PikeResearch
Cleantech Market Intelligence

Research Report

Smart Buildings: Ten Trends to Watch in 2012 and Beyond

Published 2Q 2012

Eric Bloom
Senior Analyst

Bob Gohn
Vice President, Research

Section 1

EXECUTIVE SUMMARY

1.1 A Snapshot of the Smart Building Industry Today

The smart building industry has been busy over the last few years. Advances in technology that make it easier to manage energy have considerably broadened the energy conversation, engaging not just facility managers, but also CEOs and CFOs. Although the effects of the global economic recession are still felt throughout the building and construction industries, technology vendors and integrators have continued to uncover new opportunities to improve energy efficiency in the existing building stock. The potential for energy efficiency has hardly been tapped even today.

Smart buildings employ a wide range of technologies that improve efficiency and connect buildings to each other as well as to the grid using intelligent, information and communication technology (ICT)-based devices and networks. Many of the technologies required for qualifying as a smart building, such as energy efficient heating, ventilation, and air conditioning (HVAC) systems and submeters, are mature. Others, such as building energy management systems (BEMSs) and building information modeling (BIM), are evolving rapidly and offer some of the most impactful innovations that the building industry has witnessed in years. The challenge that integrators face today, however, is tying these systems together in a way that maximizes profitability and leverages the strengths that each service provider in the smart building ecosystem brings to the table.

The one certainty is that demand for smart building technologies will continue to grow. The value proposition for many of these technologies has been demonstrated and a growing number of building owners are starting to adopt them with positive results. As the technology continues to evolve, improve, and decrease in cost, efficient and intelligent technologies will start to become an even more pervasive fixture in buildings worldwide.

1.2 Ten Trends in Smart Buildings

This white paper explores ten of the key trends that are transforming the smart building industry worldwide today, including:

- Building energy management hits the cloud
- Co-opetition is on the rise in the building industry
- Targeted acquisitions help key players deliver end-to-end monetized energy services
- Demand for smart building products in Asia Pacific will soar, driven largely by China
- U.S. energy service companies turn to the federal sector
- Building communication protocols are converging in more ways than one
- Demand response (DR) is shifting into automatic
- Submeters find new opportunities in smarter buildings
- Building information modeling is transforming the design process
- The interface between smart buildings and the smart grid is blurring

Section 2

TEN TRENDS IN SMART BUILDINGS

2.1 Building Energy Management Hits the Cloud

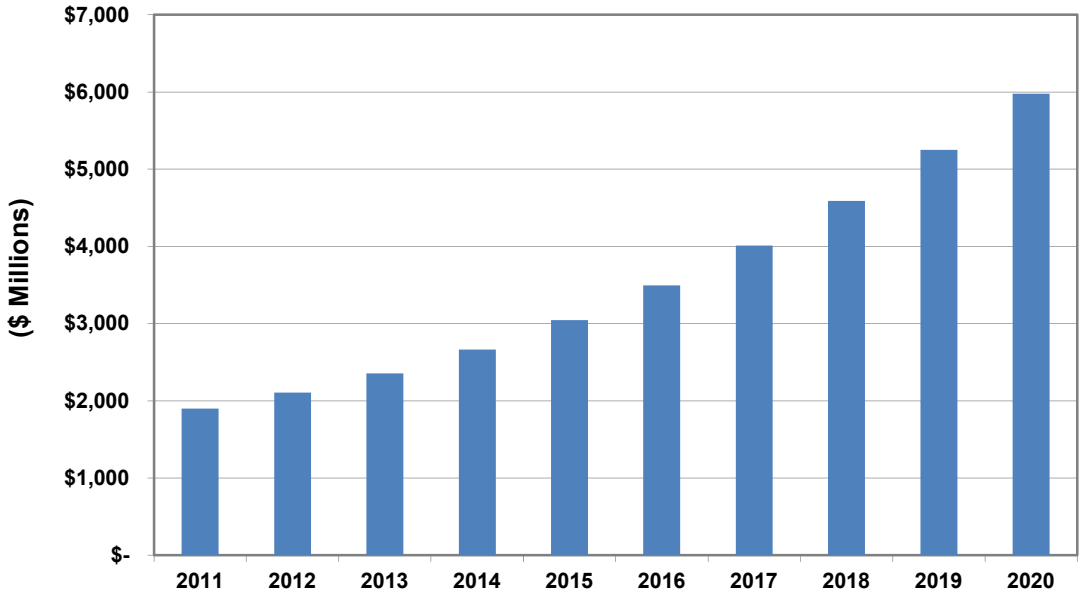
The last year has catapulted building energy management into the 21st century. Since the dawn of building automation, buildings have been producing volumes of information, but few in the building industry started tuning in until the last few years. Today, a number of players are tapping into the big data that buildings are constantly producing and uploading it into the cloud as the basis for rich software-as-a-service (SaaS) offerings.

Virtually every leading name in the building services industry has made some kind of move on BEMSs that host and manage building data in the cloud recently. For example, in November 2011, Jones Lang LaSalle (JLL), the real estate industry giant, launched IntelliCommand, a service that builds on JLL's usual business model – facility management and operations – by folding building energy data into other operational data and benchmarking it to identify areas of inefficiency and poor performance. This type of move can be seen in other commercial real estate firms, as well as with HVAC equipment vendors, including Schneider Electric and Siemens, as well as IT systems integrators, such as IBM and HP, and many others.

