IoT in energy management- Unlocking cost savings and sustainability

We are an award winning product design consultancy, we design connected products and instruments for pioneering technology companies.

IoT in energy management: Unlocking cost savings and sustainability

Key Points

- IoT devices are becoming the go-to solution for enhanced energy management due to their versatility and ability to monitor, control, and optimise energy consumption in various settings.
- The benefits of IoT in energy management include cost savings (e.g. energy efficiency, predictive maintenance, dynamic responses), sustainability (integrates renewable energy resources, reduces carbon footprint), and enabling smart grids (to enhance the reliability and efficiency of energy distribution).
- The global IoT energy management market size was valued at USD 22.02 billion in 2022 and is forecasted to grow to around USD 52.17 billion by 2030 at a compound annual growth rate (CAGR) of roughly 11.39%.
- Factors contributing to rapid market growth include increasing demand from end-consumers for sustainable solutions, rising energy costs, the inefficiencies in existing power grids, and a commitment many countries have made to reach net zero, resulting in increased investment into smart infrastructure (e.g. smart grids).
- The Internet of Energy (IoE) is an emerging trend that reflects a shift toward a more interconnected, data-driven, and technologically advanced energy landscape.
- Restraining factors and challenges to developing and implementing IoT solutions for energy management include the cost, cybersecurity concerns, data storage, interoperability and integration with existing systems.
- However, the long-term benefits often outweigh the challenges and initial

costs. As technology advances and economies of scale come into play, barriers will decrease, making these solutions more accessible.

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Ben Mazur

Managing Director

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The rapid advancement of technology has paved the way for transformative changes across various industries, and the energy sector is no exception. In recent years, the Internet of Things (IoT) has emerged as a game-changer in energy management, offering numerous opportunities for optimising resources, reducing costs, and enabling [innovation that promotes sustainability](#) even further. In addition, IoT in energy management applications are versatile and can be developed to meet the needs of large-scale businesses and industrial enterprises but also tailored for personal use in everyday scenarios.

One example is [Turn, a smart-home system](#) for temperature and lighting control that we designed, subsequently winning our clients the [2017 A'Design Award](#) for its Interface, Interaction and User

Experience Design. This showcased the versatility of IoT applications but also highlighted the importance of user-intuitive design. If you have an idea for an energy-management system but are unsure how to best incorporate the various elements needed, call us for end-to-end, cost-efficient IoT solutions that enhance the user experience without breaking the bank; we've got your solution covered!

Related services

Comprehensive IoT Design Services

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In this blog, we'll explore the impact of IoT in energy management and delve into how it unlocks cost savings and contributes to a more sustainable future. We'll also look at who some of the key players are, emerging trends and innovative solutions, and potential opportunities in light of existing challenges. If you're ready to take a deep dive into the exciting world of IoT for sustainable development, keep reading – or schedule a one-on-one consultation with an expert on our team.

What role does IoT play in energy management?

The Internet of Things (IoT) refers to the network of interconnected devices embedded with sensors, software, and other technologies that enable them to collect and exchange data. IoT devices are deployed in energy management to monitor, control, and optimise energy consumption in various settings, from industrial facilities to commercial buildings and residential spaces. The critical components of IoT in energy management include:

1. **Sensors and Actuators:** Devices equipped with sensors gather real-time data on energy consumption, environmental conditions, and equipment performance.
2. **Connectivity:** IoT devices communicate with each other and central systems through wireless or wired networks, facilitating seamless data transfer and analysis.

3. **Data Analytics:** Advanced analytics platforms process the massive volume of data generated by IoT devices, providing valuable insights for informed decision-making.

For enterprises wanting to invest in IoT solutions – either to enhance productivity, increase business opportunities, or develop new products – the return on investment must be clear and measurable. By implementing key steps and strategies (e.g. setting clear objectives to develop a practical solution, a commitment to user-centric design, and strategic execution), achieving tangible results and a competitive edge are possible.

Cost Savings

Energy efficiency: IoT identifies energy wastage and inefficiencies, allowing for the implementation of targeted strategies to optimise energy use.
Predictive maintenance: Real-time monitoring of equipment health through IoT sensors enables predictive maintenance, reducing downtime and extending the lifespan of energy assets.
Demand response: IoT facilitates dynamic response to changes in energy demand, helping organisations avoid peak pricing and optimise energy consumption during off-peak hours.

