

# Capturing Building System Data for Better Facility Performance



## Summary

Between January and May 2015, the Smart Buildings Center (SBC) deployed and evaluated two new technologies designed to quickly and cost-effectively derive more meaningful value from Building Automation System (BAS) data. BuildPulse (company and product have the same name) and Trendr (a Building Robotics product) both combine hardware, software, and cloud storage to connect to BAS and acquire relevant data points. More robust data acquisition, trending, and reporting functionalities can help building owners and operators better understand their facilities and proactively manage performance, with the ultimate goal of reducing energy costs and increasing occupant comfort. The technology demonstration identified immediate energy-savings opportunities and promises to generate additional time and energy savings benefits over a longer term deployment of the products.

**Business Challenges: BAS 'business as usual' racks up time, money, and missed opportunities**

A typical building automation system (BAS) draws data from hundreds of types of sensors and systems, all with their own complexities, to produce thousands of points of information. The primary purpose of this information is to optimize the control of building systems such as HVAC, lighting, plumbing, and security. By regularly tracking changes in system performance, a BAS can also help verify that building improvement projects are delivering their predicted energy savings.

Currently, it takes a significant amount of manual effort and added expense to take full advantage of a BAS's capabilities. Aggregating, trending, and analyzing data across even the most common systems requires a wide range of controls engineering expertise. Even where in-house technical expertise is high,

extracting actionable data is a hands-on process that takes time to download and sift through cumbersome .CSV spreadsheets. Capturing more data through the BAS can often involve significant upfront costs depending on the system and manufacturer. Adding more advanced analysis attaches more costs to the business of trending and analyzing data.

Additionally, the fault detection process either requires further controls programming to set alarms for when the system performs outside the intended sequence or requires engineers to regularly manually check the system. Furthermore, while meter-level intelligence delivered via alarms or manual checks can help identify problems, it does not offer insight into solutions.

Finally, most BAS have finite trend data storage limits, and most controls vendors store just enough data to service the systems. The reasoning is sound: too much trending in a BAS can affect the performance and compromise control of the building systems, but it adds up to a missed opportunity to leverage this wealth of granular data produced over time.

## Potential Solutions

**BuildPulse** and **Trendr** address these challenges by combining hardware, robust analytics software, a cloud storage system, and a user-friendly tracking and reporting interface program to enhance building operators' ability to monitor and verify building operational performance while cutting down on the level of effort required to do so.



## Technologies Profile

Both technologies require installation of plug-and-play devices (small black boxes) on the client's IP network. Using proprietary technology, the devices first perform a discovery on the BAS to automatically identify data points within the controls system. Data is then transferred over the client's local area network or a separate cellular connection to the cloud-based

software interface. Here the two technologies differ. BuildPulse uses a proprietary algorithm to whittle down tens of thousands of points into a subset of points that most impact operational performance of the facility. Trendr relies on users to manually select the points they want to see reported.

Once this discovery process is complete, users can log into the software user interface to see the points captured, add additional data points if desired, and generate reports. BuildPulse also includes a daily reporting function that identifies variances.

### Pilot Project Methodology

The Smart Buildings Center’s Accelerated Technology Deployment (ATD) program provided an opportunity to test the hypothesis that buildings waste energy because operators do not have a quick and effective means of monitoring performance in real time. As part of the project, BuildPulse was deployed in two buildings at McKinstry’s Seattle office and at a building and central plant at Seattle Pacific University (SPU). Trendr was also installed at the two SPU buildings. Staff members from McKinstry, a construction, energy and facility services firm based in Seattle, and Paladino & Company, a green building and sustainability consulting firm also based in Seattle, supported the deployment and evaluation process. McKinstry’s office is comprised of two single-story buildings totaling approximately 140,000 square feet. Built in the 1940s, the buildings were originally designed as warehouses and have been retrofitted multiple times, resulting in a mix of new and old mechanical systems and controls technologies. Portions of the space operate at all hours, but the majority of the building operates on a typical office schedule.

At SPU, Alexander Hall is an 11,100 square foot building constructed in 1893 that is primarily used as office space. Alexander Hall uses variable refrigerant flow (VRF) heat pumps for space conditioning, and brings outside air in through a heat recovery 100% outside air system. The

Moyer Hall Central Plant is a natural gas-fired central boiler system that serves four buildings on campus with domestic and heating hot water.

### BUILDPULSE

BuildPulse’s support team pre-programmed devices off-site in less than two days and sent devices to the various buildings for installation by facility engineering staff. The BuildPulse device is designed to be plug-and-play and was live and capturing data by the end of the same day. Facility engineering staff only had to provide a local IP address and the IP address of certain items within the BAS.

The three-day discovery process at McKinstry identified 55,000 points within the controls system and 160 energy-consuming units, including VAVs, rooftop HVAC systems, and other controlled equipment. At SPU, it identified 8,370 points. After gathering the baseline data, the BuildPulse software automatically highlighted the most valuable points for analysis, based on changes in values reported, which allowed users to focus in on most valuable data (approximately 5% of total points). The software also organized and logically named the points according to the corresponding equipment and zones.

