Alaska Housing Finance Corporation

Energy Efficiency NOW Conference 2016

Measure to Manage

LONG™
Long live your building!

Agenda

- Warm-up
- Building Automation System Fundamentals
- Protocols and Standards
- Energy Savings Strategies
- Measurement and Verification
- Building Analytics
- Open Discussion

Safety

- **Electric Hazards**
  - Electric Shocks received by
    - Defective Power Tool
    - Defective Extension Cord
    - From overloading a switch or over-riding a by-pass.
    - By not grounding electrical equipment.
    - By coming in close contact with live electric lines.
    - By coming too close to high power lines with the power arching over and making contact.

Safety

- **Electric Hazards**
  - Ways to avoid electric hazards
    - Always inspect tools and equipment for frayed cords and defective plugs before using them.
    - Never use a power tool that has had the ground plug removed; inspect the plug.
    - Never stand in water and operate a power tool without proper (i.e., insulated) footwear.
    - Keep extension cords out of water when in use.
    - Consider all power lines “live” and avoid contact with them.
    - Follow the company assured grounding/electrical protection program.
    - Disconnect all electrical tools and cords when not in use.
    - Be sure all temporary lighting is equipped with bulb covers.
    - Make sure all power supplies, circuit boxes and breaker boxes are properly marked to indicate their purpose.
    - Use Ground Fault Interrupters (GFI’s) on all jobsites. Defective Power Tool

Who is LONG?

- **LONG Building Technologies**
  - Celebrating our 50th Year
  - Business Lines
    - Building Automation and Controls (Space Wizards)
    - Energy Services and Analytics
    - Industrial / PLC
    - Mechanical Services
    - Security (Access Control / CCTV)
  - Safety Culture
  - 380 Employees

LONG™
Long live your building!

Culture

LONG Building Technologies delivers expert solutions – integrating HVAC, building comfort, parts and security for building owners, managers and tenants. We provide the peace of mind that only comes from knowing LONG expertise and technologies are keeping their buildings comfortable, productive, safe and energy efficient. We deliver confidence and ROI from their investment in optimal building performance and inside working spaces.

Long live your building!

Building Control Systems

- Pneumatic and electric control systems being replaced by Direct Digital Control (DDC) Systems
- Past systems operated in similar manner to pneumatic or electric systems
  - Electronic time clock with setpoint and schedule capabilities
- Manufacturer's proprietary protocol

Current and Future Trends

- Standardization of communication protocols
- Smart technologies applied to all types of end devices for little or no additional cost
- Traditional controls companies changing - becoming system integrators

Changing Roles

- Open platforms have changed the relationships between building owners, controls manufacturers and controls providers
- System Integrators
  - Allow multiple manufacturers and products to work together
  - Owners can select products, applications and installers based on “Best of” and competitively bid for the best solutions

Communication Protocols

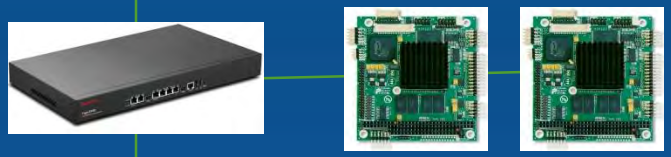
- Proprietary protocols a thing of the past
- Industry Standard Protocols
  - BACNet – ASHRAE Standard
  - LON – Industry standard for interoperable devices
  - Modbus – Industrial and Packaged Equipment
- Going Forward
  - XML, HTML, oBIX
    - Standard XML and Web Services to exchange information between building systems and IT infrastructure

Communication Protocols

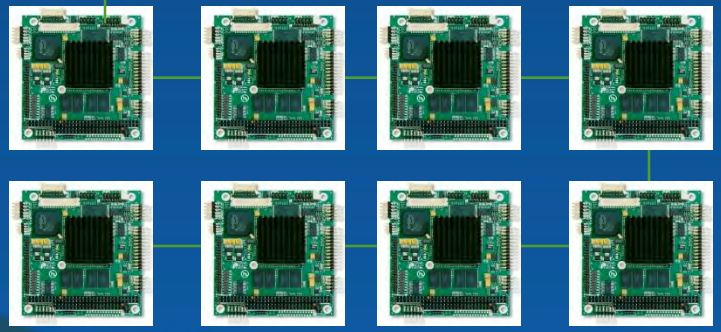
- **Standard Communication Protocols Allow for**
  - Integration
  - Interoperability
  - Connectivity between building systems
    - HVAC Packaged Systems
    - Lighting
    - Access and Surveillance
    - Energy Monitoring

Legacy / Proprietary / Closed

Proprietary Programming and Graphics Toolsets



Primary Network Level



Secondary or Field Network Level

Problems:

- Single Sourced
- Proprietary Protocols
- Proprietary Toolsets
- Proprietary Software
- Limited Integration
- **End Result… "Locked In"**

LONG™
Long live your building!

A Truly Open Building Automation System

LONG™
Long live your building!

Niagara Framework

- Quickly becoming the operating system of the Internet of Things.
- Many controls manufacturers utilizing
- Connects and translates data from nearly any device or system—managing and optimizing performance from buildings to factories to cities and beyond.
- A truly open platform, Niagara has grown an extensive community of people, machines and companies with thousands of applications and endless possibilities.

Smart Technologies

- Trend to Internet Protocol 6 (IPV6)
  - Allows smart devices to have unique address
- Ability for devices to collect data
  - Allows for measurement and verification
  - Analytics - Automatic detection of improper operation of systems
    - Finding early reduces cost energy and operational cost impacts

Basic Energy Savings Strategies (What can I take home from this conference today)

- Retro-commissioning
- Sequence of Operations
- Fresh Air Requirements
- Scheduling
- Unoccupied Control Options
- Setpoint Reset
- Maintenance Procedures
- Energy Efficient Equipment and Controls

Energy Savings Strategies

- Retro-commissioning
  - A review of all mechanical and electrical systems in a facility
    - Verify systems are operating per original specifications
      - Sequence of Operations
      - Schedules
      - Balancing
      - Loop Tuning

Energy Savings Strategies

- Sequence of Operations
  - Real Life
    - Sequences written prior to mid ‘90’s more than likely not taking advantage of smart technology
    - Building use has changed
    - No written sequences exist

Energy Savings Strategies

- Sequence of Operations
  - Mixed air control
  - One of biggest areas for excessive energy use
    - Maintain constant 55 deg F.
      - Ensures minimum air during heating
      - Requires reheat
    - Dampers stuck open (or closed)
    - Improper sequencing during cooling mode

Energy Savings Strategies

- **Mixed Air Control – Revise to:**
  - **Maintain minimum outside air during heating and when no call for cooling**
  - **Dampers to open to maintain 55 deg F on a call for cooling for free cooling**
  - **Dampers position back to minimum position when air conditioning called for**

Energy Savings Strategies

- **Mixed Air Control – Minimum Fresh Air:**
  - **ASHRAE Standard 62.1 specifies minimum fresh air requirements**
  - **ASHRAE Standard 90.1 specifies minimum requirements for energy efficient design of buildings**
    - **Smart technology provides methods to meet requirements and reduce energy consumption**
      - **Maintain minimum outside air during heating or no call for cooling**
      - **Utilize air flow measuring for minimum requirements**
      - **Base minimum air flow on actual occupant load of building**
      - **Base on CO2 level** Mixed Air Control

Energy Savings Strategies

- Scheduling
  - #1 – Ensure building systems are scheduled based on building use
    - Occupancy based on individual zone versus entire mechanical system
    - Override to occupancy mode by individual zone
  - If a system is being left on 24 hours per day during winter to protect one area that may be subject to freezing

  – FIX THAT AREA.

