



AUGUST 21-23, 2018 • CLEVELAND, OHIO

# Learning What Works: Energy Data Management

Thursday, August 23<sup>rd</sup>, 2018 from 2:00 to 3:30 PM

Room 19



# Panelists

Adam Jacobs

Energy Manager  
City of Boston



Mark Campbell

Director of Sustainable Facilities  
MGM Resorts International



David Reid

Senior Manager  
Global Energy and Productivity  
Celanese Corporation



Adam Guzzo (Moderator)

Advisor  
U.S. Department of Energy  
Office of Energy Efficiency & Renewable Energy  
Weatherization & Intergovernmental Programs Office



# Adam Guzzo, Department of Energy

# The Value Proposition for Energy Data Management

- Set realistic and achievable goals
- Improve control of energy budgets
- Track and verify progress
- Identify energy and cost saving opportunities
- Cut energy waste
- Save money/taxpayer dollars
- Demonstrate leadership
- Increase the efficiency of operations
- Create a culture of accountability and high performance
- Communicate results and receive recognition

Take control of your energy data in seven steps!

Get Started

Use the Energy Data Management Guide's step-by-step approach to establish a robust and sustainable energy data management program in your state, local government, or school district.

Access the guide's:

- Proven strategies with demonstrated, portfolio-wide energy savings
- Data management tools and resources
- Customizable templates and worksheets
- Relevant examples and case studies.

Learn more [about the guide](#).

## Step-by-Step Process

You're only seven steps away from taking control of your energy data.

### Generate Buy-In

- 1 Define the Merits of Tracking Energy Data
- 2 Align with Organizational Goals

### Build a Solid Foundation

- 3 Create a Central Database
- 4 Streamline Access to Data
- 5 Leverage Data Management Tools

### Hardwire Energy Management

- 6 Optimize the Organizational Structure
- 7 Drive Engagement and Communicate Results

# Mark Campbell, MGM Resorts International



# Energy Data Management at MGM

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Better Buildings Summit  
August 23, 2018

Mark Campbell  
Director of Sustainable Facilities

# MGM RESORTS INTERNATIONAL



- 28 Unique hotel offerings
- 740 Acres on the Las Vegas Strip
- 48,000 Total guest rooms and suites
- 400+ Restaurants
- 78,000+ Employees
- 3 Million sq. ft. of convention space

**Annual Domestic  
Energy Consumption:  
Over 1.1 Million MWh**

# Outline

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- Energy data management, analytics, and applications at MGM
- My Green Advantage program to educate employees
- Embedding sustainability & continuous improvement into culture



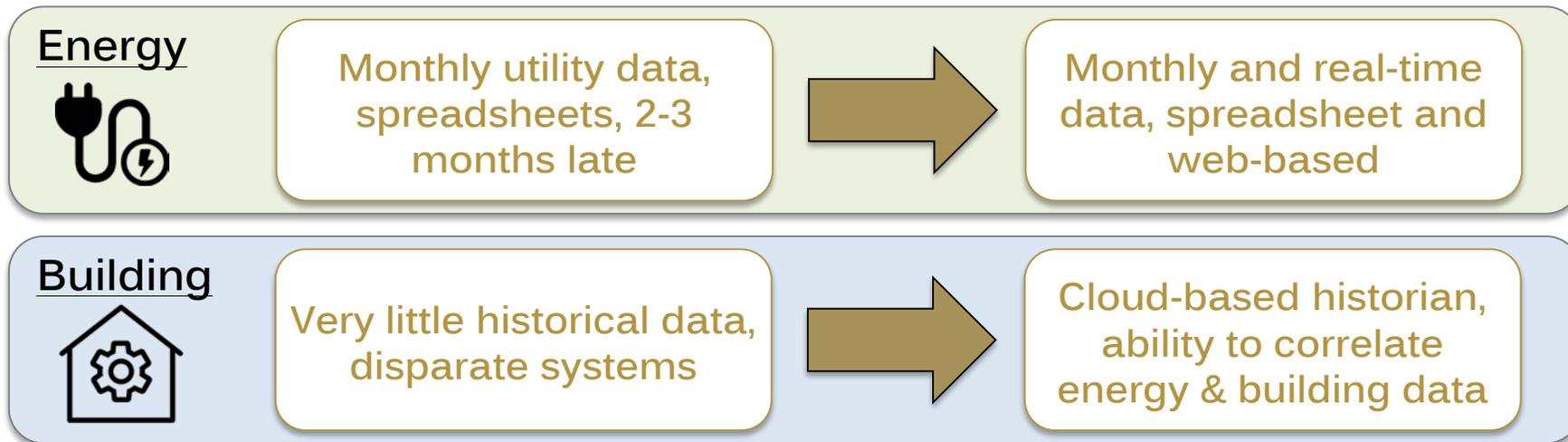
# Ambition for Energy Data Management

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- ❑ Goal: Offer the leading guest experience while using as little energy as possible (and drive a little healthy competition)
- ❑ Corporate Sustainability Division (CSD) responsible for **collecting, processing, and distributing** a range of data to property teams
  - ❑ E.g., electric & gas utilities, sub-metered electricity, flow, temperature, etc.

## UPGRADING DATA MANAGEMENT TO DELIVER ON AMBITION

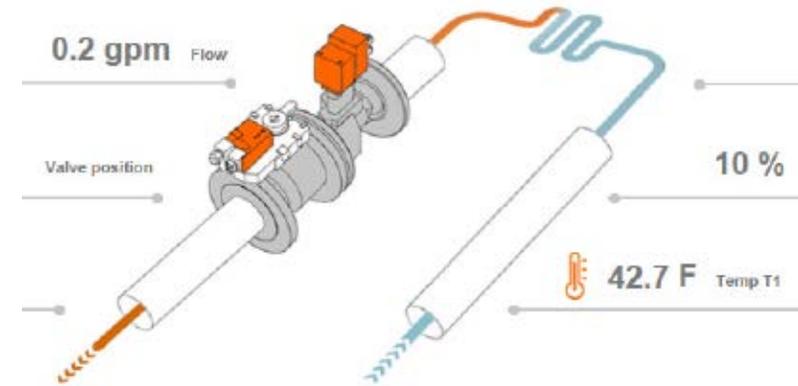
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# Energy Data Management

## DATA DRIVES PROJECTS, THEN AND NOW

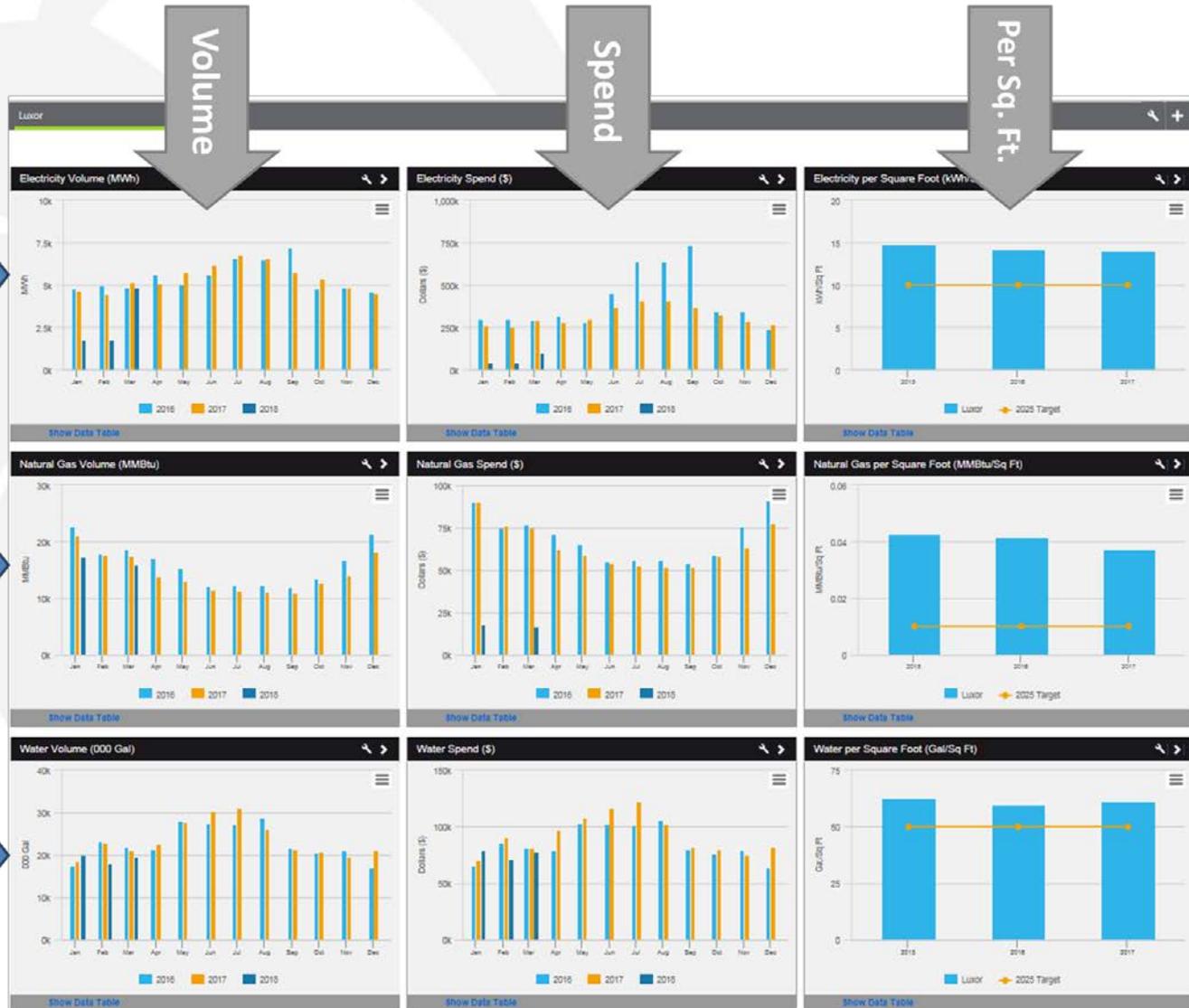
- ❑ Conduct internal **measurement & verification** and case studies on successful projects
- ❑ **Evaluate chillers against factory specifications** to ensure proper functioning from manufacturer property
- ❑ **Deliver energy and building data to facility operators** at regular cadence



