MARKET RESEARCH NOTE

How Bluetooth® technology is helping shape a more sustainable future

Bluetooth®

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As senior research director for ABI Research's Strategic Technologies team, Andrew conducts research into the rapidly changing wireless connectivity market, with an emphasis on market forecasts and qualitative insight covering Bluetooth technology, Wi-Fi, 802.15.4, near-field communications (NFC), HaLow, WiGig, and other emerging wireless standards and protocols. Andrew also writes reports on the technological evolution and long-term prospects for wireless connectivity technologies, particularly as they increasingly target new verticals across the Internet of Things (IoT).

Executive summary

Recent global events, including record-breaking heatwaves, extreme weather events, energy supply issues, and surging demands for energy worldwide, continue to demonstrate the need to shape a more sustainable future.

Alongside the urgent requirements to ensure energy security and mitigate the impact of climate change, additional drivers for sustainable practices include growing consumer and enterprise expectations for sustainable products and operations, policy and regulatory incentives, and various technology innovations that are helping accelerate their adoption. Bluetooth® technology is playing a key role in driving these processes forward, helping to reduce and optimize energy usage, minimize waste, enhance equipment lifespans, and enable new classes of devices that can not only operate without batteries but also enable products to be monitored throughout their entire lifecycle. This is being achieved through the inherent characteristics of Bluetooth® technology alongside the creation of specific Bluetooth® standards that can address these use cases. These efforts are critical in enabling more sustainable operations that can bring better outcomes for the environment, economy, health and wellbeing, and security while simultaneously enhancing enterprise visibility and productivity.

Energy-efficient environments

One of the major drivers for smart buildings is their ability to optimize energy consumption. This is becoming increasingly acute with rising energy prices around the world. As well as the ongoing transition to more efficient lighting, HVAC, and other building equipment, Bluetooth® technology can enable more adaptive building systems that automatically react to their environments to further reduce energy consumption. Furthermore, by leveraging Bluetooth® standards, previously disparate systems can be seamlessly integrated to deliver wider operational efficiencies, while building owners can also better monitor performance and power consumption of equipment, identifying and correcting any problems or anomalies as they occur.

Lighting control

Globally, lighting represents between 12-15 percent of total electricity usage. In addition to the transition towards more energy-efficient LED lighting, networked lighting control (NLC) systems can drive further efficiencies through features such as occupancy-based activation, central and zonal level scheduling, daylight harvesting, and fixture-level performance and energy monitoring. These features ensure that lighting, and the right *level* of light, is used only where it is needed, resulting in significant energy savings and more sustainable operations.

Silvair, a provider of Bluetooth® Networked Lighting Control (NLC) products, deployed its technology for a leading coworking company in Richmond, Texas. An advanced, DesignLights Consortium (DLC)-certified wireless mesh lighting network was swiftly deployed, enabling occupancy/vacancy sensing and daylight harvesting without control wiring. As a result, the deployment enabled optimized lighting efficiency, while the use of a DLC-certified Bluetooth® NLC system enabled the project to become eligible for energy efficiency and networked lighting control rebates, further accelerating ROI. ABI Research forecasts that Bluetoth® networked lighting solutions for commercial buildings, including luminaires, sensors, controllers and switches, will reach over 27 million annual unit shipments by 2031.

12-15%

of global electricity usage is attributed to lighting

Source: ABI Research 2026

27M

Bluetooth® lighting control devices will ship annually by 2031

Source: ABI Research 2026

HVAC automation

According to the US Department of Energy, energy used for heating and cooling buildings accounts for around 35 percent of all energy consumption, the largest share for any single usage. Meanwhile, air conditioning alone is calculated to account for seven percent of the world's electricity usage and around three percent% of total greenhouse gas emissions. With air conditioning units forecasted to triple by 2050, energy demand for cooling alone is expected to more than triple by this time, equating to today's total electricity usage of China and India combined.