Sustainability

Renewable energy integration: IoT plays a crucial role in integrating renewable energy sources into the grid by providing real-time energy production and consumption data.
Carbon footprint reduction: IoT contributes to lowering carbon emissions and promoting environmental sustainability by optimising energy usage and promoting energy-efficient practices.

Smart Grids

IoT technologies enable the creation of smart grids (intelligent, digital electricity distribution networks) that enhance the reliability and efficiency of energy distribution, accommodating the growing demand for clean energy sources.

Because IoT plays such a central role in energy management, the real-world applications across industries and sectors are seemingly endless. From smart buildings and industrial IoT (i.e. leveraging IoT to enhance efficiency and streamline production) to transportation (e.g. electric vehicles) and solar panel monitoring, it's no wonder that the market size of IoT in the energy sector is one of the fastest growing in the tech industry.

The market size of IoT in the energy sector

Rising smart infrastructure investments (e.g. smart grids) have contributed to IoT in the energy market's significant growth rate. Market research estimates that the global IoT energy management market size was valued at USD 22.02 billion in 2022 and is forecasted to grow to around USD 52.17

billion by 2030 at a compound annual growth rate (CAGR) of roughly 11.39%. The rising demand of end-consumers coupled with rising energy costs and the inability of existing power grids to keep up with Europe's interest in using renewable energy in the upcoming years and achieving net carbon zero are some contributing factors to the growth of IoT in the energy management sector.

Specifically, concerns such as depleting non-renewable energy resources, rising temperatures, poor air quality, environmental pollution, and damage to natural ecosystems (e.g. deforestation, desertification, marine depletion) are intrinsically connected to how energy is consumed. Integrating IoT in energy management has been proven to be an efficient solution to achieve higher smart energy consumption and conservation – especially in industrial sectors where sensors play a crucial role in automatically detecting energy requirements and managing supply accordingly.

Top 5 key players for IoT in energy management

The energy management landscape incorporating IoT solutions is dynamic, featuring both established and emerging companies – each contributing to the sector development and the deployment of solutions. Established players in this domain include:

1. Siemens offers a range of IoT solutions for energy management, including smart grid technologies and automation products, energy analytics, and industrial IoT (IIoT) applications.
2. IBM provides IoT and AI-powered solutions for energy and utilities, offering advanced analytics, asset management, and predictive maintenance capabilities to make clean energy more viable.
3. ABB is a global technology company providing solutions for electrification, industrial automation, robotics, and motion.
4. General Electric (GE) Digital focuses on IIoT solutions, including those applied in the energy sector for asset performance management and grid optimisation.
5. Cisco is known for its networking and IoT solutions, including those applied in the energy sector for smart grid management and connected devices.

While this list may give the impression that only well-established global players dominate the IoT in the energy management sector, it's important to note that the landscape is continually evolving and is by no means saturated. New players and startups are emerging and opening up opportunities for partnerships and collaborations between technology providers and other stakeholders to contribute to innovation and growth.

Top 5 'Internet of Energy' startups

Internet of Energy (IoE) refers to integrating digital technologies, connectivity, and data analytics into the traditional energy infrastructure. In the context of startups, the IoE represents innovative ventures that leverage IoT, smart devices, and advanced analytics to optimise energy production, distribution, and consumption.
Startups in this space often focus on developing solutions that enhance the energy ecosystem's efficiency, sustainability, and resilience. These companies may offer products or services related to smart grid management, renewable energy integration, demand response systems, energy monitoring and analytics, and other technologies that leverage connectivity and data to transform how energy is generated, transmitted, and consumed.

A recent global research study conducted by StartUs Insights identified five promising IoE startups, providing an exciting glimpse into some of the latest trends driving IoT in energy management forward:

1. 2GG-Smart Meters is a Slovenia-based startup that developed a smart-metering-as-a-service (SMaaS) solution to provide in-depth data on energy consumption to energy and water distribution companies, utility providers and industrial or commercial users.

2. Leap is based in the US and created a solution to allow connected devices to help balance the grid and access wholesale markets through a single application program interface (API). They then receive financial incentives for reducing energy use during peak hours.

3. Portuguese startup Bandora Systems offers a real-time management solution to complement a building's existing energy automation infrastructure. By using an Artificial Intelligence-based system, the solution reduces energy consumption, simplifies building management, and undertakes predictive maintenance.