*Pressure independent control valve & data*



# Snapshot: Whole Building Energy & Water Data



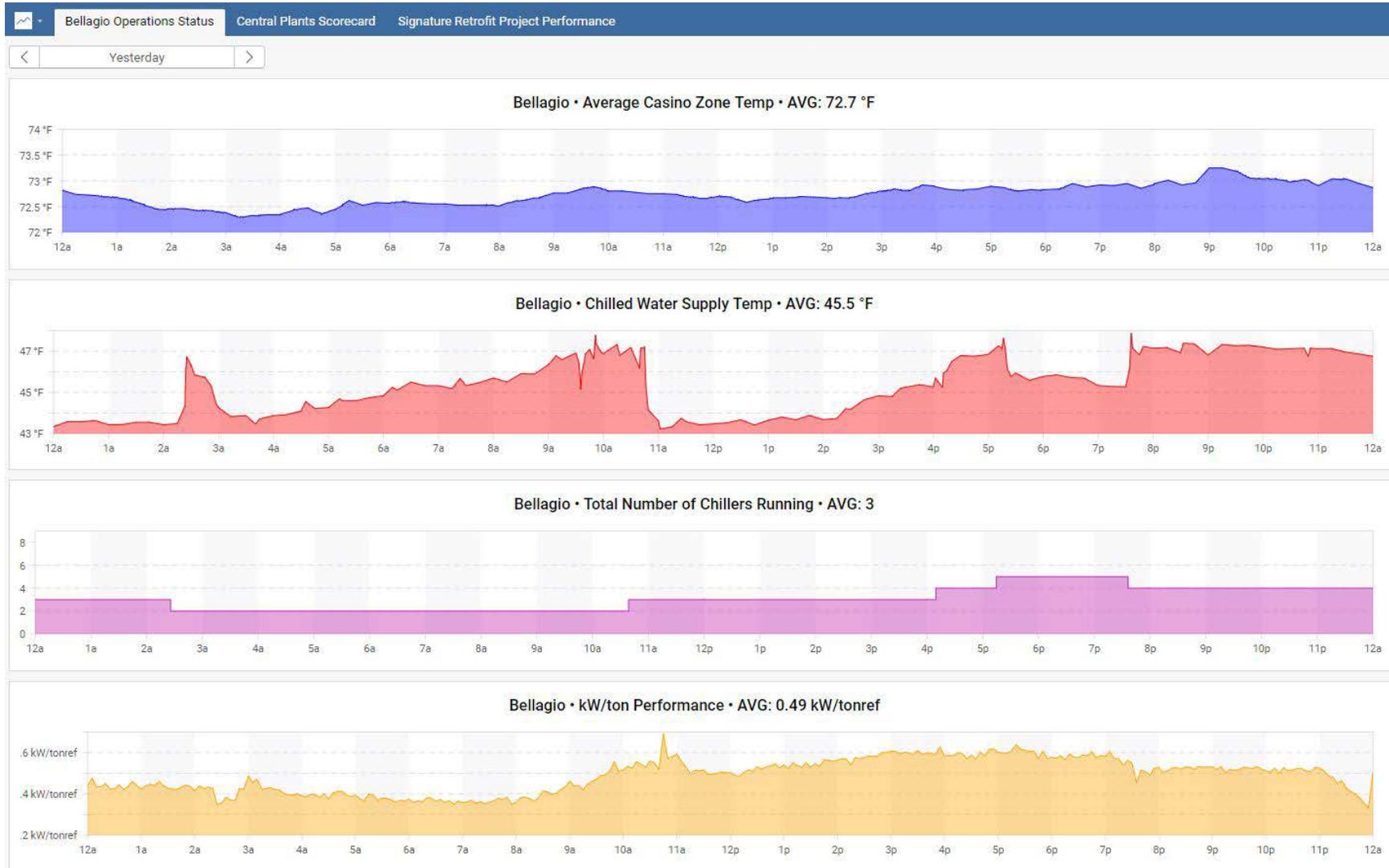
Electricity

Natural Gas

Water

- Utility bill review
- Historical data from 2010 onward
- Dashboard format

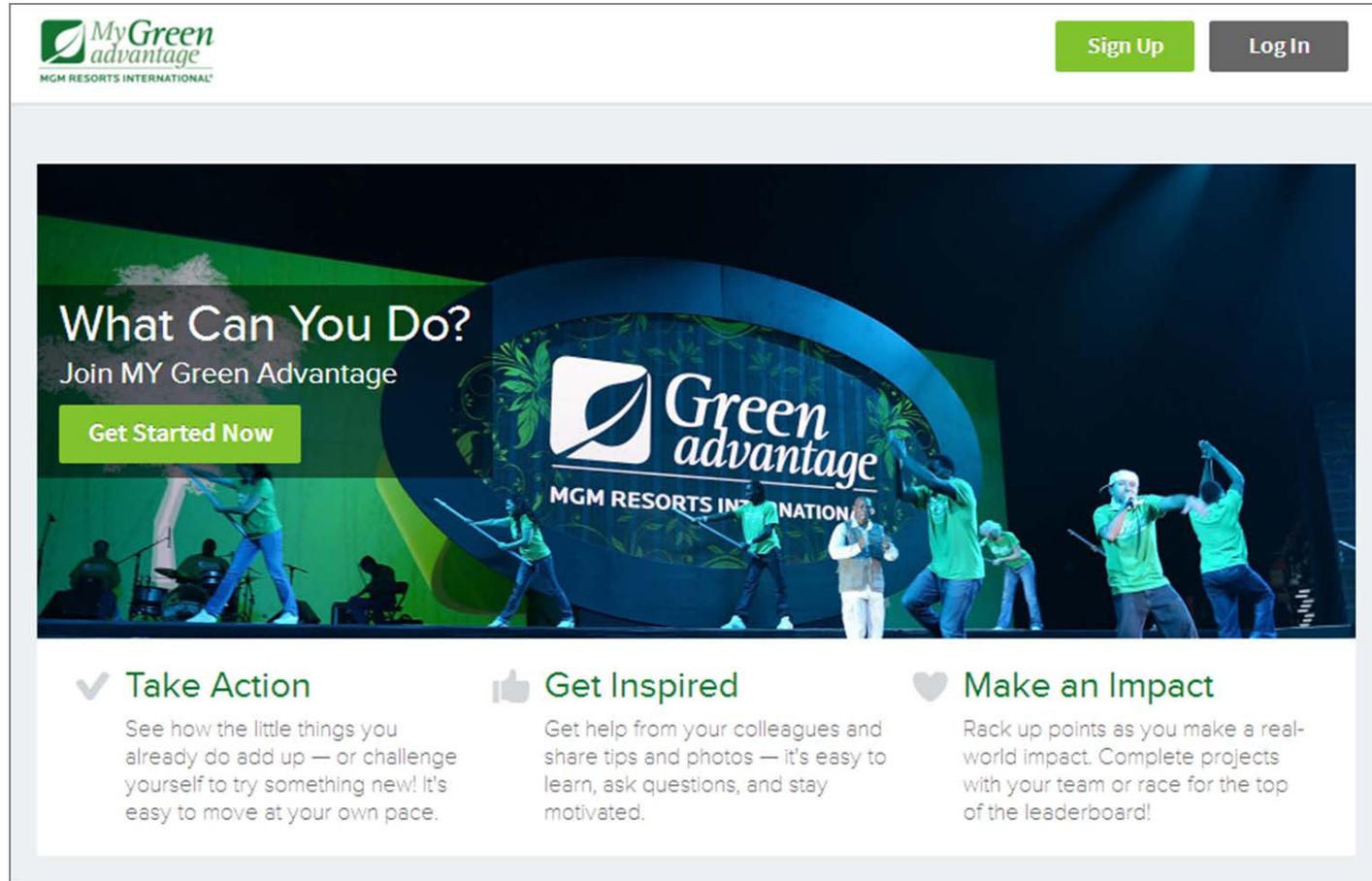
# Snapshot: Energy & Building Metrics



# Reporting on Energy & Building Data

Audience	Annually	Quarterly	Monthly	Weekly	Daily	Immediately
Senior Management						
VP Facilities			 			
Director / Manager			 			
Engineer						