Energy Savings Strategies

- Unoccupied Mode Control
  - Older sequences position the heating coil valve to 100% heating during unoccupied mode.
    - Causes excessive energy use to protect coil
    - Heat soaks the ductwork
      - When fan starts, has to dissipate heat
  - Solution
    - Use mixed air sensor to control heating coil valve when fan is off to maintain 45 deg F in the mixed air plenum

Energy Savings Strategies

- Outside Air Reset Control
  - Lower the heating water supply temperature
    - As OSA temp rises, HWS set point is lowered
  - Automatic setpoint calculations for air handling unit supply air temperature
    - Base on outside air temperature
      - Further base on cooling or heating load of all zones in building

Energy Savings Strategies

- Routine Maintenance
  - Filters
    - Ensure proper and efficient airflow
  - Lubrication
    - Extend equipment life
  - Review system operation
    - Schedules
    - History Logs
    - Alarm Events
  - Visual inspection
    - There are some things that a machine just can't do….

Energy Savings Strategies

- Replace inefficient equipment
  - Boilers
  - Chillers
  - Air Conditioning
  - Controls

Facility Management Needs

- **Reduce utility consumption.**
  - Do more with less resources ($ and labor).
  - Nip consumption “errors” before the next utility bill arrives.
  - Easy way to make sense of data quickly
  - No occupant impact.

Measure to Manage

- Tools to monitor energy savings
  - Spreadsheets – enter utility costs each month
  - Utilities – some offer reports comparing prior periods
  - Web Tools – Allows analytics of energy use and costs
  - Real time monitoring

Measure to Manage

- Energy Dashboards
  - Display complex information into easy to understand visual format
  - Update energy performance in real time
  - Detect problems
- Public Display
  - Touch screen monitor
    - Allows public interaction to view energy performance in the facility
- Drive behavioral change

Measure to Manage

- Hawthorne Effect
  - Premise that people will change their behavior if they know they are being observed and measured
    - Study done at the Hawthorne Plant for GE from 1927 to 1938
      - Attempt to determine if change in lighting level affected worker productivity
      - Concluded productivity improved whether lighting level was increased or decreased
    - Concluded that people changed behavior and increased productivity because they knew they were being measured

Energy Dashboard Benefits

- Identify energy consumption anomalies quickly = $$
- Comparative functionality to see trends
- Simple information analysis to optimize asset performance
- Easily deployed in a cost-effective manner
- Educational component to support LEED and occupant engagement
- Open protocol integration allowing interface to all DDC systems
- Automates **A**sset **P**erformance **M**anagement

LONG™
Long live your building!

Features & Attributes

- Customer Configurable
- Branded Customer Information
- Unique Background Image
- Weather Information is Displayed from an Internet RSS Feed.
- Available as Touch Screen or Display
- Energy Usage Comparison Tool
- Educational Information

Building Energy / Utilities

- **Scalable for Single Building or Campus**
  - Electrical Usage and Demand
  - Water, Oil and Gas Usage
  - Daily, Weekly and Annual Data
  - Charts for Time Periods
  - Utility Period Comparisons
  - CO_2 Consumption and Comparisons
  - Monetize Utility Consumption
  - Easily Expanded to add meters

Features & Attributes

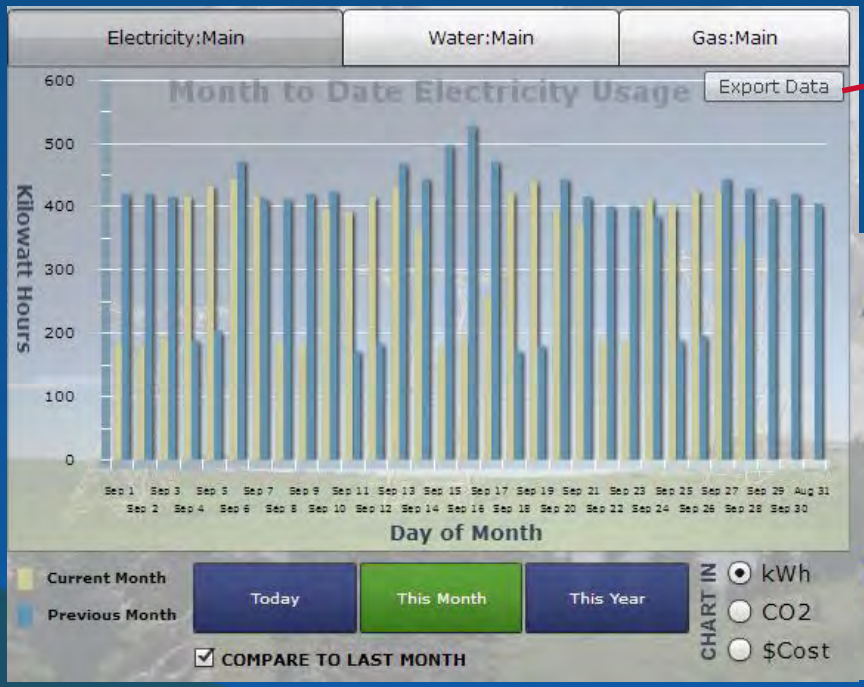
- Utility Meters: Electric, Gas, Oil, Solar and Water
- Building Energy/Utilities
- About Energy Usage Education
- Energy Tip Scroller
- Energy Usage Comparison
- About Us Information

