SkyFoundry

SkySpark® Case Study - Analytics in Action at the University of British Columbia

UBC's Pathway to Driving Value from Big Data

Case Study
July 2021

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Analytics and Fault Detection at UBC

In this case study, the University of British Columbia share's their journey of implementing analytics – a process of starting slowly, building value along the way, and generating buy-in across all levels of the organization. It describes a range of analytics use cases at UBC, highlighting how FD&D might bring value to your organization in ways you may not have considered.

To date, almost 100,000 data points have been integrated into UBC's SkySpark system, with data from over 160 buildings, representing over 1.5 million square meters (16 million sq. ft.) of floor space. SkySpark gathers data from UBC's BMS system, the industrial controls managing the 60 MW District Energy System heating plants, the utility metering systems, and more.

Today, SkySpark has become an invaluable part of the conservation group's efforts, generating more than **$10 million per year in recurring savings.**

Some Facts About the UBC Campus

The **University of British Columbia** (**UBC**) is a public research university with campuses in **Vancouver** and **Kelowna**, British Columbia. Established in 1908, UBC is **British Columbia**'s oldest university. The university ranks among the top three universities in Canada. With an annual research budget of $600 million, UBC funds over 8,000 projects a year. Utility distribution for the entire campus is by provided UBC itself. Some stats:

- 55,000 Students
- 18,000 faculty & staff
- 60,000 daily visitors to campus (pre-COVID)
- 100 buildings
- 500,000m2 (50 million ft2) academic floor space
- 200,000m2 (20 million ft2) residence floor space

UBC is in fact, a small-sized city

About Energy & Water Services

The UBC Energy & Water Services (E&WS) department was created in 2014 to manage utilities across the campus. Half of the department maintains all utilities exterior to buildings; the other half are the Energy Conservation and BMS teams. A key part of the group's mandate is to demonstrate new and innovative energy conservation solutions and strategies.

Sustainability Initiatives at UBC

- Replacement of the original steam system from 1917 with hot water DES. This project took 4 years and cost ~$100 million
- Addressed ~$90 million in deferred maintenance on equipment systems
- Installed a Bioenergy facility
  - 6 MWth biomass gasifier
  - 2 MWth/1.5MWe cogeneration engine
- Implemented analytics and FDD across 1.5m m^2

Enter Analytics and Fault Detection & Diagnostics

The E&WS group started exploring topic of analytics in 2016. They attended countless webinars and demonstrations by various companies. Based on these research efforts UBC decided to pilot test two options, one of which was SkySpark by SkyFoundry. The project started with a small SkySpark license of 200 points purchased through Yorkland Controls, SkyFoundry's VAD for Canada. The goal was to "just try it out". As you will see, it led to much more than the original test.

Results of UBC Efforts with SkySpark Analytics

What has UBC done with analytics? How has it added value?

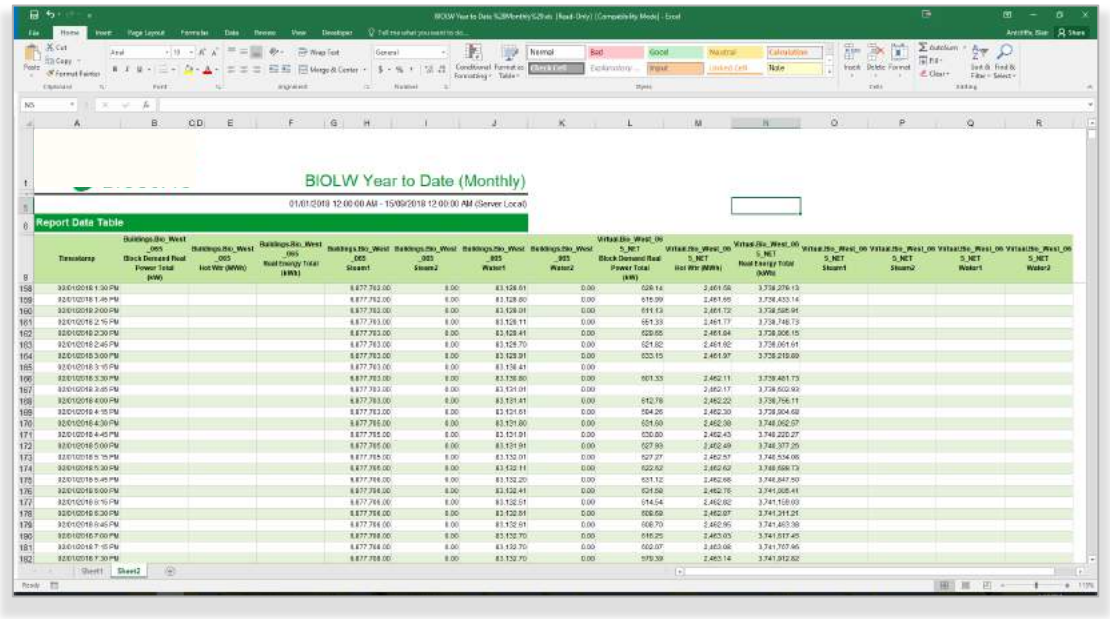
The following examples show a range of applications that demonstrate how the university benefitted from the application of analytics.

