USEA Data Big Data Workshop

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Duke Energy - M&D Center

Lightning Round Overview

About Duke Energy

Duke Energy Corporation is an energy company headquartered in Charlotte, N.C. Its Regulated Utilities business unit serves 7.4 million retail electric customers in six states in the Southeast and Midwest regions of the United States, representing a population of approximately 24 million people. Duke Energy is a Fortune 125 company traded on the New York Stock Exchange under the symbol DUK. More information about the company is available at **duke-energy.com**.

Duke Energy Service Area – Regulated Utilities
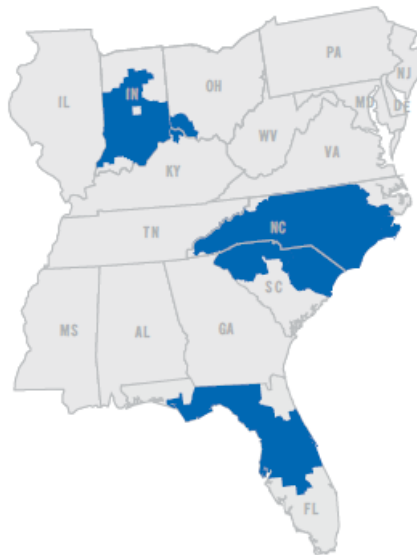
Corporation*	
Market Cap (as of 2/16/16)	$52.1 billion
2015 Operating Revenues	$23.5 billion
Total Assets (as of 12/31/15)	$121 billion
Employees (as of 12/31/15)	29,188
Total U.S. Generating Capacity (owned capacity)	52,697 megawatts (MW)

Regulated Utilities*	
States Served	NC, SC, IN, OH, KY, FL
Size of Service Area	95,000 square miles
Total Generation Capacity (owned capacity)	50,200 MW
Total Transmission Lines	32,300 miles
Total Distribution Lines	263,900 miles
Total Natural Gas Mains	7,200 miles
Total Natural Gas Service Lines	5,800 miles
Total Electric Retail Customers	7.4 million
North Carolina	3.3 million
South Carolina	730,000
Ohio/Kentucky	840,000
Indiana	810,000
Florida	1.7 million
Total Natural Gas Customers	525,000
Ohio	427,000
Kentucky	98,000

Duke Energy Regulated Utilities conducts operations primarily through Duke Energy Carolinas, Duke Energy Progress, Duke Energy Florida, Duke Energy Indiana, and the regulated transmission and distribution operations of Duke Energy Ohio.

- Data is the critical input to the M&D mission
- Programs that we utilize on a daily basis to collect and analyze data.
  - EtaPRO – Our First Principles Thermal Performance Monitoring program
  - PRiSM – Our Advanced Pattern Recognition program.
  - InSightCM – SmartGen Data Collection and Analysis program.
    - VDMS – Vibration Diagnostics and Monitoring System - Turbines, Generators, Boiler Feedwater Pumps, and Large Fans
    - BOP – Auxiliary Rotating Equipment
    - EMSA – Generator and Transformer Electromagnetic Signature Analysis
    - MCSA – Large Motor Current Signature Analysis
    - IR – Infrared Thermography
  - PI Processbook – provides a visual representation of various data streams
  - EDS Terminal
- Advanced analytics will need much more data than our current infrastructure can support

Scope of the APR Program

- Portion of fleet monitored by APR
  - 43,000MW, 87% of regulated fleet
  - 237 Units, (44 Steam, 13 CC's, 167 CT's, 8 PS, 5 Hydro so far)
  - >11,000 APR Models, (5000 Classic, 6000 SG)
  - >500,000 Points monitored every 5 minutes
  - 46 PI servers

