SkyFoundry

DoE Better Buildings Smart Energy Analytics Award Recipients

SkySpark Case Studies from DoE Award Recipients

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SkySpark® Award Recipients from the Better Buildings Smart Energy Analytics Campaign

SkyFoundry partners and facility owners have been recipients of many of the awards throughout the years of the program. This document provides a selection of case studies from those award recipients.

Through the Smart Energy Analytics Campaign, the U.S. Department of Energy's Better Buildings Alliance, with the Lawrence Berkeley National Laboratory (LBNL), and other key organizers, work with industry to encourage and track adoption of Energy Management Information Systems (EMIS) technology used with monitoring-based commissioning (MBCx) and other energy management processes in the commercial buildings sector.

You can find all of the Better Buildings Smart Energy Analytics Campaign Success Stories at the link below:

https://smart-energy-analytics.org/success-stories

Building Analytics Success Story

Sprint Headquarters

In 2014 Sprint decided to invest in energy analytics for the HVAC systems in their headquarters campus in Overland Park, Kansas. The HVAC systems were well-maintained, but the facilities staff advocated for more advanced tools to help uncover additional energy savings and improve operations. Investing in an energy management & information system (EMIS) has paid off for Sprint, as they embedded performance tracking in everyday operation of their buildings to cut annual energy waste by over $400,000.

Sprint uses Fault Detection and Diagnostics (FDD) software to detect HVAC faults and continuously analyze HVAC operations.

Sprint's FDD software:

- Automatically detects performance problems
- Helps prioritize issues based on cost impact
- Helps visualize the frequency and duration of the fault

In addition to identifying specific system faults, Sprint wanted to ensure they fully captured the true energy impact of their FDD efforts. Fortunately, they had the tools and energy metering in place that allowed them to develop a method for documenting and verifying their savings.

What is FDD?

Fault Detection and Diagnostics (FDD) tools are software that identify building systems performing sub-optimally. FDD is one type of tool known as energy management and information systems (EMIS).

Sprint continuously tracks campus energy consumption, ensuring they stay focused on their sustainability goals. FDD has been a key element in supporting energy saving efforts since 2014.

Sprint's EMIS can identify issues we didn't previously know existed, so we can address them before they become a problem, saving money and providing better comfort for our associates.
- Darrel Carter, Sprint Enterprise Energy Manager

Quick Facts

Location: Overland Park, Kansas

Building type: Office and data center

Gross floor area: 4 million square feet

Total buildings: 20

Service provider: CBRE|ESI

EMIS Tool: SkySpark by SkyFoundry

Energy savings: 4,787,000 kWh savings in calendar year 2016, compared to a 2014 baseline (5% of campus electric use), for $431,000 in cost savings

Smart Energy Analytics Campaign: Recognition for Best Practice in Use of EMIS

In partnership with CBRE|ESI, Sprint received national recognition from the U.S. Department of Energy's Smart Energy Analytics Campaign in 2017, acknowledging their exemplary work to save energy through the use of EMIS.

Building Analytics Success Story

The Franklin

TISHMAN SPEYER

Tishman Speyer was seeking fresh insight into how its two-building downtown Chicago office property – The Franklin – consumed energy. How much opportunity was there to further optimize heating and cooling performance through energy analytics and reduce energy costs? Through a multi-year process beginning in 2015 and supported by ComEd's Monitoring-Based Commissioning (MBCx) incentive program, The Franklin integrated fault detection and diagnostics (FDD) software that helped drive down energy costs by 9%.

The Franklin's MBCx provider implemented an on-line dashboard that provides full FDD transparency to on-site staff. The FDD system identifies sub-optimal system operation and prioritizes efforts to improve occupant comfort and reduce energy use. The Franklin also utilizes ComEd's Business Energy Analyzer interval meter data to perform load analysis and to help establish load shape baselines.

What is MBCx?