Rather than operating on preset schedules, Bluetooth® technology can help ensure that HVAC systems are only used when they are most needed while adapting to real-time conditions such as occupancy. This ensures workers remain comfortable and productive, reduces over and under heating and cooling, places less strain on the energy grid, and can help to extend the lifespan of HVAC equipment that is no longer running unnecessarily.

Meanwhile, with the introduction of the Bluetooth® HVAC Integration NLC Profile specification, there is now a standardized approach to how occupancy data from existing Bluetooth® NLC deployments can exchange data with HVAC systems. This can help enable more automated and efficient HVAC systems that adapt to real-time occupancy levels without the need to deploy a separate occupancy sensing infrastructure. These efforts can maximize the ROI of both the NLC and HVAC deployments while bringing much greater energy efficiency. Enhanced occupancy visibility can also help buildings re-organize their working areas to maximize comfort while minimizing energy usage.

35%

of all energy consumption is attributed to heating and cooling buildings

Source: US Department of Energy

Reduced waste

According to Avery Dennison's 2022 ***The Missing Billions: The Real Cost of Supply Chain Waste*** report, nearly eight percent of all stock perishes or is discarded annually. Over four percent of stock spoils in the supply chain before it hits the shelf, while over three percent is discarded due to overproduction. This equates to over $163.1 billion worth of inventory each year. Thankfully, various Bluetooth® asset tracking solutions can help to provide enhanced visibility of products as they move across the supply chain. This can bring enormous operational efficiencies, eliminate costly errors in production, identify bottlenecks and incorrect handling practices, automate traceability records, and improve customer satisfaction, which can all further reduce waste to deliver enhanced sustainability.

$163.1B

worth of inventory is discarded annually

Source: Avery Dennison, 2022

Asset tracking

One Bluetooth® product category that directly addresses these challenges is smart labels. These are flexible, printed, electronic labels that transmit vital condition information of products moving across the supply chain. This includes temperature, humidity, motion, light exposure, location, and other metrics, which can deliver enhanced visibility at the pallet, case, or item level and enable informed decision making on how to best reduce waste. These same labels can also be utilized by end users to ensure they are disposed of or recycled correctly, bringing additional indirect sustainability benefits.

A multi-national grocery retailer deployed Wiliot's Intelligence Platform solution to solve spoilage issues through enhanced monitoring of fresh goods. This solution deployed Wiliot's battery-free Bluetooth® IoT pixel temperature and location tags to their cases of strawberries to deliver continuous case-level temperature and location monitoring from the distribution center, in transit, all the way to multiple retail stores. The results identified previously unnoticed significant temperature fluctuations en route within the same trailers, helped optimize routes to reduce fuel wastage, identified unattended pallets or storage conditions, and enabled them to take immediate action to reduce waste across their supply chain.

1.9B

Bluetooth® smart labels will ship annually by 2031

Source: ABI Research 2026

Due to the huge addressable market and continued technology innovation, ABI Research expects Bluetooth® smart labels, whether using energy harvesting technology or batteries, to grow enormously over the next few years. Annual shipments of Bluetooth® smart labels are forecasted to grow from 169 million in 2026 to 1.9 billion in 2031, achieving a CAGR of 62 percent.

Electronic shelf labels (ESLs)

The retail market is increasingly adopting electronic shelf labels (ESLs), typically wireless-connected, battery-powered displays that contain information such as pricing, offers and promotions, inventory status, and product details.

From a sustainability perspective, ESLs bring multiple benefits. Firstly, ESLs reduce paper and printing waste, while enabling more frequent pricing updates, alongside a lengthy product lifecycle of more than ten years. Secondly, ESLs can help reduce food or perishable item wastage via dynamic pricing or expiration date alerts to help clear inventory. Thirdly, ESLs can provide additional sustainability information (e.g., recycling, carbon footprint, energy rating, sourcing information) to enable better supply chain transparency and foster more responsible purchasing. Fourthly, ESLs can enable retailers to accurately track inventory levels in real time, ensuring faster replenishment and better control of pricing and inventory availability and activate promotions on overstocked items to reduce waste and minimize losses on seasonal products.. Finally, ESLs can help enable more accurate pricing via automatic updates. With estimates that five to ten percentof paper label prices are errors due to slow updates or misplaced labels, by automating this process, conversion can be increased to avoid further unnecessary waste.

