AABC Commissioning Group

AIA Provider Number 50111116

Automated Equipment Data Analytics to Detect Issues, Trends, Faults & Anomalies

Course Number: CXENERGY1633

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Course Description

Using real world examples, this presentation reviews the method of application and the capabilities of automated analytics for smart devices. The session shows how applying analytics to data from sensors, meters and building equipment systems enables operators to identify operational faults, deviations from expected performance, and opportunities for energy and cost savings.

Learning Objectives

At the end of the this course, participants will be able to:

1. Develop an understanding of the capabilities of analytics, and the viability of applying the technology to a wide range of remote equipment monitoring applications.

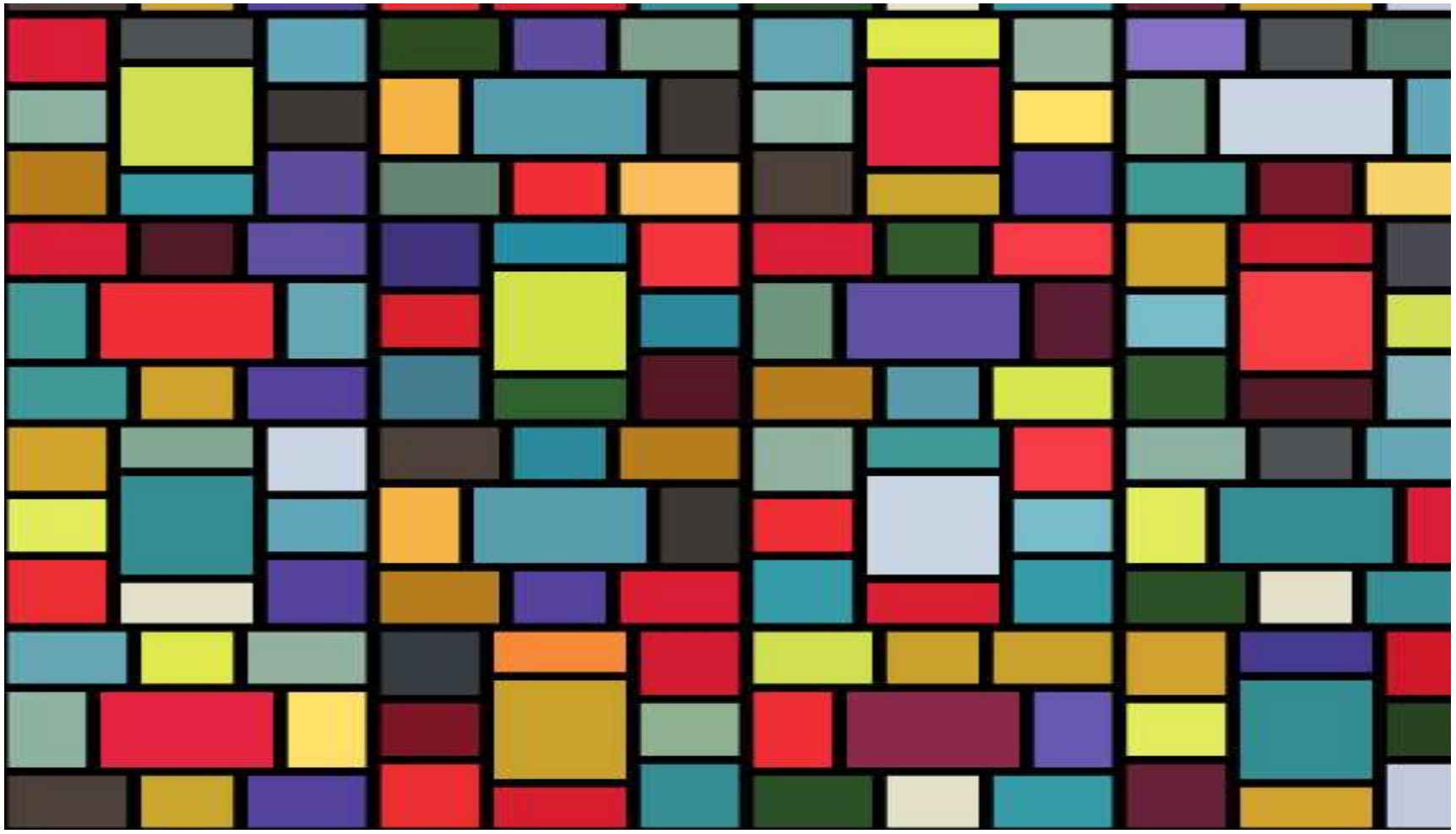
2. Understand the types of tools available on the market and, in particular, know the difference between “Analytics vs Alarms” and “Analysis vs Analytics.”

