White Paper

The Efficiency Nexus: Creating Advantage by Pursuing an Aggregated Approach to Building Efficiency

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Energy, water, technology and behaviors interact in an "efficiency nexus" so the aggregated benefits of a complete building efficiency project can greatly exceed the sum of its parts.

The Efficiency Nexus

Critical business objectives can be advanced by an integrated approach to efficiency where buildings save energy and water, reduce greenhouse gas emissions, and promote higher occupant productivity.

A study of building owners[1] shows that 73 percent choose building efficiency as one of their top six strategies for reducing carbon emissions. And yet, traditional approaches to building efficiency, focusing only on energy savings or on basic measures such as lighting, merely scratch the surface. True efficiency means looking deeper – at fuel, at all uses of electricity, water, and renewable resources, at the benefits of data and control technology, and at the human side of the equation. For example:

- Technology and data dashboards enhance the effects of physical improvements, enabling owners to monitor, measure, and continuously improve efficiency across multiple buildings.
- Informed and engaged people can add substantially to efficiency by adopting behaviors that reduce water and energy usage and by understanding how they connect to business objectives.
- Energy-efficient, comfortable, properly-lit work environments can yield human productivity increases with value that dwarfs all energy and operational savings.

Energy, water, technology, and behaviors interact in an "efficiency nexus," so the aggregated benefits of a complete efficiency project can greatly exceed the sum of the parts.

Innovative funding mechanisms available today can help organizations undertake projects that address the entire efficiency spectrum with little or no capital outlay. Benefits extend beyond straight energy savings paybacks. They can extend to multiple budgets throughout an organization, including reductions in operating budgets, maintenance and repair budgets, capital budgets and even human resource budgets.

The Efficiency Nexus optimizes the combined benefits of energy, water, renewables, technology, and education improvements.

Making a Difference in Specific Business Objectives

Building improvement projects traditionally focus on energy-consuming systems with upgrades in lighting, boilers and chillers, HVAC systems, climate controls, power monitoring systems, and the building envelope (windows, doors, insulation).

Such projects can achieve simple payback on investment within a few years and provide energy savings that endure for many years more. For example, while an average 20-year-old building operates at energy costs of $2.10 per square foot, an energy-efficient retrofitted building may operate for as little as $1.65 per square foot.

Still, these disaggregated projects can leave big opportunities unaddressed. More comprehensive projects reach far beyond energy savings to help support owners' strategic objectives:

- Improving key performance areas such as employee productivity, student achievement, and patient outcomes drive **critical customer connections** to benefit any organization, from service businesses to schools, governments and healthcare providers.
- Furthering sustainability goals such as reducing carbon emissions, as well as measuring, monitoring and reporting these reductions, which can in turn be leveraged to build brand and public perception.
- Investing in critical initiatives like increasing market share, attracting and retaining top talent, improving processes, and supporting research and development can be enhanced with freed resources resulting from lower operating, energy, water, maintenance and repair costs.
- Capital projects can be pursued sooner when deferred maintenance is tackled, maintenance is targeted and costly emergency repairs are avoided. Equipment lasts longer with good maintenance programs, and the use of diagnostics predict repair needs prior to breakdown.

In short, by cutting costs and emissions, organizations are able to improve both financial and customer outcomes.

Water efficiency

Water and energy are intimately connected. For example, Sandia National Laboratories has reported that at the community level, some 40 percent of all daily fresh water withdrawals in the United States are used to cool electric utility power plants. And, in a 2009 report, the River Network estimated that water pumping, treatment and distribution consumes 13 percent of all electricity in the United States.

This means actions that conserve energy inevitably conserve water, and actions that conserve water also save energy. This interplay is evident at the level of buildings and campuses. For example:

- Less water consumed means not just lower water bills but less energy spent on water pumping and water heating.
- A more efficient building boiler means not just lower costs for fuel but less cooling tower discharge and lower water consumption.

On average, applying water-efficient designs and products leads to 15 percent less water use, about 10 percent less energy consumption, and about 12 percent lower operating costs (2009 study, "Water Use in Buildings: Achieving Business Performance Benefits through Efficiency," McGraw-Hill Construction.)