Educational Use

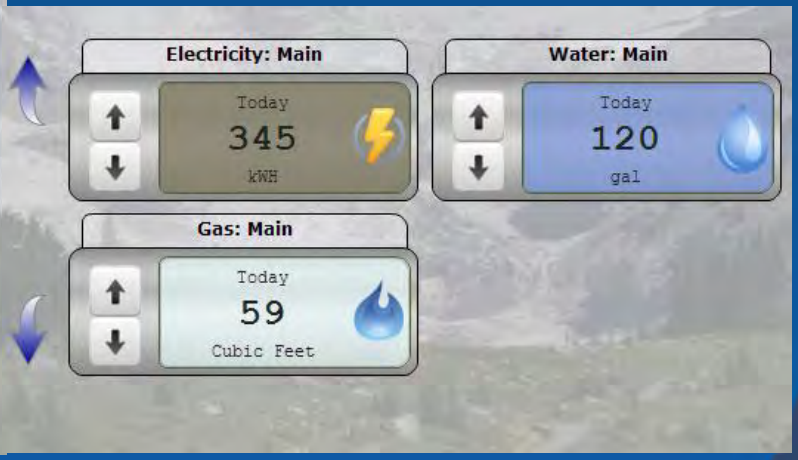
- **An Energy Tip Scroller is Displayed to Inform People on How to Conserve.**
  - Reducing lighting levels in office areas and hallways by increasing use of existing task lights.
  - Be sure to turn off your computer and other office equipment, such as printers and copiers, to conserve energy and reduce internal heat gain.
  - To save power during periods of inactivity during the normal working day, be sure that energy saving features are enabled in equipment such as your office copier

Real Time Consumption & Comparison

- Electrical Usage and Demand
- Water, Oil and Gas Usage
- Daily, Weekly and Annual Data
- Charts for Time Periods
- Utility Period Comparisons
- Carbon Consumption and Comparisons
- Monetize Utility Consumption



CSV file export for data reporting and archive



LONG™
Long live your building!

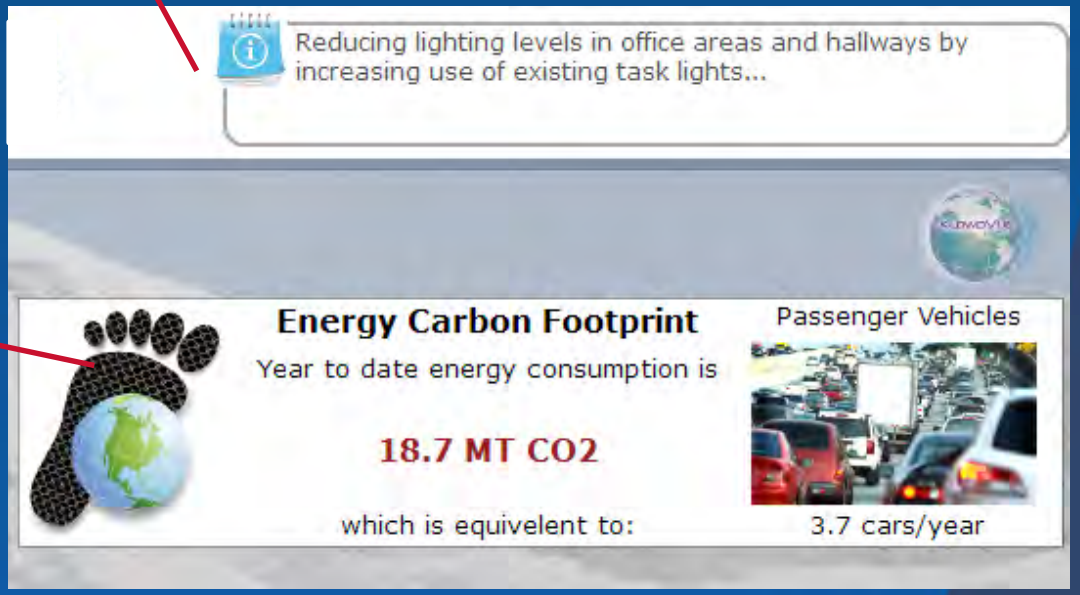
Energy Tips and Impact

Dozens of scrolling Energy Tips …..

Be sure to turn off your computer and other office equipment, such as printers and copiers, to conserve energy and reduce internal heat gain.

To save power during periods of inactivity during the normal working day, be sure that energy saving features are enabled in equipment such as your office copier

Easily recognizable measurement
in million tons carbon footprint



LONG™
Long live your building!

Technology

- **Build with IT Standards**
  - **XML, Flash, .Net**
    - **Controls Agnostic**
      - **Does not matter what manufacturer system or which communication protocol being used**
    - **View on public monitor or via Internet Web page**

INFRASTRUCTURE

Web User
Internet Browser

Internet

Firewall

Secure Proxy

Cloud Services

Datacenter

Collector

Enterprise
(If not on local site)

Local Operator
Workstation

Public Kiosk Display

Enterprise Network
Server

Enterprise Network
Controller

Honeywell

TRIDIUM

Schneider Electric

ALERTON

Johnson Controls

Building Automation Systems

Metering

Educational Energy Dashboard

Consumption Graph

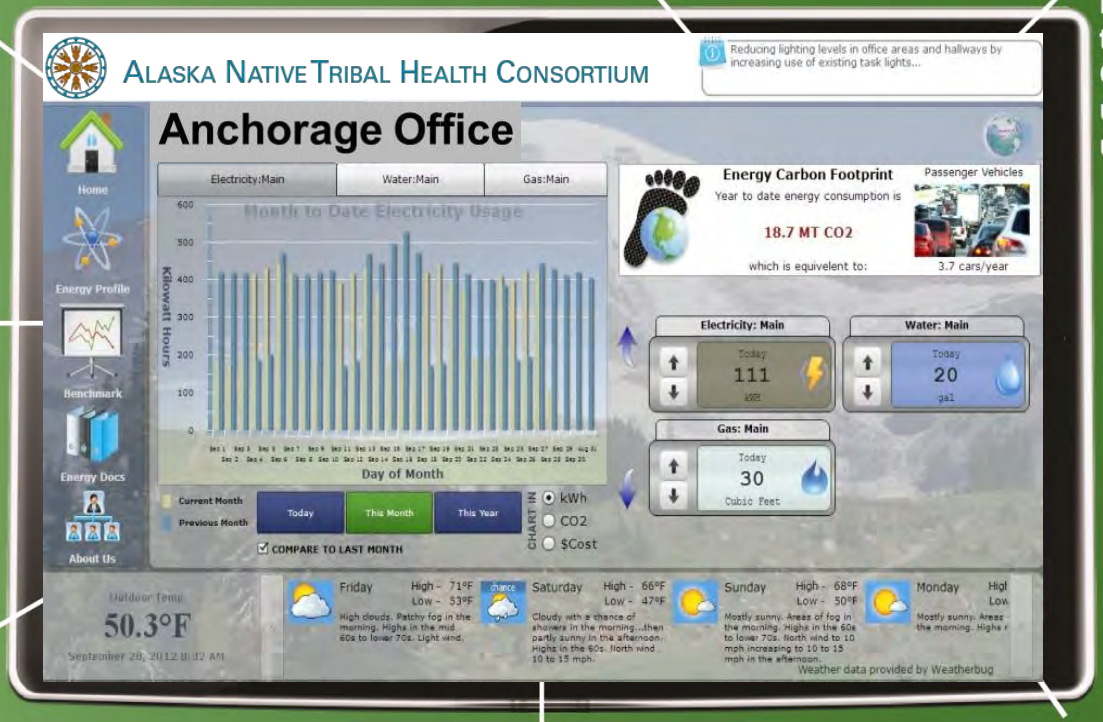
A snapshot of a facilitys' energy consumption in an easy-to-read format.

