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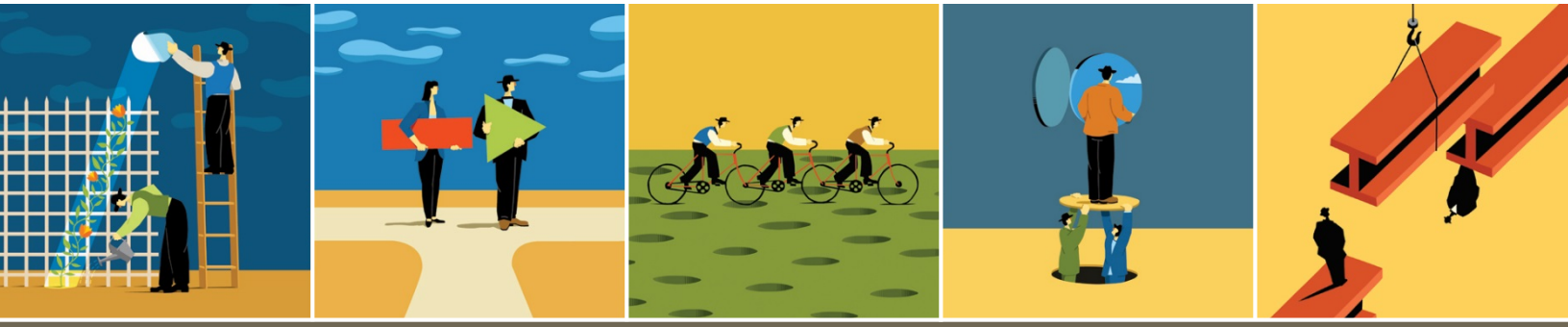

WHITE PAPER

# Next-Generation Building Energy Management Systems

## New Opportunities and Experiences Enabled by Intelligent Equipment

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**Sponsored By Daikin Applied and Intel**

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# Section 1
# DEFINING NEXT-GENERATION FACILITIES AND ENERGY STRATEGY

## 1.1 Introduction

IT has permeated the tools of facilities management and enabled the emergence of building energy management systems (BEMSs) that transform the paradigm of energy and operational strategy. These solutions are characterized by the convergence of traditional and innovative hardware, software, and services to enhance the control and automation of building systems and manual procedures. The ubiquity of IT tools in business helps set the stage for the adoption of BEMSs. In particular, the software as a service (SaaS) solution model and the connectivity of the Internet of Things (IoT) help bring BEMSs to an ever-growing audience of real estate and facilities management stakeholders.

## 1.2 Defining the BEMS Market

The term BEMS characterizes a broad set of solutions that have emerged in response to the opportunity for cost-effective energy efficiency in buildings. These solutions utilize data from traditional control and automation systems, smart meter interval electricity consumption data, supplemental submeters and advanced sensors, and/or other business intelligence offerings.

Industry stakeholders report diverging perspectives on the precise definition of BEMSs. Navigant Research provides the following definition to clarify the boundary around technologies and services that shape this next generation in energy management solutions:

> *"IT-based solutions that extend the capabilities of sensing, control, and automation hardware to direct both automated and manual improvements to system operations."*

BEMSs provide efficiency in one of two ways: via focused improvements in heating, ventilation, and air conditioning (HVAC), lighting, plug loads, or fire and security systems, or via the integrated management of multiple systems. Furthermore, BEMSs change the energy management paradigm to deliver strategic and holistic management of facilities and equipment.