Use Case: Building Benchmarking

The old way:

Manually download energy data from metering system…

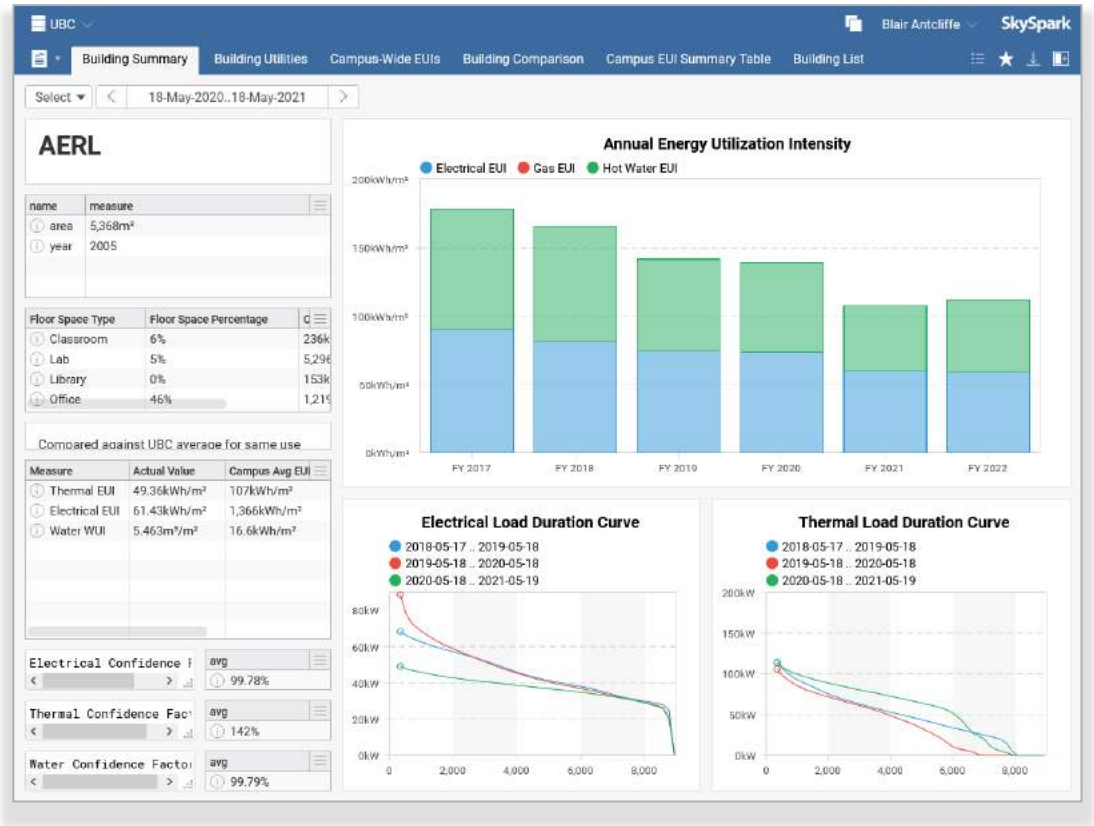
Paste into an excel spreadsheet with a gazillion macros! Painful and inefficient!