# MGM My Green Advantage



The screenshot shows the top of the website with the 'My Green advantage' logo and 'MGM RESORTS INTERNATIONAL' text on the left. On the right, there are 'Sign Up' and 'Log In' buttons. Below the navigation is a large banner image of a band performing on stage. The banner contains the text 'What Can You Do? Join MY Green Advantage' and a 'Get Started Now' button. Below the banner are three columns of content:

- ✓ Take Action**  
See how the little things you already do add up — or challenge yourself to try something new! It's easy to move at your own pace.
- 👍 Get Inspired**  
Get help from your colleagues and share tips and photos — it's easy to learn, ask questions, and stay motivated.
- ♥ Make an Impact**  
Rack up points as you make a real-world impact. Complete projects with your team or race for the top of the leaderboard!



# MGM My Green Advantage



# Embedding Sustainability into Company Culture

## ACTIVATING OUR EMPLOYEE BASE

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- ❑ Employees at every level encouraged to submit ideas for all areas of MGM's operations
- ❑ Energy & water management programs instituted to inform staff, create teams, set roles and share best practices
- ❑ Lessons learned and data-driven insights inform continuous improvement projects

*"Not everything that counts can be counted, and not everything that can be counted counts."*

## ENGAGING LEADERSHIP

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- ❑ MGM leadership sets ambitious annual goals for properties focused on energy efficiency
- ❑ Progress toward these goals is tracked, reported, and tied to bonuses



*2017 Goal of installing over 1 million LEDs  
(now 1.4 million)*

**Adam Jacobs, City of Boston**

# Energy Data Management

City of Boston, Environment Department  
Adam Jacobs, Energy Manager



# Intro: Boston's Municipal Government Energy Use

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67,000 Street Lights  
(11%)



3,500 Fleet Vehicles  
(24%)



315 Buildings  
(65%)



# Energy Data - *the bill*

**EVERSOURCE**

21 80 2719 856 9991 H

COB-PROP MGMT/CITY HLL SQ  
 AUDITING  
 CITY HALL PLAZA  
 BOSTON MA 02201-0001

NO  
 PAYMENT  
 NECESSARY

Electric

Please allow 7-10 business days for your payment to post. 9

STATEMENT ACCOUNT 2719-856-9991

ACCOUNT NUMBER	BILLING DATE	NEXT READ DATE
2643 214 1005	JAN 2, 2018	JAN 31, 2018

SERVICE PROVIDED TO  
 COB-PROP MGMT/CITY HLL SQ  
 1 CITY-HALL SQ  
 BOSTON MA 02201

ACCOUNT SUMMARY	
PREVIOUS BILL	-27,555.92
PAYMENT - THANK YOU	-58,927.87
PRIOR BALANCE	-86,483.79
CURRENT DELIVERY CHARGES	62,672.30
OTHER CHARGES/CREDITS	-288.10
<b>CREDIT BALANCE</b>	<b>- \$24,099.59</b>

**ELECTRICITY USED**

RATE B7-NEMA LG GENERAL TOU  
 METER 5116812

CONSTANT 400

NOV 30, 2017 - DEC 29, 2017  
 29 DAY BILLED USE 1,145,720

USE COMBINED FROM MULTIPLE METERS

CURRENT ELECTRIC CHARGES	
(SEE DETAIL PAGE)	62,672.30
OTHER CHARGES AND CREDITS	
TRANSFER AMOUNT	-503.10
ENERGY LINK SVC CHARGE	215.00
<b>TOTAL OTHER CREDITS</b>	<b>-288.10</b>

## Available Data

- Location
- Rate class/tariff
- Consumption
- Demand

## Uses

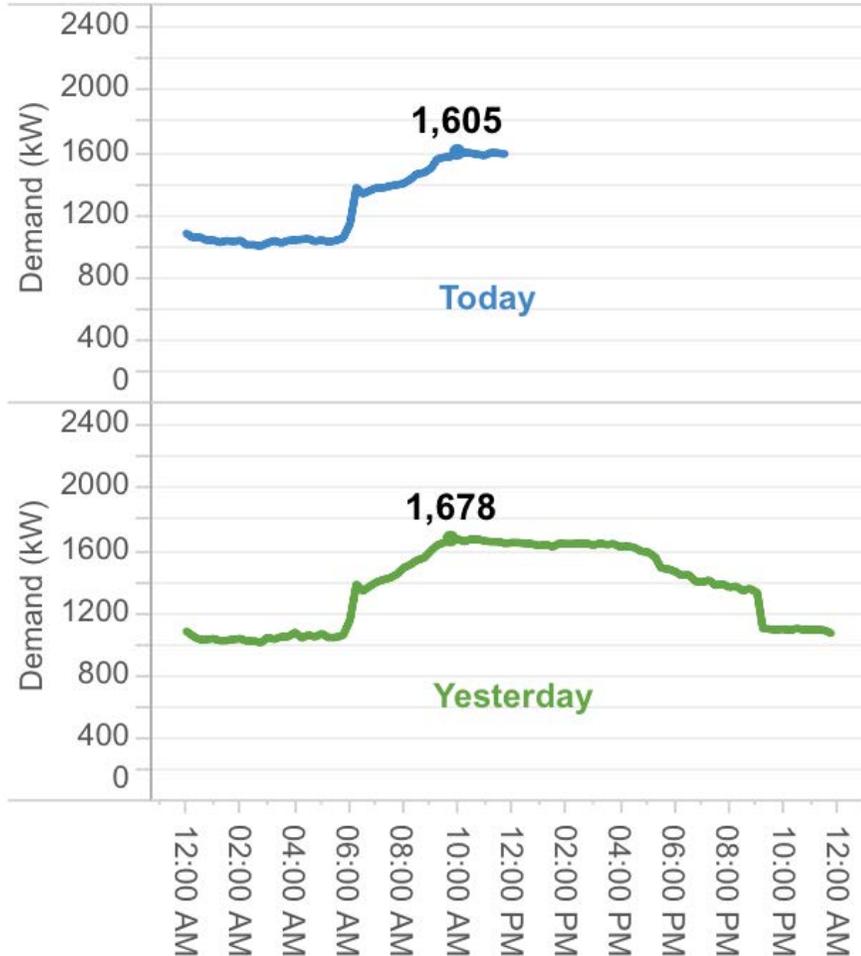
- Budgeting
- Energy Performance
- Emissions Reporting



# Energy Data – Time of Use (TOU) meters



City Hall - Electric Load



## Sources

- Utility TOU meters
- 3rd party meters

## Available Data

- Demand (kW)
- Consumption (kWh)

## Uses

- Building Scheduling
- Energy Savings M&V
- Demand Response
- More Budgeting!



# Boston's Implementation and Results

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**Bills** - Verified for accuracy by 3rd party before payment

- Cost = \$250k ( 3yr contract)
- Savings = \$1.3 million in credits recovered from utilities

**TOU** - data internally cataloged/displayed with help of city's IT dept

- Cost = internal staff time, existing dashboarding tool
- Savings = ~\$430k
  - \$200k reduced 3rd party vendor costs
  - \$180k demand response revenues and capacity tag avoidance
  - \$50k from building scheduling

# Tips for Solution Development

## Utility billing data

- A simple, searchable tool
- Utility data is messy...trying to clean it up can make things worse
- Give vendors original data, not derivative sets
  - For Energy Star - do the opposite!