But some companies and organizations are taking the BEMS concept one step further to offer not just a proprietary solution but rather a much broader platform for building energy management that will soon play host to hundreds of third-party app developers and their customers – building owners and occupants. For example, in October 2011, Johnson Controls announced the launch of Panoptix, a platform that pulls together data from disparate building systems (e.g., the building automation system (BAS), the meter system, weather data, security systems, etc.), and offers a suite of cloud-hosted building efficiency applications that allows users to link their own building management system (BMS) to the platform and start monitoring and managing their buildings. Soon, the app suite will also be open to independent software developers. Johnson Controls hopes to have a social network-like effect on building efficiency by crowdsourcing best practices and innovative building energy management techniques.

The benefits are wide-ranging. On a basic level, simply providing a window into energy use through a BEMS paints a picture of how buildings are operating and using energy for CEOs and CFOs, and this service alone adds significant value in corporate decision-making, even before energy is saved. In addition, these cloud-based solutions allow key decision-makers to access data on energy use in buildings in real time from any web-enabled device, with fresh data streams available at every log-in. This inverts the process by which building owners and managers have traditionally reacted to energy costs – in hindsight. In the past, these decision-makers have been able to do little but speculate as to why the monthly or quarterly energy bills they received were so high. Building energy management systems, however, provide insight into how energy is being used before the bills arrive and can often recommend cost-effective efficiency measures to reduce them.

Chart 2.1 Building Energy Management Systems Market Revenue, World Markets: 2011-2020



(Source: Pike Research)

As these cloud-based solutions mature and improve, the BEMS market will grow. Pike Research forecasts that the global BEMS market will grow from $1.9 billion in 2011 to $6.0 billion in 2020, including the associated hardware, software, and services components.

2.2 Co-opetition is on the Rise in the Building Industry

The building industry is highly fragmented. On the HVAC and equipment side, a handful of leaders, such as Schneider Electric and Johnson Controls, have large, multinational presences, but most of the market is divvied up among thousands of smaller companies, with a relatively narrow regional or technological focus. On the commercial real estate side, even CB Richard Ellis, the real estate firm with the largest footprint of space under management – 2.9 billion square feet (SF) – has captured less than 1% of the world's 400 billion SF of commercial space.

These vendor-specific fiefdoms are starting to break down, as the demands of deep energy efficiency and energy management require considerable integration between disparate building systems. As demand for BEMSs, as well as comprehensive, end-to-end solutions for energy efficiency, including new capabilities like demand response and energy procurement, increases, the need for end-to-end services will push players to create alliances that plug gaps in service offerings and also to find ways to mutually reinforce one another, rather than compete against each other.

This is having a dramatic effect on the way companies design and market their products as well. In the past, vendors often designed products, such as BASs, controls, and certain types of equipment specifically so that they would not work with other vendors' products, ensuring the vendor a long-term market for replacements and upgrades. Now, companies are moving away from proprietary products and communication protocols and converging on a few industry favorites that will guarantee them a leading spot in the era of high-

performance buildings. Leaders in the building industry may have diverging views as to which business models make the most sense for building energy efficiency services, but they all agree on one thing – no single player can do it alone.

The co-opetition trend, however, is not all about vendors deciding to play nicely. It is about vendors finding that the combined capability of two systems – whether information and communication technology systems linked with BMSs, DR services tied with energy procurement services, or one of the dozens of other possible permutations – is often greater than the sum of the parts. Combining two powerful solutions from separate vendors can open up new opportunities that are impossible to achieve individually. Competition is, of course, still alive and well in the building sector, which is good for the industry as a whole. But these co-opetition arrangements demonstrate that the highly fragmented building industry is finding novel opportunities to pair technologies in mutually beneficial ways to deliver smarter buildings.

2.3 Targeted Acquisitions Help Key Players Deliver End-to-end Monetized Energy Services

When a nascent technology market reaches a certain point of maturity, smaller pure-plays start getting snapped up by larger established firms at breakneck pace. The smart building industry is starting to reach this point, as evidenced by a number of important acquisitions over the last year. Table 2.1 highlights several key acquisitions.

Table 2.1 Major Smart Building Acquisitions: 2011-2012

Parent Company	Company Acquired	Description
Ameresco	Energy and Power Solutions	Auto-DR, energy management
Honeywell	E-Mon	Submetering
IBM	TRIRIGA	Facility management
Johnson Controls	EnergyConnect	Demand response
Schneider Electric	Summit Energy	Energy management, procurement
Schneider Electric	Telvent	Smart grid
Schneider Electric	Viconics	Industrial process controls
Siemens	Encelium	Lighting controls
Siemens	Advanced Telemetry	Cloud-based energy management
Siemens	Pace Global Energy Services	Enterprise energy management

(Source: Pike Research)

These are not examples of companies swallowing their peers to squelch competition. Rather, they are moves that indicate that the smart building industry is accelerating at such a pace that, when faced with the decision of whether to buy or to build, many of the major players are opting to buy, placing them on the map either geographically or technologically, rather than taking the time and investing in the resources to build new capabilities.

What is also striking about these moves is that they are lateral, increasing the parent company's breadth, rather than depth, in many cases. Many of these acquisitions seem to fit into a consistent storyline: "Established leader in the building industry acquires specialist firm to broaden the parent company's arsenal." Leaders like Schneider Electric and Siemens are already strong at what they do, but acquisitions of companies like Summit Energy, an energy procurement leader, instantaneously add a new capability. And, in an increasingly competitive request for proposal (RFP) environment, offering a value-added