Due to the effort required, these manual analyses were limited to a maximum of 4x per year

The New Way: Benchmarking with SkySpark

SkySpark automatically gets energy data from the UBC metering database. Any necessary calculations and transformations are performed continuously and in real-time. The automated process provides quick identification or errors in data. SkySpark's View Builder tools enabled quick creation of customized view to presents results in a format to meet UBC needs as shown in the view below. With SkySpark, these views are always up to date and available to the team. The result - building benchmarking is now a continuous process:



The BMS Data Warehouse – Bringing All BMS Data into SkySpark

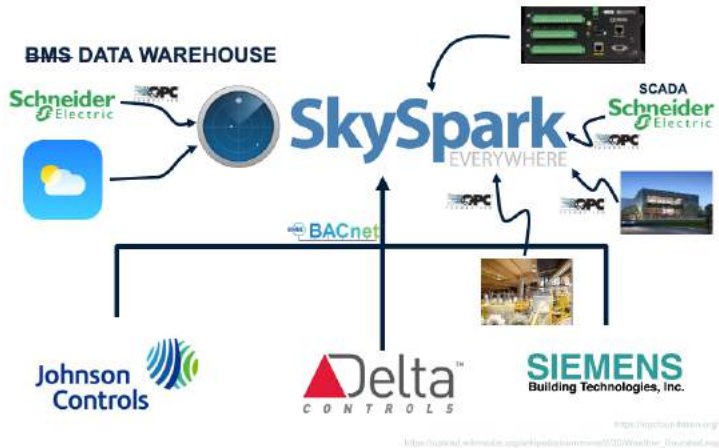
UBC has three different approved BMS controls vendors, each with their own data archiving solution.

SkySpark was used to continuously synchronize *all* trendlogs from all of the BMS, to ensure no data was lost. The system is currently syncing data from ~80,000 trend logs in about 20 minutes.

Going Beyond the BMS – Moving to a Unified Data Warehouse

Based on how well it worked well for BMS data, UBC started bringing data into the system from other sources creating a unified data warehouse. Systems included:

- Utilities metering system in real-time
- Weather station on campus (forecasts & observations)
- Remote air quality station for emissions monitoring from biomass facility
- Electrical submeter SCADA system
- DES Plants' industrial controls systems

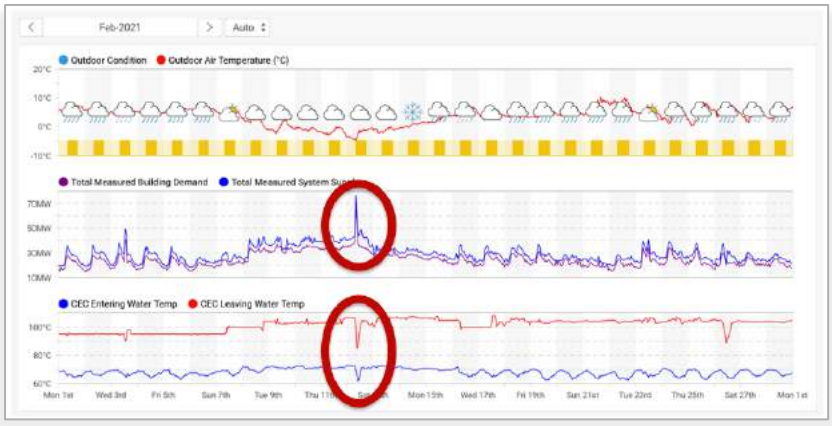


Use Case: The DES View – Bringing it All Together

One of the major advantages is that the SkySpark platform allows for easy viewing of the data from BMS alongside plant operational data and energy data. The view below shows the "Total measured building demand" which is the sum of all the individual buildings' energy meters (connected to BMS). Note that some buildings don't have connected meters, hence the constant gap.

In this example, we can clearly see that on Monday, Feb 12th, a leak in the system required that operators refilled in the morning, leading to a spike in plant power to heat all that new cold water.

Operators leave this and other highly informative views open in the control room at all times to monitor system performance.



Use Case: Applying Analytics to M&V Activities

The ability to have BMS and meter data combined in a single platform dramatically streamlined the effort to perform Monitoring & Verification on projects at UBC.