## TOU Meter Data

- Vary solution to meet needs/abilities of staff
- Make it easily accessible
- Some education required



# Tips for Procurement

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## Software as a Service (SaaS)

- Vendor *is* a partner, an extension of your staff
- Vendor *is not* a silver bullet

## Existing Tools / In-house?

- Don't buy new things if you don't have to
- Does your organization's IT department have an existing BI tool?
  - Examples - Tableau, Parisclope, SAP, Google

## Data Ownership

- Ensure you have complete ownership (and backup) of all data in externally hosted SaaS products, and put it in the contract!

# Open Data and Transparency



Home > Datasets

- ORGANIZATIONS
- Environment Department (5)
- Department of Innovation and Technology (2)
- Boston Maps (1)
- TOPICS
- Environment (3)
- Public Property (2)
- Facilities (2)
- Geospatial (1)
- TAGS
- FORMATS
- LICENSES

energy

## 8 DATASETS FOUND FOR "ENERGY"

ORDER BY: Last Modified



### Central Library Electricity Usage

Electric power load at Boston Public Library's Central Branch (700 Boylston Street, in Copley Square) measured every five minutes.  
Modified on March 30, 2018  
606 total views

CSV



### City Hall Electricity Usage

Electric power load at City Hall (1 City Hall Square) measured every 15 minutes.  
Modified on March 30, 2018  
385 total views

CSV



### City of Boston Utility Data

Monthly utility data for all City of Boston accounts. This data comes from Boston's Enterprise Energy Management System. This software tool serves as the system of record for...  
Modified on March 25, 2018  
265 total views

CSV PDF



### Greenhouse Gas Emissions

This dataset represents the annual greenhouse gas emissions produced by the City of Boston from 2005 to 2015. The annual inventory is based on a combination of direct data and...  
Modified on February 8, 2018  
143 total views

A photograph of the Boston skyline, including the Prudential Center and the Hancock Tower, viewed from a park area with trees and a body of water. The image is overlaid with a semi-transparent blue filter.

# THANK YOU

Adam Jacobs - Energy Manager  
City of Boston  
[adam.jacobs@boston.gov](mailto:adam.jacobs@boston.gov)

The logo for the City of Boston, featuring a white letter 'B' on a black square background with a red horizontal bar at the bottom.

**B**

# David Reid, Celanese Corporation

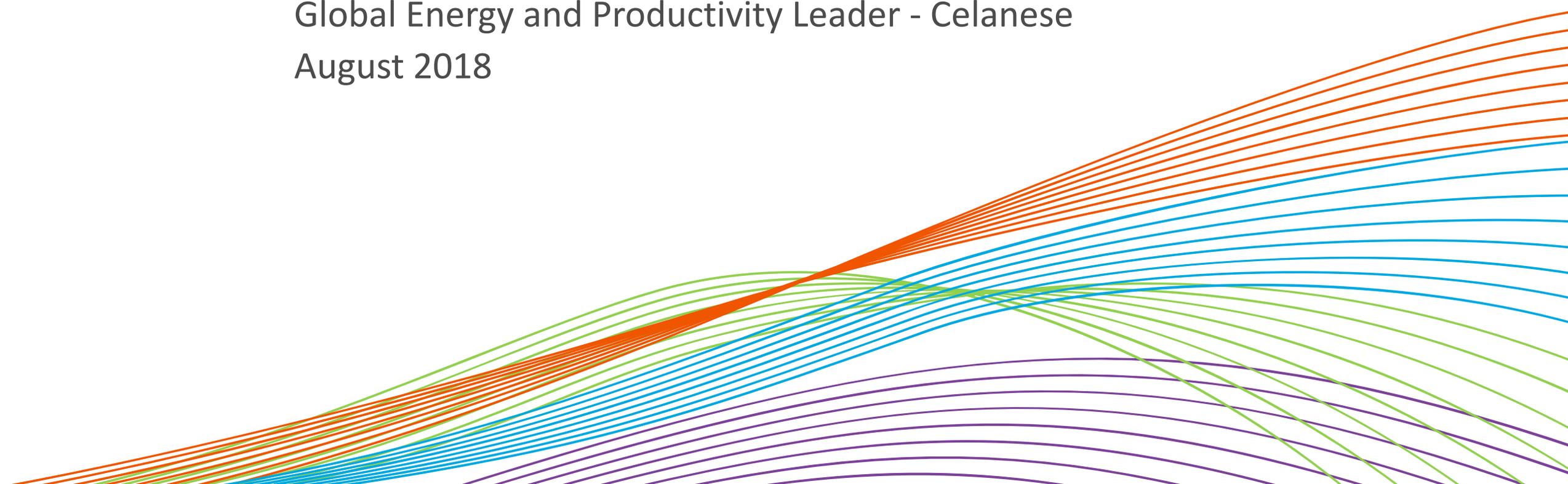
# Strategies In Energy Data Management

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David Reid P.Eng, CEM

Global Energy and Productivity Leader - Celanese

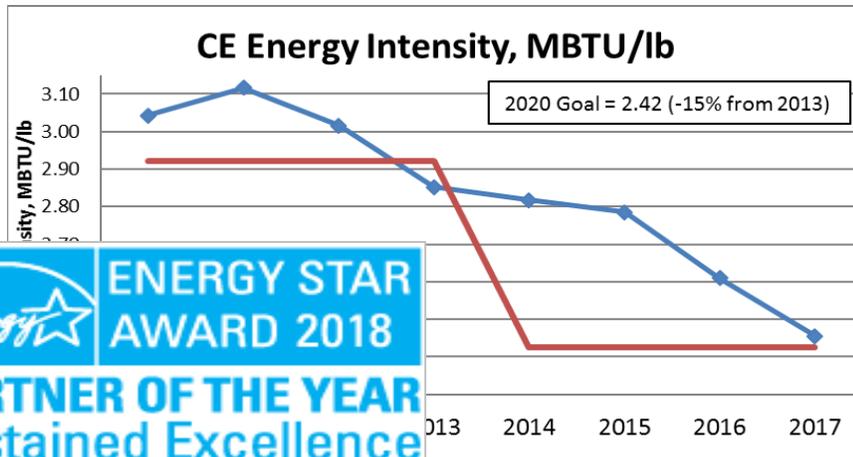
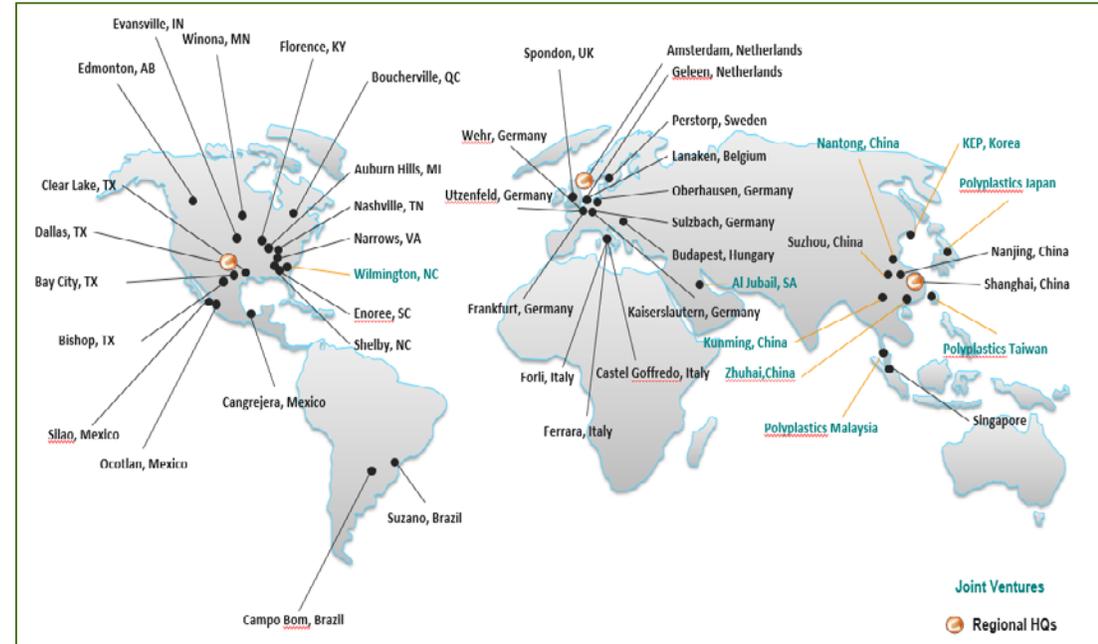
August 2018



# Celanese Corporation

We are a global technology and specialty materials company that engineers and manufactures a variety of products essential to everyday living.