Feature	BuildPulse
Pricing	\$ per square foot per year; varies based on facility size
Deployment Speed	Under 4 hours install; 2-3 days for “discovery” process
System Compatibility	Most BAS protocols
Visualization Approach	Standard reports provide majority of basic views, custom reports possible

To evaluate the technology compared to standard practice, McKinstry and Paladino staff, including analysts, remote technicians, on-site maintenance and operations staff, and resource conservation managers, were trained on the system and provided log-in credentials. The staff performed regular and one-time tasks using BuildPulse from late February through April

2015. The staff reported on their experience through surveys and interviews.

### TRENDR

Trendr was installed at SPU in approximately three hours. Similar to BuildPulse, facility staff simply have to provide basic IP address information for the device to begin collecting information. Points are quickly available to begin generating building reports.

Feature	Trendr
Pricing	First cost per device plus \$/month
Deployment Speed	Under 4 hours install; 2-3 days for “discovery” process
System Compatibility	BACnet only
Visualization Approach	Allows user to create fast, simple custom reports

Paladino staff performed an assessment of the facilities with the goal of identifying meaningful energy conservation measures and reported on their experience through surveys. Trendr and BuildPulse installations followed the same process at the SPU facilities.

## Results

The demonstration project found that even in the short test period, BuildPulse and Trendr unlocked valuable findings from the building data. This information showed that the test buildings had opportunities for energy savings based on simple-to-implement controls programming. The technologies made the identification of these opportunities significantly less time-intensive than alternative approaches, increasing the likelihood issues would be caught and corrected leading to return on investment for the building owner.

### Rapid Identification of Hidden Energy Issues

McKinstry staff used BuildPulse's search feature to quickly find that many of the heating set points within the building were both higher than expected and were not setting back to lower temperatures

through the evening. Of more than 20 temperature set points viewed, less than half followed a schedule. This lack of scheduling means some spaces may be conditioned unnecessarily after hours, resulting in wasted energy.

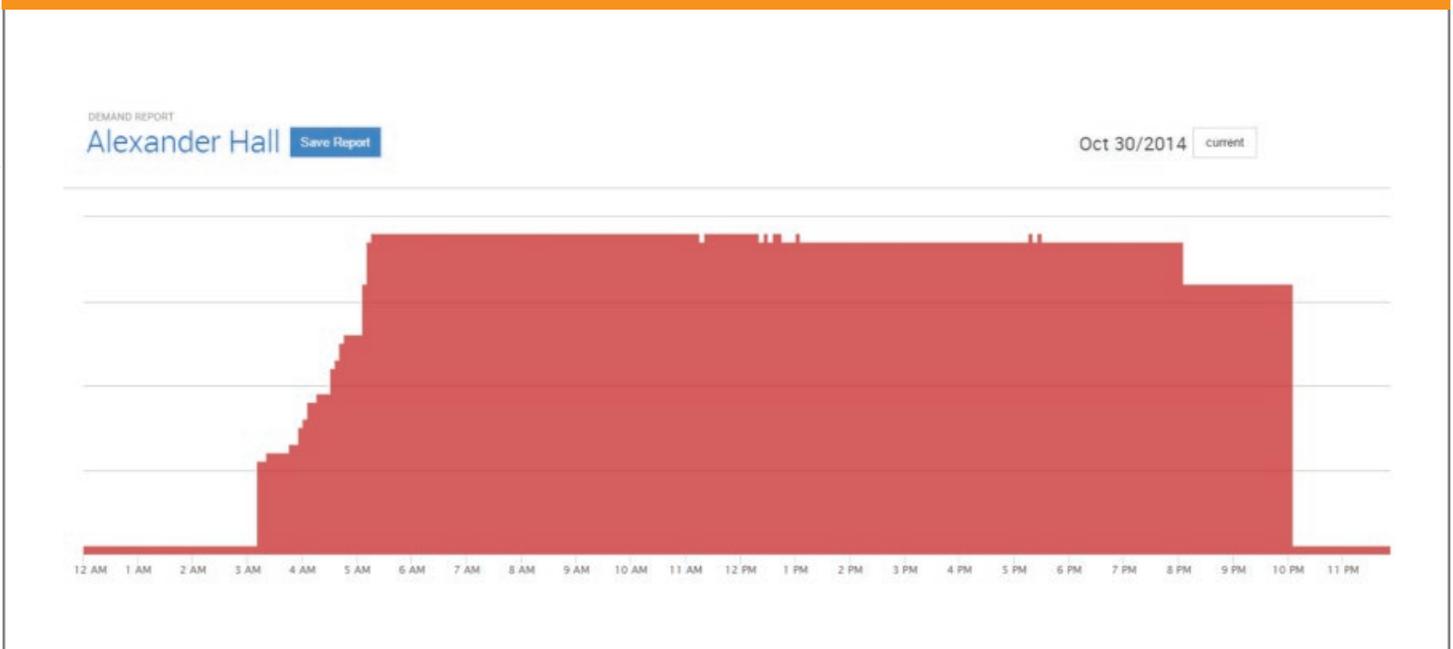
At SPU, within 72 hours of installation, BuildPulse identified that the VRF units were running 24 hours, 7 days a week due to a failure in the original programming of the controls system. This simple fix of programming will save 5-15% of the energy used by the VRF based on adjusted set points during over 6,000 non-occupied hours. The VRF is usually one of the top energy consumers in a building of this type and size, so the savings will be noticeable. Building Robotics and BuildPulse both aided Paladino staff in identifying systems that were using more energy than necessary. While BAS trending logs could have helped identify these same issues, the logs were not set up due to the upfront cost/time and additional complexity of