4. Covert Science is a German startup manufacturing embedded firmware for digital power conversion and lighting control.

5. RESYNC is based in Singapore and combines machine learning and data analytics to provide intelligent cloud solutions for smart grids and buildings. By optimising the use of renewables in the system, overall costs are reduced by predicting energy generation and consumption patterns.

IoE is an emerging trend that reflects a shift toward a more interconnected, data-driven, and technologically advanced energy landscape. Startups in this space play a transformative role in addressing energy challenges and contributing to a more sustainable and efficient energy future.

Looking for a tech provider to help you innovate new solutions or develop existing products to fit into the energy management landscape? Call us for a quote!

Is the IoT energy management market growing rapidly or emerging?

Depending on where you're based and the markets you're developing products or solutions for, IoT in energy management is a sector that's both growing rapidly (fuelled by increased adoption, technological advancement, and regulatory support) and emerging (especially in regions where IoT capabilities, e.g. infrastructure and workforce are underdeveloped).

A [Fortune Business Insights Report](#) highlights that despite rapid growth in regions with a developed IT sector, certain IoT energy management market aspects are still emerging. Continuous advancements in technology, ongoing research and development, and the exploration of new use cases contribute to the evolving nature of this market – especially as it relates to real-time and cloud-based energy management systems.

IoT in energy management: Challenges, opportunities, and restraining factors

The cost is one of the most significant restraining factors to implementing IoT in energy management solutions.

1. Hardware Costs: Deploying IoT involves the installation of a network of sensors, actuators, and other hardware devices. The upfront cost of purchasing and installing these devices can be substantial, especially for large-scale deployments in industrial settings or across extensive smart grid infrastructure.

2. Connectivity Expenses: IoT devices require reliable and often high-bandwidth connectivity to transfer data to centralised systems for analysis. The costs associated with communication protocols, data plans, and network infrastructure can contribute significantly to the overall implementation expenses.

3. Data Storage and Processing: The massive amounts of data generated by IoT devices need storage and processing capabilities. The cost of setting up and maintaining robust cloud or on-premises infrastructure for data storage, processing, and analytics can be a significant factor.

4. Security Measures: Implementing robust cybersecurity measures is crucial to protect IoT devices and their data from potential threats. Incorporating encryption, secure communication protocols, and other security features adds to the overall cost of implementation.

5. Interoperability and Integration with Existing Systems: Many organisations already have legacy systems in place for energy management. Integrating new IoT solutions with existing infrastructure can be complex and may require additional investments to ensure seamless compatibility.

6. Training and Skill Development: Implementing IoT technologies often necessitates training

personnel or hiring individuals with expertise in IoT, data analytics, and related fields. The cost of upskilling or hiring skilled professionals can be a factor in overall implementation costs.

7. Lifecycle Management: Over time, IoT devices may require maintenance, updates, or replacement. Planning for the lifecycle management of devices incurs ongoing costs, including software updates, firmware upgrades, and potential hardware replacements.

8. Regulatory Compliance: Meeting regulatory standards and compliance requirements in the energy sector can add to implementation costs. Ensuring IoT systems adhere to industry-specific regulations may involve additional design, testing, and documentation investments.

Despite these challenges, the long-term benefits of implementing IoT in energy management often outweigh the initial costs. Improved efficiency, optimised energy consumption, predictive maintenance, and sustainability gains are among the potential advantages that can result in cost savings and a positive return on investment over time.

As technology advances and economies of scale come into play, the cost barriers associated with IoT implementation in energy management systems are expected to decrease, making these solutions more accessible to a broader range of businesses and product developers.

Call us if you have an energy management solution you'd like to develop or implement but are concerned about the costs. Our team of multidisciplinary experts will help you uncover hidden opportunities and help ensure you get a return on your investment.

A final word on smart energy management using IoT

IoT in energy management represents a paradigm shift in how we generate, distribute, and consume energy. By unlocking cost savings and contributing to sustainability goals, IoT is poised to play a pivotal role in shaping the future of the energy sector. As businesses, consumers, and governments continue embracing these technologies, the journey towards a more efficient, resilient, and sustainable energy landscape is underway.

Looking for a partner to collaborate and accompany you on your journey? Schedule a free and confidential consultation to discuss how we can make it as seamless – and profitable – as possible!

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FAQ's

Why is IoT important in energy management?

