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## WHITE PAPER

# A Systems Approach to Energy and Water Efficiency in Commercial Buildings

### Introduction

Designers and managers of commercial buildings face ever-increasing demands to improve the energy and water efficiency of their buildings:

- Building codes continue to raise efficiency standards for new and existing buildings
- Economic conditions pressure organizations to cut energy costs wherever possible
- Corporate sustainability initiatives require steady efficiency improvements to achieve results

To compound matters, the complexity of buildings and building systems continues to rise, making effective solutions harder to design, install and operate.

In response, architects and specifiers of new commercial buildings, and facility managers of existing ones, are increasingly adopting a new approach: a systems approach to energy and water efficiency improvements.

### Building Codes Drive Changes

Green building codes and standards are driving commercial building owners to operate their buildings more sustainably – taking into account the economic, environmental and social impacts their facilities have on the people who use them and the communities where they are located.

Leading the way are American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) building energy codes that are rapidly and dramatically changing the energy and water efficiency landscape for commercial buildings.

In the U.S., the federal government has required that states adopt ASHRAE code 90.1-2010 – the latest version of its energy standards for new and substantially renovated commercial buildings – as their mandatory building energy codes by no later than October 18, 2013 (though individual states may apply for and receive an extension).

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New and substantially renovated federal buildings must currently comply with ASHRAE 90.1-2007 – the previous version of the code. But adoption of the newer 90.1-2010 at some point appears certain as the federal government pushes toward a 100% reduction in energy usage in its buildings by 2030.

In general, 90.1-2010 aims to increase the overall energy efficiency of commercial buildings by roughly 18% over previous standards. It also sets higher efficiency requirements for individual components of a building's HVAC system, including air conditioners, heat pumps, chillers, furnaces, boilers, heat exchangers and other components.

ASHRAE 189.1-2011 sets the bar even higher for greening commercial buildings. Developed by ASHRAE in collaboration with the Illuminating Engineering Society of America (IES) and United States Green Building Council (USGBC) – creators of the LEED green building rating system – 189.1-2011 is appropriately called the *Standard for the design of High-Performance Green Buildings*.

This standard requires aggressive improvements in:

- Site Sustainability
- Water Use Efficiency
- Energy Efficiency
- Indoor Environmental Quality
- Building Impact on Atmosphere, Materials and Resources
- Construction and Plans for Operation

Water use efficiency standards contained in 189.1-2011 require reduced water use for landscaping, minimum efficiency standards for plumbing fixtures and appliances, more efficient cooling towers, better water use monitoring and other improvements.

Similarly, energy efficiency standards require additional reductions in energy usage beyond what was achieved through 90.1-2010 compliance, improved energy usage monitoring, readiness for renewable energy and other measures.

In 2010, the U.S. Army adopted 189.1-2011 as its standard for all new and renovated buildings. The U.S. Department of Defense is conducting a cost-benefit analysis of 189.1-2011 to help determine if it should adopt the standard department-wide.

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So while 189.1-2011 establishes a standard for green building construction today, it appears likely that as the drive towards net zero energy buildings continues, it may be adopted soon as a mandatory building code by federal, state and local governments.

### **Other Significant Drivers**

In addition to compliance with existing and emerging building codes, commercial building designers and managers are under continuous pressure to control energy and water costs, and to help achieve corporate sustainability goals.

According to the 2012 Energy Efficiency Indicator – a survey of nearly 3,500 building owners and managers from around the world conducted by the Institute for Building Efficiency – energy cost savings are the number one factor driving decisions related to energy efficiency improvements.

In the same survey, 80% of respondents in the industrial sector, and 72% in the commercial sector, reported setting goals for reductions in energy usage. Similarly, 72% of industrial sector respondents and 63% of those in the commercial sector say their organizations have set goals for reducing their carbon emissions.

The desire to conform to emerging green building codes and standards – coupled with a continual focus on cutting costs, reducing energy usage and shrinking carbon footprints – is driving the urgent pursuit of greater energy and water efficiency in commercial buildings.

### **A System Approach**

Commercial buildings are composed of many individual components – the building envelope and internal structures, along with electrical, mechanical, plumbing and lighting components, and countless other elements that turn structures into comfortable and productive offices and factories, hotels and hospitals, schools and retail stores, and other facilities that are used in an endless variety of ways by businesses, governments and other organizations.

The components in just a commercial building's HVAC system can include boilers, chillers, cooling towers, pumps, drives, valves, heat exchangers and other economizers, heat pumps, solar panels, fans, temperature and pressure regulators, automated building management systems in most larger facilities, and a host of other components.

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A traditional “lowest first cost” or “contract compliance” approach to specifying and procuring these components is unlikely to produce the best long-term operating results for the building owner and occupants – whether in the design and construction of new buildings, or in the replacement of equipment in existing buildings.

A HVAC system composed of even the highest-efficiency components will still only enjoy the efficiency gains of the individual components if they are not designed, installed and operated as a *system*.

For example: if a high-efficiency pump is feeding water to a boiler at a rate that is faster than the boiler can use it, the pump and its accompanying drive are needlessly overworking, shortening their life expectancy, using energy inefficiently, and creating unnecessarily high pressure on piping, valves and other components, potentially shortening their life expectancy as well.