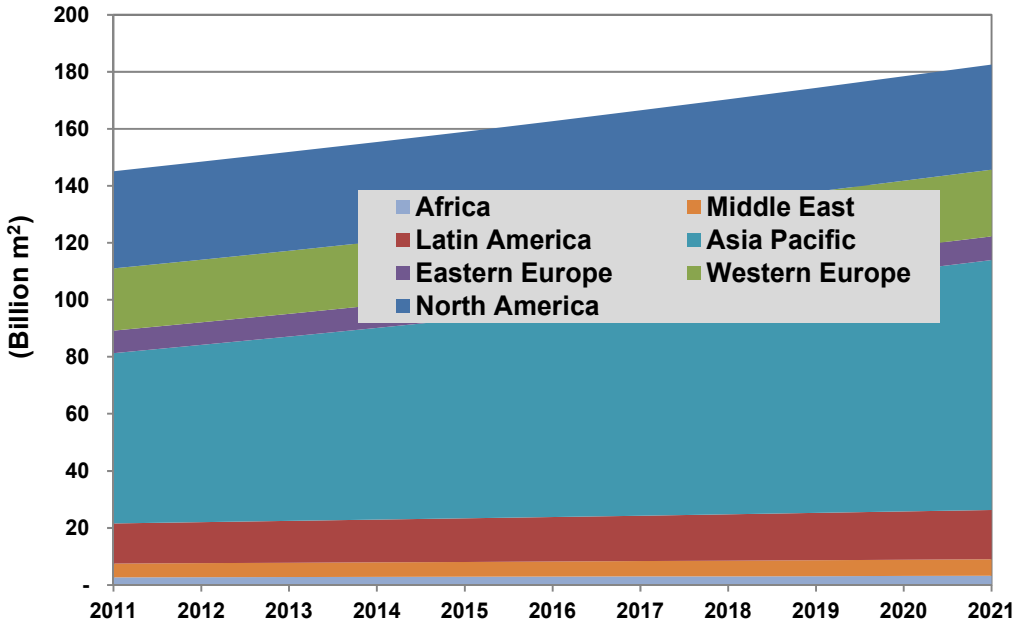
service can make the difference between a winning RFP response and a losing one.

Smart building industry leaders are moving toward what might be called monetized energy services, in which integrators can optimize buildings and the potential energy cost savings both in terms of energy efficiency as well as other energy-related cost concerns, such as DR and energy procurement. For example, while it is true that an energy-efficient retrofit can save a building owner 10% on energy costs in the long term, in the increasingly competitive retail and wholesale energy markets, a building owner can also save 10% on energy simply by switching from one supplier to another in some cases. Add DR payments on top of that and the building owner can enjoy much better return on energy-related investments than a retrofit alone could achieve. The market leaders realize this and are aiming to provide a broader range of services that can optimize energy costs across a full range of options, many of which are being added through targeted acquisitions of specialist firms.

2.4 Demand for Smart Building Products in Asia Pacific Will Soar, Driven Largely by China

The figures surrounding the growth of the building industry in Asia Pacific are staggering. The region's building stock represents over 40% of the world's building space and is growing by over 2.4 billion square meters (m^2) per year, most of which is in China. By 2025, China will build over 200 cities with a population of over 1 million, according to McKinsey & Company.

Chart 2.2 Building Stock by Region, World Markets: 2011-2021



(Source: Pike Research)

However, these huge numbers are not always reflected in the Asia Pacific region's share of smart building technology today. Despite the region's dynamic construction activity, it represents just 25% of the global market for BASs and controls, 20% of the global market for BEMSs, 17% of the global market for intelligent lighting controls, and a mere 6% of the

global market for DR services. Despite the billions of square meters of new space that are added every year in the region, smart building technologies still have a proportionally low rate of penetration in new buildings in Asia Pacific.

However, Asia Pacific's heft is reflected in several smart building niches. For example, in the energy efficient lighting market, Asia Pacific represents over half of annual light-emitting diode (LED) sales globally. The region's prominence is also reflected in the growth rates for the above technologies, as Asia Pacific's markets, often characterized by double-digit year-on-year growth, routinely outpace North America and Western Europe in terms of growth for smart building technologies. The nascent nature of smart building technology adoption in Asia Pacific means the region has considerable untapped potential and the next few years will witness rapid growth, as smart technology demand increases.

Most of this new growth in the Asia Pacific market for smart building technologies will, unsurprisingly, occur in China. The Chinese government has laid out support for a number of energy-efficient and smart building technologies in its five-year plans, which outline the country's main priorities for market development and social transformation. In its 11th Five-Year Plan, released in 2006, the Chinese government set out a number of environmental goals, such as energy consumption per unit of gross domestic product (GDP) reductions of 20%. In its 12th Five-Year Plan, these goals were built upon with targets to cut energy consumption per GDP by 16%. In addition, China's Three Star green building certification, which covers a range of green building issues similar to Leadership in Energy and Environmental Design (LEED), was developed with strong support from the Chinese government and is being applied to an increasing number of building projects in China, driving demand for energy efficiency products as well.

2.5 U.S. Energy Service Companies Turn to the Federal Sector

Energy service companies (ESCOs), the core of energy efficiency activity in many building markets around the world, tend to stick with known client categories and rarely change direction. In Western Europe, ESCOs focus their business on the public and commercial building sectors. In China, they tend to focus on the commercial and industrial sectors. In the United States, nearly three-quarters of ESCO business focuses on the municipalities, universities, schools, and hospitals (MUSH) markets. The MUSH market has provided a consistent source of revenue over the last few decades and the level of familiarity with ESCOs and energy performance contracting is high among these clients.