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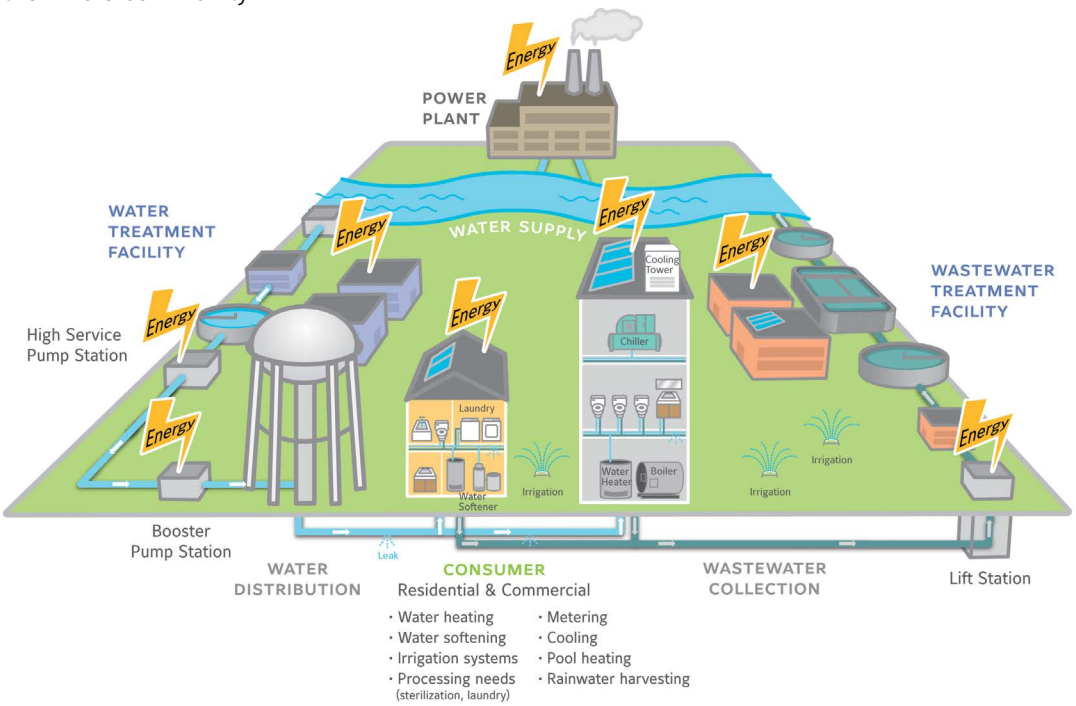
It is considered a best practice to pursue "efficiency first" by improving a facility's efficiency as a precursor to or in tandem with renewable energy solutions.

Furthermore, measures like water reuse, smart irrigation systems, rainwater harvesting, permeable pavement, and creation of greenways to limit runoff reduce stress on municipal drinking water, wastewater, and stormwater management systems, helping to cut costs for the whole community.



The energy/water-saving interplay is evident at the building and enterprise level.

Renewable energy

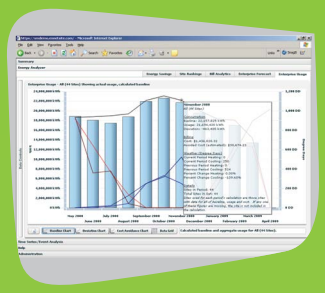
Renewable energy sources are powerful additions to efficiency programs. It is considered a best practice to pursue "efficiency first" by improving a facility's efficiency as a precursor to or in tandem with renewable energy solutions. Conventional energy conservation and renewables can combine to produce significant long-term cost savings, as well as greenhouse gas emission reductions that support efforts to combat climate change. While large-scale wind and solar power generation are growing rapidly, the most cost-effective building-level renewables include solar thermal and geothermal systems. Both have strong impacts on lowering water and energy use.

Solar thermal systems have a variety of uses for water heating, which accounts for an average of 12 percent of energy usage in a typical building. Applications range from domestic water heating, to swimming pool heating, to driving absorption chillers for cooling. Promising locations include hospitals, universities, schools, water-intensive process industries, and commercial laundries. These systems have attractive paybacks, and several states offer generous incentives for them. In an effort to reduce the cost of heating the pool at its middle school, the Glendale-River Hills School District in Wisconsin selected a renewable energy approach using a Solar Pool Heating System. The district is saving $5,000 annually, was awarded two grants which paid for two-thirds of the project, and is achieving a three and one-half year payback on the system.

