AT&T 10x Case Study:

Using the Internet of Things to reduce facility costs and emissions

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AT&T believes technology plays a critical role in reducing carbon emissions, so we're using the power of our network to create a better, more environmentally sustainable world. We've set a 10x carbon reduction goal to enable carbon savings 10x the footprint of our operations by the end of 2025.

To meet this goal, we're working companywide to make our operations more efficient. We're also working with our customers and technology partners to implement and scale carbon-saving solutions. This case study discusses and quantifies the carbon benefits of using AT&T technology to boost efficiency. This is one study in a series we're sharing as we progress toward our 10x goal.

Learn about our goals, our progress, and more case studies like this at att.com/10x.

Summary

To reduce energy costs and greenhouse gas emissions (GHG), AT&T has incorporated Internet of Things (IoT) connectivity with legacy building information to identify when facility equipment is operating inefficiently. The AT&T IoT Professional Services group, experts in the design, testing, and implementation of IoT projects, has worked with the AT&T Energy team to use IoT sensors to gather data on previously unmonitored equipment and merge it with data from existing building management systems (BMS). Bringing equipment performance information together has led AT&T to optimize maintenance and address problems in a timely manner via dashboards, reports and alerts. This has reduced electricity use and the associated emissions. At the end of 2017, 27,000 pieces of AT&T building equipment across 250 cities were on the system, reducing electricity expense by about $925,000 and GHG emissions by 5,150 metric tons in 2017. **Based on the success of the program, the AT&T IoT Professional Services team is offering Consulting Services for the IoT-Enabled Building Energy Management system to AT&T customers.**

2017 Estimated Annual Savings:

$925K Electricity Expense

5,150 metric tons of CO_2e

The Challenge: Many buildings are not energy efficient, but identifying the causes can be difficult.

In 2010, buildings accounted for 32% of total global final energy use and 19% of energy-related GHG emissions.[1] On top of that, an average of 30% of the energy consumed in commercial buildings is wasted.[2] This waste results in higher costs and energy usage, contributing to higher GHG emissions.

Building Environmental Impacts

32% of global energy use

19% of energy-related GHG

30% energy waste

1 https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter9.pdf

2 https://www.energystar.gov/buildings/about-us/how-can-we-help-you/improve-building-and-plant-performance/improve-energy-use-commercial

Understanding building equipment performance is a critical first step to boosting efficiency. Being able to identify inefficient equipment sooner means we can addresses the issue more quickly. But because facility managers are typically faced with a complex and disparate set of legacy BMS, especially among older buildings, getting an accurate view can be challenging. Even if a building has a BMS, managers don't always get all the information they need in a timely and usable format. And in some cases, equipment is not monitored, requiring a technician do an in-person inspection.

Many proactive facility managers are searching for ways to gain accurate and timely equipment performance data to help them identify waste, reduce emissions and reduce total building costs from maintenance and new capital equipment.

AT&T is committed to efficiency, but its wide-ranging building portfolio presents challenges.

As part of our commitment to energy efficiency, AT&T established a goal in 2008 to reduce our electricity consumption relative to data growth on our network by 60%. By 2013, we met that goal by implementing thousands of building and network energy efficiency projects. So, we extended the goal to generate an additional 60% of improved energy intensity by 2020.[3]

Our size presents both opportunities and challenges in meeting this goal. AT&T manages a complex real estate portfolio covering over 250,000,000 square feet and comprised of approximately 247,000 locations, more than 2,500 of which are occupied buildings. Many of the buildings utilize a BMS, but because those systems have been installed over decades, there are many different platforms across the portfolio, making it difficult to compare sites to identify poorly performing facilities.

Many pieces of equipment were not monitored at all for a number of reasons, including the costs to install a wired system and the difficulty managing a Wi-Fi network dedicated to building equipment. As a result, AT&T found it difficult to identify when equipment was running inefficiently and needed to be adjusted. Unable to consistently get equipment performance data, facility managers normally perform maintenance on a scheduled basis or reactively when a problem is reported. It became clear to John Schinter, assistant vice president of Energy at AT&T, that we lacked visibility. And it was creating unidentified inefficiencies and waste.