- ~7,700 employees
- 42 global manufacturing facilities
- \$6.1 billion in net sales in 2017
- Global headquarters in Dallas, Texas, USA
- Number 455 on the 2017 Fortune 500 list
- Innovation is at the core of our business
- Differentiated business model



**Engineered Materials**  
\$2.88 BILLION  
NET SALES

Leverages **chemistry**, **material science** and **applications** based on **customer relationships** and **insight** to create unique solutions and value

**Acetyl Chain**  
\$3.37 BILLION  
NET SALES

Leverages **technology**, our **global production network** and a deep understanding of **global trade flows** to create value



## We All Have A Lot Of Energy Data

There were 5 exabytes of information created between the dawn of civilization through 2003, but that much information is now created every 2 days

Is It Important / Usable?  
 What Did We Do With It?  
 Eric Schmidt (Google) 2010

**“We’re Drowning In Data, But Starving For Information!”**

- ▶ It is a capital mistake to theorize before one has data. Insensibly, one begins to twist the facts to suit theories, instead of theories to suit facts.” – *Sherlock Holmes - Sir A. C. Doyle*
- ▶ “If we have data, let’s look at data. If all we have are opinions, let’s go with mine.” – *Jim Barksdale*
- ▶ We cannot solve our problems with the same thinking we used when we created them - *Einstein*
- ▶ “Somewhere, something incredible is waiting to be known” *Carl Sagan*



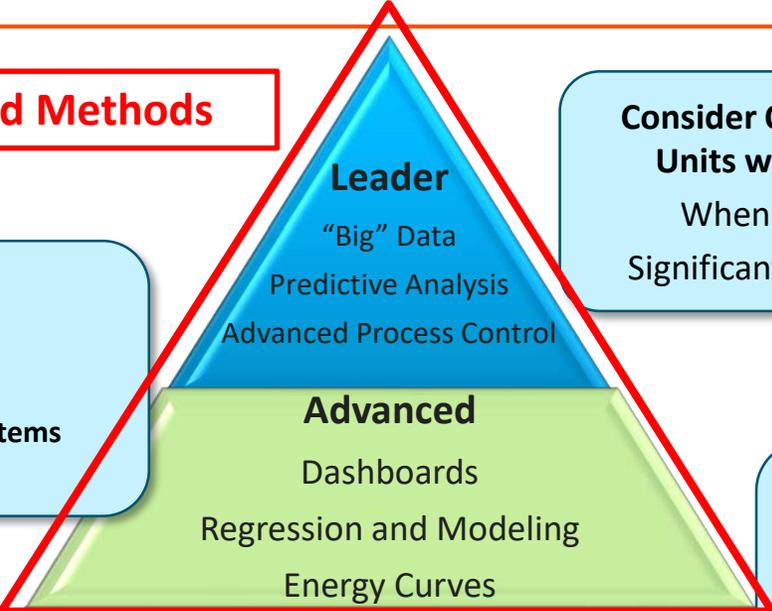
**“Without data,  
you're just another  
person with an  
opinion.”**  
~W. Edwards Deming

**Data Driven Analysis → Sustainable Results**

**Enhanced Methods**

**Consider Only for Most Critical Business Units with Significant Energy Spend**  
When Other Methods Exhausted  
Significant Business Benefit Justification

**Complex interactions**  
**Operations Engagement**  
Drive energy to the equipment owner level  
**Build Models And Advanced Controls Into Systems**  
Sustainability, Automation, Response Consistency



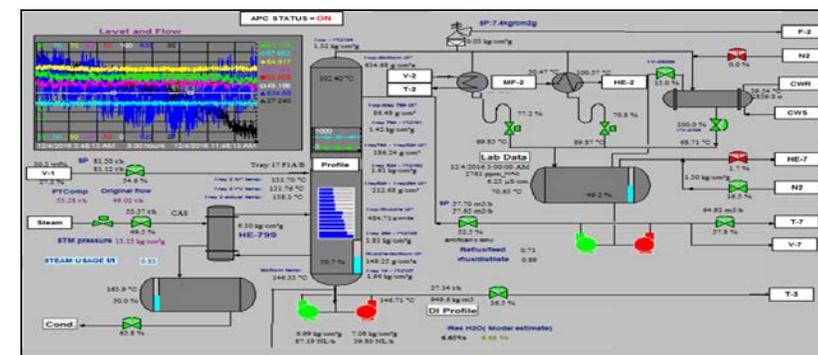
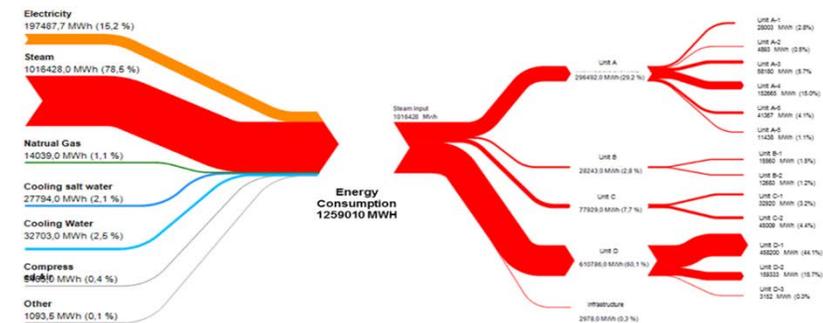
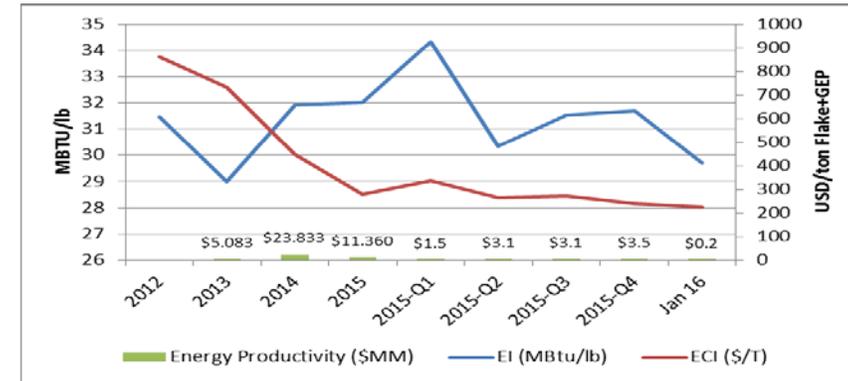
**Prioritize Most Important**  
Effective implementation with limited resources and capital  
**Continuous Improvement**  
Transition from reactive to proactive and develops improved process knowledge

**Blocking and Tackling**  
Effective programs for basic activities  
Foundational Understanding of Energy Use

- ▶ **Analysis Level?**
- ▶ **Resources?**
- ▶ **Value?**

**Strategy Aligned with Operating Context**

- ▶ **Simple Metrics and KPIs**
  - High level energy data (energy usage, energy intensity and energy cost)
  - Trending for directional indications
- ▶ **Energy Balance**
  - Detailed information into where energy is being used
  - Accounting for all the energy
- ▶ **Process Control**
  - Metering and process instrumentation (temperatures, flows and pressures)
  - Process control, alarms and historian systems