trending so many data points. Integration of data sets provided by both products is valuable. Figure 1 on the left shows a sample demand report.

### Easy-to-Deploy and Digest Large Data Sets

Staff on both evaluation teams reported that both technologies were simple to deploy and generated valuable information from previously overwhelming amounts of data in a manner of days. Specifically, BuildPulse's built-in reporting capabilities and interface provide flexibility and accessibility that does not exist in most installed control and automation systems, which rely on manually downloading, tracking, analyzing and storing .CSV files. While Trendr does not have the same out of the box report capabilities as BuildPulse, it does provide a fast and effective platform for performing a range of analytical tasks associated with identifying energy savings opportunities.

Figure 1: Demand Report – Alexander Hall



BuildPulse's standard demand report shows energy demand on the y-axis and time of day on the x-axis. The report indicates units are running outside of schedule.

## Future Opportunities

### Long-Term Trending to Help Ongoing Monitoring

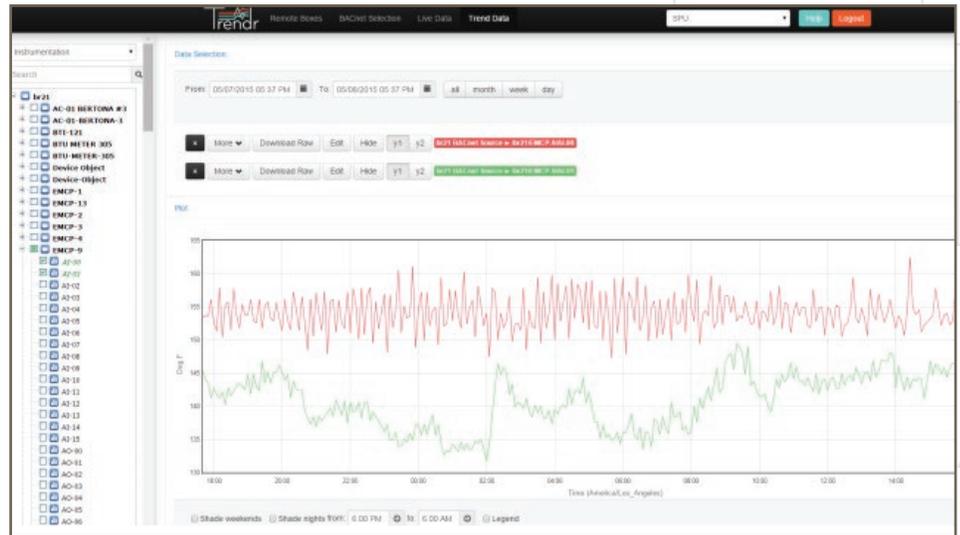
Building engineers reported that they are excited by the technologies' ability to store information in the cloud for years, as opposed to just days or weeks. Performance trends built up over a longer time period may yield additional findings as well as validate the persistence of savings associated with past corrective actions.

## Conclusion

Overall, the two deployments were a successful test of a promising new application of technology. The solutions have unique capabilities and applications in the smart building environment and provided immediate return-on-investment for study participants McKinstry and SPU. Few technologies exist on the market that can so effortlessly demystify BAS information for the average building operator. BuildPulse and Trendr fill a missing link of data integration and reporting that is necessary for identifying opportunities, making adjustments, and monitoring performance.

### Daily Reports to Prompt Faster Corrective Action

A potentially significant benefit is the ability to generate daily reports to identify issues and corrective action on a real-time basis. This fast tracks the standard approach of performing monthly reviews, which allow an energy-wasting or comfort-disrupting problem to persist much longer than it should.



*Trendr's user interface. This graph is showing hot water supply and return temperatures.*

## About the Smart Buildings Center

The Smart Buildings Center (SBC) is a project of the Northwest Energy Efficiency Council (NEEC), which is a non-profit industry association of the energy efficiency industry. The SBC supports growth and innovation in the Pacific Northwest's energy efficiency industry, serving as a hub for industry activities and raising the visibility of energy efficiency companies and projects.



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