Monitoring-based commissioning (MBCx) is an ongoing commissioning process that focuses on analyzing large amounts of data on a continuous basis to improve and maintain building energy performance and comfort.

The combination of FDD and energy analysis tools enables The Franklin's property management team to flag issues, support root cause diagnosis, and verify and maintain performance. However, the software alone cannot optimize performance. The collaboration between the site operations staff and their MBCx service provider has helped ensure that identified issues are resolved and maintained. The support of ComEd's MBCx program has been key to that process.

Wireless sensors and communication bridges were installed to acquire important performance data that wasn't visible through the BAS.
- Jerry Burin, Sieben Energy Associates

Quick Facts

Location: Chicago, Illinois

Property Manager: Tishman Speyer

Building type: Multi-tenant Office

Gross floor area: 2,480,000 square feet

Total buildings: 2

Energy Savings since installation of EMIS: 9% whole building energy savings

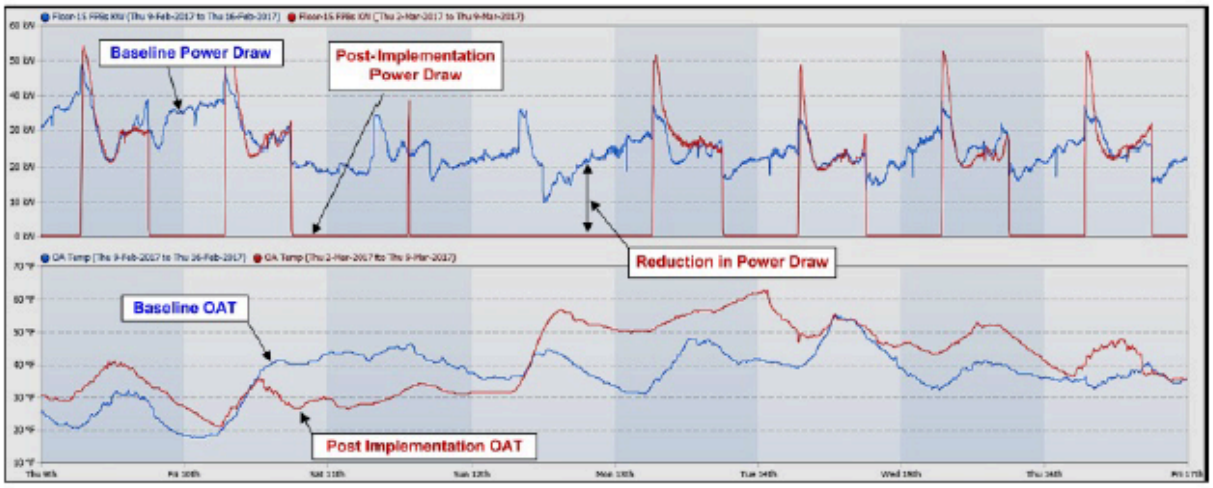
MBCx Service provider: Sieben Energy Associates

EMIS Tools: SkySpark by SkyFoundry and Business Energy Analyzer by ComEd

Smart Energy Analytics Campaign: Recognition for Energy Performance in a Single Site

The Franklin was recognized by Lawrence Berkeley National Laboratory and the U.S. Dept. of Energy in May 2018 for their exemplary work to save energy through the use of energy management and information systems (EMIS).

The Franklin *con't*



Fan-powered VAV box performance monitoring through The Franklin's FDD platform

Analytics Identifies Energy Waste

Major opportunities were identified through the FDD software, implemented, and are currently being tracked using the FDD software to maintain performance. HVAC system improvements include:

- Fan-powered VAV box setback and schedules
- Outside air dampers closed during unoccupied hours
- Modify setpoint of plenum heaters
- Discharge air temperature reset
- Modify setpoint of plenum heaters
- Delay start time of air handlers
- Reduce pressure setpoint of secondary pumps
- Lockout electric heat of VAV boxes during summer