IoT in energy management is crucial as it enables real-time monitoring, optimisation, and efficiency improvements across various sectors, from smart grids to industrial facilities. This technology empowers organisations to make data-driven decisions, reduce energy waste, and contribute to sustainable practices.

How does IoT contribute to sustainability in energy management?

IoT plays a pivotal role in promoting sustainability by facilitating the integration of renewable energy sources, optimising energy consumption, and enabling smart grid management. These advancements contribute to a more environmentally friendly and resource-efficient energy ecosystem.

What are the benefits of implementing IoT in energy management?

The adoption of IoT in energy management brings numerous benefits, including enhanced energy efficiency, predictive maintenance, and the ability to optimise energy consumption, resulting in significant cost savings for businesses and a reduced environmental impact.

How does IoT impact smart grid management in energy systems?

IoT transforms smart grid management by providing real-time data on energy production, distribution, and consumption. This facilitates better grid control, load balancing, and the integration of renewable energy sources, contributing to a more resilient and efficient energy infrastructure.

What role does IoT play in optimising energy consumption in buildings?

In buildings, IoT enables the deployment of smart systems that monitor and adjust energy usage based on real-time data. This results in optimised HVAC systems, efficient lighting, and overall energy savings, creating a more sustainable and cost-effective environment.

Why is predictive maintenance crucial in IoT for energy management?

Predictive maintenance in IoT allows for the proactive monitoring and addressing of equipment issues before they lead to failures, reducing downtime and extending the lifespan of energy assets. This approach enhances overall operational efficiency and minimises maintenance costs.

How does IoT facilitate demand response in energy management?

IoT enables dynamic responses to changes in energy demand through demand response strategies. Organisations can optimise energy consumption during off-peak hours, reducing costs and supporting a more balanced and efficient energy distribution.

What are the challenges of implementing IoT in energy management?

Implementing IoT in energy management faces challenges such as cybersecurity concerns, interoperability issues, and the need for standardised protocols. Addressing these challenges is essential for ensuring the secure and seamless integration of IoT technologies.

Which industries benefit the most from IoT in energy management?

Industries such as manufacturing, utilities, and commercial buildings benefit significantly from IoT in energy management. These sectors can leverage real-time data and analytics to optimise energy usage, enhance efficiency, and reduce operational costs.

How does IoT contribute to the integration of renewable energy sources?

IoT facilitates the integration of renewable energy sources by providing real-time data on energy production and consumption. This information allows for better management of fluctuations in renewable energy generation, promoting a more reliable and sustainable energy grid.

What are the applications of IoT in industrial energy management?

In industrial settings, IoT applications focus on optimising energy usage, monitoring equipment performance, and implementing predictive maintenance. These solutions enhance overall operational efficiency and contribute to cost savings in industrial energy management.

Who are the key players in the IoT for energy management sector?

Key players in the IoT for energy management sector include Siemens, Schneider Electric, ABB, Cisco, and Honeywell. These companies offer a range of solutions for smart grid management, energy efficiency, and industrial IoT applications.

How does IoT enable remote control of energy consumption in smart homes?

In smart homes, IoT enables remote control of energy consumption through connected devices like smart thermostats and lighting systems. Users can adjust settings, monitor energy usage, and

optimise efficiency, contributing to overall energy savings.

What role does IoT play in the development of smart city energy solutions?

IoT is integral to the development of smart city energy solutions by enabling efficient energy distribution, monitoring, and optimisation. These technologies contribute to the creation of sustainable and resilient energy infrastructures in urban environments.

When did IoT technologies start influencing energy management practices?

IoT technologies started influencing energy management practices in the early 21st century, with a growing emphasis on connectivity, data analytics, and smart technologies for optimising energy consumption and promoting sustainability.

How do IoT devices enhance energy monitoring in households?

IoT devices enhance energy monitoring in households by providing real-time data on energy usage, helping residents identify energy-intensive appliances and adopt more energy-efficient practices for cost savings and environmental benefits.

What are the security considerations in implementing IoT for energy management?

Implementing IoT for energy management requires robust security measures, including encryption, secure communication protocols, and protection against cyber threats. Addressing these considerations is essential to safeguard sensitive energy data and ensure the integrity of IoT systems.

What are the emerging trends in IoT for energy management startups?

Emerging trends in IoT for energy management startups include a focus on decentralised energy systems, renewable energy integration, and innovative solutions for optimising energy efficiency in various sectors. These trends reflect the ongoing evolution of the industry towards more sustainable and interconnected energy ecosystems.