3. Learn how to manage and derive value from the exploding amount of data available from our smart and connected devices.

4. Learn to use analytics to identify operational faults, deviations from expected performance, and opportunities for energy and cost savings.

Data, data, data...what does it all mean to building owners and operators?

Data – Its the New Money



Simply put…we can create value by detecting patterns that represent faults, deviations, anomalies, and opportunities for savings

It starts with a simple question:

Do we know how our building systems really operate?

Why do we care?

- Reduce operating costs
- Meet regulatory requirements
- Increase asset value
- Increase cash flows
- Meet societal demands

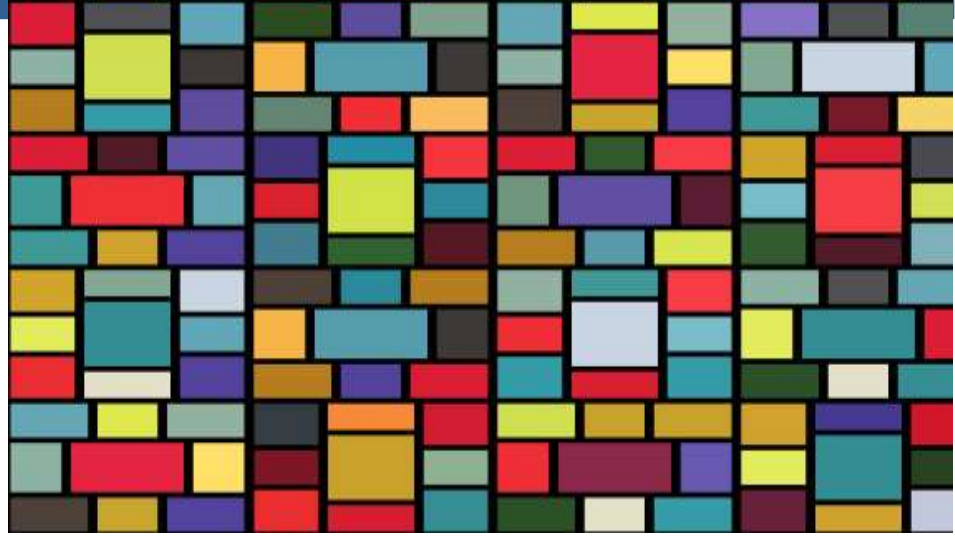
Studies continue to show that real estate owners see higher financial returns when they excel in energy efficiency and sustainability...

Data point:
"…research by the Carbon War Room found that each [1%] increase in a REIT's Global Real Estate Sustainability Benchmark (GRESB) score corresponded to a [1.3%] increase in its return on assets and an almost [3.5%] increase in return on equity."

Who's watching to make sure?

- Who verifies that what they are doing is right?
- *That control strategies were well designed?*
- *That assumptions were (are) correct?*
- *That equipment, sensors and other devices have not degraded*
- *That they are still running as expected… haven't been interfered with or overridden – a common problem*
- ***Too much data… systems too complex... not enough people***

Analytics is the Solution



- Analytics software automatically looks for “issues” in our data….
- Equipment faults, deviations from expected performance, actual results vs goals or benchmarks, etc
- *Unlike energy efficiency measures that involve the installation of major capital equipment, analytics can work with existing data sources –* ***including historical data***
- *Relatively easy to add to what we have*

The Bigger Picture: Analytics is changing our world…

British Gas Uses Analytics to Build Deeper Customer Relationships

Verizon: Creating their own upturn
Verizon unleashes the power of analytics to transform customer relationships and generate growth.