- Option C (whole building) using meter data
- Option A (key parameter measurement) for most projects, e.g. before/after of fan speed after programming a static pressure reset

Option C is fairly standard in M&V, with the features available in SkySpark for storing historical data and overlaying different time periods features, option A was able to be utilized as well, providing deeper understanding of before-and-after energy use patterns.

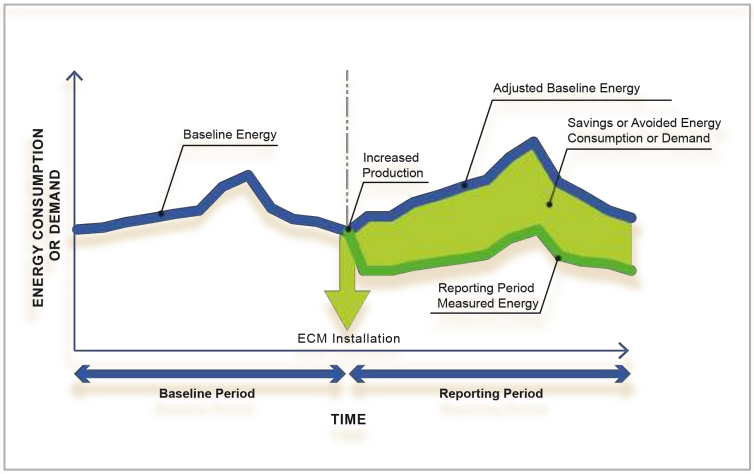


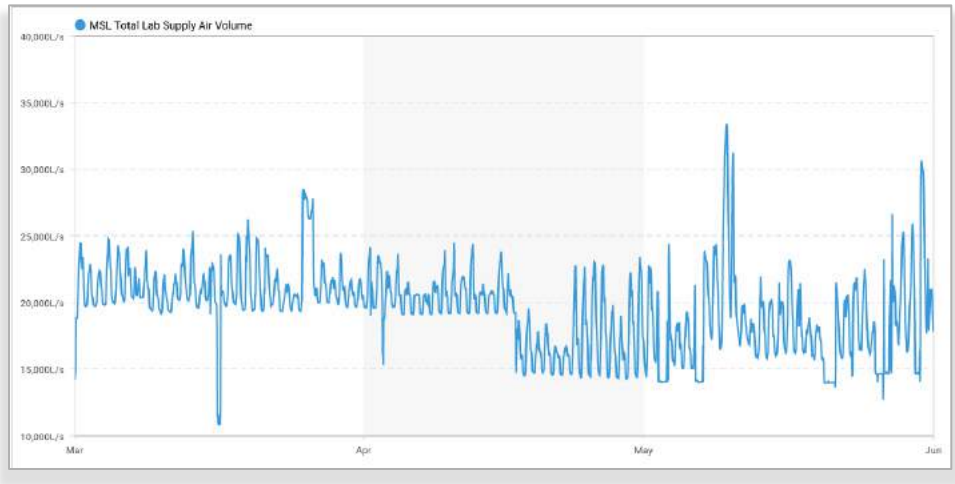
Image source: https://energywatch-inc.com/ipmvp-options/