> "After years of energy efficiency projects, we had addressed many of the obvious opportunities to reduce energy waste. But it was clear that we weren't seeing the whole picture. We needed a tool to increase the visibility of building equipment across the portfolio and identify new opportunities to save money and reduce our energy and carbon footprint."
>
> -John Schinter, assistant vice president, Energy, AT&T

3 http://about.att.com/csr/goals

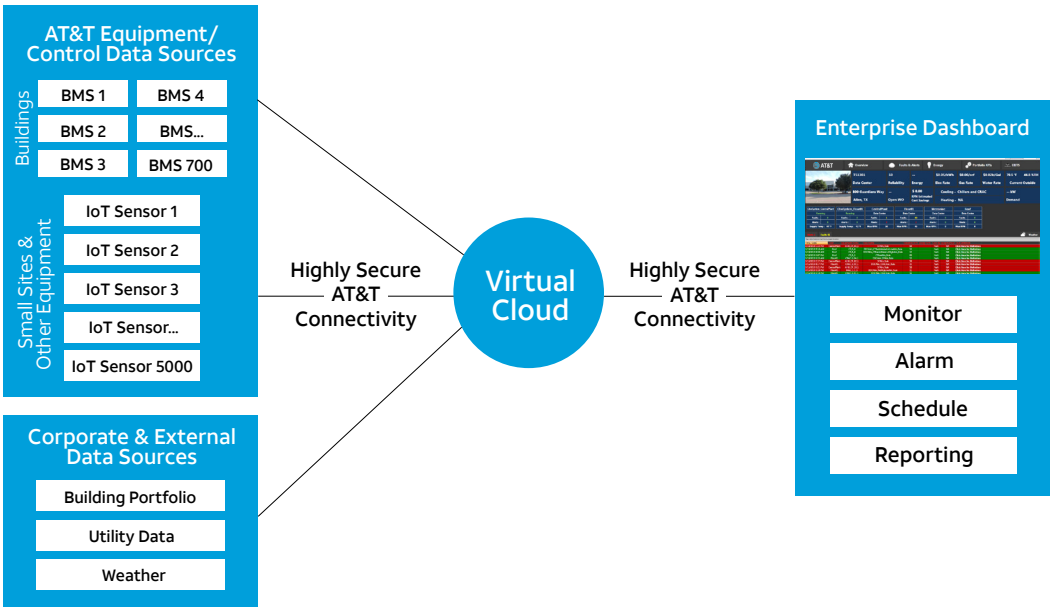
The Solution: AT&T IoT gathers and analyzes building data in near real-time.

To address this problem, AT&T set out to create a single platform to track facility equipment data. AT&T IoT Professional Services worked closely with the AT&T Energy team and other technology collaborators to develop reporting platforms comprised of two primary internal data sources:

- **Building Management Systems (BMS)** – Legacy BMS collect basic equipment information at many large AT&T facilities, but the data was inconsistent as many of these systems had been installed over decades. Because many of these systems used slow dial-up modems with no security, they were updated to secure, cellular gateways.

- **IoT Sensors** – AT&T operates many small facilities for which it was too difficult or expensive to gather data. AT&T added IoT sensors and connectivity to gather information about equipment performance at these sites, detecting a range of information including electricity usage, air and water flow, temperature, humidity and more. Some also include a push-button that can be used to confirm when a technician inspects a piece of equipment.

The IoT-Enabled Building Energy Management system not only collects information from the IoT sensors and BMS, but also integrates other data that aids in analyzing building efficiency such as the building portfolio details, utility data and weather details.



The data from all of these sources is transported over the AT&T network into a virtual cloud. It then is analyzed and presented to managers and technicians via a dashboard equipped with easy-to-read reports. The IoT-Enabled Building Energy Management system also provides AT&T with tools to create customized data visualization, analytics and fault detection. The AT&T network allows the system to share this information with the facility management team much faster and more securely than before.