How Durham, N.C. fights crime with data – and wins
http://smartcitiescouncil.com/article/how-durham-nc-fights-crime-data-%E2%80%93-and-wins

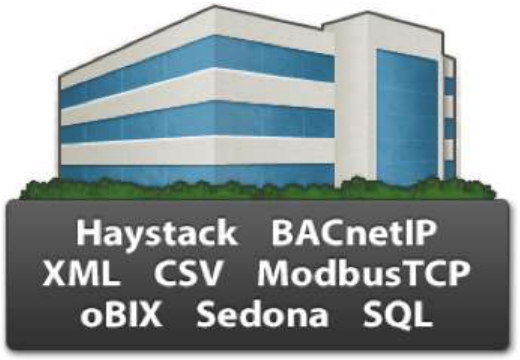
Preventing Crime with Analytics: The Memphis Police Department
Posted by Amy DeWolf on July 16, 2012 at 1:09pm in Analytics to Outcomes
Back to Analytics to Outcomes Discussions

Fighting Crime Using Geospatial Analytics
By Dale Peet, Senior Industry Consultant, SAS Institute, Cary, North Carolina; and Commander (Retired), Michigan Intelligence Operations Center

- **It can change our buildings too!**

Using web analytics to improve sales

Applying analytics to our buildings



BAS data

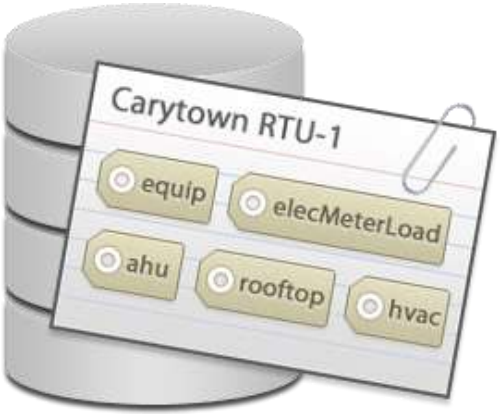
Facility data

Utility data

Weather data

Production data

Easy to get started – what data do you have?



Data can be "live" or historical

Results – Issues Detected

Connect to available data sources

Aggregate and normalize available data

Detect patterns that represent issues

The Result: Know what your systems are really doing

Examples of Real World Issues

- Simultaneous heating and cooling short cycling, lack of diversity control
- Deviation of energy intensity (kw/sq ft/degree day) from benchmarks, baselines, along with time, duration and cost
- Degradation of performance (i.e., unit runs but does not deliver expected cooling/heating)
- Economizers open while heating and cooling
- Non-functioning sensors (temp, kw, etc)
- Lights and other loads operating when they shouldn't – buildings starting early, running late
- ***Different Buildings Have Different Operating Characteristics***
- ***Analytics Need to be Tailored to Building System Design, Usage, Project Scope***

Example: Defective Pressure Sensor on a VAV Fan System

- Pitot tube sensor on VAV fan sensor was dirty
- Always reading a low value that resulted in the fan being commanded to 100% operation
- Comfort is fine. No alarms or complaints. But significant energy waste
- Resolved with 15 minutes of service – clean the sensor!

The Results

- After cleaning the pitot tubes there was a reduction of 250 kWh in first week! With a 52 week hospital year that is 13,000 kWh saved or at $0.10 a kWh $1,300 in savings from about 15 minutes of cleaning (**pretty good payback !!!**)
- Analytics quickly calculates and report savings from simple PM measures that would normally require metering or a measurement and verification process

Lots of Tools – Where Do Analytics Fit?