Energy Tips

Energy Carbon Footprint

Energy consumption in terms of metric tons of CO2. Provides energy usage in alternative units of value.

Menu Bar



Usage Period

Select the consumption graph to view energy usage for the current day, year-to-date, or previous year.

Weather Data

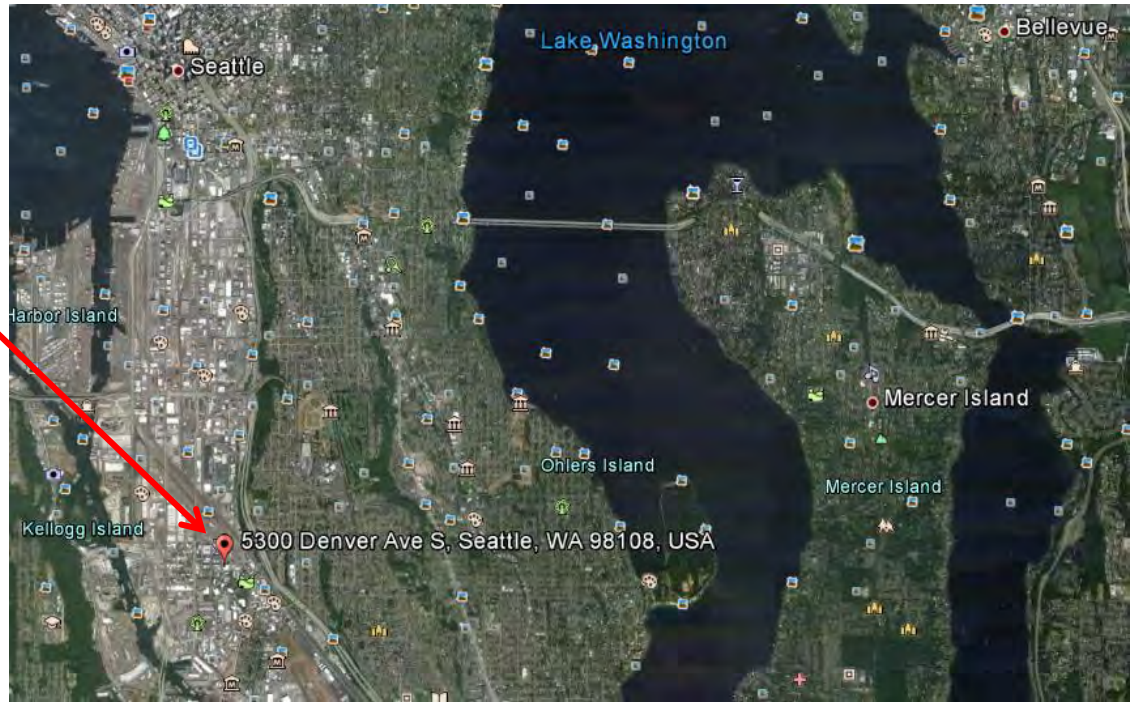
Quick View Boxes

Real-time energy usage data.

LONG™
Long live your building!

Live Demonstration

- Live demo of our LONG Seattle Office
- 1 meter each: Electricity, Gas, Water



Demo

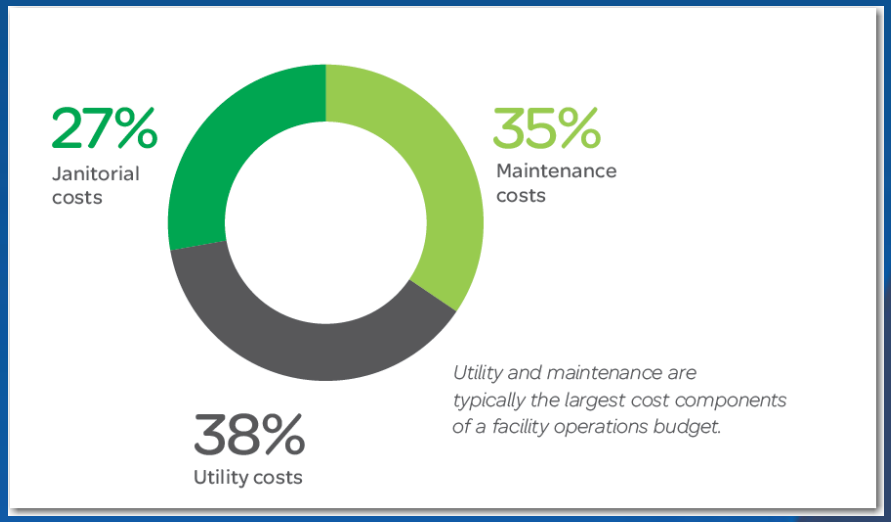
Building Analytics

With Building Analytics, building owners and operators can….
Identify, prioritize and act on cost savings opportunities

With Analytics -

- Take advantage of your building data
- Find hidden costs and inefficiencies
- Optimize operational performance
- Reduce energy expenditures
- Create more environmentally friendly, high-performance buildings

Utility and maintenance …
Typically the largest cost components of a facility operations budget



LONG™
Long live your building!

What do Building Owners and Managers Want?

They are looking for….

- Monitoring based, continuous or ongoing commissioning
- Automated fault detection and diagnostics
- LEED credits
- Performance based utility incentives
- Better service and insight how service resources should be
- Delivering energy and cost savings

Or they want to….

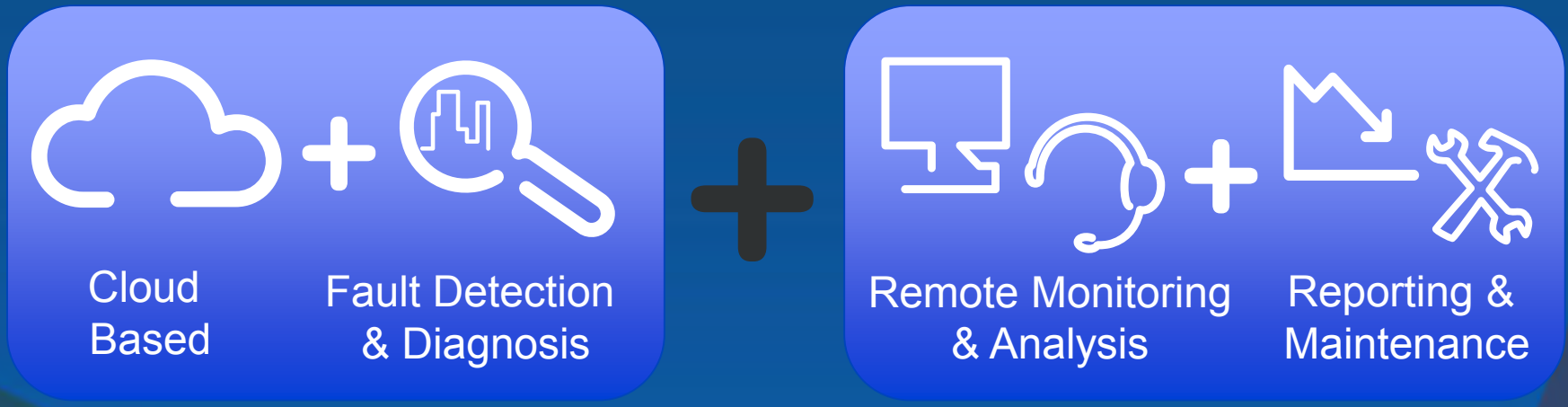
- Have more confidence where spending money for our operations
- Have answers so can make fact-based decisions when investing in improvements
- Know improvements are highest priority that will produce measureable results
- Make real impact to energy, operational efficiency, comfort and the financial well being of our buildings

LONG™
Long live your building!

