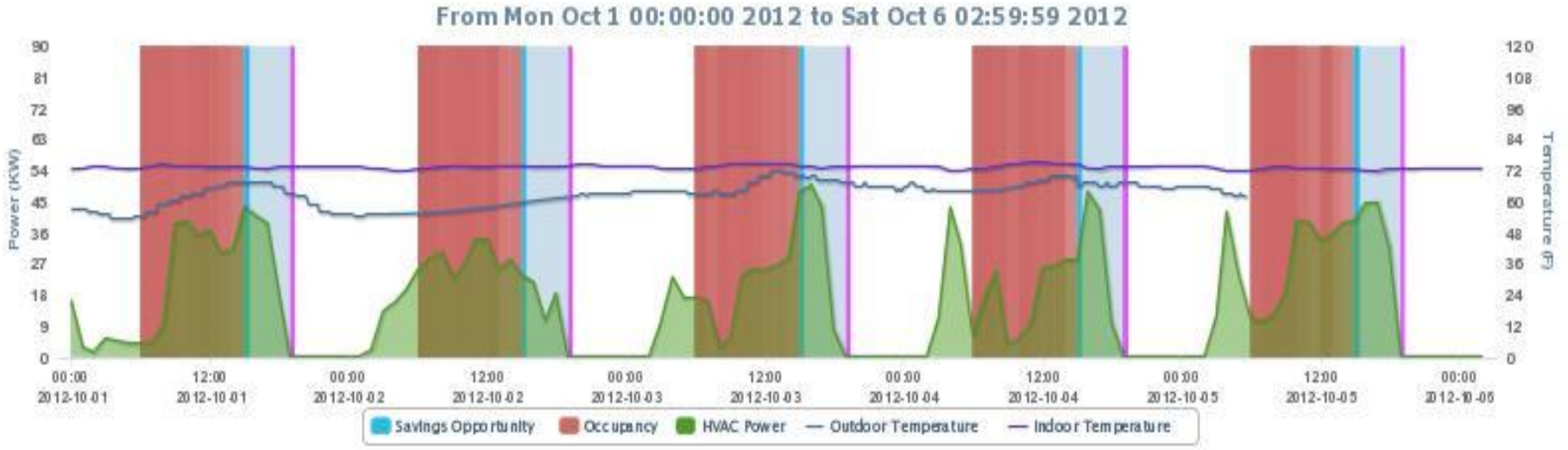
Identified But Not Realized



- Shut-off the HVAC loads when occupants leave the building
- Measured over 1 month, savings extrapolated to 32,000kWh over summer season
- To be implemented summer of 2013

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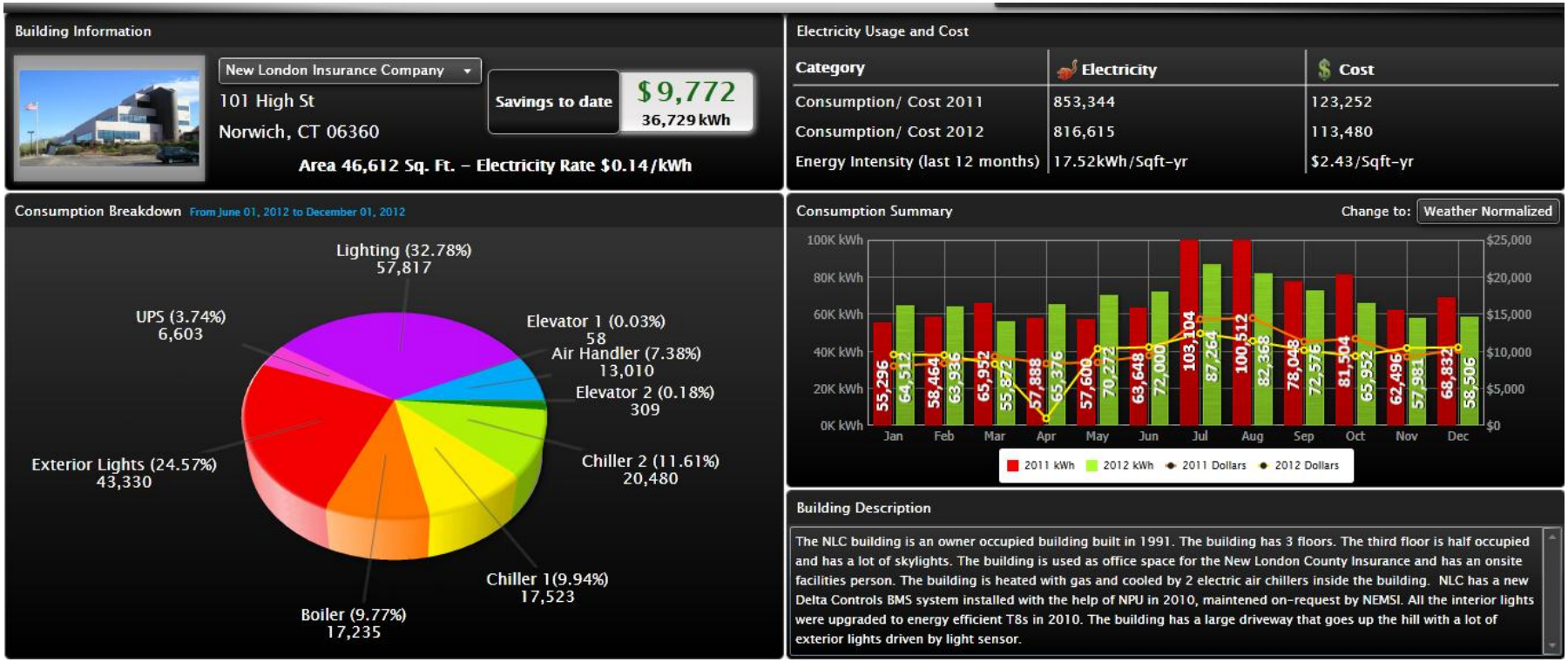
User's View – Consumption Summary