Meanwhile, the U.S. EPA ranks geothermal technology as the most energy-efficient and cost-effective form of space conditioning. Geothermal heat pumps can reduce energy costs by 25 to 40 percent over conventional systems, while eliminating cooling towers and saving thousands of gallons of water those towers would lose to evaporation.

Solar photovoltaic systems at the building level are becoming attractive to building owners in light of state and local incentives and power purchase agreements that encourage the technology investments. Orange County, Florida installed a 1.016 megawatt PV array on the roof of the Convention Center's North/South Building. The Convention Center now has the largest rooftop solar array in the southeast, encompassing the space of five football fields and generating an estimated 1,158,253 kilowatt-hours of AC electricity per year – without producing any greenhouse gases. That's equivalent to the power used by 100 typical homes annually. The sun fuels about 10 percent of the Convention Center's North/South Building. The State of Florida awarded a $2.5 million grant to install the system, and the Orlando Utilities Commission contributed $1.5 million to the project in exchange for the Renewable Energy Credits generated in the first 10 years of operation.

In municipal wastewater treatment, the use of digester methane to generate power and heat combines renewable energy with water and energy efficiency. Modular digester-gas-to-energy systems make this technology available to wastewater treatment plants of nearly any size.



Data and technology

It is difficult to achieve top-tier efficiency without appropriate technology. One key technology is building automation that manages temperature and security of the indoor environment. Smart meters, tools that can leverage the smart grid, can help manage demand of energy and water. Dashboarding technology gathers data, graphically displays performance, and creates reports that guide decision-making. Accurate data helps users evaluate performance in a variety of ways: against industry peer groups, from one year or season to the next, and between facilities.

Dashboarding tools let decision makers define the metrics they want to measure, display easy-to-read summaries of performance across a building portfolio, identify trends, and adjust and optimize operating practices. Such tools are especially helpful to organizations with multiple geographic locations and building types, like state governments, major universities, and large businesses.

The State of Missouri, for example, uses an "Enterprise Sustainability Manager" system that pulls together information on more than 1,000 buildings that cost $300 million a year to operate. A simple computerized dashboard provides real-time information on utility usage, maintenance spending, capital investments, work orders, and more. The system is part of an efficiency initiative that saved $35 million in its first year and reduced the state's carbon footprint by more than 205 million pounds of carbon dioxide.

Education and Engagement

Driving performance

The greatest gains from the "efficiency nexus" appear in the ways people respond to efficient, healthful workspaces. The benefits of clean indoor air, comfortable temperatures, and proper lighting are documented across a variety of settings. Calculating the financial benefits of these performance gains will demonstrate how these gains far outweigh other direct financial benefits. For example, studies indicate that:

- Labor productivity can increase by 6 to 16 percent in efficient buildings.
- Retail sales can increase by 40 percent in well-lit stores.
- Improved work environments can reduce health care costs and work losses from 9-29%.

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- A more comfortable, well-lit environment enhances student performance, as measured by up to 11 percent better results on standardized tests.
- Green hospitals report shorter average hospital stays and improved patient healing.

Fostering occupant cooperation

In addition to direct financial benefits, building occupants can contribute to efficiency gains by using energy and water wisely. Education and engagement programs can foster cooperation toward efficiency goals AND improve internal communications and engagement. For example, studies show that:

- Communication and engagement in corporate initiatives drives employee productivity and retention.
- Students who understand the goals of a campus efficiency initiative and know how to contribute are more likely to pitch in to help a school or university reach its targets. For example, the Utah State Energy Program's Solar for Schools is a statewide energy education initiative created to help students learn the value of renewable energy technology first hand. The energy education program is slated to be the first of its kind in the state of Utah. Under the program, which received $3 million in American Recovery and Reinvestment Act (ARRA) funds from the U.S. Department of Energy, each of the state's 41 school districts is to receive at least one 5-kilowatt solar photovoltaic system.
- Public housing residents who understand energy efficiency goals are more likely to accept changes in their homes and to adopt more efficient living habits.
- The branding and public relations possibilities of an aggregated sustainability and energy efficiency project can also reap tangible and powerful gains for a private sector or public sector entity.