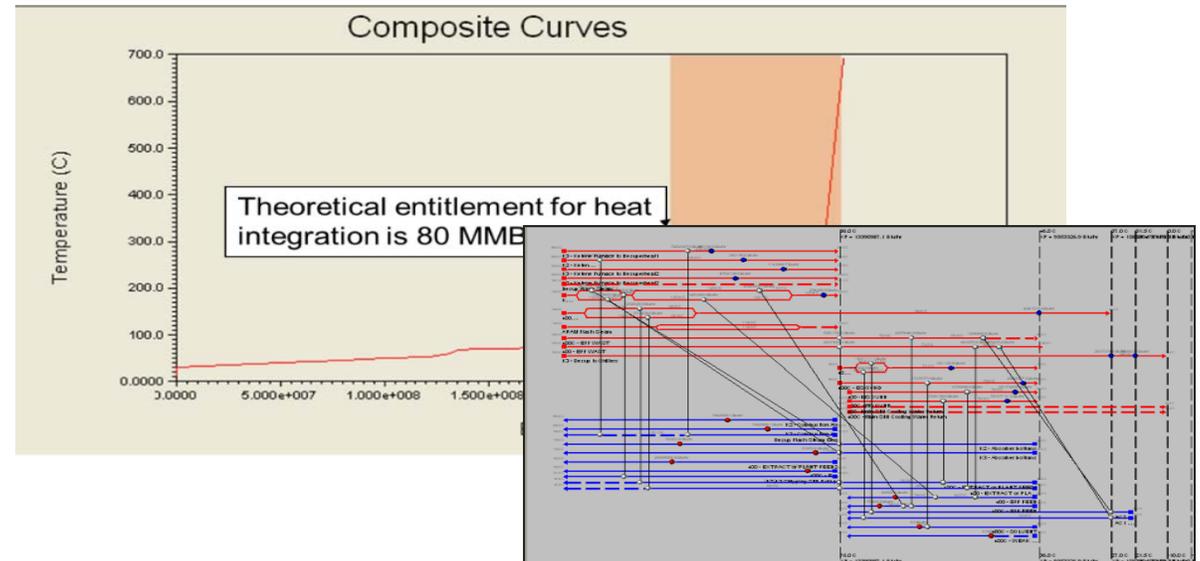
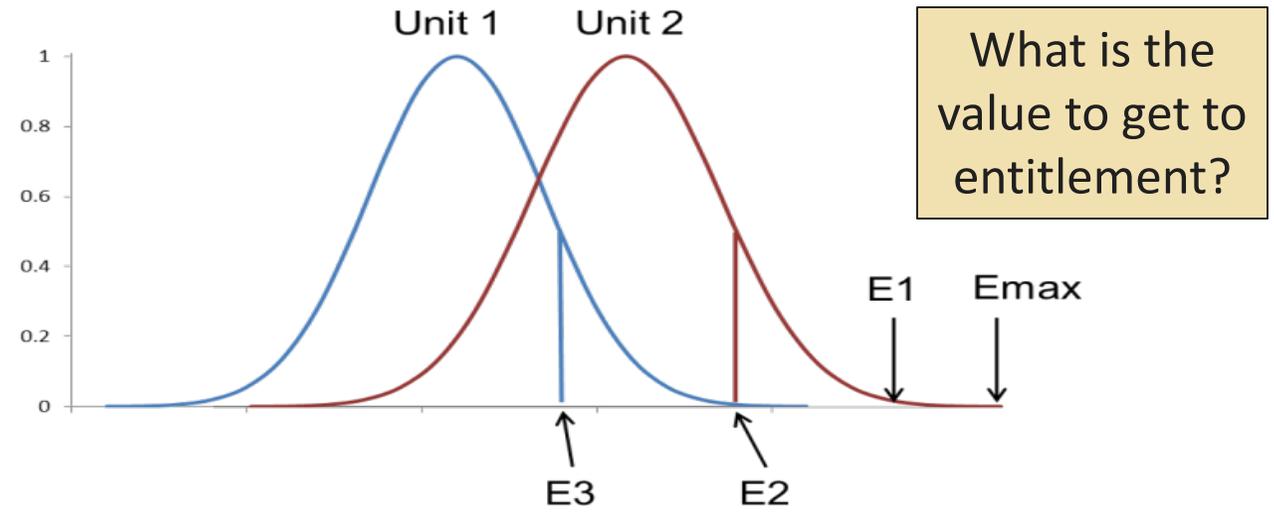


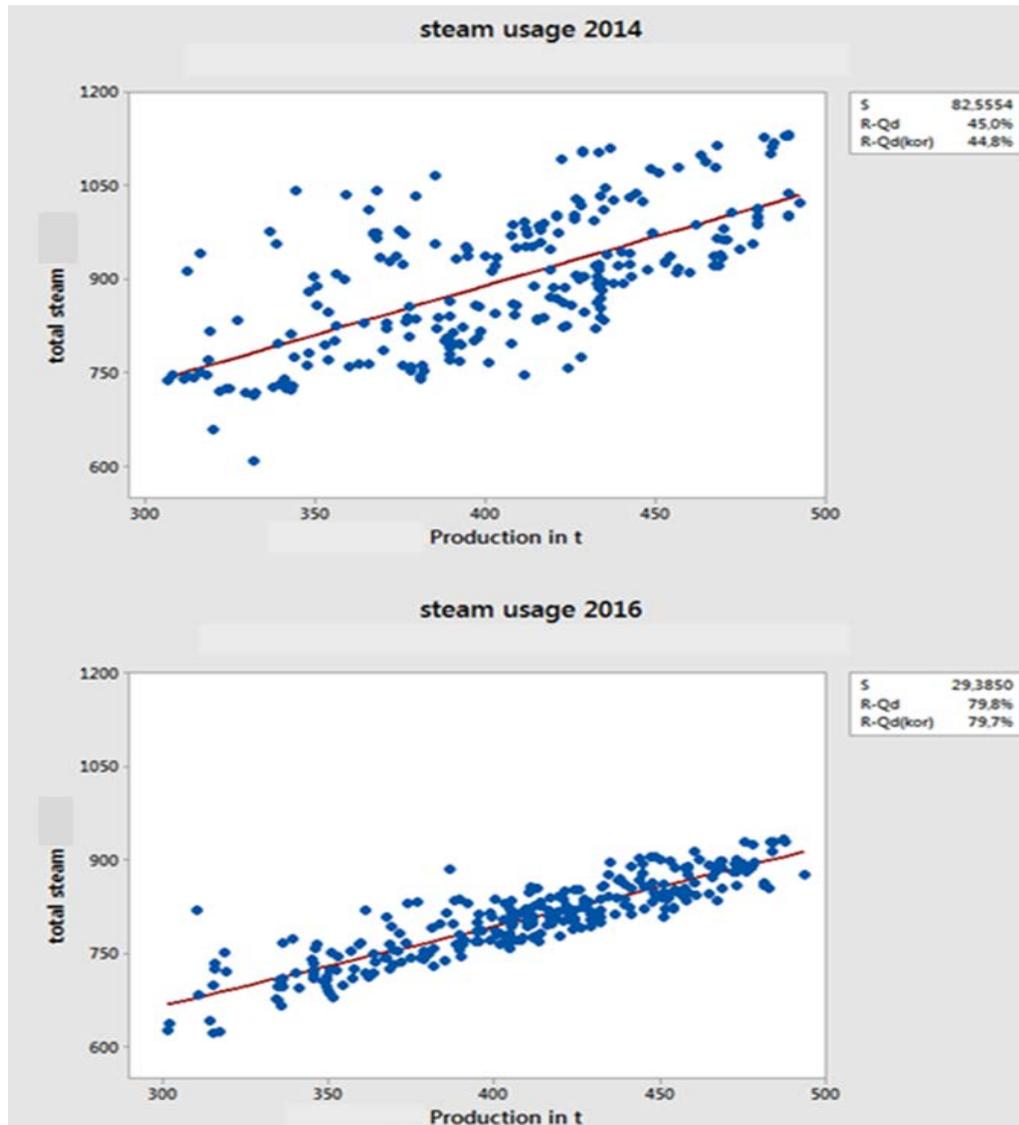
## ► Entitlement Analysis

- Measurement of “Best Performance”
- Used for
  - Development, Prioritization and Resourcing of Projects
  - Target Setting

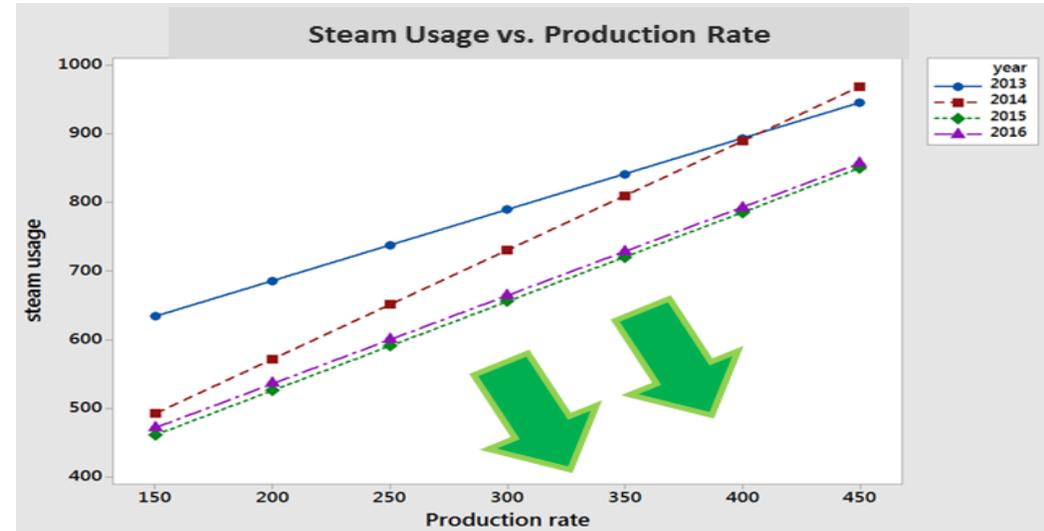
## ► Pinch Analysis and Heat Integration

- Finds potential heat exchange between hot and cold streams
- Energy that might normally be wasted
- Holistic process / plant analysis





- Reduce Variation
- Move the Mean
- Improvement at all Production Rates



### Analysis of energy consumers

- ▶ Is there variability in the process?
- ▶ Any discrepancies between theoretical and actual usage?
- ▶ Comparison with design data
- ▶ Challenge of operating parameters, set points, operating limits
- ▶ Is there a more efficient way?