Monitoring Additions Lead to Savings

One example measure at The Franklin illustrates how the addition of monitoring points can help achieve and maintain significant savings. Analysis of building electric meters and power panels serving individual floors showed there was high load during unoccupied hours, with load profiles suggesting it was related to space heating. Upon deeper investigation the project team discovered that the many of the property's fan-powered box night set-back controls had failed, resulting in unnecessary power draw during unoccupied hours. This type of fault is common yet often 'invisible' because such power draw isn't monitored by the BAS. The fault was corrected after installing 282 wireless current transducers to verify unnecessary power draw. These new monitoring points have enabled building staff to monitor performance and flag any future performance issues. This measure alone achieved verified savings of over 2 million kWh per year.

Partnering for Success

The Tishman Speyer project team and Sieben Energy Associates engineers held monthly energy team meetings to review FDD faults and discuss trends that reveal energy reduction opportunities. Following the resolution of performance issues, the FDD software is revisited to verify that faults have been corrected and expected energy savings are being realized.

The Smart Energy Analytics Campaign is a public-private sector partnership program focused on commercially available Energy Management and Information Systems (EMIS) and monitoring-based commissioning practices. The campaign couples technical assistance with qualitative and quantitative data collection to inform research, development, and field study priorities. Partnering participants are encouraged to share their progress and may receive national recognition for implementations that demonstrate exemplary practices.

Building Analytics Success Story

MGM Resorts International

With over 80 million square feet of properties that have undergone extensive renovations over the years, pursuing aggressive energy savings goals is a highly complex undertaking for MGM Resorts International, the Las Vegas-based hospitality company. A variety of building automation systems (BAS) and 24/7 nature of the business creates additional challenges in gathering the necessary data for improving and maintaining operations. With a smart approach to building analytics, MGM Resorts is addressing those challenges and reaping significant savings.

MGM Resorts has achieved significant operational energy efficiencies through retrocommissioning (RCx) projects, but encountered two main challenges:

- Operational improvements can degrade over time
- RCx, built on a manual investigation process, is hard to scale across a large portfolio quickly

In 2015, MGM Resorts decided to augment their RCx efforts by installing fault detection and diagnostic (FDD) software. Nine properties are now equipped with FDD software, covering 39 million square feet of floorspace, and MGM Resorts is seeing a reduction in annual energy costs from the combination of RCx and FDD software.

What is FDD?

Fault Detection and Diagnostic (FDD) software identifies building systems with suboptimal performance. FDD is a type of energy management and information system (EMIS) that analyzes BAS data.

Beyond the significant energy waste reduction, the addition of analytics has changed the organization's energy management culture, and allows for accurate, actionable reporting at all levels of the organization.

When issues arise involving major HVAC equipment, the first call is to the EMIS team to diagnose in the EMIS system. This process helps maintain guest comfort, decrease avoidable service calls and ultimately unnecessary equipment replacement.
- Chris Magee, Vice President of Sustainable Facilities, MGM Resorts International

Quick Facts

Location: Las Vegas, Nevada

Building type: Hotels, convention centers, entertainment/gaming/dining spaces, theaters

Gross floor area covered by FDD: 39 million square feet

Total buildings with FDD: 9

EMIS Tool: SkySpark by SkyFoundry

EMIS service provider: Altura Associates

Smart Energy Analytics Campaign: Recognition for Largest Portfolio Using EMIS

MGM Resorts International received national recognition from the U.S. Department of Energy's Smart Energy Analytics Campaign in 2017, acknowledging their exemplary work to save energy through the use of EMIS.

Building Analytics Success Story
CSU Dominguez Hills

California State University, Dominquez Hills (CSUDH) has fault detection and diagnostic (FDD) software on 22 buildings across campus, tracking data from 183 energy meters and over 9,000 points from their building automation system (BAS). This robust installation didn't happen overnight but was pulled together incrementally over the course of 4 years without a large impact on the facilities budget in any one year.