183M

Bluetooth® enabled electronic shelf labels will ship annually by 2030

Source: ABI Research 2026

Multiple ESL vendors have utilized Bluetooth® technology in their portfolio for many years, but the arrival of the Bluetooth ESL Profile in 2023 helped create an ultra-low power, secure, scalable, and standards-based interoperable ESL solution to further ramp up the ESL market and address some of the hesitations from retailers in adopting ESL technologies.

One major success story leveraging this ESL standard is Vusion. The company entered a strategic partnership with Walmart to deploy its SESimagotag ESL solutions across all its stores in the US. Meanwhile, in February 2026, Vusion announced that it would also be deploying its Bluetooth® solutions across all Carrefour hypermarkets and supermarkets in France by 2030. This follows other announcements such as equipping nearly 500 Morrisons supermarkets in the UK with over 10.8 million ESLs.

According to ABI Research, the ESL market continues to grow rapidly. By 2030, ABI Research expects over 183 million Bluetooth® enabled electronic shelf labels will ship annually.

Increased equipment lifespans

In addition to optimizing the energy usage of equipment within homes, buildings, industrial facilities, and other settings, the continuous monitoring of the performance, condition, and efficiency of the equipment itself can help detect anomalies early on, help reduce the risk of failures, and minimize inefficient energy usage.

Predictive maintenance

Thanks to condition monitoring sensors and predictive maintenance, organizations can significantly enhance the lifespan of their equipment, avoid wasteful expenditure on new equipment, further optimize energy usage, and reduce costly production errors and waste. In addition to equipping machinery itself with a range of sensors to reduce replacements, environmental sensors can also ensure that materials are stored correctly, while RTLS solutions can ensure that the right piece of equipment is being used at the right time, further reducing operational wastage and material consumption.

10M

Bluetooth® condition monitoring solutions will ship annually by 2030

Source: ABI Research 2026

To achieve this, vendors such as ABB offer Bluetooth® enabled condition monitoring sensors that can be attached to industrial machinery, including motors, powertrains, and fans, to detect even the most minor changes or anomalies in machine health through advanced machine-learning algorithms. This supports proactive and predictive maintenance, enabling operators to take action to reduce the threat of downtime and increase the effectiveness and lifespan of their equipment.

Bluetooth® enabled condition monitoring solutions are expected to reach nearly 10 million unit shipments by 2030, achieving a CAGR of 30 percent between 2025 and 2030, making it one of the fastest growing opportunities for Bluetooth® technology in the industrial sector. Meanwhile, the continued evolution of edge AI capabilities within these sensors will help to accelerate performance and adoption further.

Reduced environmental and ecosystem impacts

Alongside monitoring equipment itself, minimizing the wider unnecessary waste of resources, such as water and gas, as well as protecting natural systems, including wildlife and the broader environment, are critical to ensuring a more sustainable future.

Leak detection

A 2026 UN report declared that the world has entered an era of global water bankruptcy caused by chronic groundwater depletion, water overallocation, land and soil degradation, deforestation, and pollution, all of which have been compounded by global heating. Water leaks are one issue that is contributing to multiple negative environmental and societal impacts, including resource depletion and environmental damage. Meanwhile, in some countries, such as Bulgaria, an estimated 60 percent of drinking water never reaches the home.

18M

Bluetooth® commercial wireless leak detection sensors installed by 2030

Source: ABI Research 2026

In homes and commercial buildings, Bluetooth® leak detection sensors are often deployed to detect water leaks from critical areas such as toilets, kitchens, or HVAC equipment. Solutions such as the battery-free AquaSensing Leak Sensor 2.0 can remain operational for more than 20 years thanks to energy harvesting technology. According to ABI Research, the installed base of commercial wireless leak detection sensors is expected to reach 18 million units by 2030, while annual shipments of Bluetooth® smart home water sensors are forecast to reach eight million units by 2030, achieving a CAGR of nearly 25 percent between 2026 and 2030.