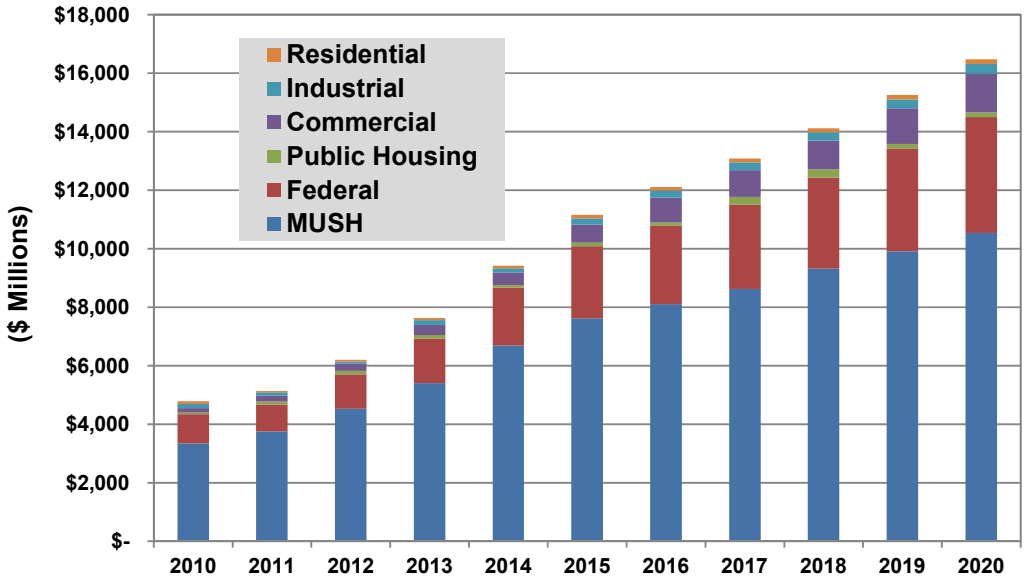
Over the last few years, however, the federal sector has started to prove more inviting to ESCOs and energy performance contracting in the United States. Historically, the federal sector has represented a considerable portion of the U.S. ESCO industry – about 15% to 20% in a given year. Although the federal government has the foundations for strong ESCO support, including a number of federal mandates and targets for energy efficiency that have been put in place since 2005, adoption of the energy performance contracting model has not been uniform across all agencies. The inconsistent support for the ESCO model stems from a number of issues, such as a lack of familiarity with performance contracting among staff, the availability of direct Congressional appropriations for energy efficiency programs, and the availability of other avenues, such as purchases of renewable energy credits (RECs) to achieve federal agency emissions reduction targets.

However, the industry is turning its gaze toward the ESCO model. As Congressional appropriations become harder to obtain, complying with federal energy efficiency mandates requires a more creative approach. Energy performance contracting offers one alternative energy efficiency financing vehicle without using taxpayer money. Activity will also swell following the October 2011 announcement of the federal government's Better

Buildings Initiative, in which President Obama pledged $2 billion for energy efficiency projects over the next few years by the federal government, largely using the energy performance contracting model.

Counting the 500,000 buildings under the federal government's control, the potential for financing energy efficiency improvements through the ESCO model is great. Sixteen firms, known as Super ESPCs and including well-known firms, such as Schneider Electric and Johnson Controls, are allowed a maximum contract volume of $5 billion each, for a total of $80 billion of total investment. Pike Research forecasts that U.S. ESCO revenues from the federal sector will grow from $1.2 billion in 2012 to $4.0 billion in 2020, at a compound annual growth rate (CAGR) of 18%.

Chart 2.3 ESCO Revenues by End-Use Market, United States: 2010-2020



(Source: Pike Research)

2.6 Building Communication Protocols are Converging in More Ways than One

The word of the year in smart buildings is convergence. This concept broadly applies to the convergence of ICT with BMSs and other systems within buildings to create BEMSs that feed BMS-related data into centralized servers and software applications. Without a common IT network for building systems, coordinating all of a building's systems in a way that optimizes energy efficiency and performance is difficult, if not impossible. ICT-enabled building devices – including the traditional networked devices, such as thermostats, sensors, and controls, as well as, increasingly, HVAC equipment and lighting fixtures themselves – are becoming ubiquitous, leading to a complete landscape of smart devices that can be integrated into a single system.

Communication protocols are the thread that holds the entire system together and a different type of convergence is taking hold of the communication world. Today, dozens of open (e.g., BACnet, LonWorks) and proprietary (e.g., Johnson Controls/Metasys) protocols exist, through which systems communicate with each other within a building or campus. Some devices with a proprietary protocol can communicate with others with an aftermarket

translation device, but some systems simply cannot be integrated harmoniously into single networks.

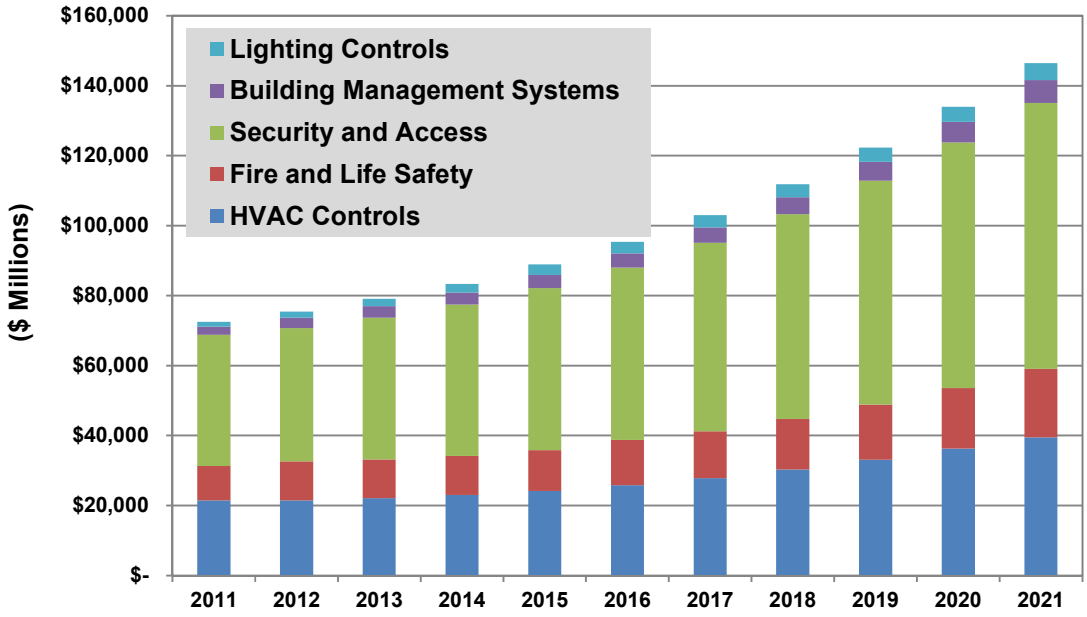
BACnet was originally developed in the late 1980s in association with the American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE), the HVAC industry association, and is one of the leading protocols in the United States, particularly for HVAC and lighting control systems. LonWorks, the other top protocol in the United States, was developed in the 1990s by Echelon, one of the leading smart grid and automation technology firms. While BACnet's association with ASHRAE has curried favor among HVAC vendors, LonWorks has been a favorite among lighting control manufacturers, given its rapid response time. Other protocols serve other niches or are favored by specific vendors as a way of discouraging mixing-and-matching of products from competitors.