FDD helps the facilities team find savings opportunities and make sure performance doesn't drift after the implementation of energy efficiency measures. CSUDH's energy manager relies on FDD email alerts and monthly reports created by their service provider. For the 22 buildings with FDD the monthly report lists problems (prioritized by importance) which are then turned into work orders for the facilities team or outside contractors. CSUDH also uses the FDD software to give data to outside engineers for campus master planning to determine current needs for new buildings.

What is FDD?

Fault Detection and Diagnostic (FDD) software identifies buildings with suboptimal performance by analyzing building automation system (BAS) data. FDD is one type of energy management and information system (EMIS).

EMIS Supports Innovation

The data transparency and flexibility provided by CSUDH's FDD system has helped open the door to more holistic opportunities for advanced projects and partnerships. CSUDH uses their FDD software to help validate energy savings from new technologies and control sequences. For example, CSUDH recently installed smart energy valves and used their analytic software to analyze savings.

I shared the data with everyone I could to build excitement around it and show how easy it was to do. The business case built itself by sharing the data and giving log-in access to the anyone that wanted to see more.
- Kenny Seeton, Energy Manager

Quick Facts

Location: Carson, California

Building type: University Campus

Floor area: 1.2 million sq ft

Total buildings with EMIS: 22

Service provider: EcoVox, Inc.

FDD Software: SkySpark by SkyFoundry

Smart Energy Analytics Campaign: Recognition for Innovation

California State University Dominguez Hills was recognized by Lawrence Berkeley National Laboratory and the U.S. Dept. of Energy in May 2018 for Innovation in the Use of Energy Management and Information Systems (EMIS).

CSU Dominguez Hills Success Story *con't*

FDD helps CSUDH ensure systems operate as intended during and after demand response events

FDD has also proven useful in supporting demand response efforts – the FDD software monitors system performance during and after a demand response event to ensure that systems turn down as intended and subsequently return to normal operation. CSUDH's energy manager doesn't believe these and other innovative projects would have been considered if it were not for the easy access to data allowed through the EMIS.

Top Opportunities

The most common measures implemented with the support of CSUDH's FDD software have included:

- Improved HVAC scheduling and setpoints
- Improved economizer control
- Optimized equipment staging
- Control loop tuning
- Reduced VAV box min airflow
- Supply air temperature and duct static pressure resets

The FDD system automatically analyzes their BAS and meter data to look for measures like these and more, focusing facility staff time on optimizing systems and proactive maintenance rather than random inspections and responding to system breakdowns.

Funding the EMIS

Upfront cost is often a major hurdle for organizations getting started with analytics. CSUDH tackled this through implementing their system over the course of multiple projects in phases. For instance, they installed energy meters over many years using in-house labor to save cost. The CSUDH energy manager's mantra is "slow and steady", as he continues to build out his EMIS. He advises to have analytics proposals prepared, to be ready when funding streams become available.

Having FDD gives me the confidence to take on innovative projects, knowing that we'll be able to easily see the performance and cost benefits.
- Kenny Seeton, Energy Manager

CSUDH has performed monitoring-based commissioning (MBCx) twice – the first time resulted in $100,000 energy cost savings, then 6 months later they went deeper and uncovered opportunities for another $100,000 in savings. Now they strive to maintain savings using FDD to identify performance degradation.

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Building Analytics Success Story

Salt Lake City Public Safety Building

Salt Lake City's Public Safety Building is a prime example of how building analytics can be essential in turning a high performance building design into reality. Opening in 2013, the building was designed to achieve net-zero energy, with annual renewable energy generation equivalent to annual energy consumption. As with any complex high performance building design, it takes time and effort to reach peak performance – and that's where building analytics was essential.