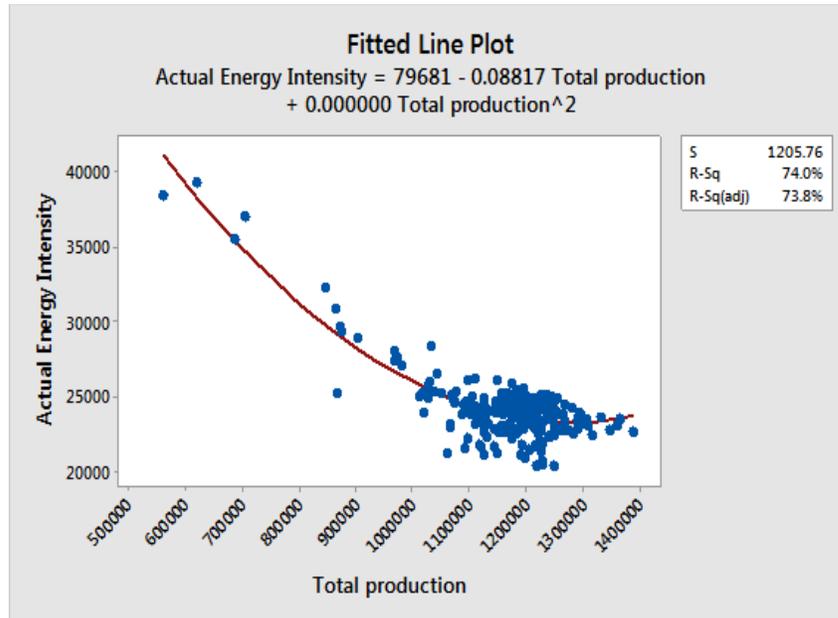
- ▶ Measure Energy using continuous data and statistical multiple regression analysis
- ▶ Define parameters (X's) that effect Energy (Y)
- ▶ Control collateral variables - Counter Y's

**Regression Analysis: Steam vs. Production Rate, Reflux, etc.**

The regression equation is  

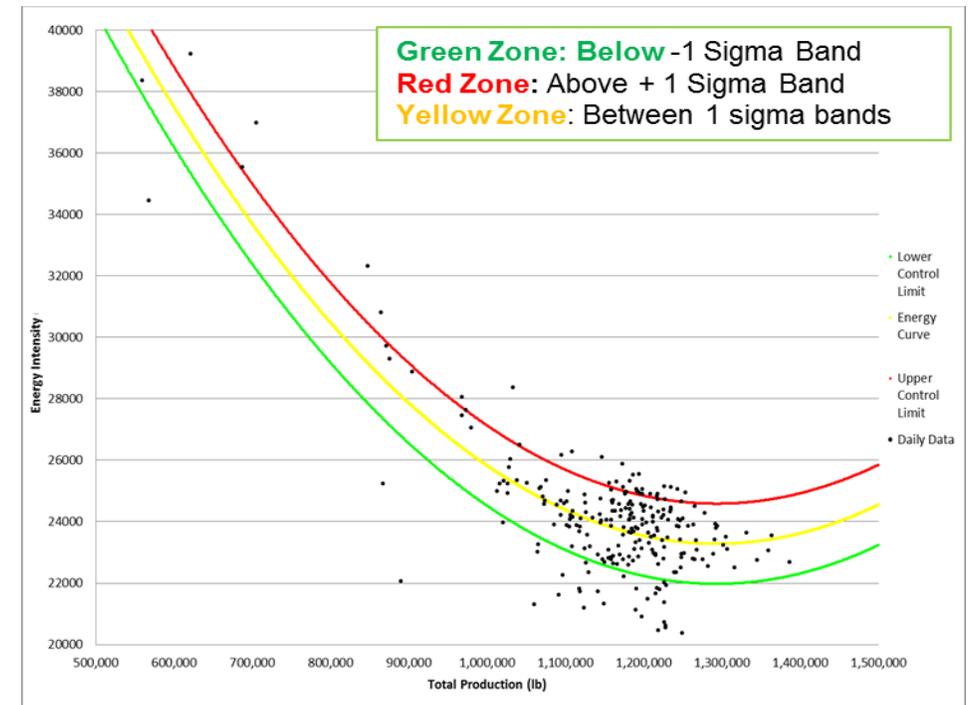
$$\text{steam} = 1800 + 4292 \text{ production rate} + 0,008 \text{ reflux [kg/h]} + 1,82 \text{ T bd } 53 + 8,60 \text{ 1/T(2480)} + 5,07 \text{ c(RM1) } 2480 [\%] - 334 \text{ R}$$

S = 0,00395544    R-Qd = 97,0%    **R-Qd(kor) = 95,8%**



### Used for:

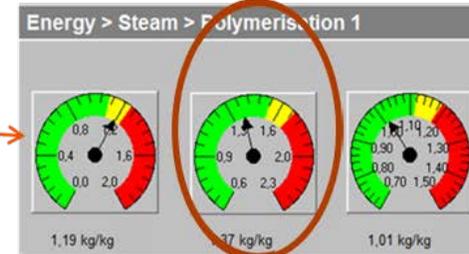
- ▶ Understanding of major variables that impact energy
- ▶ Quantify the influence of multiple parameters on energy usage
- ▶ Dynamic KPIs
- ▶ Understanding the effect of reduced production



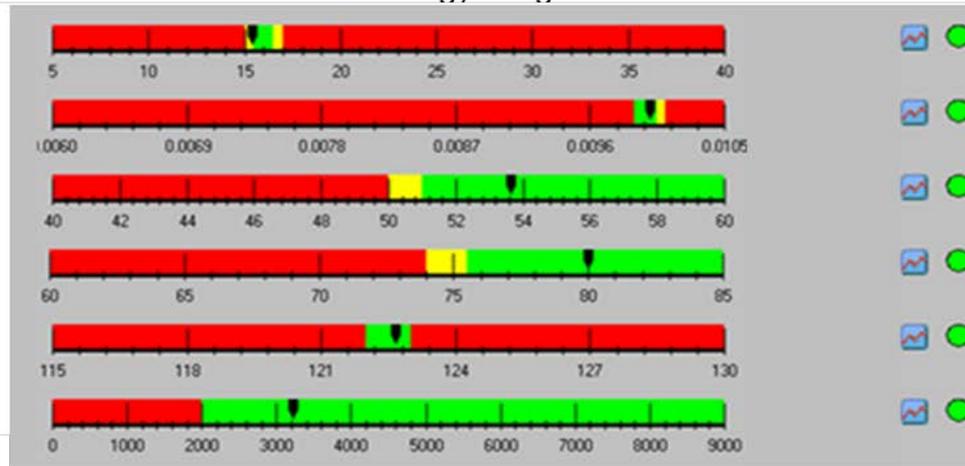
## Layer 1: Specific steam consumption of operating unit