Building Analytics defined

A SMART managed service…

providing actionable intelligence and expert guidance with clear prioritized asset optimization recommendations that are based on statistical analysis, performance trending, and automated diagnostics with results that improve the energy, comfort and financial well being of buildings.



Software **Services**

LONG™
Long live your building!

Supplements existing BMS

Building Automation System

- integrates building systems
- performs control tasks as designed
- reacts to current state conditions
- provides notification of nonconformance or exceeding threshold settings

Ideal for Operations & Maintenance
to maintain day-to-day building operations

Building Analytics Managed Service

- analyzes trend performance energy, maintenance & comfort information over a given period - day, month, year
- automatically quantifies and identifies persistent performance issues in the building(s) or site
- top issue validation made by experienced building engineer along with recommendations to remedy

Ideal for engineering planning
to pinpoint top energy, maintenance, and comfort priorities that can maximize O&M resources and budget

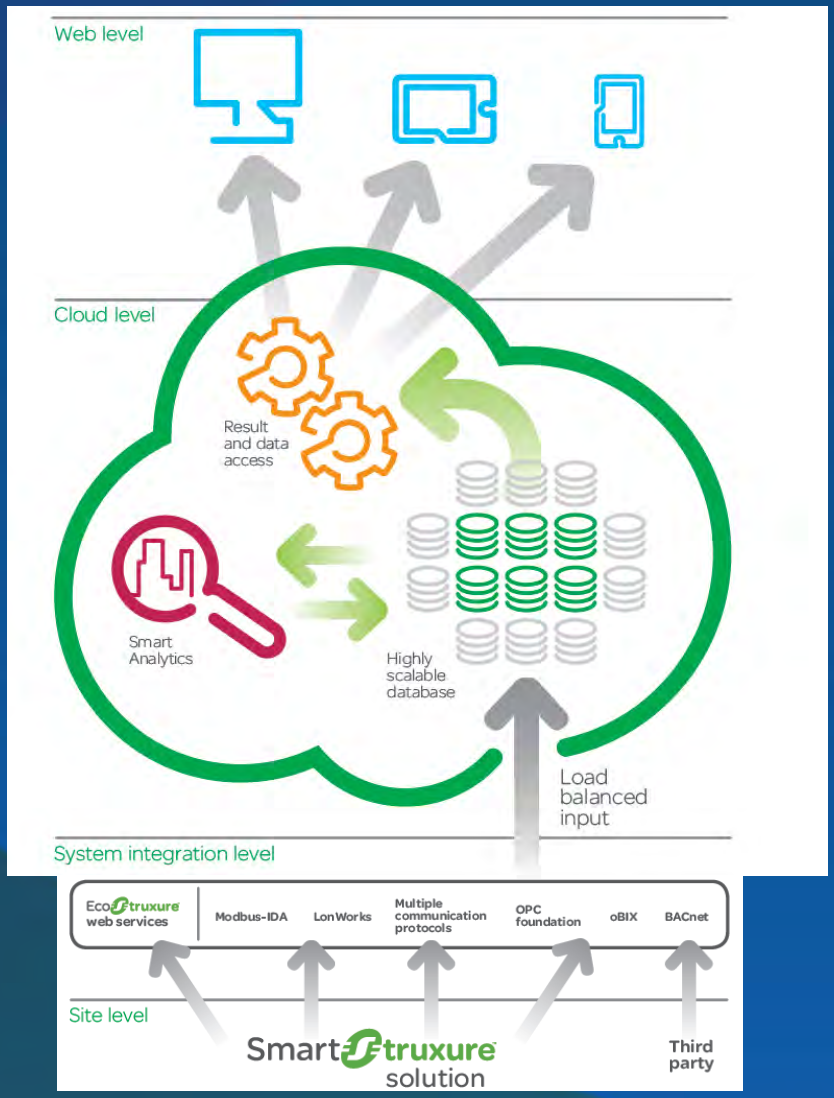
LONG™
Long live your building!

Building Analytics FAQ:

Question	Answers:
How does it help me with planning?	Automated system based diagnostics that identifies faults, inefficiencies, and system degradation with recommendations for improvement
Will it work with my existing systems?	Yes! Cross-platform data integration consolidates information from multiple BAS, buildings and clients
Is this just extended trending?	NO! This is a systemic monitoring approach where the diagnostics are evaluating systems and then the data is converted into coherent analytics with equipment and system faults including opportunities to improve control sequences and operations.
How often do I receive feedback?	System continuously monitors and can alert if immediate concern. Typically, Monthly or Quarterly for trend analysis with periodic report providing prioritized list of efficiency opportunities sorted by energy, cost and comfort impact.
How can I ensure equipment operation?	By continuously monitoring system performance over time and identifying equipment issues provides for more proactive operation
Can I use system for LEED?	Yes! Measurement and verification supports LEED & incentives.

LONG™
Long live your building!