After a year of operation, the Public Safety Building wasn't performing to its maximum capability. Systems were operating to original design specifications but actual electric and natural gas usage was above energy model predictions developed during design. To reach net-zero performance, the Salt Lake City energy team initiated a monitoring-based commissioning (MBCx) project at the Public Safety Building in 2015. MBCx combines a detailed operational assessment with building analytics to identify and fix deficiencies, and then to ensure that energy savings persist.

What is FDD?

Fault Detection and Diagnostics (FDD) tools are software that identify building systems performing sub-optimally. FDD is one type of tool known as energy management and information systems (EMIS).

Salt Lake City's MBCx project utilized fault detection & diagnostics (FDD) software to continuously analyze HVAC system performance. Through FDD and additional analysis of the control systems, the following issues were identified and resolved:

- Simultaneous heating and cooling
- Over-ventilation of occupied spaces
- Air handlers operating during unoccupied periods

We were running the air handler as hard as it can go and our gas usage was high – our FDD software helped us find and fix the problems.
- Cameron Scott, Energy/Utilities Coordinator

Optimizing the control of the air handlers, chilled beams, and radiant floors contributed to an overall 57% reduction in natural gas consumption from the MBCx project.

Quick Facts

Location: Salt Lake City, Utah

Building type: Office and data center

Gross floor area: 175,000 square feet

Energy Star Score: 100

Rating: LEED Platinum; Carbon net-zero

EMIS Tools: SkySpark FDD software, Luminetric monthly bill tracking software

Energy Savings: 2016 saw 35% reduction in gas and electric combined, compared to a 2015 baseline

Smart Energy Analytics Campaign: Recognition for Energy Performance

Salt Lake City received national recognition from the U.S. Department of Energy's Smart Energy Analytics Campaign in 2017, acknowledging their exemplary work to save energy through the use of EMIS.

Salt Lake City Public Safety Bldg *con't*

Salt Lake City's FDD system continuously monitors all building HVAC equipment (Source: Salt Lake City)

Optimize & Maintain

The Public Safety Building MBCx project saw overall energy savings of 35%, but that's not the end of the story. Salt Lake City is continuing its use of FDD to ensure that performance is maintained or improved over time. FDD software can alert facility staff immediately if performance drops over time, for example due to:

- Sensor or equipment failure
- Equipment controls being over-ridden
- Changes in building occupancy patterns

In addition, the FDD software programming can be refined to cover more systems or to hone control settings further.

The Bottom Line

Salt Lake City's MBCx efforts have resulted in the Public Safety Building achieving the maximum Energy Star rating of 100. While FDD software is monitoring the performance of individual building systems, Salt Lake City is also tracking whole building energy consumption with monthly utility bill tracking software. The combination of FDD and monthly energy use tracking helps ensure that they are meeting and maintaining their overall building performance targets. Salt Lake City has shown that their FDD investment paid back within one and a half years.

Due to the complexity of the building, it is necessary to have software analyzing the data to ensure our systems are working well
- Cameron Scott, Energy/Utilities Coordinator

Following the success of the Public Safety Building, Salt Lake City's energy team plans to expand its MBCx process to more buildings across the city.

The Smart Energy Analytics Campaign is led by the U.S. Department of Energy to support commercial building owners in adopting energy management and information systems (EMIS). The program provides technical assistance, recognition opportunities, and a chance to network with industry-leading peers. Whether you have an established EMIS or are in the early stage of considering EMIS, the Smart Energy Analytics Campaign will support your move to the next level. Learn more at smart-energy-analytics.org

Building Analytics Success Story
U.S. General Services Administration

In 2012 GSA started implementing fault detection and diagnostics (FDD) in their buildings. Six years later, this work forms the core of a national platform called GSALink, serving 85 buildings and over 52 million square feet. GSA analyzes energy meter and building automation system (BAS) data to get the full picture of operations, detecting faults and identifying energy trends. They bring new points into their EMIS as needed for FDD, verification of savings, and other reporting - 140,000 points to date have been integrated.