The result is a world in which systems that perform very similar functions cannot communicate with each other. Imagine if BlackBerry owners could not call iPhone owners. That is the basic reality in the BAS world today. However, the field of communication protocols is starting to narrow, as the demands for interoperability between devices and systems increase.

Echelon recently took a major step toward breaking these barriers down through the launch of a suite of tools and products aimed at integrating systems based on LonWorks and BACnet. This is a particularly fitting move for Echelon, the gatekeeper of the LonWorks protocol, which is carving out a leading role in developing technologies at the edge of the grid such as at the interface between buildings and the utility distribution network.

Over time, automation systems will likely shift to IP networks for new buildings, doing away with the polyglot automation world of today. And as they do, the market for BASs will grow, from $72.5 billion in 2011 to $146.4 billion in 2021, bolstered by construction activity in Asia Pacific, as well as increased demand for energy efficiency-related controls, such as lighting and BMS controls. However, the existing building stock will continue to speak many languages and solutions like Echelon's will play an important role in synthesizing building energy data to make buildings smarter and more energy efficient.

Chart 2.4 Commercial Building Automation Revenue by Segment, World Markets: 2011-2021



(Source: Pike Research)

2.7 Demand Response Is Shifting into Automatic

The average peak load is increasing every year. Last July, peak load in several grid operators' domains broke their historic records. Extremely hot summers and cold winter days are partly to blame, but the growing population and the increasingly energy-intensive lifestyles of building occupants have also contributed to the increase. In response, many utilities and grid operators have turned to DR programs as a way to incentivize customers to reduce their non-essential energy demand.

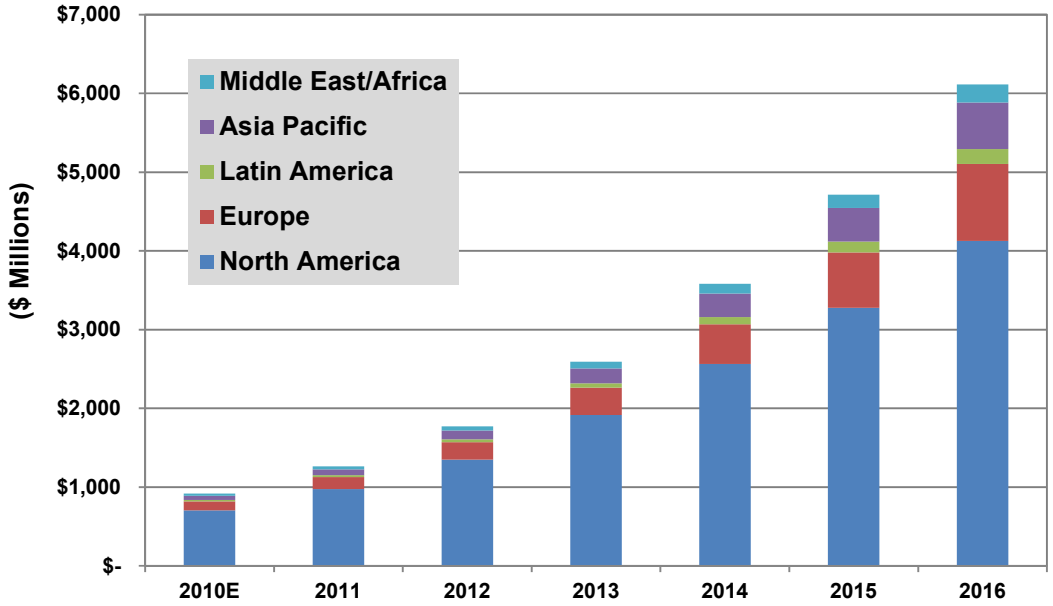
DR, however, remains a largely manual process. Once an agreement has been reached between utilities, customers, and, in some cases, curtailment service providers (CSPs) like EnerNOC, DR resources are only dispatched after a facility manager at the customer site receives a signal from the utility or CSP. The manual process for dispatching DR often allows a grace period of 30 minutes or longer and many utilities could benefit significantly from faster response times.

As a result, automated demand response (Auto-DR) is starting to emerge as a solution to the manual approach to DR. Auto-DR connects to a BAS directly, avoiding the middleman and giving those charged with balancing supply and demand far better control over the demand side. This guarantees a faster response time and opens the door for DR resources to enter into ancillary services markets and serve as a true partner technology to intermittent renewable energy resources.

