Welcome! We’ll be starting shortly…

Today’s data quiz: what has 22.4 trillion digits (so far) and tastes delicious?
Welcome!

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Smart Energy Analytics Campaign

- Goal: Facilitate adoption of EMIS and monitoring-based commissioning
- Participants use EMIS and share results
- Produce research reports summarizing the EMIS and MBCx industry

https://smart-energy-analytics.org/
Benefits of Campaign Participation

- Gain national recognition for leading edge energy management
- Receive technical assistance from Lawrence Berkeley National Laboratory
- Access peer network groups
- Contribute to EMIS and MBCx research
We’re on LinkedIn, Facebook, and Twitter!

https://twitter.com/SEACampaign

https://www.facebook.com/SEACampaign

https://www.linkedin.com/groups/13560773, or search for Smart Energy Analytics Campaign
Data Management Challenges

- Data was stored separately in a variety of ways
- How to get and store data from many sources, for access by many applications

BAS – Building Automation System; AMI – Advanced Metering Infrastructure
Analytics and Advanced Controls

**Whole-building Level EMIS**
- Benchmarking and Monthly Utility Bill Analysis
- Energy Information System
- Advanced EIS

**System Level EMIS**
- Building Automation System
- Fault Detection and Diagnostics
- Automated System Optimization
Legacy Meters and Control Systems

manual
meters

connected
meters

BMS

another
BMS

smart
thermostat

Excel

?  

Datalogger

?  

BMS

?  

Another BMS

?  

Smart Thermostat

Cloud

Legacy Meters and Control Systems
New Analytics Platforms!
Example 1
Example 1
Lesson 1: think about your whole data architecture (not just applications)
Lesson 2: need for a (new) FM-IT approach

<table>
<thead>
<tr>
<th>Facility Management</th>
<th>Information Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data quality control</td>
<td>Network architecture</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Security</td>
</tr>
<tr>
<td>(Development of custom analysis)</td>
<td>Privacy</td>
</tr>
<tr>
<td>(Action: generation of work orders)</td>
<td>System upgrades-maintenance</td>
</tr>
<tr>
<td>(Action: control system adjustments)</td>
<td>(Development of new connectors)</td>
</tr>
<tr>
<td>(Action: commissioning)</td>
<td>(Integration with IT infrastructure)</td>
</tr>
</tbody>
</table>

(*) -> not always implemented by this department
Five stages of grief data integration

1. create central data warehouse
   - data is all scattered!

2. assign metadata
   - I do not understand what this data means!

3. establish a data cleaning procedure
   - data quality is terrible!

4. develop aggregated analytics
   - that's great, but nothing gets fixed!

5. integrate analytics with actions
   - this is really too much data to look at!
Lesson 3: metadata is essential

- Metadata are descriptors of building systems (e.g., sensor names, relationships between components)
- Stored in point names, graphics, and other tables
- Typically set up manually by technicians (inconsistent)
- Any convention is better than no convention!
- Emerging schemas: Haystack, BRICK

EX:
ACAD.CHW.MAX CCO
Ghausi.AHU01.CCO
HWC.CBCHW.CCOMAX
CHEMX.4SFC3.RM4475A.CCO
VM3A.CHW.CCO OPEN ENABLE

New metadata tags (Haystack):
- cool
- water
- cmd
- equipRef: @AHU1
- siteRef: @Ghausi
Lesson 4: need for data-cleaning process

- Look for points of failure from the device to the database

<table>
<thead>
<tr>
<th>Point of Failure</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter specification</td>
<td>data below threshold and not recorded</td>
</tr>
<tr>
<td>Meter installation</td>
<td>transducers installed wrong</td>
</tr>
<tr>
<td>Data collection device configuration</td>
<td>insufficient memory in field device</td>
</tr>
<tr>
<td>Database settings</td>
<td>Database firewall prevent data transfer</td>
</tr>
<tr>
<td>Integration software settings</td>
<td>Units and meter multipliers wrong</td>
</tr>
<tr>
<td>Database software settings</td>
<td>not configured to be trended</td>
</tr>
</tbody>
</table>
Lesson 5: how to aggregate data is not obvious