But the most impressive part about their effort is the savings they've seen across their portfolio. For 57 of the buildings reporting, they reduced whole building energy use by 14% through a combination of operational improvements and retrofits.

What is an EMIS?

Energy management and information systems (EMIS) store, analyze, and display energy use and system data. EMIS is an umbrella term that covers both energy meter analytics and fault detection using building automation system data.

Making EMIS Accessible

The GSALink team has developed an EMIS interface that is usable by staff who are not engineers. A facility manager views faults prioritized by estimated cost impact, and they work with their O&M staff to review the underlying trends and troubleshoot the issue.

With the connection of GSALink into GSA's maintenance management system, the faults can be turned into work orders. Faults are categorized in the system (completed, deferred due to cost, requested service provider review), which streamlines tracking and reporting.

We've designed our EMIS so you don't need to be an engineer to use it. A centralized support center helps our facility managers work through and act on the analytics.

- Chip Pierpont, GSA Facility Technologies

Quick Facts

Location: Nationwide

Building type: Offices, courthouses, other federal facilities

Gross floor area: 52 million sq. ft.

Total buildings: 85

Energy reduction since EMIS installed: 14% whole building energy reduction for 57 buildings

Service provider: CBRE|ESI

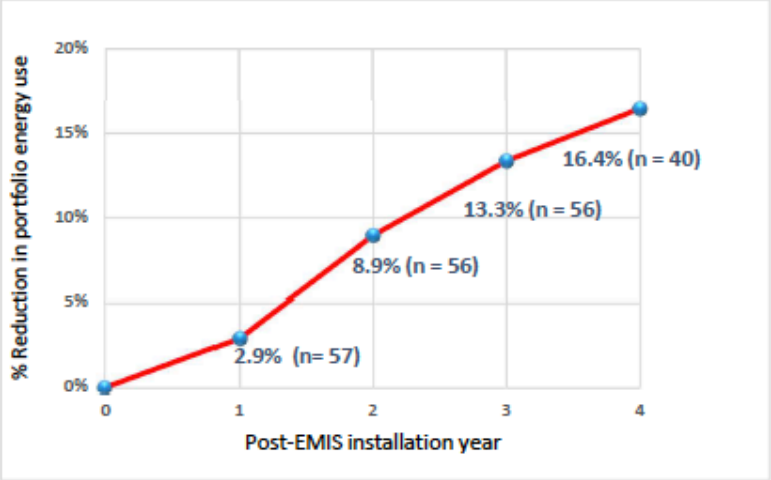
EIS Software: Schneider ION for energy meter data

FDD Software: SkySpark by SkyFoundry

Smart Energy Analytics Campaign: Recognition for Energy Performance of a Portfolio

The U.S. General Services Administration was recognized by Lawrence Berkeley National Laboratory and the U.S. Dept. of Energy in May 2018 for their exemplary work to save energy through the use of EMIS.

U.S. General Services Administration *con't*



Portfolio-level savings increases since GSALink implementation; overall mean savings is 14%
n=number of buildings with 1 or more years of post-implementation data

Scaling EMIS to a Large Portfolio

GSA set up their EMIS data management and analytics platform so that it could scale up to serve a significant portion of their 1,500 buildings. By investing in up-front design and programming, the current integration costs of adding a new building to the platform are greatly reduced.

Utilizing a nationwide standard and software platform is key to the scalability of GSA's EMIS solution. As buildings are added, the overall cost per building is driven down through economies of scale. Also, having a scalable architecture allows the GSA the flexibility to adapt to new technology and include those data points for analysis at a minimal cost to existing buildings.

GSA's central energy group analyzes reports daily from the EMIS, and provides quarterly and on-call support to facility managers across the country. This centralized support structure (including GSA staff and service providers) will help the organization scale in the future without needing analytics expertise within every facility.