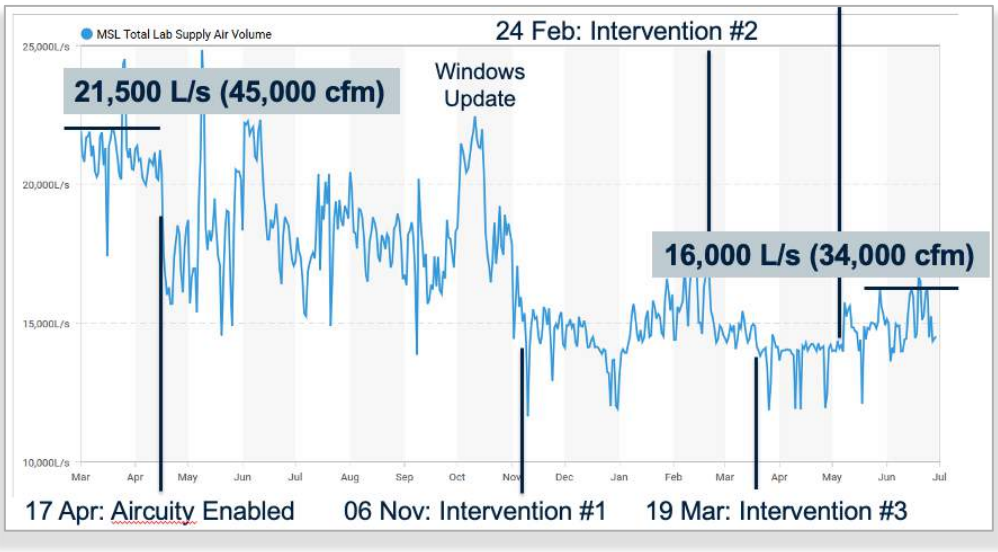
Use Case: Aircuity Lab Airflow

The UBC team installed equipment in a lab building which was desigend to help to reduce airflow rates in the lab spaces. Here again, data analysis by subject matter experts was a key part of the project. To do this level of data analysis the old-fashioned way would require downloading the BMS trends from sixty-four separate air valves, paste them all into excel, hope the timestamps line up, hope excel doesn't crash…

SkySpark provided a much more effective solution to view and analyze the performance of all of the lab air flows as shown below in a chart from the Historian App:

SkySpark easily normalized and correlated the data from the air valves (chart above), but there is still a lot to absorb. One function in SkySpark UBC transformed all of that data into something that could quickly and easily show the project's impacts. The function totalized all of the airflow values, providing a single trend (below). The result clearly showed that the reductions in airflow that were expected to be achieved with the system **were not being seen**. Tuning the control parameters eventually resulted in reducing average airflow rates by 25% resulting in significant energy and cost savings. See next image →





The key point demonstrated in this example is that UBC was able to track the results of interventions and adjustments to the new system easily in SkySpark and achieve the performance expected with the investment in the airflow management system.

Using Automated Analytics to Identify Opportunities

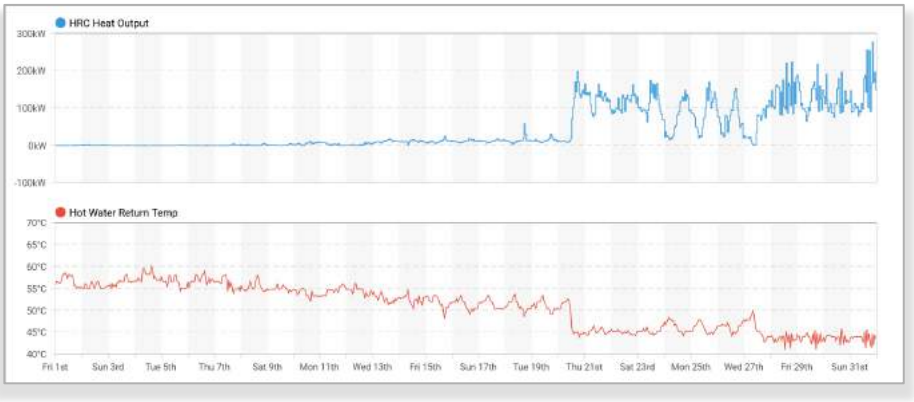
With all BMS and energy data in SkySpark, UBC could effectively use the system to look for energy conservation opportunities. The process is still not fully automated though! All of these examples shown are based on manually looking at trends using SkySpark's data visualization tools – including both the Historian and Axon scripts to create custom data views.

Implementing analytic rules to automatically find the trends the team identifies based on their expertise is **the next step**. Read on →