The new technology demands of Auto-DR are starting to create buzz in the buildings world. Companies like Honeywell and Johnson Controls have acquired DR players in the last few years and, in December, Ameresco acquired the Auto-DR business of Energy and Power Solutions to address the growing Auto-DR opportunity. In California, industry leaders have developed a standard, OpenADR, which is now required by the California Public Utilities

Commission (CPUC) and is being applied to Auto-DR installations around the world, including in the United Kingdom and China.

Chart 2.5 Demand Response Services External Spending by Region, World Markets: 2010-2016



(Source: Pike Research)

The total market for DR services is growing rapidly and will reach $6.1 billion by 2016 at a CAGR of 37.2% over the 2010-2016 timeframe. While the U.S. market will represent the largest portion of this market, the emerging DR markets of Western Europe and Asia Pacific will further accelerate the growth. Look for an increasing portion of this market to be fully automated, as utilities and CSPs look to deepen the ability of DR to manage the grid ever more efficiently and reliably.

2.8 Submeters Find New Opportunities in Smarter Buildings

Submeters – or metering devices – that building owners install to log utilities like electricity, gas, and water are by no means a new technology. Technologically similar to utility meters, which mediate the utility-customer relationship as opposed to the interface between building owners and tenants or individual building components, submeters have historically focused on two main applications. The first is basic tenant billing/cost allocation, in which submeters measure the energy consumption of individual building tenants, pieces of equipment, or individual buildings within a larger campus, filling in where utility meters leave off. The second is deep energy and power quality monitoring that tracks a wider range of concerns, such as current and voltage, particularly in commercial and industrial facilities. A handful of vendors have sold submeters over the years and installations have largely been ad hoc and based on a specific niche need at a given time.

However, the recent push toward energy management in buildings is breathing new life into this mature technology. The mantra, "You can't manage what you don't measure," is at the core of new thinking around energy in buildings, and few technologies are better positioned to measure and report energy consumption at a tenant or end-use level than submeters. An effective submeter system is like having an army of energy auditors with

deep analytical capabilities taking building energy measurements every 15 minutes. That level of monitoring and control is of great appeal to business decision-makers. Although submeters by themselves do not reduce energy consumption, the information they provide can help building owners immediately detect poorly performing systems, and many submeter installations have been followed with energy cost savings of about 5% to 10% and short payback periods for the installation.

The increased demand for submeters is a result of the growing interest in energy management, as well as a series of policies and green building standards that directly or indirectly encourages submetering. In the United States, the Energy Policy Act of 2005 requires building-level metering of federal facilities by 2012, including utility meters or non-utility submeters, covering the federal government's 500,000 buildings and 3 billion SF of space. The new commercial building code in the state of Washington, the Washington State Energy Code (WSEC), specifically requires submetering for certain applications. It is possible that submetering will also become obligatory in other state energy codes, such as California's rigorous Title 24 code or perhaps even the next iteration of ASHRAE 90.1. In Europe, adoption of the ISO 50001 energy management standard, which has rigorous ongoing measurement and verification requirements, is growing, and submetering is the technology that most readily satisfies those requirements.

In addition, the LEED green building certification program encourages submetering by offering a number of points specifically tied to submetering (as shown in the Table 2.2 below), as well as by requiring building owners to maintain high levels of energy performance for 5 years after initial design, a task that submetering can help accomplish.

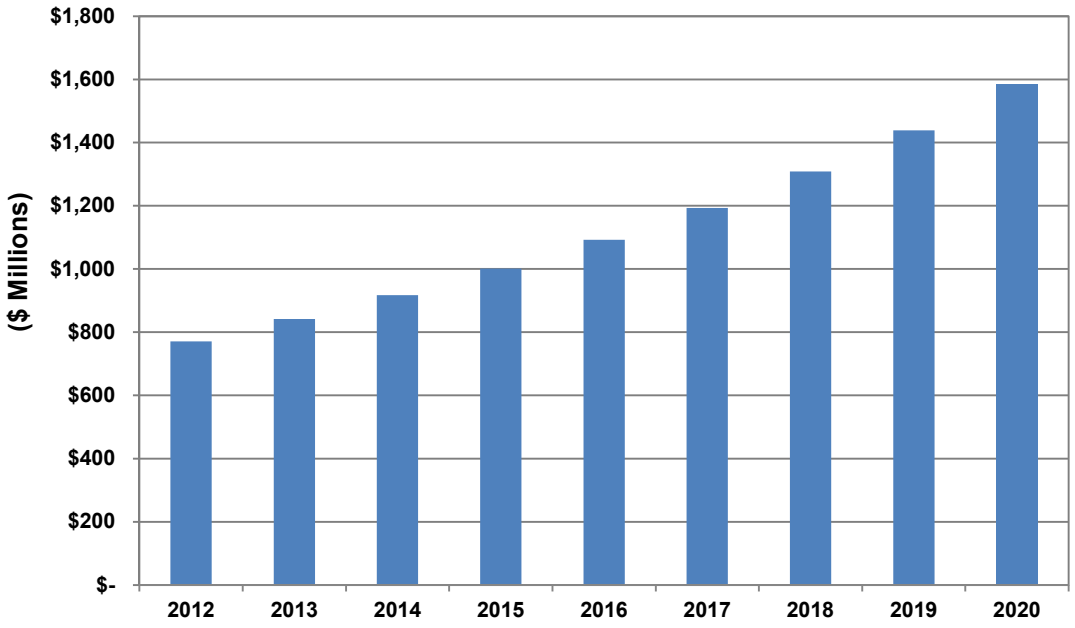
Table 2.2 Submetering Criteria in LEED Certification Programs

LEED Credit Title	Credit Reference Number	Description
Measurement & Verification	LEED NC Energy & Atmosphere: Credit 5	"Install the necessary **metering equipment** to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate."
Measurement & Verification	LEED CI Energy & Atmosphere: Credit 3	"Install **continuous metering equipment** for the following end uses: Lighting systems and controls; constant and variable motor loads; variable frequency drive operation, etc."
Performance Measurement	LEED EB Energy & Atmosphere: Credit 3.2	"Employ **system-level metering** covering at least 40% or 80% of the total expected annual energy consumption of the building. Permanent metering and recording are required."