Analytics saves $0 on its own. You have to take the analytic results and go fix stuff.
- Chip Pierpont, GSA Facility Technologies

Using Meter Data Analytics

Analysis of meter data doesn't have to be a manual and time-consuming process. GSALink automates the analysis of whole building meter data to detect the following issues:

- Building starting too early or running too late
- Peak demand spikes during occupancy
- Equipment impact on demand of the facility
- Load profile analysis to identify demand response load shedding opportunities

GSA avoids flagging faults for one-off occurrences and instead looks for trends and compares energy metrics (normalized for weather and building size) across facilities.

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Building Analytics Success Story

University of California, Davis

UC Davis has a long-standing commitment to energy efficiency and building analytics – and it shows. As an early adopter of energy management and information systems (EMIS) they have had almost a decade of continuously improving the quality of their data, skills, and tools to reap significant savings. The campus energy team has now moved to a new level with campus-wide occupant engagement dashboards and a fault detection & diagnostics (FDD) pilot.

Fault Detection & Diagnostics Pilot

UC Davis has chosen two buildings as a pilot for SkySpark fault detection and diagnostics (FDD) software. Having already improved performance through existing building commissioning (EBCx) and a review of building automation system (BAS) controls, FDD software preserves those savings and enables deeper analysis with continuous monitoring.

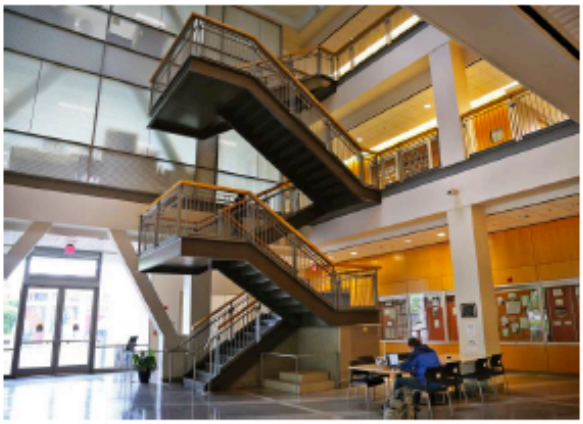
What is FDD?

Fault Detection and Diagnostic (FDD) software identifies building systems with suboptimal performance. FDD is a type of energy management and information system (EMIS) that analyzes BAS data.

The types of optimization opportunities uncovered by the FDD software to date include:

- Temperature sensor failure
- Valves cycling on/off unnecessarily
- Smoke dampers stuck closed
- HVAC operation not matched to occupancy

The two pilot buildings have reaped 22% and 24% savings through the combined EBCx/FDD efforts.



We use FDD to look for sensor values that are constant. We've found significant savings related to failed sensors
- Sam Cole, Energy Project Engineer

Quick Facts

Location: Davis, California

Building type: Classrooms, Labs, Offices, Assembly Spaces

Gross floor area with EMIS: 8 million square feet

FDD Tools: SkySpark

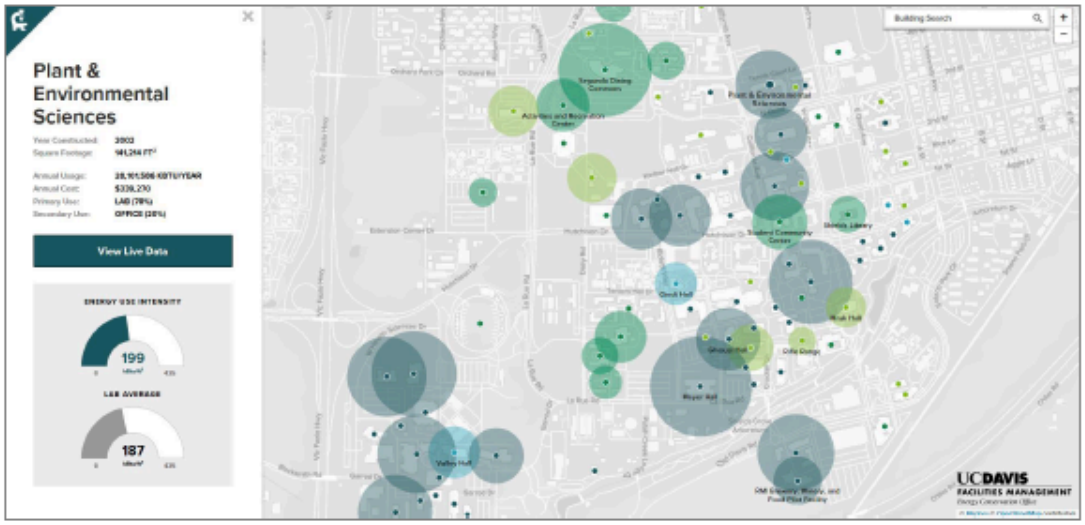
EIS tools (developed in-house): Campus Energy Education Dashboard (CEED), and TherMOOstat occupant feedback dashboard/app