- Regional Locations, Charlotte, Indianapolis, St. Petersburg

- 5 team members dedicated to APR. Mix of new employees, field support and plant experience. 2 contract model builders, 2 IT support.
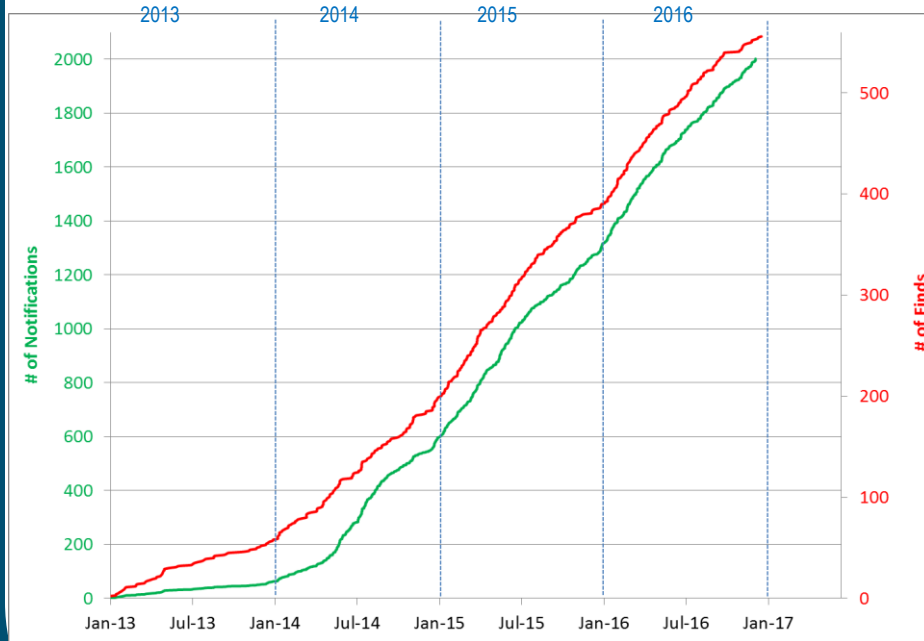
- Roughly 35 unique model types

M&D Center Success

		2013	2014	2015	2016	Total
NOTIFICATIONS	*An abnormal condition is detected and there is interaction between the station and the M&D center to investigate further*	52	503	730	756	**2,041**
FINDS	*An investigated notification identified an equipment issue that requires corrective action*	52	134	200	171	**555**
N / F RATIO	*Every (N / F) NOTIFICATIONS results in one FIND*	N/A	3.75	3.65	4.18	**3.68***
COST AVOIDANCE	*Based on the difference between probability and impact of failure with and without M&D center interaction*	10%	5%	45%	70%	**130%**