(Source: U.S. Green Building Council)

Several vendors have aimed to capitalize on the growth of demand for submeters in recent years. Honeywell's acquisition of E-Mon and Leviton's acquisition of IMS, both in 2010, suggest that energy efficiency service providers see submetering as a crucial part of the energy management equation and a strong growth market. Pike Research expects to see an increase in activity on submetering, as demand for energy management increases and a growing number of policies and standards incentivize ongoing efficient performance and submetering system adoption.

Chart 2.6 Submetering Technology and Services Market by Category, North America: 2012–2020



(Source: Pike Research)

Overall, the worldwide market for submetering technology and services totals $771 million and will grow to $1.58 billion in 2020 at a CAGR of 9.4%. North America, Western Europe, and Asia Pacific collectively amount to 85% of the global market, with the remaining 15% spread between the Middle East, Latin America, Eastern Europe, and Africa. This split will remain consistent over the next 8 years as demand for submeters and their associated services surges in the largest three regions.

2.9 Building Information Modeling Is Transforming the Design Process

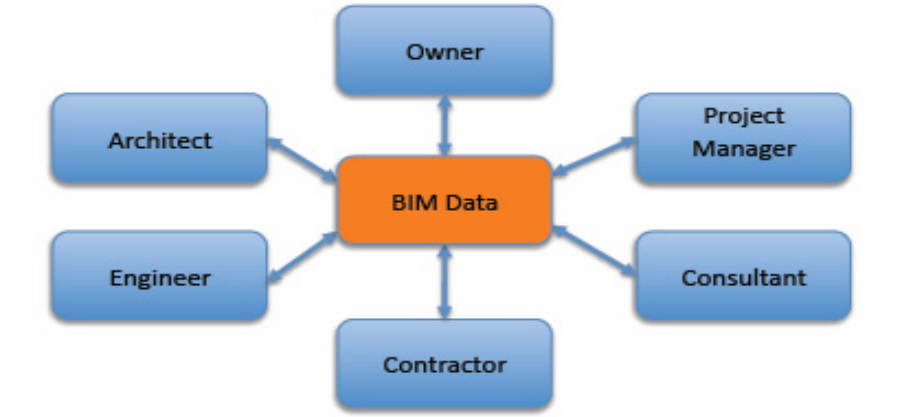
A smart building starts with a smart design. Many of the decisions that impact energy efficiency, such as the integration of HVAC, lighting, and other building systems, as well as basic considerations like orientation and materials, are made early in the design process and are difficult to change after the building's initial design phases.

It is remarkable, therefore, that the design and construction process today remains highly fractious and poorly coordinated. Architects, engineers, and contractors operate largely independently of one another and optimize individual systems without using a whole-systems approach to design. This can have catastrophic implications for green and energy-efficient buildings, as the standards required by LEED and increasingly stringent building codes raise the bar for energy performance.

BIM is a set of technologies and processes that facilitate the coordination of construction industry professionals from the earliest phases of design. The National Institute of Building Sciences (NIBS) defines BIM as "a digital representation of physical and functional characteristics of a facility…[serving] as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward." In essence, BIM software houses design and construction documents in a

central repository that all stakeholders can access via computer interface. This new resource enables design stakeholders to achieve a far greater degree of coordination than is possible through conventional design and construction methods, using the software's technology to run many different scenarios to estimate building performance with different technologies, materials, and designs. Many view BIM as the solution to the inefficiencies that perennially hamper the construction industry.

Chart 2.7 Diagram of BIM Project Team Interaction

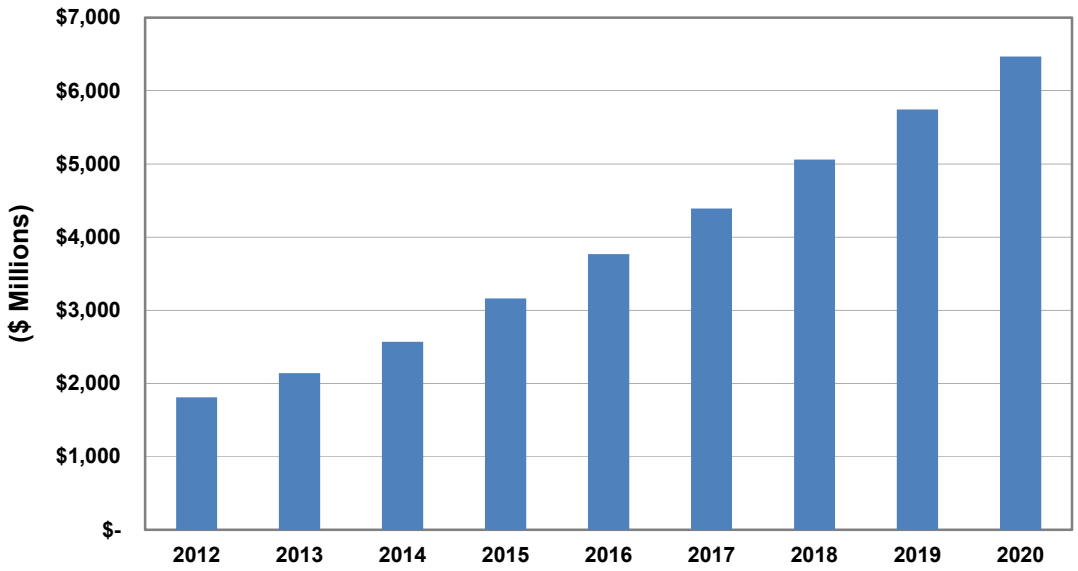


(Source: Pike Research)

Leading architectural and engineering software firms Autodesk and Bentley are at the forefront of BIM software development. Each has a large and expanding suite of BIM-related products that facilitate collaboration on a range of building and infrastructure projects. In addition, a number of leading trade associations and governmental agencies, including the American Institute of Architects (AIA), the Building Owners and Managers Association (BOMA), and the U.S. General Services Administration (GSA), have adopted BIM as an integral part of design or promote it within their member bases and networks.

