Real-World Impact of IoT Energy Management

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This article is the first in the on-going IoT Energy Management series that Silicon Labs launched to explore the potential of energy management technologies and to help commercial buildings reduce energy consumption and costs.

Roughly 40% of global energy consumption and 70% of electricity usage stems from buildings. These numbers are probably not surprising, given that we spend most of our time inside offices, schools, or homes, while simultaneously connected to electrified things. Fortunately, opportunities to boost building efficiency are now emerging. Data, insights, and most importantly – actions – are transforming the way we use energy, and this is reaching far beyond our smart homes.

Beyond remote control of a thermostat, internet-connected technology is addressing global sustainability, personal inhabitant health, and bottom-line financial savings. The commercial buildings adopting IoT technology are seeing double-digit operating efficiency savings per year. The best part is these efficiency percentages scale with the total size of the building, meaning total energy savings, which drastically increases the larger the building.

Consider the most extreme and complex example, the Burj Khalifa. As the tallest building in the world, the Burj Khalifa in Dubai, which is over 200 stories and 800 m (2,100 ft) in height, provides over 2 million square feet of inhabitable space. The electrical distribution system must be capable of delivering a peak of 36 MW of energy, equivalent to 360,000 light bulbs illuminated simultaneously to enable a building to withstand this scale of human demand. Similarly, the condensation from cooling the building equates to about 15 million gallons of water per year, which is roughly 20 Olympic-size swimming pools. Needless to say, there are critical pieces of equipment and interconnected systems to make this all work efficiently. Even a 1% drop in efficiency would have significant effects on lifetime utility consumption, operating costs, and the inhabitants.

Some of the key building equipment includes the heating, cooling, and AC system (HVAC), the lighting network, the security network, and the 50 elevators that are essential for moving inhabitants. These systems are constantly sharing data and being monitored. The building manager of the Burj Khalifa, like other building managers, is primarily interested in two things – the on-going and consistent health of these systems and the efficiency of them. Automated systems, and now IoT, are absolutely necessary for these types of buildings and operating goals. In larger buildings like this, manually monitoring is simply unfeasible.

The scale of the tallest building in the world is a bit extreme, but these same principles apply to all commercial buildings, no matter the size. Building managers are adding more and more sensors and internet-integrated systems to monitor the health and activity of their buildings, with energy efficiency being the primary focus.

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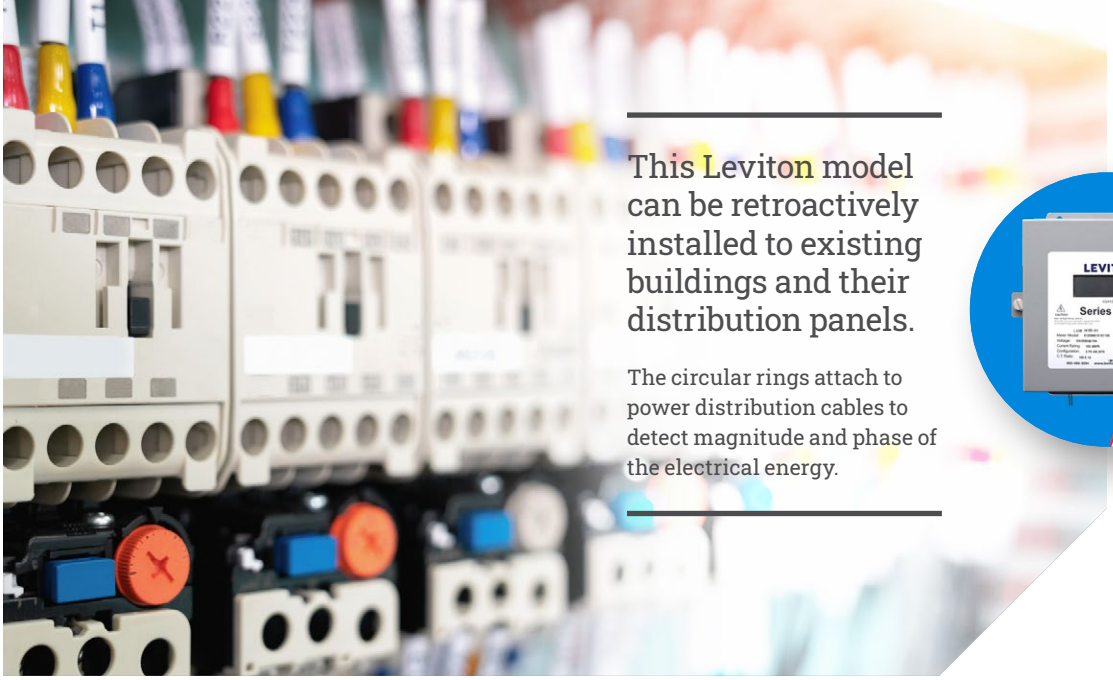


This Leviton model can be retroactively installed to existing buildings and their distribution panels.