Avoided Cost = % of SmartGen Project Budget

1 Notifications vs. Finds

2 Avoided Cost
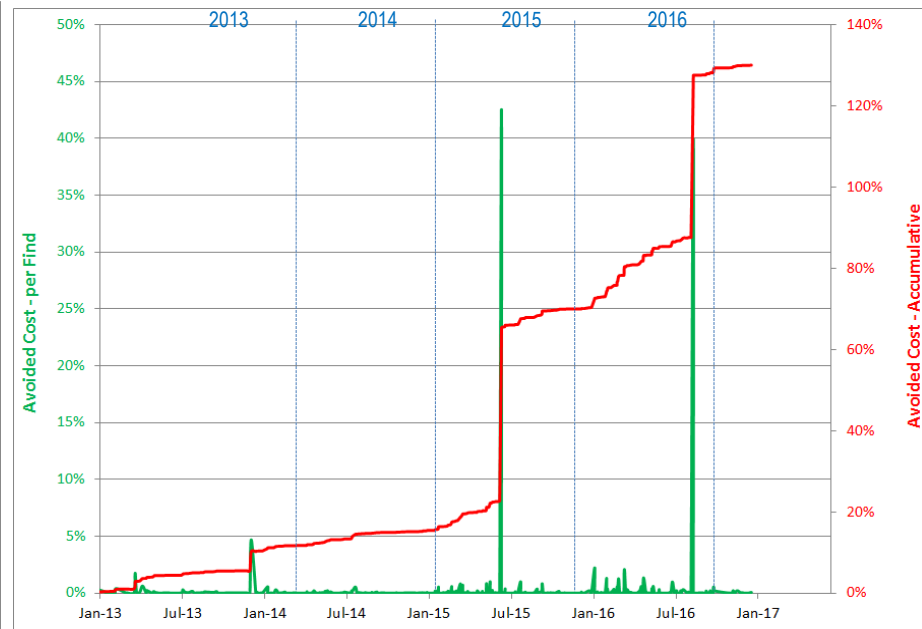
SmartGen – Return on Investment
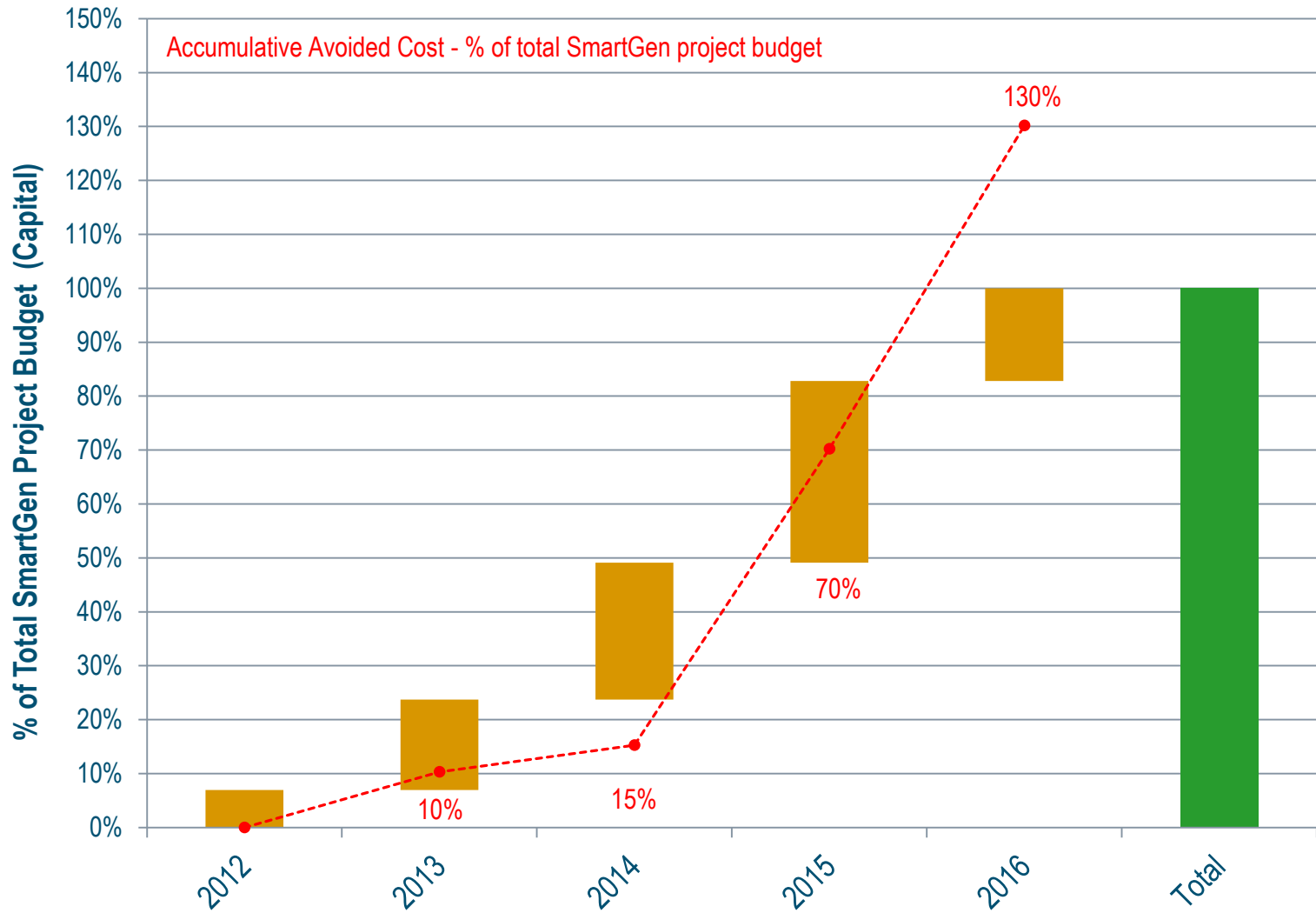
Smart M&D – Automation of Data Collection

Automation of CBM data collection and analysis is key to Equipment Reliability in future resource constrained environment.
On-line monitoring is key piece to optimized maintenance strategy with increasing reliance on predictive maintenance.