Building Analytics: Architecture

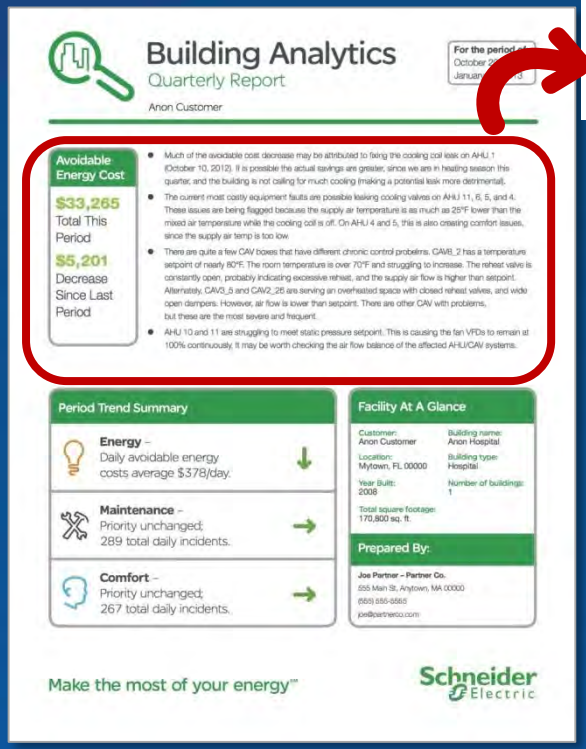


Example of findings…

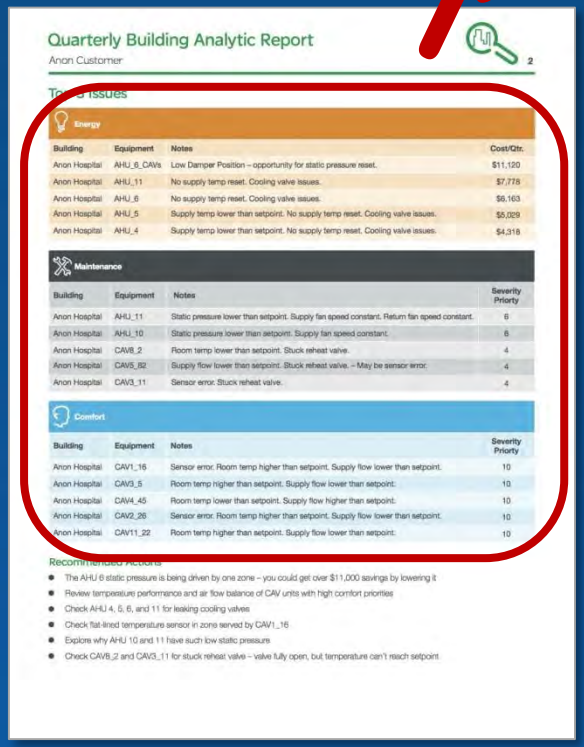
- *Simultaneous heating and cooling*
- *Suboptimal economizer controls*
- *Opportunity for higher/lower loop setpoints*
- *Opportunity for static pressure reset*
- *Leaking valves, broken dampers*
- *Manual overrides*
- *Poor occupancy scheduling*
- *Excessive zone temperature setpoints*
- *Excess reheating*
- *Trends in chiller efficiency*
- *Short cycling*
- *Custom analytics*

LONG™
Long live your building!

Building Analytics: Reporting



Avoidable costs for period AND analyst commentary on building operating issues



Prioritize energy, maintenance, and comfort issues with recommended actions

Trend analysis over time to track performance plus validate repairs

Long live your building!

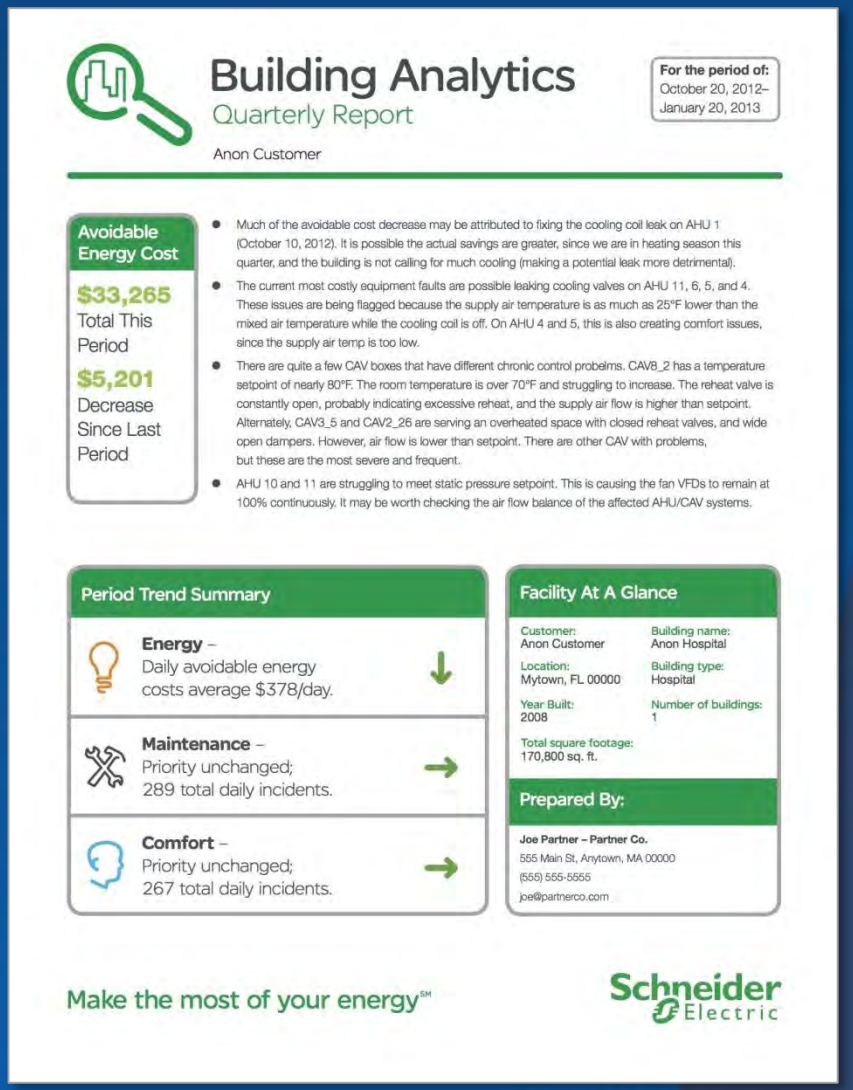
Custom Reporting

Know the WHY and its impact:

Report Period – frequency of analysis review and reporting is selectable service - weekly, monthly, semi-annual, end of year

Expert Opinion – experienced engineer analysis, opinion & recommendation

Trend Summary – over reporting period – avoidable energy, number and trend of comfort, energy & maintenance incidents



Building Analytics
Quarterly Report

Anon Customer

For the period of:
October 20, 2012–
January 20, 2013

Avoidable Energy Cost

$33,265
Total This Period

$5,201
Decrease Since Last Period

- Much of the avoidable cost decrease may be attributed to fixing the cooling coil leak on AHU 1 (October 10, 2012). It is possible the actual savings are greater, since we are in heating season this quarter, and the building is not calling for much cooling (making a potential leak more detrimental).
- The current most costly equipment faults are possible leaking cooling valves on AHU 11, 6, 5, and 4. These issues are being flagged because the supply air temperature is as much as 25°F lower than the mixed air temperature while the cooling coil is off. On AHU 4 and 5, this is also creating comfort issues, since the supply air temp is too low.
- There are quite a few CAV boxes that have different chronic control problems. CAV8_2 has a temperature setpoint of nearly 80°F. The room temperature is over 70°F and struggling to increase. The reheat valve is constantly open, probably indicating excessive reheat, and the supply air flow is higher than setpoint. Alternately, CAV3_5 and CAV2_26 are serving an overheated space with closed reheat valves, and wide open dampers. However, air flow is lower than setpoint. There are other CAV with problems, but these are the most severe and frequent.
- AHU 10 and 11 are struggling to meet static pressure setpoint. This is causing the fan VFDs to remain at 100% continuously. It may be worth checking the air flow balance of the affected AHU/CAV systems.

