Next Generation Energy Management Using Big Data & Predictive Analytics
Let’s run a thought experiment
Root3 introduces

**BALANCE**

Hourly operational recommendations for Central Energy Plants
Balance uses Big Data and Predictive Analytics

**Features**
- Nothing to install
- Balance automatically detects and corrects bad measurements
- RCx included
- Continuous monitoring of assets and people
- Closed loop or open loop system

**Data sources**
- Historical data
- Real-time data from BMS/EMS/DCS/Operator
- Plant schematics
- Operations rules and business rules
- Tariffs
- Weather data source
FS team is using Balance at University of Chicago Central Plants

**SCP – (2) 2500 ton each Chiller**

**SSP – (4) 150k lb/hr each Steam Boilers**

**WCCUP – (2) 250k lb/hr each Steam Boilers + (2) 2500 ton each chiller**

### Operators
- Receive hourly set-point recommendations for the next 24 hours and determine if they want to use it or not.
- Leave for continuity between shifts.
- See impact of actions, both for reliability and for cost of running the plant.

### Operations Managers
- Early warning system if loads are not going to be met
- Daily look-back with metrics on reliability, safety, consistency, and economics
- Up to 10 day look-ahead on reliability, safety, consistency, and economics

### Energy Managers
- Gets to understand if any operational hedging is possible
- Can keep an eye on what will happen over the next few days and decide best course for energy purchases
Opportunities discovered right after set up

Setup

▲ Protocol agnostic system
▲ Uses historical data to forecast loads for 10 days based on weather and other parameters
▲ Automatic calculation of efficiency curves across entire operating range for all assets (very different from manufacturer’s curves)
▲ Continuous energy cost calculation and tracking for entire Central Plant
▲ Optimum dispatch schedule generated hourly
▲ Early warning system acts as necessary

Balance-driven discoveries

▲ Various operational system deficiencies such as lack of condenser water reset program, boiler turndown not to the level previously thought, etc.
▲ Running more machines than is necessary and no consistency in operator actions for similar load levels
▲ Chillers surge at low-load conditions
▲ Auto switchover between chillers and HX not working as it should
▲ Bad utility meters
Operators take better decisions and save $$ using Balance

- Before Balance: $89
- Balance Pilot: $19
- Balance Off (1 month): $41
- Balance Off (3 months): $65
- Balance On (Last 5 months): $9
Dynamic operational strategies instead of static ones

Predictive demand charge management led to more cost savings

Continuously updating MMBtu meter forecasted EOD
Projected Total

<table>
<thead>
<tr>
<th>West Plant Remaining MMBTU</th>
<th>Total Used (mmbtu)</th>
<th>Projected Total (mmbtu)</th>
<th>Current Peak (mmbtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3327</td>
<td>1172</td>
<td>4188</td>
</tr>
</tbody>
</table>

U Chicago Gas Demand Charge Management

- West Plant daily total
- West Plant Hard Limit
- Campus daily total
- West Plant - Root3 Balance max projected during day
- Root3 Balance Chat Window messages/hour
Continuous performance monitoring

Electricity Assets
Hourly from 05/01/2013 12:00 am to 05/28/2013 11:00 pm

Select Month: 05/01/2013 12:00 am