- As building operators you are faced with a deluge of products that may help you
- Categorizing can help sort through the noise
- Lets Look at Data-oriented Tools and Key Concepts:
  - Alarms
  - Analysis Tools
  - Fault Detection & Diagnosis
  - Analytics
  - Time series data – from interval energy data to real-time equipment data

Analytics vs Alarms

vs **Analytics**

- An alarm is when you are on the gurney in the ER
  Analytics are the lab tests you take every year to stay out of the ER
- Alarms require that you fully understand the issue ahead of time so you could set them up – have to be pre-programmed
  Analytics find patterns & issues you couldn't have foreseen
  Can be added at anytime
- Controller-based alarms deal with control system data
  Analytics combine operational, energy, production, facility and corporate data to show patterns and correlations across your portfolio of device data
  - Correlation examples – equipment type, age, material, vendor, weather effects, production factors, etc

Analytics vs Alarms

vs **Analytics**

- An alarm is a value compared to a limit “now”
  Analytics look at patterns or signatures in the data – and can include multiple data sets from different systems
- Alarms require “touching” the end device programming
  Analytics allows you to add rules as your understanding increases WITHOUT modifying the end device
- Alarms often “cascade” overwhelming operators
  Analytics can often replace majority of non-productive alarms – better explain what is happening and why

Analysis Tools

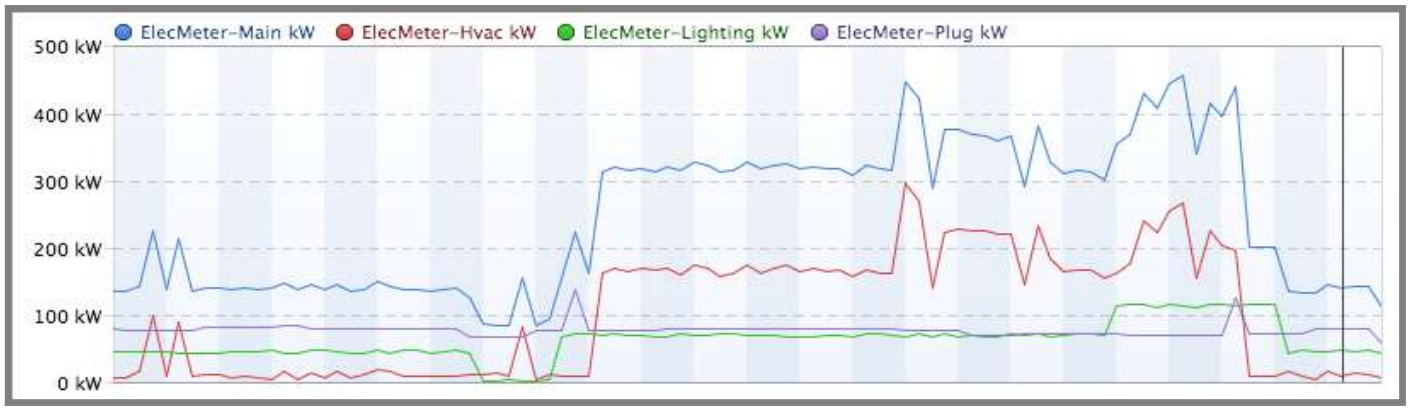
- **Analysis Tools** – software used to analyze data such as energy meter data.
- Provide an experienced user with the ability to look at data graphically and slice and dice it with a range of tools to identify peaks, and anomalies, and perform normalization against weather, building size, baseline data and other factors.
- Requires a knowledgeable user to run the tool and interpret the charts and graphs to identify the important issues
- The human is an essential part of the analysis

Analytics

- Analytics – **automatically** crunches through data to find the issues and report them to operators
- The human doesn't need to do the analysis – analytics can even auto generate work orders
- Analytics go beyond predefined conditions – ***expose things you were not expecting***
- A better solution for many alarms where cross referencing of information is essential. Example: lights & temps with schedules that change!!!
- **Compared to analysis tools, the difference is that analytics continuously processes data to look for issue/patterns and then automatically provides results to operators**

Analysis vs Analytics

- **An analysis**: Generate a graph of energy consumption across a specific time. A user would then look to discern patterns, such as peaks or toughs and their duration