The circular rings attach to power distribution cables to detect magnitude and phase of the electrical energy.

REMOTE SUBMETER MONITORING

Unlocking the Power of Real-Time Insights

The potential to reduce the energy consumption footprint of buildings worldwide is enormous. Sensors combined with wireless technology are helping more and more building managers take proactive measures not only to monitor energy usage data but also to take proactive steps to reduce electricity usage based on new data insights.

Because electricity is the largest category of energy consumption, understanding this part of a building's operation is the first and major objective. Once a building manager understands where and how energy is being used in the building, they can then take the appropriate actions.

Before explaining the technological approach in commercial buildings, consider the difference in the approach of a building owner versus a homeowner. In general, homeowners don't actively monitor their energy consumption on a daily or real-time basis. Yes, monthly reports and bills help show the past energy consumption, but it's too late. It's more reactive, and consumers rarely adapt and take action to conserve.

Instead, the quest for home energy efficiency usually requires conscious mindfulness and manual effort to be green.

In commercial buildings, manual effort and mindfulness are also important, but the biggest value comes from automated monitoring. The magical difference is understanding the electrical energy consumption of specific loads in real-time, without the need to watch it or react manually. This concept is made possible by devices called submeters, which have already made enough positive impact that many U.S. states and countries have passed legislation to enforce or encourage this technology.

Specifically, submetering is the act of adding sensors to the building's utility distribution networks, and electrical submetering is usually the first choice for operators. Building managers might also choose to monitor water and gas utilities, which can provide additional insights such as leaky pipes.

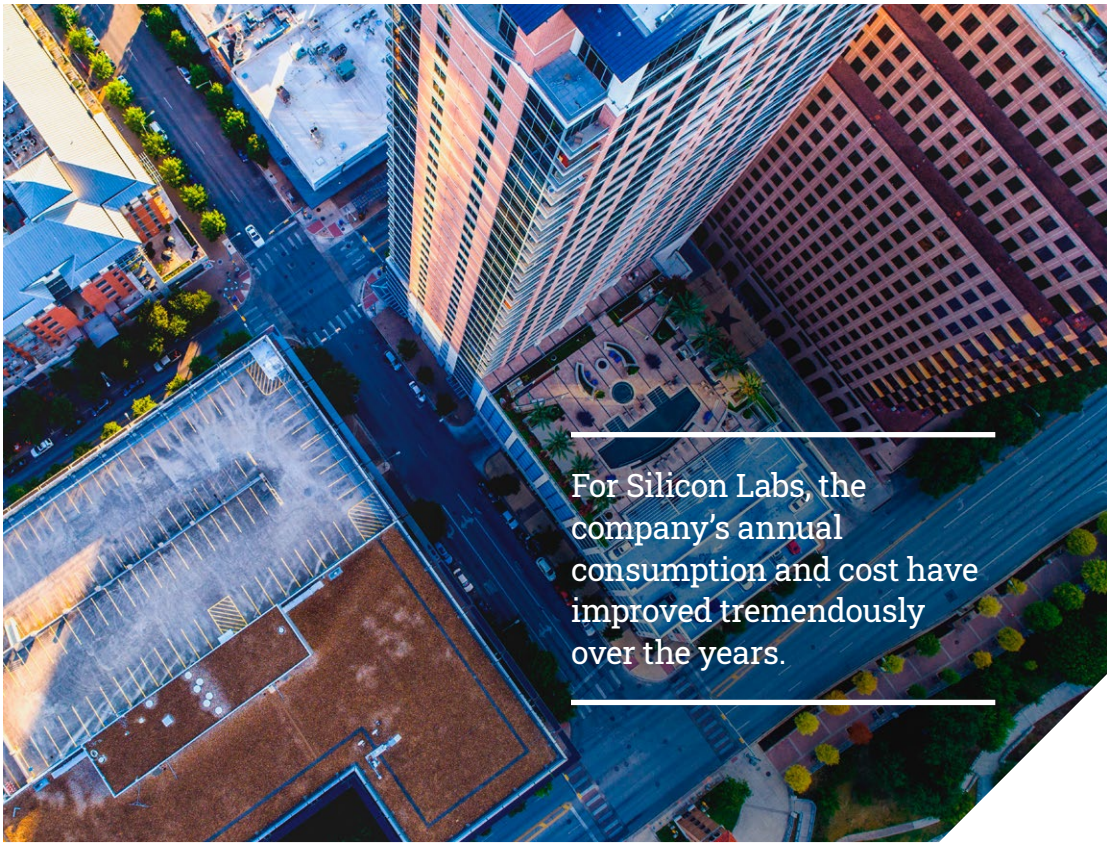
The figure above provides an example of a single-phase electrical meter from Leviton.