Implementation: 105 Million data points every day

AT&T began using the IoT-Enabled Building Energy Management system in late 2015. By the end of 2017, we were collecting more than 1.2 million pieces of information associated with 27,000 pieces of equipment at over 350 facilities. Collecting data throughout the day, the system generates about 105 million data points daily. As a result, AT&T has a connected real estate portfolio across a range of facility types and geographies.

Comprehensive and timely visibility:

Pumps	Fans
Motors	Generators
Lighting	Boilers
Fans	Chillers

Perhaps most important, the system transformed AT&T's facility management capabilities from primarily reactive to proactive. The AT&T IoT Professional Services and Energy teams have developed over 420 unique rules that generate alerts when a "fault" occurs, indicating that a piece of equipment isn't running efficiently. The system has identified almost 7 million faults since 2015, creating centralized dashboards and reports that facility managers can access to better understand how their facilities are performing. In the past, the vast majority of building maintenance events were scheduled activities, with only a small percentage handled as needed. Now, an increasing amount of maintenance is proactively prioritized based on information from the IoT-Enabled Building Energy Management system.

BEFORE		NOW
Scheduled & Reactive	>>>	Informed & Prioritized
Human Equipment Inspection	>>>	Sensor-driven Fault Detection & Diagnostic

The AT&T IoT Professional Services team worked with the AT&T Energy team and leading real estate analytics organizations to develop customized dashboards to provide a comprehensive view of energy efficiency across the portfolio.

When an alert occurs, the system generates a Facility Improvement Measure (FIM) to address the issue.

Common Alerts:	Common FIMs:
• Climate Control not in Automatic mode • Leaking Valve • Overcooling • Damper stuck • High Fan Speed • Overheating • Dirty Filter	• Reprogramming equipment such as chillers, economizers, fans and variable frequency drives (VFDs), etc. • Replace broken sensors. • Return controls to automatic mode to improve operations and energy efficiency. • Repair outside air dampers reducing the need for mechanical cooling.

Sustainability Impact Overview

AT&T reduced energy consumption and associated GHG emissions by using the IoT-Enabled Building Energy Management system to actively monitor equipment performance across a large portion of the portfolio. In 2017, AT&T managers evaluated 2,900 Facility Improvement Measures (FIMs) at over 350 facilities, with heating and cooling efficiency representing much of the work. Examples include:

- 1,000 fan system FIMs resetting discharge air set points or adjusting VFDs, economizers and other miscellaneous equipment.
- 115 chiller plants FIMs saving 41,000 hours of run time, reducing capital and avoiding premature equipment replacement.

In sum, the system enabled **$925,000 in annualized electricity savings** and a **9 million kWh energy reduction** in 2017. The effort is ramping up in 2018, and we expect to see significant incremental energy savings over time.

This electricity savings equals almost **5,150 metric tons of CO_2e**, which is the same as:

Taking over **1,100 cars off the road**
or

Not using over **580K gallons of gas**
or

Switching over **170,000 incandescent lamps to LEDs**[4]

This has been so successful that AT&T IoT Professional Services team is offering Consulting Services for the IoT-Enabled Building Energy Management service to customers looking to reduce energy costs and associated GHG emissions.

We believe this savings estimate is conservative because it doesn't include all accounts of time, fuel and electricity savings from technicians in the field. The following are anecdotal evidence of savings that are not included in these estimates.

Detailed fault information makes it easier to find and address a specific issue that may not have been found until routine maintenance

"The IoT-Enabled Building Energy Management system alerted me when the space temperature and supply air temperature at one of my remote sites was way too low. I traveled to the site to investigate and learned someone had the temperature set points way down, so I changed the settings. I only visit this site once a month at most, so this setting would have remained in effect for who knows how long."

- Facility technician, AT&T, Washington

"After getting an alert from the IoT-Enabled Building Energy Management system, I found debris and dust from the construction of another facility located next to the building blocking the intake. This issue may not have been discovered until the regular maintenance routine was to be performed, which was scheduled for a couple of months later. Because it was discovered early using fault detection, the issue was corrected before the dampers and unit could fail."

- Facility technician, AT&T, East region

Alerts help avoid early equipment failure and replacement

Constant equipment information at remote sites reduces lengthy truck rolls

"Before the IoT-Enabled Building Energy Management system, I would spend hours traveling to remote sites to perform routine maintenance. Now, getting real-time information about those remote sites, I only make those trips when needed, saving me time and fuel."