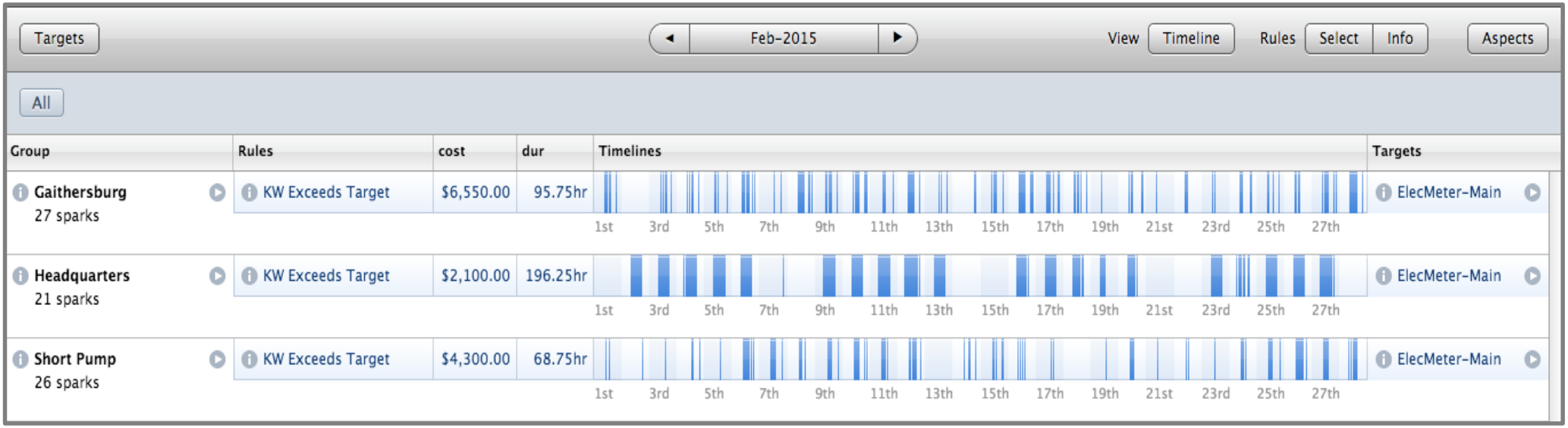
- **Analytics Example**: <u>Automatically correlate</u> equipment operating status with energy consumption across a specific period of time. This enables users to see how equipment operation influences energy consumption patterns