How does IoT contribute to the resilience of energy infrastructure during disruptions?

IoT contributes to the resilience of energy infrastructure by enabling real-time monitoring and adaptive responses during disruptions. This enhances the ability to detect and address issues promptly, minimising downtime and ensuring the reliability of energy distribution systems.
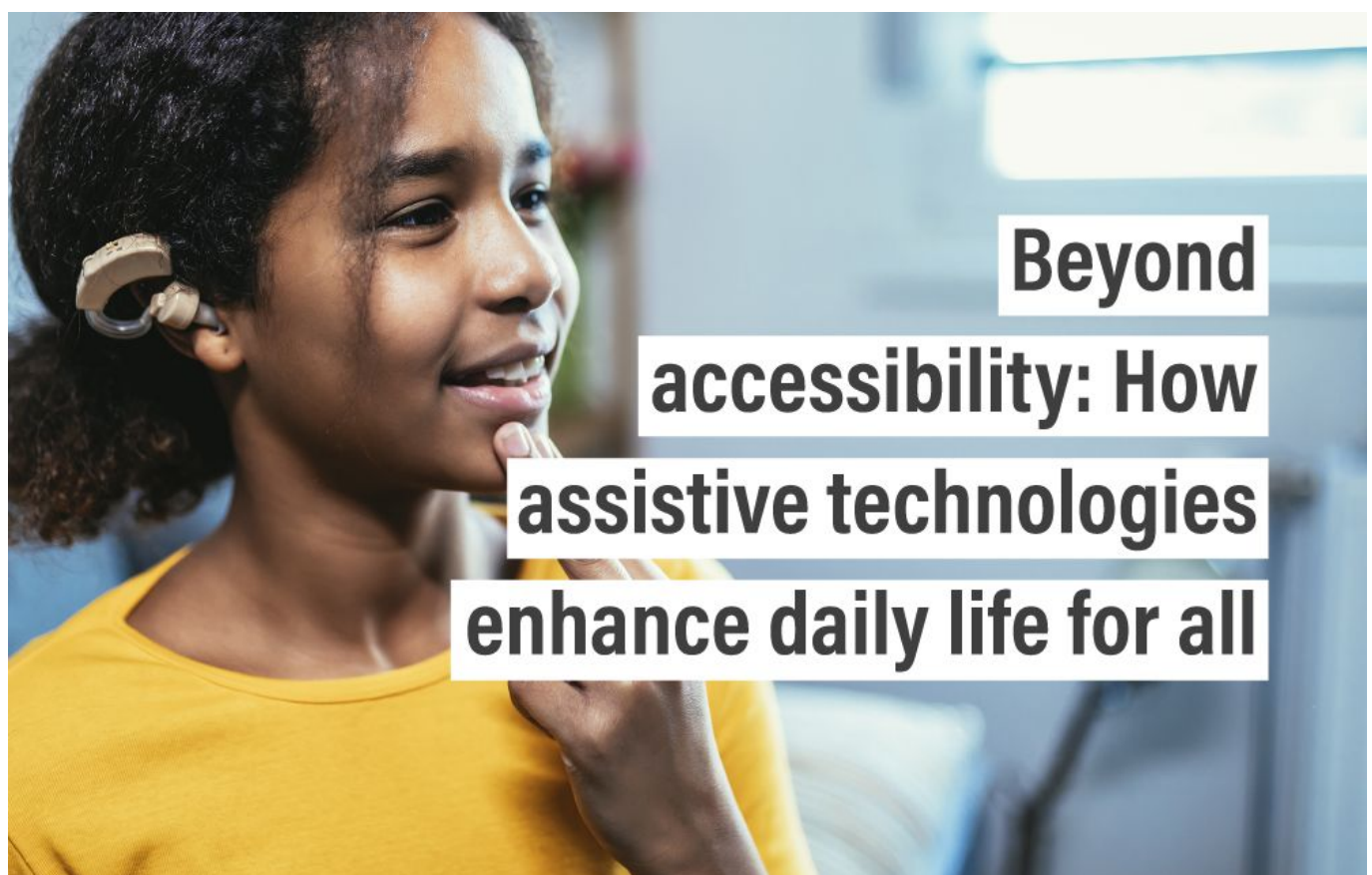
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