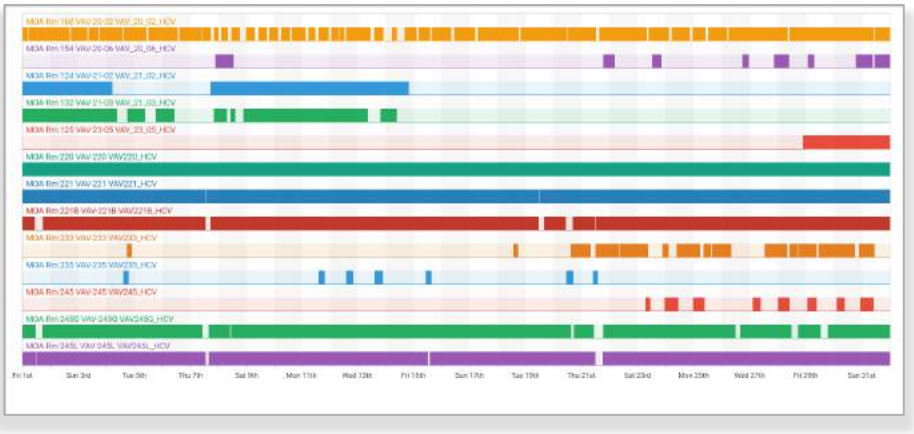
Use Case: MOA Reheat Valves

As part of their energy efficiency initiatives, UBC sent invested $500k on installation of a Heat Recovery Chiller in November of 2018. SkySpark was used to analyze its performance.

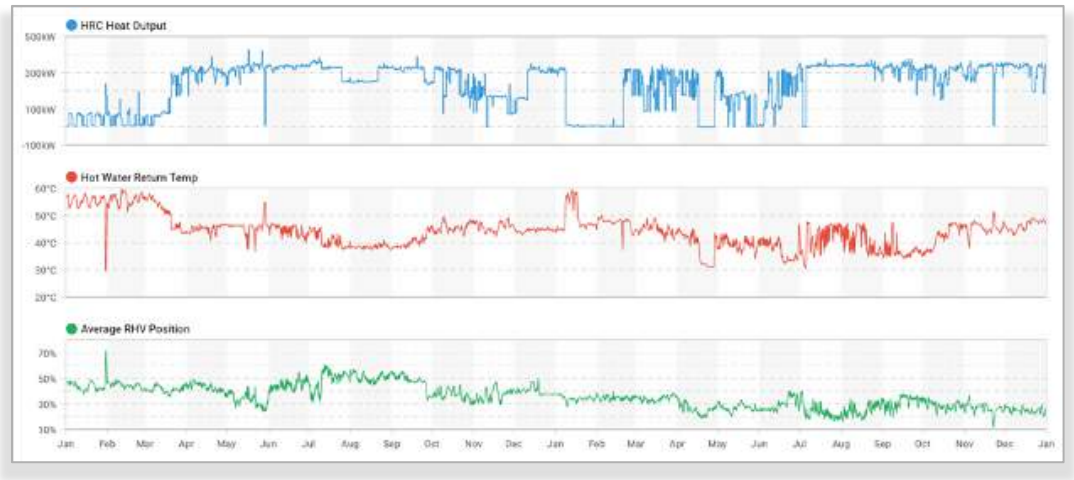
What was learned: “The HRC was very sensitive to its condenser-side entering water temperature. If too high, it would trip and shut off. To maximize our use of the HRC, we’d have to find ways of reducing heating loop temp.” See chart below.



Analytic rules were written to automatically look for those specific behavior patterns resulting in “sparks” that show exactly when and where the inefficient conditions were occurring. The view below shows all terminal unit valves open greater than 90% for at least 4 continuous hours in the month of March 2019. It was found that they were actually pressure-independent valves, many of which had been undersized. The worst performing valves were replaced, and loop temperature was reduced slightly. It was found that an additional set of valves were open continuously. These were also replaced.



Based on this analysis, 31 reheat valves were replaced in six batches from March 2019 to October 2020. The HRC is now running much more effectively as can be seen in the chart below.



Today – 5 Years Into UBC's Analytics Journey

The SkySpark® analytics platform is integrated into a Continuous Optimization Program and UBC is now moving further into Automated FD&D by applying analytic rules and algorithms to automatically identify issues, faults and opportunities for savings.

"A key part of the program's success is to integrate analytics 100% into team workflow. The UBC team is comfortable using SkySpark, and it's become an invaluable part of the conservation group's efforts, generating more than **$10 million per year in recurring savings**. It's been a clear success."

Blair Antcliffe, Energy Engineer

UBC Energy & Water Services

THE UNIVERSITY OF BRITISH COLUMBIA

SkyFoundry would like to thank UBC for providing this detailed summary of their experiences in the process of implementing a large scale SkySpark system to support their energy efficiency initiatives.

We would also like to thank Yorkland Controls for their support of the project.

Contact Yorkland at: https://www.yorkland.net/

SkySpark® – Analytics for a World of Smart Device Data

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 "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.

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