

Strategies and Incentives for Retrofitting Commercial Buildings to Reduce Energy Consumption

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ABSTRACT

Rising electricity prices, climate change and a sagging economy are driving institutions to focus on energy efficiency in the built environment. Businesses today are trying to find ways to lower their energy related expenditures, realizing that innovative solutions can reduce energy consumption by 25 to 40 percent. According to the Energy Information Administration, buildings today consume 42 percent of energy generated, making investing in energy efficiency a critical piece of efforts to reduce our unsustainable energy needs. Why then aren't building owners rushing to retrofit their structures if it means saving money, improving employee comfort and property values, not to mention saving the planet? The reason lies in the inconvenient truth that you have to spend money to save money. For many building owners, capital costs are the primary barrier to investing in building retrofits and without incentives and financing, large-scale adoption of energy saving retrofits will remain a challenge.

INTRODUCTION

Many are in agreement that improving our built environment is the single greatest opportunity to reduce our current energy demand. There are many approaches currently being investigated and employed. Tactics including common sense weatherization and the incorporation of renewables are all favorable strategies. Although weatherization is essential, it is not an effective strategy in most commercial buildings and incorporating renewables can be very expensive, significantly extending pay back periods. Smarter, greener buildings, where energy efficiency is made a top priority, can result in substantial cost savings for the owner, increased comfort for the occupants and valuable energy saved for the environment.

According to the Department of Energy, it is estimated that buildings today account for 38 percent of all greenhouse gas emissions in the United States, which is about 35 percent of our continent's total. In the U.S. alone, buildings account for over 40 percent of total energy use. Furthermore, the Electric Power Research

Institute reports energy and energy related expenditures in the U.S. costs companies \$800 billion annually. The unfortunate part is that roughly 42 percent of the energy used to heat and cool a space is wasted.¹

Building automation and control technologies, referred to herein as "smart building technologies", have the ability to alleviate energy consumption concerns in existing, and even historic, commercial structures. This paper discusses energy harvesting wireless technologies, which are proven solutions for building retrofits (as well as new construction) because they are considered "no new wire" solutions. The ability to retrofit a building without installing new wiring is critical in keeping costs down. Even though interest in retrofits is increasing, building owners remain challenged by initial "first" costs, which depending on the size of the building, can seem out of reach, particularly since financing has dried up. A simple ROI analysis, however, can

¹ <http://my.epri.com/portal/server.pt?>

demonstrate that the energy saved with a retrofit results in decreased operational costs over the long term.

THE NEED FOR SMARTER BUILDINGS

Smart buildings are considered to be intelligent in that they are electronically enhanced. Elements that work in an integrated way in a smart building system include sensors, integrated information management, communications infrastructure, controls and energy management devices. Sophisticated systems involve both interior and exterior building components, including parking operations and even street lighting. Although many building owners are finding it difficult to undertake renovations because of the current recession, now is a good time to start the process of finding ways to cut energy related expenses. Budget items like energy costs are now being reviewed as areas for reductions. Today, concepts and technologies are being introduced that can help building owners conserve energy.

Innovative, energy harvesting wireless technology is paving the way towards green, intelligent buildings. HVAC&R, monitoring and lighting control systems are readily available and a wide-ranging product portfolio exists, based on an interoperable standard managed by the EnOcean Alliance. Energy harvesting solutions make use of energy created from slight changes in motion, pressure, light, temperature or vibration. These wireless sensors make buildings smarter, safer, more comfortable and more energy efficient.

Self-powered, wireless control systems make retrofitting fast and cost effective. Because self-powered end devices rely on existing energy to power themselves, they don't require any line power or batteries, making them virtually maintenance free. Wireless solutions have been successfully deployed in virtually all types of residential and commercial buildings, including those of historical significance.

In this report we discuss the benefits of energy harvesting technology as a strategy for retrofitting buildings and consider why energy efficiency is a resource that warrants becoming a

national priority. Finally, we address the issue of reducing the first costs associated with a retrofit so that building owners can take the necessary steps to improve the efficiency of their buildings. These state and federal incentives have the ability to reduce payback periods. Educating building owners about the available off-the-shelf technologies, while at the same time highlighting economic drivers, will hopefully lead to more intelligent buildings.

GREEN STARTS WITH ENERGY

Market trends and other indicators suggest that our demand for energy will rise dramatically in the coming years. As international communities continue to develop, more energy will be needed to feed their desire to grow and industrialize. According to the EPA, global demand for energy sources is forecasted to grow by 57 percent over the next 25 years. By 2030, 56 percent of the world's energy use will be in Asia. Electricity demand in the U.S. will grow at least 40 percent by 2032. Even more staggering is the fact that nearly 300 new power plants will be needed to meet these electricity demands by 2030.²

There are various green building rating systems in the U.S. today, the most common one being the U.S. Green Building Council's LEED program³. The LEED program includes minimum program requirements and is based on a point system. Program requirements include sustainability at the site, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in operations and a regional priority. Although LEED is a great program for both new construction and retrofits, there are many components and as a result, the path to getting a building LEED certified can be expensive.