Analytics vs Alarms

A Typical Alarm: Detect KW above a specified limit in real time

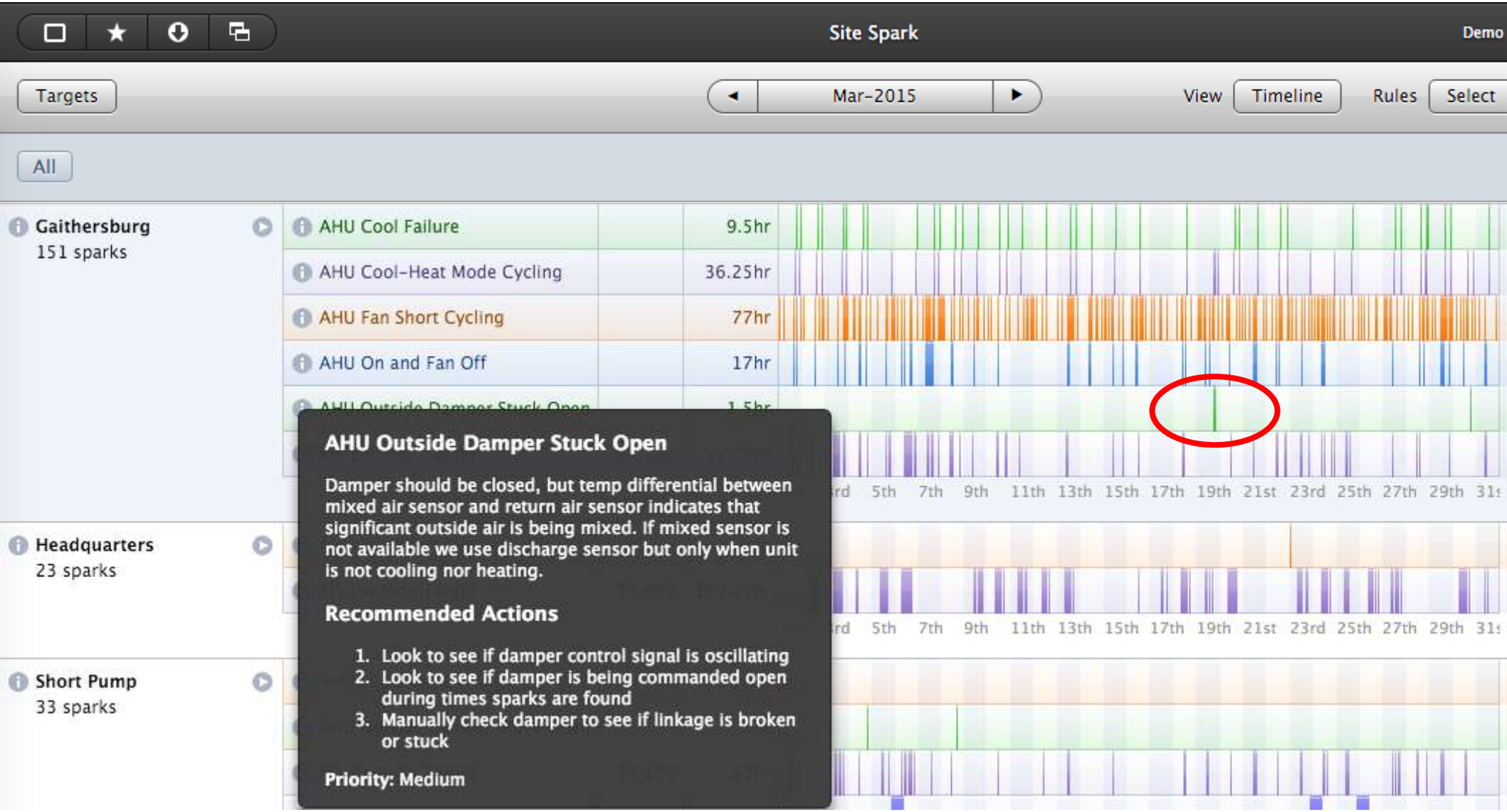
Analytic rule: Identify periods of time KW demand is above a specified KW limit across any user-selected time frame. Calculate cost impact, generate reports showing duration, frequency and cost of the issue. Provide continuous real time processing of the rule as new KW data is received

Analytics can run against historical data – it doesn't require a live data feed. Makes it a great tool for commissioning and off-line studies of existing data



The view above shows periods of time when demand exceeded 400KW, along with duration, and cost, per site for the month of Feb 2015