Period Trend Summary

Energy – Daily avoidable energy costs average $378/day. ↓

Maintenance – Priority unchanged; 289 total daily incidents. →

Comfort – Priority unchanged; 267 total daily incidents. →

Facility At A Glance

Customer: Anon Customer
Building name: Anon Hospital
Location: Mytown, FL 00000
Building type: Hospital
Year Built: 2008
Number of buildings: 1
Total square footage: 170,800 sq. ft.

Prepared By:

Joe Partner – Partner Co.
555 Main St, Anytown, MA 00000
(555) 555-5555
joe@partnerco.com

Make the most of your energy℠

Schneider Electric

LONG™
Long live your building!

Custom Reporting

Know the WHY and its impact:

Top 5 Issues – report will include highest priority issues for energy, maintenance& comfort

Action Items – lists any repairs, changes and next step items open for discussion that can lead to issue resolution

Quarterly Building Analytic Report

Anon Customer

2

Top 5 Issues

Energy

Building	Equipment	Notes	Cost/Qtr.
Anon Hospital	AHU_6_CAVs	Low Damper Position – opportunity for static pressure reset.	$11,120
Anon Hospital	AHU_11	No supply temp reset. Cooling valve issues.	$7,778
Anon Hospital	AHU_6	No supply temp reset. Cooling valve issues.	$6,163
Anon Hospital	AHU_5	Supply temp lower than setpoint. No supply temp reset. Cooling valve issues.	$5,029
Anon Hospital	AHU_4	Supply temp lower than setpoint. No supply temp reset. Cooling valve issues.	$4,318

Maintenance

Building	Equipment	Notes	Severity Priorty
Anon Hospital	AHU_11	Static pressure lower than setpoint. Supply fan speed constant. Return fan speed constant.	6
Anon Hospital	AHU_10	Static pressure lower than setpoint. Supply fan speed constant.	6
Anon Hospital	CAV8_2	Room temp lower than setpoint. Stuck reheat valve.	4
Anon Hospital	CAV5_82	Supply flow lower than setpoint. Stuck reheat valve. – May be sensor error.	4
Anon Hospital	CAV3_11	Sensor error. Stuck reheat valve.	4

Comfort

Building	Equipment	Notes	Severity Priorty
Anon Hospital	CAV1_16	Sensor error. Room temp higher than setpoint. Supply flow lower than setpoint.	10
Anon Hospital	CAV3_5	Room temp higher than setpoint. Supply flow lower than setpoint.	10
Anon Hospital	CAV4_45	Room temp lower than setpoint. Supply flow higher than setpoint.	10
Anon Hospital	CAV2_26	Sensor error. Room temp higher than setpoint. Supply flow lower than setpoint.	10
Anon Hospital	CAV11_22	Room temp higher than setpoint. Supply flow lower than setpoint.	10

Recommended Actions

- The AHU 6 static pressure is being driven by one zone – you could get over $11,000 savings by lowering it
- Review temperature performance and air flow balance of CAV units with high comfort priorities
- Check AHU 4, 5, 6, and 11 for leaking cooling valves
- Check flat-lined temperature sensor in zone served by CAV1_16
- Explore why AHU 10 and 11 have such low static pressure
- Check CAV8_2 and CAV3_11 for stuck reheat valve – valve fully open, but temperature can't reach setpoint

LONG™

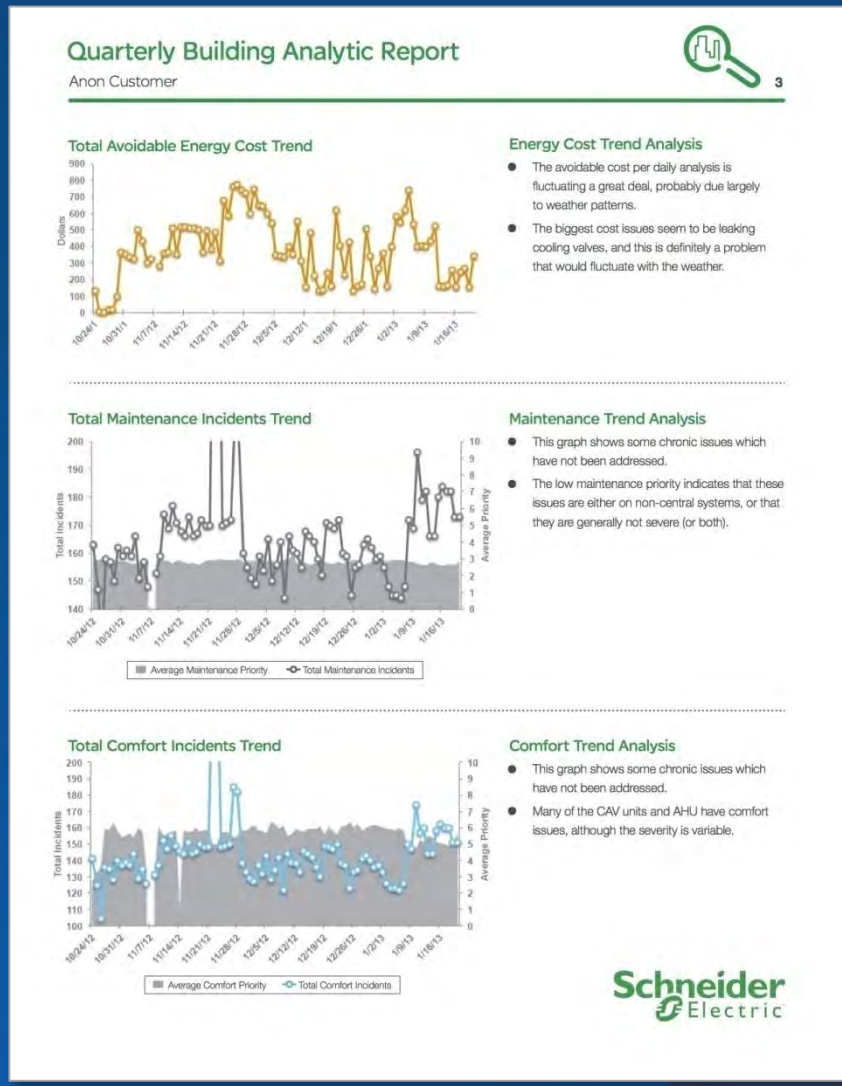
Long live your building!

Custom Reporting

Know the WHY and its impact:

Performance Trend – impact regarding persistent equipment issues and avoidable energy costs impact over analysis period

Commentary – performance trends reinforce recommendations and validate service repairs and impacting positive change



LONG™
Long live your building!