The Wireless PowerTag Submeter from Schneider Electric uses low power, wireless technology to easily add sensors to large distribution panels with hundreds of loads.

Wireless PowerTag Submeter from Schneider Electric

Many suppliers are leveraging wireless technology to make installation even easier, especially in large scale buildings. The Power Tag meter from Schneider Electric is a **perfect example**. These products use low power, wireless technology to easily add sensors to large distribution panels with hundreds of loads. As mentioned earlier, large industrial factories and urban skyrise buildings can take advantage of these products to automate energy efficiency on a grand scale.

According to the Global Status Report for Buildings and Construction published in 2019, buildings and their construction accounted for **39% of energy-related carbon dioxide emissions in 2018**. As pressure grows globally for commercial buildings to reduce energy consumption and ultimately drive down their carbon emissions, we anticipate more building managers will implement sub-metering technology. This finding is especially notable when building managers start to see the cost benefits derived from automating their energy management. Deploying wireless technologies into existing buildings versus installing expensive and time-intensive wired systems is another key factor why this type of technology will most likely be adopted more quickly in the future.



For Silicon Labs, the company's annual consumption and cost have improved tremendously over the years.

Reducing Our Own Energy Footprint with Real-Time Building Data

Silicon Labs, as a leading IoT supplier, has taken its own technology and passion for real-world change to heart. Located in the center of downtown Austin, Texas, Silicon Labs owns two twin commercial office buildings that provide a total of more than 400,000 square feet to its employees and other leasing companies.

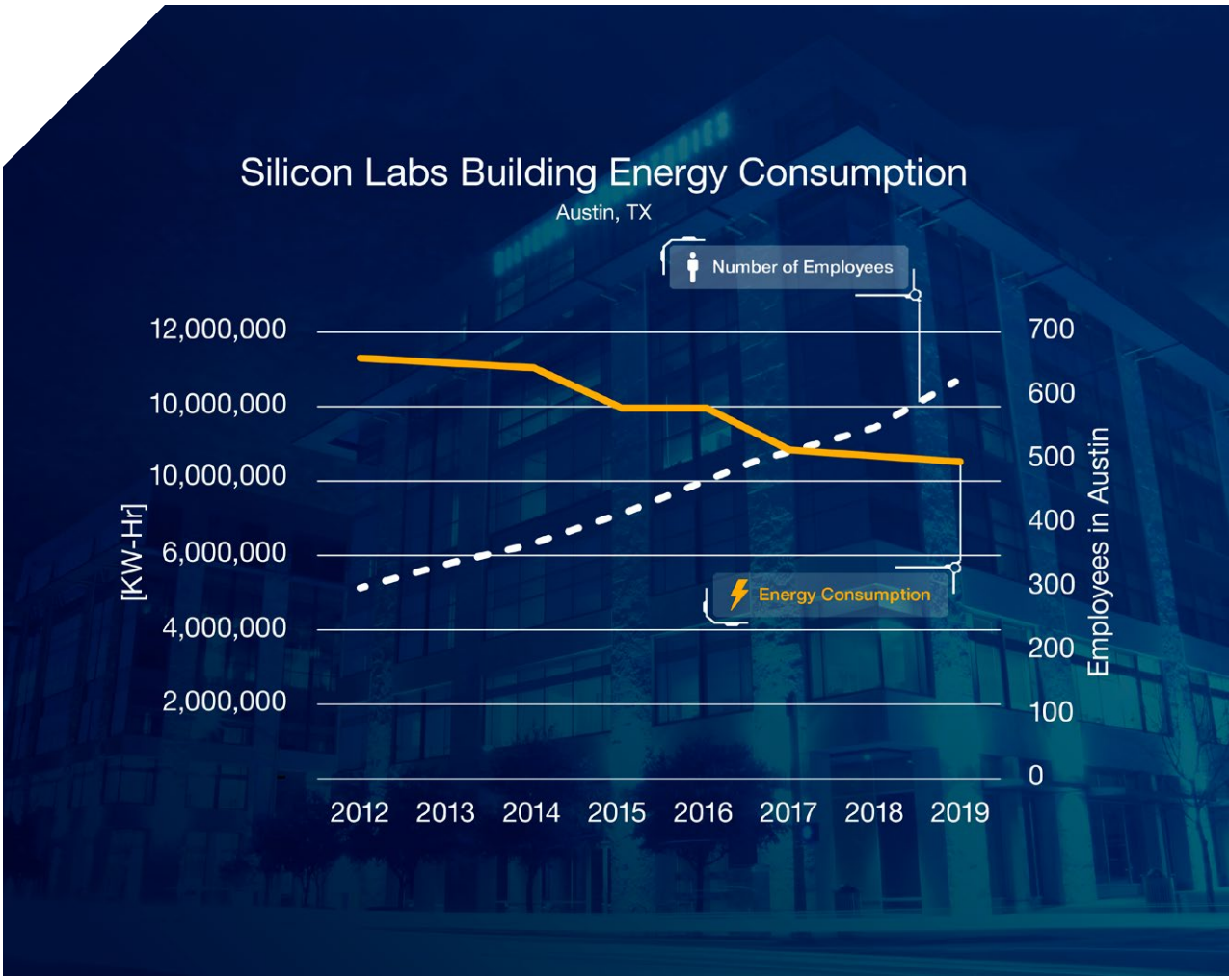
More than 800 people use these buildings every day, and this equates to a lot of electricity: electrical energy to heat and cool the building interior; power the on-site testing labs; and illuminate the thousands of lights throughout the offices, hallways, and conference rooms, and more. During active hours, peak energy demand can exceed 800 kiloWatts (kW). In 2019, the total annual energy consumption exceeded 8,500 MegaWatt-hrs (MWh). At $0.09/kW-hour, that's over $1 million in annual electricity costs.