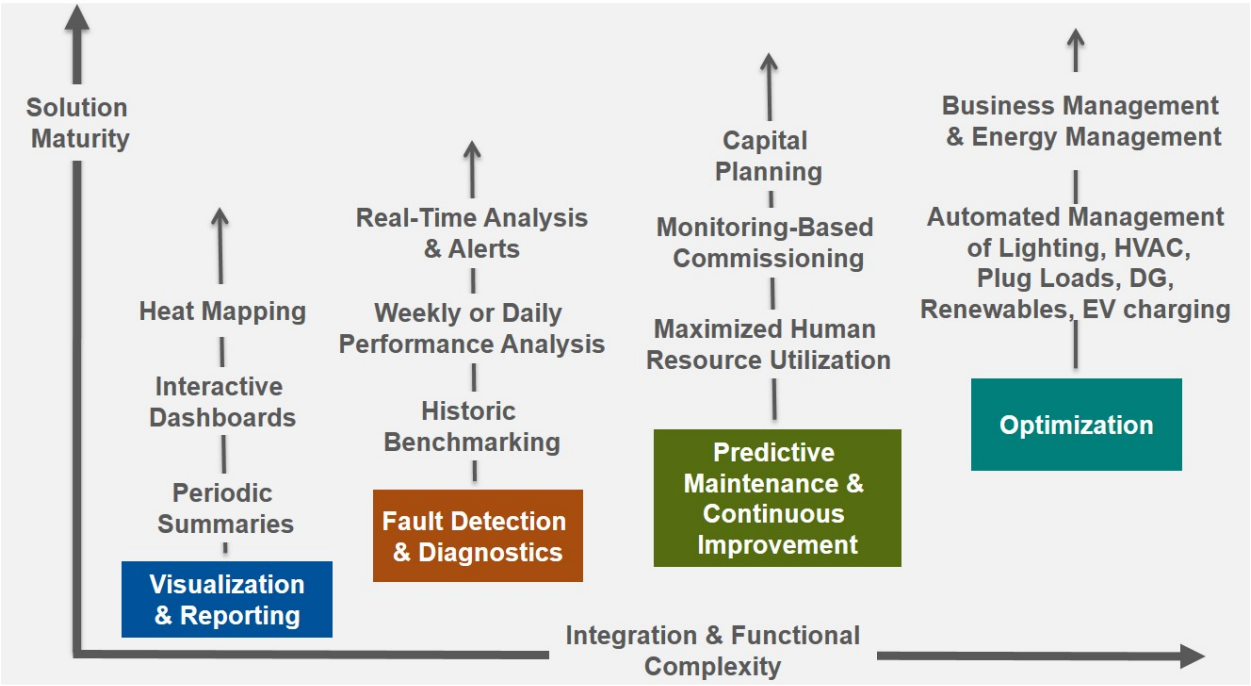
## 1.3 BEMS Solution Offerings

The global market for BEMSs continues to grow as customers embrace new technologies that leverage legacy investments to deliver more business value than was possible just a few years ago. BEMSs can be fully networked into a cloud-based environment with end-to-end strategies accomplished by an open type of integration. This holistic networking concept is the IoT. Once networked, rich sources of data that were conventionally stand-alone now enable better ways to manage and measure buildings and portfolios of buildings. The integration to today's standards of computing has officially entered the BEMS space. Customers are demanding control systems that are much easier to use and that can also provide useful graphic-based information and suggested ways to optimize the operation of their facilities.

The business value of BEMSs does not directly correlate with solution complexity in the market today because of the diversity of customer needs and building infrastructure. For example, for an owner of a single building just starting to explore the opportunities of more strategic energy management, a BEMS visualization and reporting offering may be the ideal investment. On the other hand, an executive seeking to manage energy across a corporate real estate portfolio may require an integrated BEMS that manages a broad spectrum of equipment, helps expedite a centralized maintenance team, and tracks progress toward corporate sustainability targets. In this situation, the most beneficial BEMS solution would include the sophisticated capabilities in each of the four classes: visualization and reporting, fault detection and diagnostics, predictive maintenance and continuous improvement, and optimization. Furthermore, a BEMS solution that is initially implemented with a focus on a particular building or equipment type but is scalable to add complexity and integrate across systems over time may generate more business value and support a phased investment approach.

BEMS can be categorized in terms of functional offerings, but in the same way that the architecture may vary, the solution maturity may vary in terms of integration complexity and capabilities. In terms of solution architecture, BEMS offerings can include software, services, and/or hardware in an array of combinations designed to address the customer's specific needs based on the existing infrastructure and human capital. The figure below presents a roadmap of BEMS complexity across four offering classes.

***Figure 1.1 BEMS Offerings Roadmap***




*(Source: Navigant Research)*

## 1.4 Focus on HVAC

The emergence of the IoT has made strategic energy management enabled by analytics available to a growing audience of customers via BEMSs. Solution providers have a specific interest in meeting the needs of smaller facilities, a largely untapped and sizable market opportunity relative to the large building segment supported by traditional controls and automation. For example, vendors from the traditional automation and control segment, IT, and niche specialty providers have identified HVAC system optimization as a specific avenue through which BEMSs can support smaller facilities.

For example, Daikin Applied and Intel have partnered to introduce a new solution for HVAC management. The Intelligent Equipment offering utilizes the IoT to remotely monitor and control HVAC systems using any mobile device. The Intelligent Equipment control solution utilizes real-time data streams to benchmark system performance and monitor operations.

The solution offers customers with packaged rooftop systems as their primary HVAC solution an alternative to the traditional management approach supported by external controls contractors or traditional building automation systems. Intelligent Equipment offers remote access, trend information, energy monitoring and management, diagnostics, and alarm management as an embedded feature of the new rooftop unit. The image below illustrates the visualization and reporting interface accessible via Daikin Intelligent Equipment.