Energy Savings: 22% and 24% (pilot buildings)

Smart Energy Analytics Campaign: Recognition for Innovation in the Use of EMIS

University of California Davis received national recognition from the U.S. Department of Energy's Smart Energy Analytics Campaign in 2017, acknowledging their exemplary work to save energy through the use of EMIS.

University of California Davis *con't*



UC Davis developed the public Campus Energy Education Dashboard (CEED) to raise awareness (Source: UC Davis)

Occupant Engagement Dashboards

In 2014 UC Davis developed a comprehensive web-based energy information system (EIS) to support campus-wide occupant engagement. The Campus Energy Education Dashboard (CEED) incorporates user-friendly graphics showing energy and water usage data for over 100 buildings, not only raising awareness of building usage but also supporting conservation competitions among occupants of different buildings.

The EIS is crucial both as a communication tool and also as a means to track and report on energy savings over time.

In the Comfort Zone?

Alongside the web-based EIS UC Davis also developed an engagement tool called TherMOOstat. Using a web-based interface occupants of any building can flag comfort conditions on a on a 5-point scale from hot to cold. This tool not only allows facility staff to respond to individual issues but also to track which buildings have persistent issues worthy of deeper analysis.

To date over 6,200 users have submitted feedback via TherMOOstat, with hundreds of new users being added every month.

People can't act on energy use if they don't know how much they use and how it's changing over days, seasons, years, etc. Our EIS does this for both the campus community and for our team
- Kiernan Salmon, EIS Project Developer

UC Davis has invested significant effort in ensuring access to reliable, accurate data from their campus meters and BAS. Aside from public-facing energy dashboards, accurate energy data is also being used to develop energy models that take weather variation into account. Weather-normalized energy models are being used for measurement & verification, demonstrating the benefits of UC Davis' energy improvement projects and giving campus leadership the confidence to support further project investment.

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SkySpark – Analytics for a World of Smart Devices

The past decade has seen dramatic advances in automation systems and smart devices. From IP connected systems using a variety of standard protocols, to support for web services and xml data schemas, it is now possible to get the data produced by the wide range of devices found in today's buildings and equipment systems.

Access to this data opens up new opportunities for the creation of value-added services to help businesses reduce energy consumption and cost and to identify opportunities to enhance operations through improved control, and replacement or repair of capital equipment. Access to the data is just the first step in that journey, however. The new challenge is how to manage and derive value from the exploding amount of data available from these smart and connected devices. SkyFoundry SkySpark directly addresses this challenge.

The new frontier is to efficiently manage and analyze data to find what matters.

About SkyFoundry

SkyFoundry's mission is to provide software solutions for the age of the "Internet of Things". Areas of focus include:

- Building automation and facility management
- Energy management, utility data analytics
- Remote device and equipment monitoring
- Asset management

SkyFoundry's software helps customers derive value from their investments in smart systems. Learn more and request a demonstration at www.skyfoundry.com.

SkyFoundry

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