Opportunity: automation of manual data collection and analysis
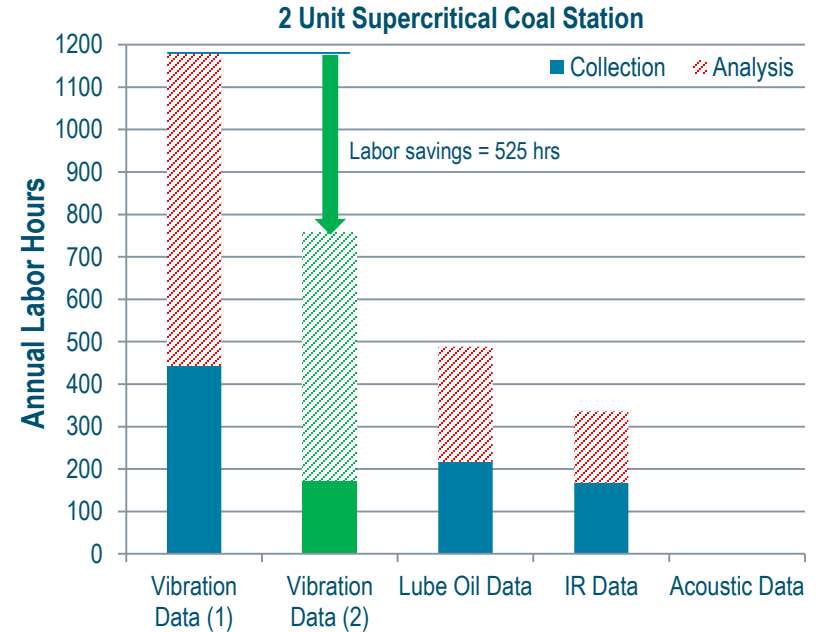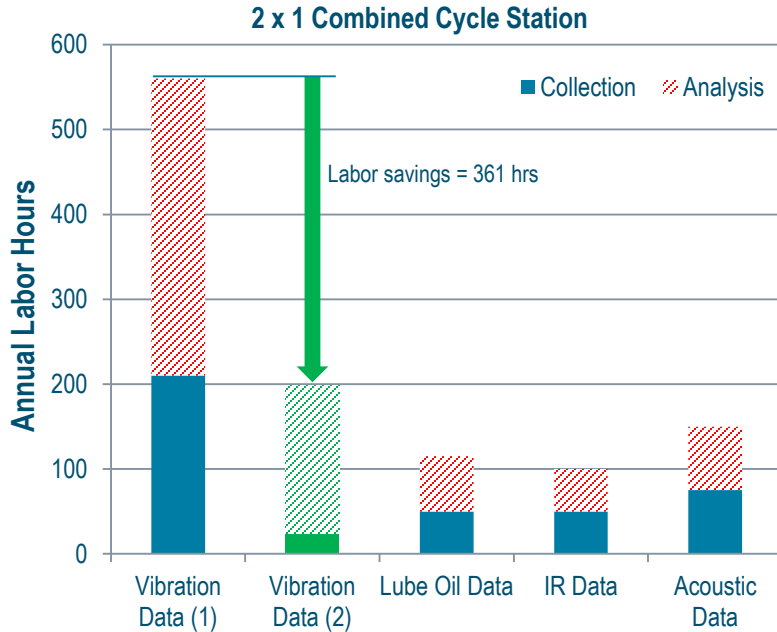
Note: Assumption - data collection will be reduced by 90% and data analysis will be reduced by 50%.

	2 x 1 CC	2 Unit SC Coal
# Pieces of Equipment / Components	166 / 265	248 / 511
% of Vibration Components Instrumented for On-Line Monitoring	99%	69%
Vibration: Annual Labor Totals / Savings – quarterly rounds	560 / 361 hours*	1,181 / 525 hours*
Vibration: Annual Labor Total / Savings – monthly rounds	2,240 / 1,444 hours*	4,724 / 2,100 hours*
Vibration: Annual Labor Total / Savings – weekly rounds	26,880 / 17,328 hours*	56,688 / 25,200 hours*