What else? Well, you can't manage what you can't measure. A $20 million energy retrofit of the Empire State Building in New York City, expected to make that building one of the most energy-efficient in the nation and save $4.4 million per year, combines tenant education with a web-based system to help tenants track and manage their energy usage.

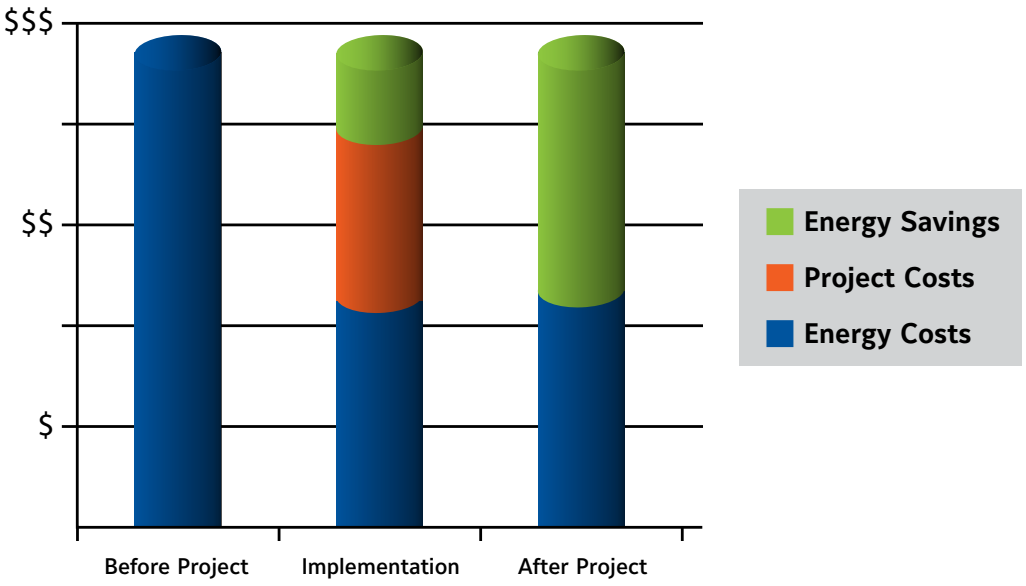
Making the Investment

Today there are various ways to fund efficiency projects. Private and public entities alike can receive grants or low interest loans under government-sponsored efficiency initiatives. They can also take advantage of financing tools such performance contracting.

In a typical performance contract, an organization engages an energy service company (ESCO) to engineer and deliver a holistic sustainability and building efficiency project. Be sure an ESCO proposes a comprehensive approach, usually including the replacement of aging equipment and systems with modern, efficient technologies, including renewable energy, water efficiency solutions, technology and data solutions, and building occupant education programs – all in a single project.

The ESCO guarantees the customer savings over a contract period, such as 10 to 15 years, and those savings pay off the project investment in the improvements. Usually, the owner's operating costs go down immediately, even as the initial investment is repaid. At the end of the contract, when the project is paid in full, the owner has substantially lower costs than before the improvements were made.

A significant benefit of a bundled set of efficiency measures, versus an organization choosing to pursue a few measures at a time on their own, is the immediate benefit of savings, productivity and employee and occupant engagement that the customer enjoys extended over the life of the contract, maximizing their impact, savings and aggregated benefits.



Performance Contracting Funding Model

Strategic Advantage

Bundled components work synergistically; projects that focus on the entire "efficiency nexus" can help owners achieve the ultimate in building efficiency and performance. Initiatives that address energy, water, renewables, technology, and occupant behaviors complement and reinforce one another. The results reach far beyond energy savings, helping to create a more efficient, more vibrant, and more effective organization.

Resources

[1] Energy Efficiency Indicator by Institute for Building Efficiency, March, 2010

The results reach far beyond energy savings, helping to create a more efficient, more vibrant, and more effective organization.

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