For Silicon Labs, the company's annual consumption and cost have improved tremendously over the years. In 2012, energy consumption was much higher – roughly 11,300 MWh, 33% higher than in 2019. What changed? In 2012, Silicon Labs building managers and "Green Team" sought opportunities to improve. Some changes were not so techy. For example, the lighting in the shipping and receiving dock stations were replaced with more energy-efficient lighting. The lights in this area are typically powered on all day and throughout the year, so this was a simple "set it and forget it" action to conserve.

Other changes were more sophisticated and invoked our own IoT expertise. Silicon Labs had hundreds of sensors installed in the building, including both occupancy sensors and Internet-connected submeters. In partnership with a local Texas company, SmarteBuilding, the companies teamed up to start gathering real-time data and insights into the building's energy profiles. Where Silicon Labs was once operating blind and agnostically to make building energy decisions, we now had historical and live data on where energy was being used across our buildings.

Perhaps the biggest change from this new enlightenment was altering the buildings' warm-up and cool-down cycles in the early morning. The data quickly demonstrated that the HVAC system was turning on at a much earlier time than needed. Once again, Silicon Labs made a significant change, with the help of this new insight.

In addition to one-time adjustments, the on-going live data is useful too. By submetering specific building zones and electrical loads, remote monitoring is easy. For example, it's possible to see that specific test equipment in the labs is left on and operating overnight. Was the equipment left on intentionally and related to the staff of test engineers who test millions of integrated circuits per year, or was it done because of human forgetfulness? IoT and real-time energy monitoring make this observation and question possible.



The next wave, which has already started, is adding intelligence in service to work with these sensors and equipment actuators. New algorithms, digital twins, AI, and complimentary cloud services are being applied to building energy management data to automate control of HVAC. Why is this so valuable? According to the co-owner of SmarteBuilding, Mike Kounnas, buildings are very dynamic. Tenants change; seasons change; even unpredictable events like COVID-19 can occur. Specifically, in hotels, the building behavior and needs for each room change each minute. Adding AI and automated adjustments can help the building respond in real-time to maximize comfort and minimize costs.

Deploying our own technology within our buildings has been an exciting process for Silicon Labs. The experience has made it clear to us that we're past the "disillusion" stage on the hype curve, where we're only talking about the technology – submetering combined with AI and cloud services are now being deployed with tangible and valuable benefits for users. As more real-world deployments and real-world benefits emerge, we are optimistic that submetering technologies will be viewed as a critical tool for the vast majority of global building managers in the future. People from various parts of a value chain are coming together to solve tough problems like global sustainability. The commercial building automation sector is one of the key Industrial IoT segments to tackle, and Silicon Labs is excited to be part of the transformation.

Want to learn how you can implement energy management technologies in your own buildings?

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