Report Findings: Energy Savings

Avoidable Energy Cost

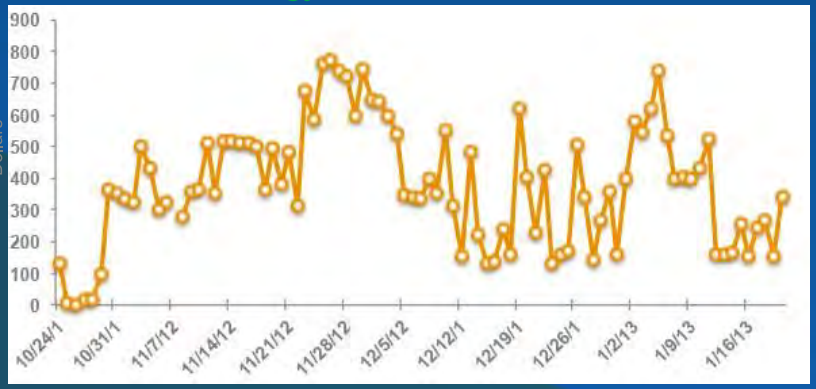
$33,265
Total This Period

$5,201
Decrease Since Last Period

Expert Opinion:
Much of the avoidable cost decrease may be attributed to fixing the cooling coil leak on AHU 1 (October 10, 2012). It is possible the actual savings are greater, since we are in heating season this quarter, and the building is not calling for much cooling (making a potential leak more detrimental).

The current most costly equipment faults are possible leaking cooling valves on AHU 11, 6, 5, and 4. These issues are being flagged because the supply air temperature is as much as 25°F lower than the mixed air temperature while the cooling coil is off.

Total Avoidable Energy Cost Trend



Energy Cost Trend Analysis

- **The avoidable cost per daily analysis is fluctuating a great deal, probably due largely to weather patterns.**
- **The biggest cost issues seem to be leaking cooling valves, and this is definitely a problem that would fluctuate with the weather.**

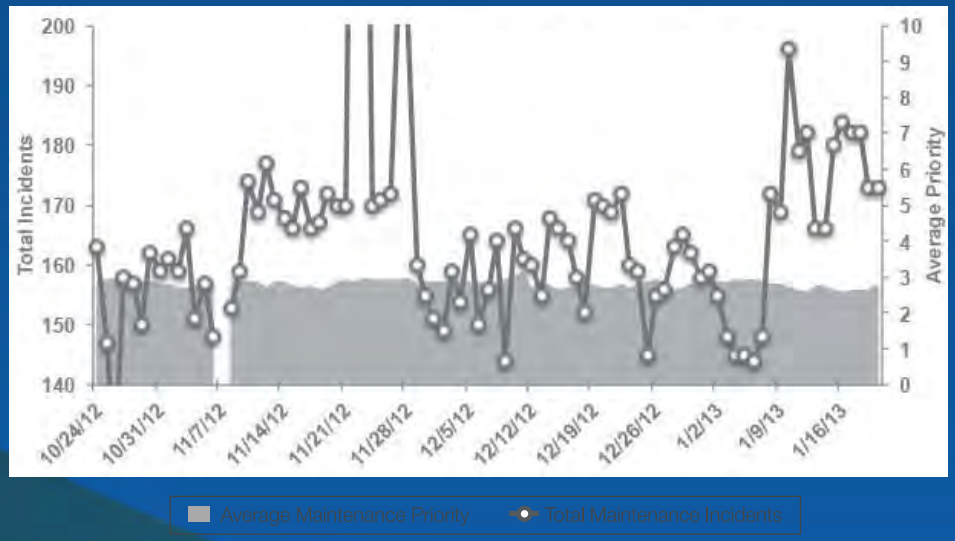
LONG™
Long live your building!

Report Findings: Maintenance Efficiency

Maintenance Trend Analysis

- **This graph shows some chronic issues which have not been addressed.**
- **The low maintenance priority indicates that these issues are either on non-central systems, or that they are generally not severe (or both).**

Total Maintenance Incidents Trend



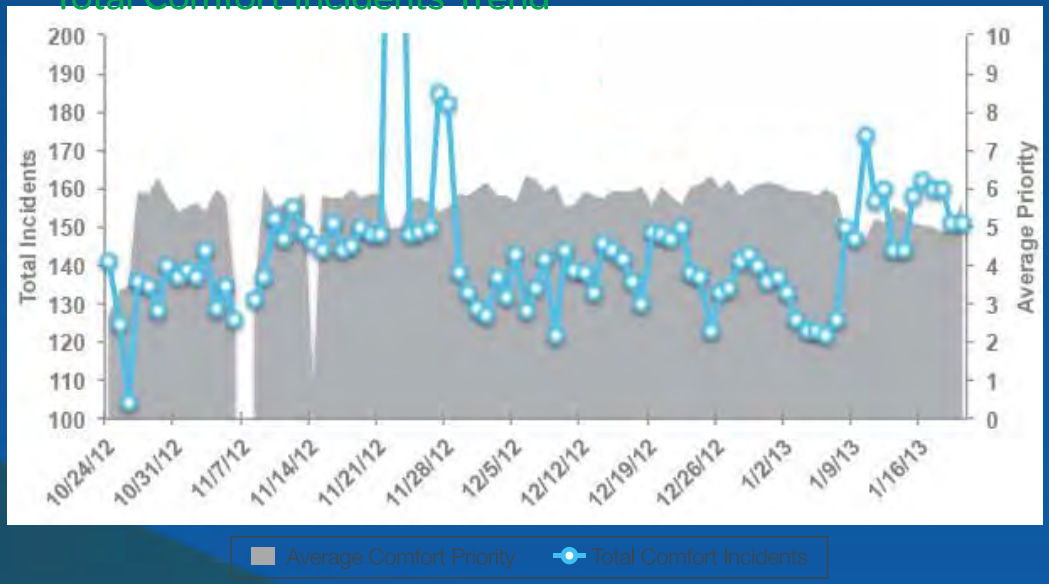
Recommended actions:
The AHU 6 static pressure is being driven by one zone – you could get over $11,000 savings by lowering it.

LONG™
Long live your building!

Report Findings: Comfort Improvement

Comfort Trend Analysis

- **This graph shows some chronic issues which have not been addressed.**
- **Many of the CAV units and AHU have comfort issues, although the severity is variable.**



Recommended actions:
Review temperature performance and air flow balance of CAV units with high comfort priorities.

AHU 4 and 5 are creating comfort issues since the supply air temp is too low.

LONG™
Long live your building!

Demonstration

LONG™
Long live your building!

Questions?

Brian Miller
Vice President
LONG Building Technologies
5660 B Street
Anchorage, Alaska 99518
(907) 561-3044
bmiller@long.com

LONG™
Long live your building!