User Portal



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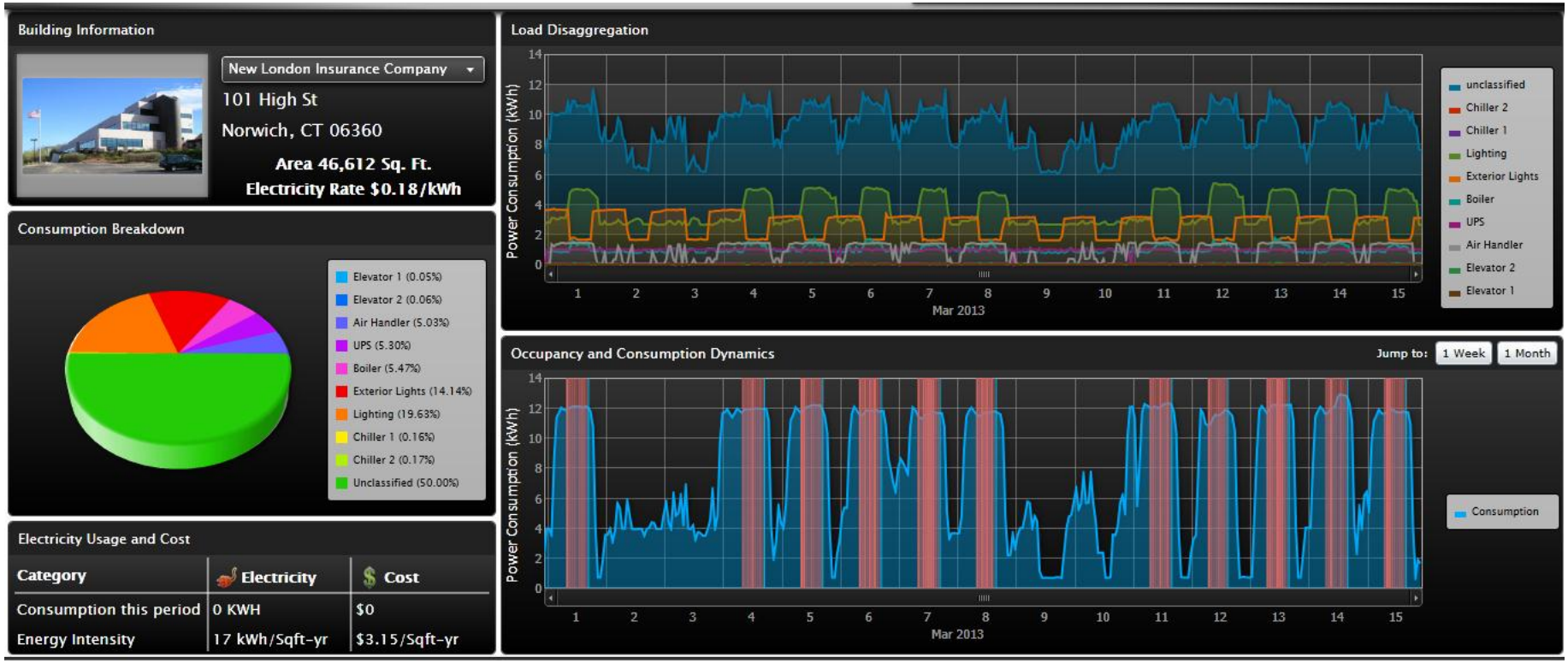
User's View – Load Disaggregation

User Portal



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Summary

- Traditional approaches are running out of potential (especially with low avoided costs)
- Changes in technology now allow much better understanding of building operations and consumption
- Continuous monitoring and commissioning now possible
- Opportunities for new types of energy efficiency programs and services based on dynamic data collection

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