Ecosystem preservation

With 75 percent of global food crops relying at least partially on insect pollination, protecting the health of bees is increasingly critical in ensuring the future food supply. However, a recent survey of beekeepers in the US identified catastrophic honey bee colony losses, with commercial beekeepers reporting an average loss of 62 percent of their colonies. Bluetooth® technology can play a role in reducing this loss through non-invasive monitoring of the colonies through wireless sensors. Some companies are deploying Bluetooth® sensors to monitor critical parameters such as hive temperature, humidity, activity, and acoustics to enable beekeepers to have real-time visibility on their hives and enable them to intervene to help prevent the collapse of a colony.

Smart energy

The transition toward distributed renewable energy generation is transforming the entire energy value chain. However, with inherent variability within renewable energy generation, real-time performance monitoring and communication across the entire energy supply chain is required. This includes homes and multi-dwelling units (MDUs), alongside on-site energy systems within commercial and industrial enterprises. To ensure reliable operations at all times, the entire energy value chain from the grid to the enterprise increasingly needs to be equipped with wireless sensors for more effective visibility.

One emerging opportunity for Bluetooth® technology within the energy space is within solar photovoltaic (PV) energy generation. Solar PV arrays consist of numerous individual modules supplying direct current (DC), which needs to be converted to alternating current (AC) to be used by the grid. This is achieved by using solar inverters. Increasingly, it is desired to be able to monitor these at the module level in order to provide increased yield. Microinverters are increasingly deployed to enable module-level optimization to monitor the output of each module, provide improved safety, increase installation flexibility, eliminate single points of failure, and provide increased yield. These microinverters are now coming equipped with wireless connectivity technologies such as Bluetooth® to offer remote diagnostics, provide support for rapid shutdown, identify performance concerns, simplify installation and repair, and enable firmware updates, among other benefits.

Battery energy storage systems (BESS) are also being increasingly deployed/installed/implemented to circumvent some of the challenges brought about by unpredictable energy generation from renewable sources such as solar. Bluetooth® monitoring devices can provide enhanced visibility of battery capacity while monitoring their performance and ensuring any potential issues are identified as soon as possible. Using wireless technologies can help streamline the design process, reduce complexity, simplify installation, and provide easier maintenance and support. Innovations such as these will be key to energy storage systems becoming a more critical part of energy networks over the next decade.

Bluetooth® sensor technology is also deployed within smart farming applications to enable better monitoring of crops, soil, livestock, and to enable more intelligent irrigation or indoor lighting for indoor farming systems. For example, Dusun IoT has deployed a greenhouse monitoring and control system sensor network based on Bluetooth® Mesh Networking technology to provide real-time insight into plant status, resource utilization, and equipment condition while also identifying any errors in a timely manner that could lead to lost productivity.

Bluetooth® innovations at the forefront of sustainable transformation

Bluetooth® technology is playing a critical role in shaping a more sustainable future. As increasing pressures are placed on the environment, resources, energy supply, ecosystems, and wildlife, the continued development of technologies and solutions that can enhance sustainability will become increasingly vital in the coming years.

The unique combination of ultra-low power consumption, support for smart labels and energy harvesting devices, low-cost chipset solutions, an ability to support small form factors, and multiple standardized topologies that enable flexible and scalable deployment scenarios are placing Bluetooth® connectivity at the forefront of the transition to more sustainable operations across homes, smart buildings, retail settings, supply chains, energy infrastructure, industrial facilities, and agricultural environments. These benefits can allow previously unmonitored assets and products to share information on their status, location, and condition, enabling more efficient energy utilization, reducing waste and spoilage, extending equipment lifespans, and protecting resources and ecosystems, all while providing enhanced operational visibility that can help deliver more sustainable operations.

The continued evolution of Bluetooth® technology and the diverse Bluetooth member ecosystem targeting these applications will ensure it continues to play a vital role in developing more resilient and sustainable systems that can help address the enormous challenges impacting our future.

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