A designer or facilities manager taking a systems approach to this challenge would consider installing a variable frequency drive to operate the pump at the optimal speed to deliver the right flow of water to the boiler based on its precise needs at any given moment, maximizing the efficiency of both pump and boiler while minimizing unnecessary wear and tear on the individual components.

Applying this approach to all components in an HVAC *system* – new or existing – optimizes the lifecycle efficiency and cost savings for the entire building and its equipment.

### **Where Energy and Water Meet**

To maximize energy and water efficiency, it's also critically important for commercial building designers and managers to ensure they're applying a systems approach to the points where energy and water intersect in their facilities.

Creating and sustaining comfortable and productive environments in commercial buildings requires both energy and water. Boilers, chillers, cooling towers, air conditioners, pumps, drives, solar collectors, geothermal heat pumps and other system components consume energy to condition, heat, cool and move water throughout a commercial building to provide heating and air conditioning, generate electricity through geothermal and solar systems, and deliver water wherever it's needed for a variety of uses.

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As a result, gains in energy efficiency also generate improvements in water efficiency – and vice versa – helping reduce a building's lifecycle costs and boost its performance.

### **Controlled Success**

Automated building management systems (BMS) common in larger structures also multiply the positive impacts of a systems approach to improving energy and water efficiency in commercial buildings.

These complex BMS systems enable facilities managers to operate buildings to maintain a comfortable environment, while closely monitoring the performance of the individual mechanical, electrical, plumbing and other components that must work together to achieve that goal.

If those individual components are designed, installed and operated to function as a system – and if they all communicate effectively with the BMS – energy and water efficiency can be maximized, predictive maintenance can be performed to extend the life expectancy of equipment, and operating and maintenance costs can be more effectively managed.

### **Less Risk, More Comfort**

For commercial building designers, a systems approach to designing, installing and operating electrical, mechanical, plumbing and other building components reduces considerable risks involved in their work.

These systems are often designed to ensure they will meet peak demands. But since buildings operate at peak demand for only a small percentage of the time, boilers, chillers, cooling towers, and other components are underutilized most of the time.

This has a number of consequences – all of them negative:

- Energy and water efficiency decline
- Equipment breaks down sooner
- Operating and maintenance costs increase
- Occupant comfort is compromised

Another worry for commercial building designers is the risk that components cobbled together on the basis of “lowest first cost” will not deliver the performance and efficiency gains promised.

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When a systems approach is taken, these risks virtually disappear:

- Energy and water efficiency are maximized
- The life expectancy of equipment is extended
- Operating and maintenance costs are lowered
- The building's performance satisfies occupants and building owners

Additionally, viewing building components as a system – rather than as individual pieces – simplifies design, procurement, installation, operation and maintenance.

### **A Clear Future**

Commercial buildings use nearly one-fifth of the energy consumed in the U.S. An estimated 30% of that energy is wasted.

Through mandatory building codes and voluntary standards, governments at all levels are increasingly driving commercial building owners to improve the energy and water efficiency of their structures. Cost savings and reductions in environmental impacts are also creating strong incentives for advances in commercial building efficiency.

As a result, the “lowest first cost” approach to procuring building components is disappearing, because it does not deliver the efficiency gains and cost savings.

Increasingly, a *systems approach* is being adopted to the design, procurement, installation, operation and maintenance of building components, because it helps achieve compliance with existing and emergency building codes, maximize energy and water efficiency in their structures, and help them meet corporate sustainability goals while creating comfortable and productive building environments.

Architects and specifiers for new commercial buildings – as well as owners and facility managers of existing ones -- who adopt this systems approach now will begin to reap the benefits of these lifecycle performance improvements sooner rather than later.

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### **About Xylem Applied Water Systems**

Xylem's Applied Water Systems (AWS) comprises global brands that work together and deliver premium products, comprehensive solutions and unmatched application expertise to meet the demanding needs of growing populations, communities and industries. The range of energy-efficient pumps, boosters, drives, valves, controllers

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and water systems support numerous applications in building services, general industrial, food and beverage, marine and agricultural markets around the world. For more information on AWS and its leading brands visit [www.xylemappliedwater.com](http://www.xylemappliedwater.com).

### **About Xylem**

Xylem (XYL) is a leading global water technology provider, enabling customers to transport, treat, test and efficiently use water in public utility, residential and commercial building services, industrial and agricultural settings. The company does business in more than 150 countries through a number of market-leading product brands, and its people bring broad applications expertise with a strong focus on finding local solutions to the world's most challenging water and wastewater problems. Launched in 2011 from the spinoff of the water-related businesses of ITT Corporation, Xylem is headquartered in White Plains, N.Y., with 2011 revenues of \$3.8 billion and 12,500 employees worldwide.

The name Xylem is derived from classical Greek and is the tissue that transports water in plants, highlighting the engineering efficiency of our water-centric business by linking it with the best water transportation of all -- that which occurs in nature. For more information, please visit us at [www.xylem.com](http://www.xylem.com).