## Layer 2: Specific steam consumption of single consumers



## Layer 3: Process parameters, which influence the energy usage

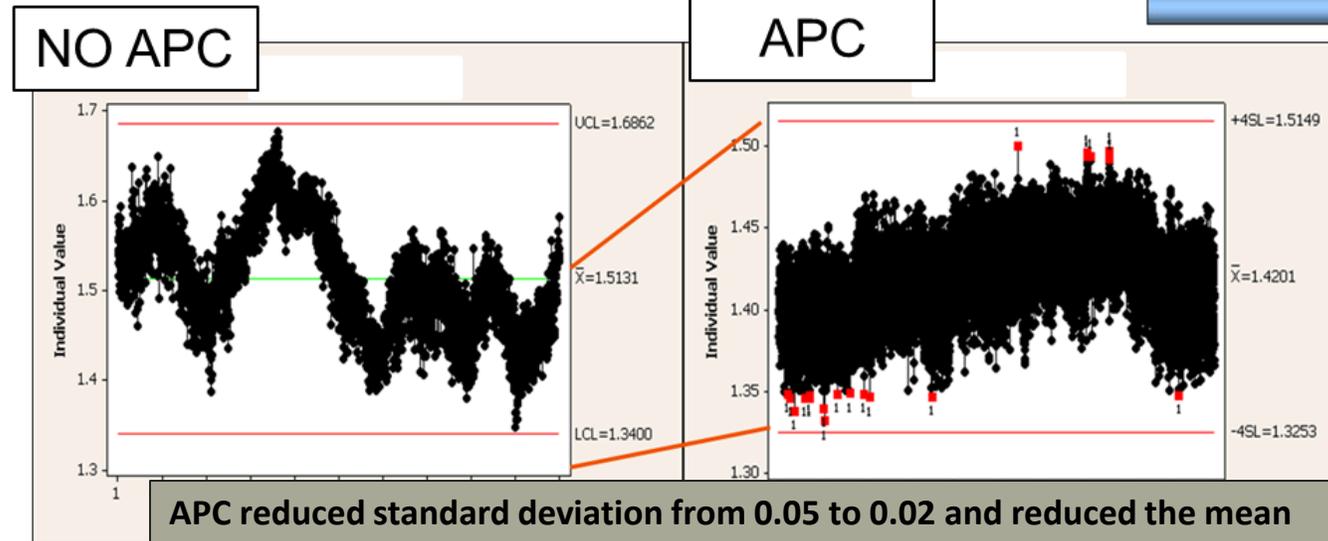
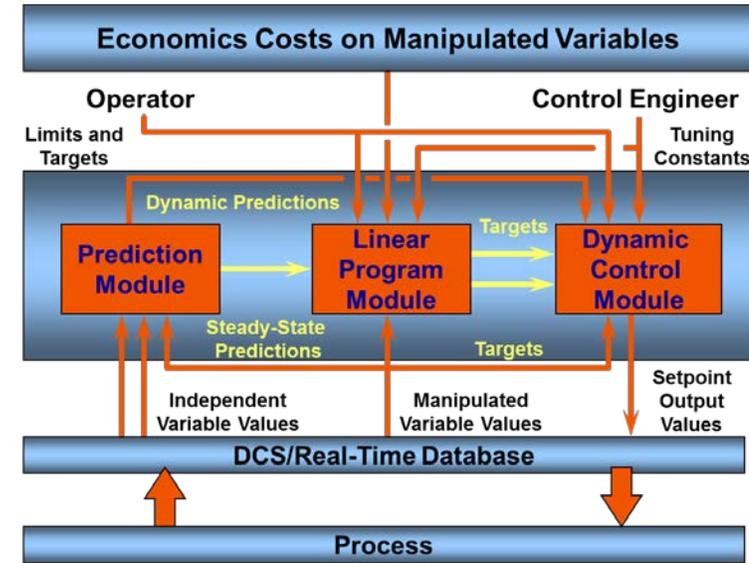


- ▶ Continuous display of real time energy consumption / cost indicators
- ▶ Drill down capability to key energy drivers
- ▶ Integrated with quality and production metrics incorporated in the plant controls systems
- ▶ Dynamic dashboard limits and key variables identified through statistical modeling / engineering validation

**Dynamic limits:** Dependent on rate and product type ...

**Energy Dashboards are a Real Time Online Control Chart**

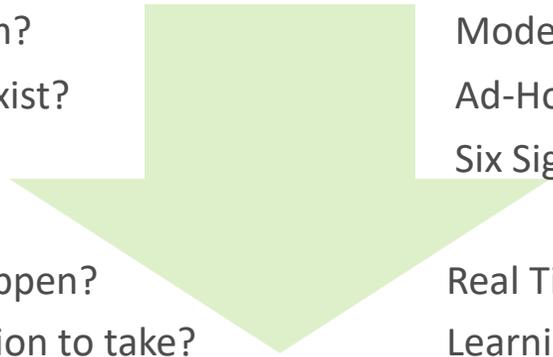
- Multivariable: Uses multiple inputs to control multiple outputs
- Model-based: Process information is encoded in the form of models. This information is used to **predict future system behavior**
- Constrained: Ability to predict violation of process constraints in the future and **generate control moves** to prevent violation
- Optimizing: Steady-state economic optimization incorporating costs to **maximize profit**



*From Wikipedia*

The term "big data" often refers simply to the use of **predictive analytics, user behavior analytics, or certain other advanced data analytics methods that extract value from data**, and seldom to a particular size of data set.

- Where is the problem?
  - What relationships exist?
  - Why did it occur?
  - What is about to happen?
  - What is the best action to take?
  - How can analytical view be improved?
- ▶ Enterprise and Systems Analysis
- ▶ When other analytics methods have reached diminishing returns



Modeling  
Ad-Hoc Statistical Analysis  
Six Sigma  
  
Real Time Analytics  
Learning  
Enterprise

## What qualifies as Big Data?

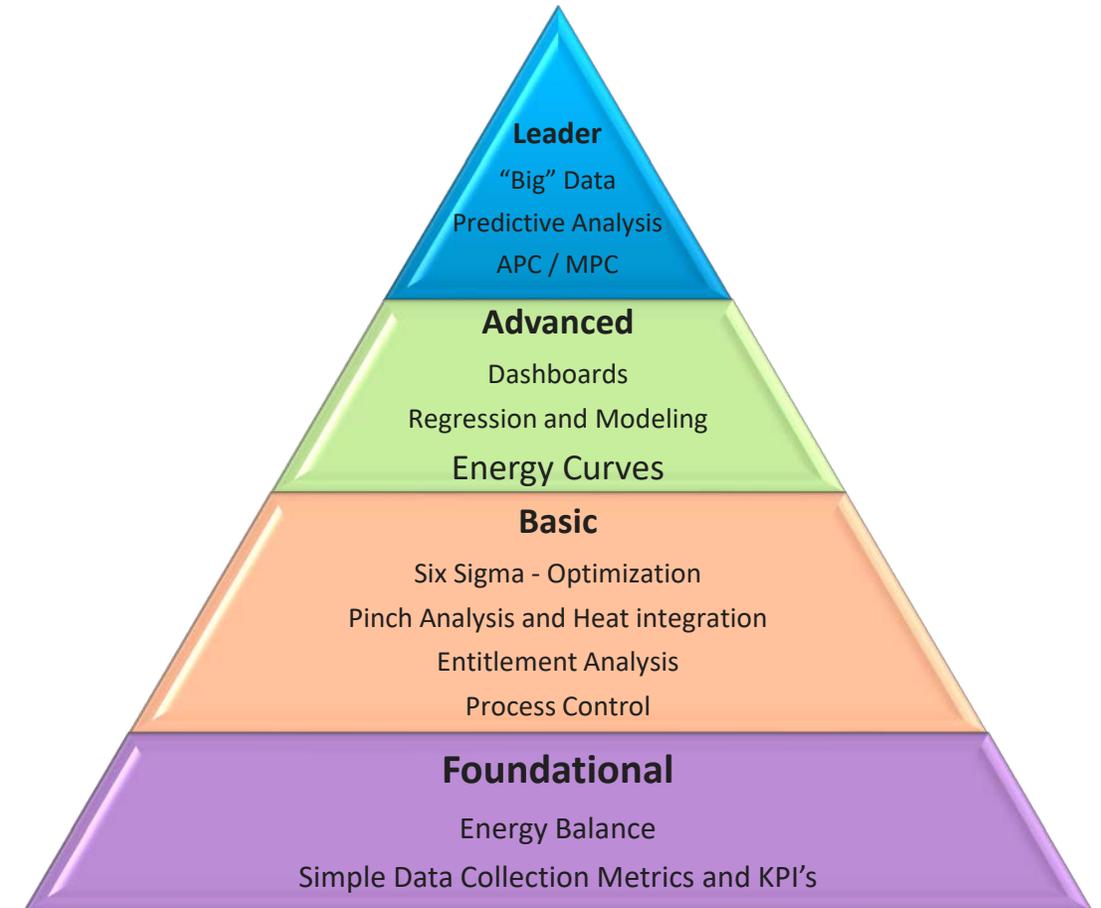
- Large amounts of structured and unstructured data
- Time based data
- Transactional data
- enterprise-wide information
- data-rich streams such as images and video feeds
- broadly deployed measurements and sensors

www.nwasoft.com

**Traditional**

**Leader "Big"**

- ▶ We have a lot of data
- ▶ Tools and Analysis Uses the Data to get Results
- ▶ Hierarchy To Fit Need And Value Add
  
- ▶ Foundational – Blocking and Tackling
  - KPIs and Energy Balance
- ▶ Basic – More Sophisticated Analysis
  - Six Sigma, Pinch, Entitlement and Process Control
- ▶ Advanced – Complex Interactions
  - Modeling, Dashboards, MPC
- ▶ Leader – Predictive
  - Enterprise / Multi-System



Transform Energy Data Into Usable Information to Reduce Cost, Environmental Impact and to Drive Value.



### Disclaimer

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