- Facility technician, AT&T, Central region

"This innovation is at the heart of how we think about environmental sustainability at AT&T. It tackles an important issue for our business and our environment by leveraging the technical and operational expertise that AT&T has developed over the decades."

- Charles Herget, assistant vice president, Sustainability Integration, AT&T

USING AT&T CONNECTIVITY TO AGGREGATE DISPARATE BUILDING SYSTEMS HAS THE POTENTIAL TO:

1. Give facility managers the timely information they need to correct energy efficiency problems.
2. Reduce energy use and associated emissions from building operations.
3. Reduce facility equipment maintenance and repair costs.
4. Reduce capital costs by extending the life of existing equipment.

Applying the 10x Carbon Impact Methodology

Carbon Trust and Business for Social Responsibility (BSR) collaborated with AT&T in the development of a methodology to measure the carbon benefits of AT&T's technology. The details of the methodology can be found on the AT&T 10x website. The table below summarizes how the 10x methodology was applied to estimate the environmental impacts described in this case study:

Description of the Enabling Technology	Using IoT connectivity for data aggregation and data management of Building Management Systems (BMS) enables AT&T to proactively monitor energy use and equipment performance. This allows preventative maintenance and more timely responses to equipment malfunctions that results in improved energy use of building infrastructure equipment.
Impact Category	This case study focuses on electricity use and GHG emission impacts.
Materiality	IoT-Enabled Building Management system leads to reductions in electricity use and corresponding reductions in GHG emissions.
Attribution of Impacts	The reductions in GHG emissions are a direct result of coordinated monitoring and maintenance of the building equipment, which is possible due to the collation of the disparate data by the deployment of the IoT connectivity and cloud technologies.
Primary Effects	The monitoring, IoT connectivity, cloud, and enterprise dashboard system enables improved maintenance resulting in reduced electricity consumption and reduced GHG emissions.
Secondary Effects	There are no secondary effects.
Rebound Effects	No rebound effects were identified.
Trade-Offs or Negative Effects	This technology does not appear to create other outsized or irreparable environmental or social impacts.
Carbon Burden from the Enabling Technology	The carbon emissions related to the enabling technology is the embodied and in-use emissions associated with the system. That includes the embodied emissions and electricity use of the monitoring devices, IoT devices, the cloud and dashboard systems. We expect these will be minimal compared to the overall emissions reductions.
Scope	The scope of the case study covered 378 of AT&T's larger facilities, by analyzing improvement measures identified by the IoT enabled building management system.
Timeframe	The timeframe was for the calendar year 2017.
Functional Unit	The functional unit was the electricity and GHG emissions savings per site.

Methodology	The system identifies a number of 'facility improvement measures' (FIMs), which engineers can respond to, and which may result in electricity and GHG emission savings. The FIMs for 2017 were analyzed and classified into the following categories: chiller setpoints, economizers, fans and VFDs, air reset controls, water reset controls, and freeze protection. The system also automatically monitors run-hours for the different equipment, thus allowing an estimate of electricity savings; additionally the system can capture estimate kWh and savings against each FIM. The total savings are summed up for all the categories. This method will likely underestimate the savings, as not all of the savings are captured using this approach. (For example, savings outside of the above categories would not have been captured).
Key Assumptions	• Detailed saving figures were derived based on expert opinion, and then aggregated by system reports.
Exclusions	• Smaller sites were not included as they are on a different system with less accessible data. • Reduced engineer trips to site were not included due to the difficulty of reliably capturing the required information.
Data Sources	• FIM and site data provided from the system by AT&T • EPA eGRID 2016 electricity emission factors
Carbon Abatement Factor	13.6 metric tons CO_2e per site for the year
Electricity Savings Factor	24,500 kWh per site for the year
Lessons Learned	The estimates in this study are conservative because of the distributed nature of the AT&T real estate portfolio. Additional data capture and reporting of savings could identify additional savings and benefits from the system, however the data input requirements and analysis may be onerous.