As demand for high-performance buildings grows worldwide, BIM will become an essential tool to ensure that buildings achieve energy efficiency targets. More broadly, the benefits of increased coordination will trickle into the construction industry for conventional building and infrastructure projects as well. This will, in turn, drive a broader BIM ecosystem that will include thousands of BIM consultants and trainers to help architecture, engineering, and construction (AEC) firms transform their processes to accommodate BIM. Although the transition will undoubtedly prove challenging to companies accustomed to the conventional design and construction process, the demonstrated value proposition of BIM will, over time, breathe innovation into the well-established construction industry.

Chart 2.8 Building Information Modeling Revenue, World Markets: 2012-2020



(Source: Pike Research)

2.10 The Interface between Smart Buildings and the Smart Grid Is Blurring

A broader view of the smart building industry reveals that much of the activity is happening less at the individual scale and more at the network level. BEMS tend to favor portfolios of buildings that can be controlled from a central location. In a sense, the intelligence that is finding its way into commercial and industrial buildings is creating a bird's eye view of aggregations of buildings – and utilities are starting to pay attention.

For example, Pacific Gas & Electric (PG&E) is working with the energy management firm, C3, to deploy energy management software across PG&E's commercial and industrial customer base to benchmark facilities and identify poorly performing ones. Utilities have long engaged customers on energy efficiency through demand-side management, but the pace and efficacy of such programs have received a considerable boost in recent years, as intelligent systems trickle into buildings. Around the world, moreover, grid operators are changing rules and providing market mechanisms that allow and incentivize DR, enabling demand-side resources (e.g., commercial buildings) to receive compensation for reducing their power demand during critical moments. Without sophisticated control systems, these types of programs would simply not be possible.

The interest that smart buildings have piqued among utilities has led some energy management firms to turn their gaze to utilities as customers as well. Vancouver-based Pulse Energy has shifted its strategy to utilities, providing energy management software that specifically aims to assist utilities in achieving energy efficiency targets and improving customer satisfaction with service. Others, such as Retroficiency and FirstFuel, have considerably expanded their energy management offerings for utilities as well. These moves suggest that, while the needs and priorities of utilities are far different from those of building owners, deploying a single system across an entire utility customer base makes more marketing sense than netting individual building owners as customers one by one.

The high-profile acquisitions and product announcements that smart building leaders have made in recent years also indicate that the building industry is looking increasingly upstream and is enhancing its interactions with the grid. Schneider Electric's acquisition of leading smart grid firm Telvent, and Johnson Controls' acquisition of DR firm EnergyConnect illustrate that building industry leaders are eager to tie buildings with the grid through an intelligent network. In January 2012, Echelon announced a new suite of products designed to make buildings grid-aware by integrating disparate BASs and enabling them to respond to real-time grid conditions. These are just a few of the many examples of how the building industry is taking a much more expansive view of the types of services they aim to offer building owners and managers to address the smart building market opportunity.

In the future, the definition of a smart building will continue to expand, as the technology evolves and as the regulatory and standards environment for DR and building automation matures. Together, smart buildings and the smart grid will continue to reinforce each other, providing continuing opportunities to improve energy efficiency, as well as the economics of operating the electricity grid.

Section 3

ACRONYM AND ABBREVIATION LIST

American Institute of Architects	AIA
American Society of Heating, Refrigeration, and Air Conditioning	ASHRAE
Architecture, Engineering, and Construction	AEC
Automated Demand Response	Auto-DR
Building Automation System	BAS
Building Energy Management System	BEMS
Building Information Modeling	BIM
Building Management System	BMS
California Public Utilities Commission	CPUC
Building Owners and Managers Association	BOMA
Chief Executive Officer	CEO
Chief Financial Officer	CFO
Compound Average Growth Rate	CAGR
Curtailment Service Provider	CSP
Demand Response	DR
Demand-side Management	DSM
Energy Service Company	ESCO
General Services Administration (U.S.)	GSA
Gross Domestic Product	GDP
Heating, Ventilation, and Air Conditioning	HVAC
Information and Communication Technology	ICT
Information Technology	IT
Jones Lang LaSalle	JLL
Leadership in Energy and Environmental Design	LEED
Light-emitting Diode	LED

Municipalities, Universities, Schools, and Hospitals	MUSH
National Institute of Building Sciences	NIBS
Pacific Gas & Electric	PG&E
Renewable Energy Credit	REC
Request for Proposal	RFP
Software-as-a-Service	SaaS
Square Meters	m^2
Square Feet	SF
United Kingdom	U.K.
United States	U.S.

Section 4

TABLE OF CONTENTS

Section 5

TABLE OF CHARTS AND FIGURES

Section 6

SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike 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 Pike Research's analysts and the firm's 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 Pike 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.

Pike Research is an independent market research firm whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. The firm 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:

$$CAGR = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

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 2012 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

Published 2Q 2012

1320 Pearl Street, Suite 300
Boulder, CO 80302 USA
Tel: +1 303.997.7609
http://www.pikeresearch.com