- **High:** 2.40M gal (May)
- **Median:** 1.18M gal
- **Low:** 344,169 gal (Mar)

- **172** buildings
- **956** meters
- **202** utility accounts
- **9** integrations
Lesson 6: need to turn insights into actions
ACKNOWLEDGMENT

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Some Lessons Learned While Implementing NREL’s EMIS

Dylan Cutler and Stephen Frank
DOE Smart Energy Analytics Campaign
March 14, 2018
NREL Campus

- Total building footprint (GSF): 1,136,335
- Number of employees: 2,159
- EUI in 2016 (kBtu/GSF): 118
- Reduction from 2003 EUI baseline: 55%
- Electric generation from solar PV: 15%
NREL’s EMIS

22 Facilities

- Complete: 3
- In Progress: 1
- Meters Only: 16
- No Data: 2

16,143 Data Points

- Electricity Meters
- Building Automation Systems
- Onsite Generation
- Electric Vehicles
- Weather Measurements, Forecasts
Lesson 1

First, Establish Your Goals
“We’re just going to collect all the data and then see what we can do with it!”
“We’re just going to collect all the data and then see what we can do with it!”
Key Questions

• What do you **expect to gain** from your EMIS?
  Benchmarking / Fault Detection & Diagnosis / Tenant Engagement / ... ?

• What **types of systems** are you including?
  HVAC / Electrical / On Site Generation / Transportation / ... ?

• Who is going to use **this information**, and do you have the policies in place to **take action**?
NREL Intelligent Campus Goals

- Situational Awareness
- Occupant Engagement
- Fault Detection & Diagnosis
- Demand Management
- Enhance Research
- Visitor Education
Lesson 2

Assemble Your Team Early
The Team

- Energy Managers
- Facility Managers/Operators
- Energy Analysts
- Cyber-Security
- Networking & Information Technology
- ...
Benefits of Team Approach

Data Ownership

Security Requirements
Operational

Understand
Ensure

Buy-In

Procurement Compliance
Installation

Timeline

Data Access
No single NREL organization had the knowledge needed to construct this diagram.
Lesson 3

Organize Your Data
DIKW

- Data
- Information
- Knowledge
- Wisdom
To get to **Information** from **Data**, you need **Metadata**
Metadata: Data about your data
Interoperability

Management

Supervisory

Control

Device

Technical

Informational

Organizational

GreenButton

Energy Star Portfolio Manager

OpenADR

ISO 50001

SEED

FEMP O&M Guide

oBIX

Project Haystack

Brick

BACnet

SEP2

Modbus

EMIX

Project Haystack
Display Name
dis: “VTIF”

Tags
id: @3245
site: ✓
area: 10,000 ft²
weatherRef: @1794 “Golden”
geoCity: “Golden”
geoState: “Colorado”
tz: “Denver”

Unique IDs are automatically generated and linked

Display Name
dis: “Electricity Meter Main”

Tags
id: @6748
equip: ✓
energy: ✓
siteRef: @3245 “VTIF”

Reference tags allow simple description of relationships

Display Name
dis: “Three-Phase Energy”

Tags
id: @1152
point: ✓
sensor: ✓
energy: ✓
unit: “kWh”
equipRef: @6748
“Electricity Meter Main”
siteRef: @3245 “VTIF”

Marker tags describe intrinsic characteristics of an object

SITE

EQUIPMENT

POINT

Project Haystack

Unique IDs are automatically generated and linked

Reference tags allow simple description of relationships

Marker tags describe intrinsic characteristics of an object
Your metadata schema should support your analytics goals
Lesson 4

Don’t Panic; It Gets Easier
Thank you

www.nrel.gov

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Smart-energy-analytics.org

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