***Figure 1.2 Daikin Intelligent Equipment Offerings Overview***


*(Source: Daikin)*

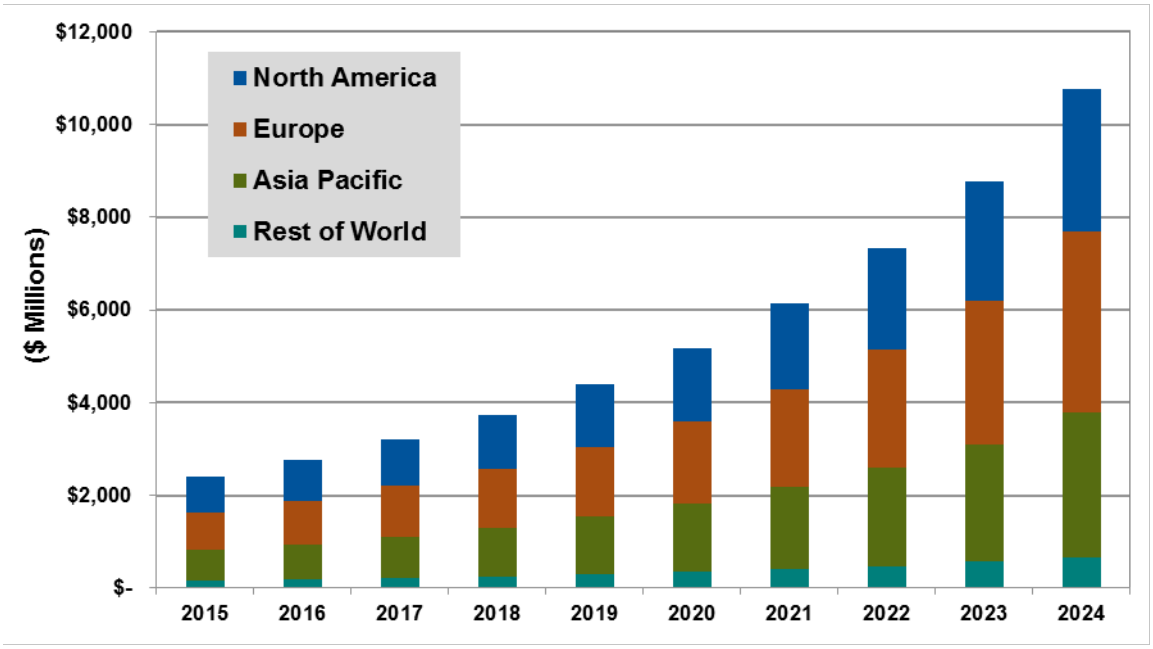
Daikin Intelligent Equipment leverages Intel-based intelligent gateways to connect its rooftop units and deliver data directly to the cloud. The system analyzes the collected data automatically as well as external data, such as weather data or grid signals, and implements changes to improve efficiency, comfort, and reliability. This new offering helps building owners better manage the performance of their buildings, anticipates potential for savings or HVAC

issues before they happen, and shifts operations and maintenance team efforts from reactive to proactive systems management.

## 1.5 Global BEMS Market Size and Forecast

According to Navigant Research, BEMS revenue is expected to reach $2.4 billion in 2015 and grow to $10.8 billion by 2024 at compound annual growth rate (CAGR) of 18.2%. Although North America and Europe are projected to continue leading in BEMS demand in the near term, Navigant Research projects increasing investment in Asia Pacific in the mid and long term. Furthermore, forecast demand will grow at differing rates by customer segment (e.g., retail, commercial offices, or hospitality) as the BEMS market continues to mature.

***Chart 1.1 Building Energy Management System Revenue by Region, World Markets: 2015-2024***




*(Source: Navigant Research)*

The global outlook for the BEMS market is optimistic, and the pace of market adoption is expected to accelerate. BEMS offerings are anticipated to remain diverse in terms of solution capabilities and integration complexity in the near term and midterm because of the distinctions in customer needs during this early adopter stage of market development.

While the period of 2010–2014 was led by the emergence of BEMS startups and acquisition strategies among large industry incumbents, the next 10 years will likely follow a different market development path. Navigant Research anticipates a new pattern of partnerships, the emergence of building energy management offerings from adjacent markets, and new business models.

BEMS solutions that are applicable for smaller facilities are expected to see rapid growth in adoption as the pipeline of pilots demonstrates the economic impacts of energy efficiency and maintenance optimization across these building portfolios. Furthermore, the connectivity and data flow associated with the IoT and the SaaS delivery model will continue to support broader adoption of BEMSs to customers outside the segments that have traditionally benefited from traditional building controls and automation. The ability to integrate intelligent devices for data acquisition and analytics will support flexible and cost-effective solutions that meet the needs of an ever-growing audience of building management stakeholders.

# Section 2

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## SCOPE OF STUDY

Navigant Research has prepared this white paper to provide building management stakeholders—including building owners, corporate executives, technology suppliers, service providers, investors, and policymakers—with an overview of the development and business case for BEMS. Its objective is to provide an understanding of some of the significant market developments and movements that are taking place as customers demand more data-driven solutions to energy and operational management. Note that this white paper does not aim to offer an exhaustive assessment of BEMSs. Deeper analysis and perspective on the market is provided in Navigant Research's in-depth Building Innovations reports.

## SOURCES AND METHODOLOGY

Navigant Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Navigant Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Navigant Research's analysts and its staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Navigant Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Navigant Research is a market research group whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. Navigant Research is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

## NOTES

CAGR refers to compound average annual growth rate, using the formula:

CAGR = (End Year Value ÷ Start Year Value)$^{(1/steps)}$ – 1.

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2015 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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