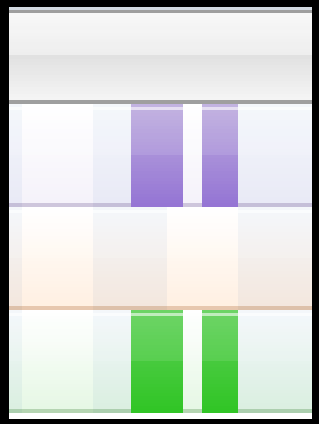
Lets Look at Another Analytics Example



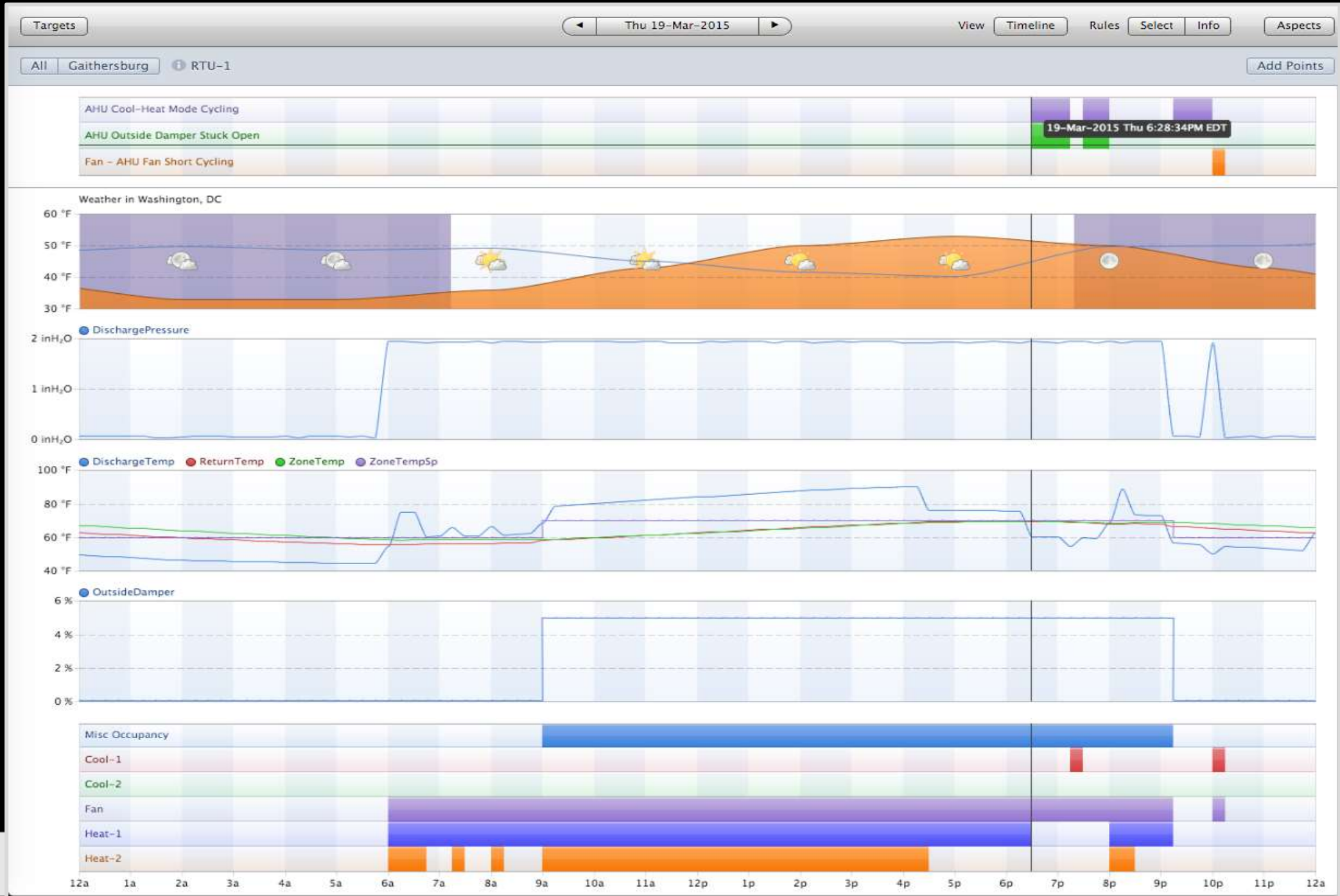
Drilling In on Our Example

The timeline visualization shows us:

- Time of occurrence
- Duration
- Correlation

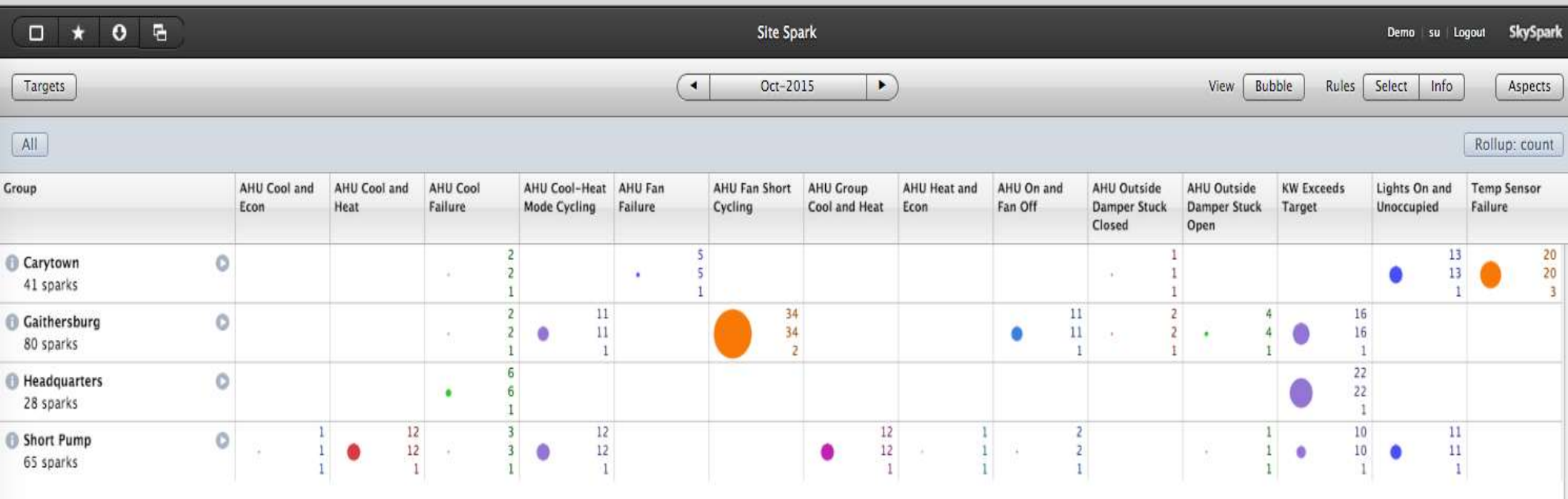


Full Details on the Issue



Other Views Provide Summary Information

- Bubble charts show:
  - What issues we are having
  - How often they occur
  - How long they last
  - How much they cost



Turning Data into Money – The Last Mile

- To get value from data analytics organizations need to be prepared to act on the results
- If I could walk into your building and magically detect 100 problems could you address them?
- How quickly? What if they require capital $
- What if they would exceed your planned budget?
- Even if they had a 1 month payback?

This All Sounds Great – What Are the Challenges?

- Accessing your data:
  - What data do you have?
  - Where is it?
  - How will you connect?
  - Will you need to add devices to connect to the data?
  - How well documented is it?
    - Is it your project so you know your way around the data?
  - What is the scope of your project
    - You could just do meters or dig into HVAC equipment
  - What rules, KPIs' and Reports fit your facility and project needs?

Getting Started

- No need to start “BIG”
- The goal is not to do a science project – the goal is to generate financial return
- Get the most easily accessible data that you can drive value from quickly...
- You can start with something as simple as interval meter energy data and expected schedules
- What data do you have?

Getting Started

- Numerous providers offering different approaches...
- ...From Analytics as a Service – a consulting model, to...
- ...On-premise tools for use by internal energy managers and facilities staffs
- Which fits your business best?
- What type of internal talent and resources do you have?

Summary – Analytic Value Propositions for Facility and Energy Managers

- An ever present expert watching the operation of your assets – know how your building systems are actually operating
- Smart exception reporting, continuous monitoring & continuous commissioning
- Cross referencing eliminates many wasted alarms and notifications
- Validate against industry benchmarks and internal goals
- Supports M&V, Portfolio assessment & regulatory reporting requirements
- Provides information to support the budgeting process and priority selection, & expense justification
- Driving energy efficiency and cost reduction through data is proven
- Numerous examples of savings in the range of 5 – 30% often with ROI < 1 year
- You need to be prepared to act on analytic findings

This concludes The American Institute of Architects Continuing Education Systems Course

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Come see us in the booth!