Many building owners are concerned with the costs associated with building operation.

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http://www.energystar.gov/index.cfm?c=business.bus_energy_strategy

<http://www.usgbc.org/DisplayPage.aspx?CategoryID=19>

Although sustainability might be a goal, retrofits in the near term are likely to focus on reducing energy consumption. For building owners interested in energy efficiency and conservation, the Energy Star building program offers guidance and easy-to-use tools to assess a building's energy performance.

The Energy Star developed *Portfolio Manager*⁴ is an interactive energy management tool that allows for the tracking and assessment of energy consumption across an entire portfolio of buildings, online. The Energy Star program allows a building owner to rate the energy performance of a building on a scale from 1-100, relative to similar buildings nationwide. Also, as improvements are made to a building, the program allows for the verification and tracking of the improvements that are made.

CONNECTING SMART BUILDINGS TO THE SMART GRID

In addition to the current conversation about making buildings smarter, debate over the need for a smarter grid continues. Although the definition of a smarter grid remains a bit of a mystery, grids and buildings are becoming more closely interconnected. Building automation systems monitor and control a building's lighting and mechanical systems and these systems are now being wired to speak to utilities, allowing owners and occupants to participate in demand response and energy efficiency programs.

Technology, which is already a critical component of energy management, will be central to demand response participation in commercial buildings. It provides a means of instantaneous information and communication, quick and automated load shed, and built-in measurement systems. Displays and dashboards can help provide building operators with a graphical interface to control devices and visualize energy information. Building automation systems that include wireless energy management devices can receive energy related

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http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

(and pricing) signals from their associated utility and systems can make automatic changes to leverage these signals to save energy and money.

According to Harry Sim, CEO of Cypress Envirosystems, "a building should know when electricity is expensive and be able to make automatic decisions such as changing thermostat set points and reducing unnecessary lighting." This concept of auto demand response is important as utilities will be able to introduce dynamic pricing via the smart grid, thereby allowing companies with "smart" buildings to avoid paying more in electricity costs.⁵

IMPORTANCE OF TAX INCENTIVES

In today's economy finding money to perform retrofits, even when deemed valuable investments, can be very tough. Many companies are just barely able to keep the lights on. In order to see a change in the retrofit and smart building market, incentives are needed. Focused incentives that bolster one's ability retrofit a building and reduce energy consumption costs are key to future energy policy.

In the past, tax incentives have historically not reached all the people who can benefit from them and have mainly subsidized affluent consumers able to purchase the kinds of products and technologies available for credits. Consumers also tend to think that incentives are too cumbersome and not worthwhile and therefore overlook incentives that are in fact valuable. Building owners tend to not utilize incentives available to them and many leave thousands of dollars on the table. Recognizing the human dimension with respect to policy implementation is important. Future energy related legislation has to address these past impediments to adoption if change is going to occur.

⁵ Harry Sim, *Retrofitting Existing Commercial Buildings for the Smart Grid*, <http://www.automatedbuildings.com/news/dec09/articles/cypress/091128020303cypress.htm> (December 2009).

In times of strong economic growth and prosperity, tax incentives might not be as necessary as they are today. With economic indicators down and a waning interest in the environment, it is important to point out the various benefits to consumers about energy efficiency. Although green might be a term that comes and goes, energy efficiency is not a trend.

Today there are many incentives related to clean energy, particularly renewables, but for our purposes we have identified incentives related to retrofitting commercial buildings for improved energy efficiency using innovative technologies.

Federal Incentives

Legislation at the federal level does currently support building retrofits and is augmented by the various state based incentives available all over the country. Some states and their associated utilities have strong, forward thinking incentive and rebate programs focused on energy efficiency, whereas other states have not yet realized the benefits of such programs.

This paper primarily addresses available legislation and incentives related to retrofits, but there are proposed efforts on the horizon to improve and speed up the retrofitting of buildings. With respect to existing federal legislation, the Energy Policy Act of 2005⁶ includes a tax deduction for investments in “energy efficient commercial building property” designed to significantly reduce heating, cooling, water heating and interior lighting energy costs in new and existing buildings.

This tax deduction, referred to as the Commercial Building Tax Deduction⁷, provides up to \$1.80 per square foot for buildings that save at least 50 percent of the heating and cooling energy of a building that meets ASHRAE Standard 90.1-2001. Partial deductions of up to \$0.60 per square foot can be taken for measures affecting: the building envelope, lighting, or heating and cooling systems. This act has been extended through December 31, 2013.

⁶ [http://thomas.loc.gov/cgi-bin/query/z?c109:H.R.6:](http://thomas.loc.gov/cgi-bin/query/z?c109:H.R.6)

⁷ <http://www.efficientbuildings.org/>

This valuable federal incentive has been utilized, but not fully realized by the building community. Multi-level parking garages are the fastest growing EAct category for lighting and the largest category of commercial property owners capturing EAct benefits are regional and national retailers, including both stores and distribution centers.

These incentives are typically reserved for only tax-exempt organizations, but the Commercial Building Tax Deduction can be utilized by non-profits as well. For publicly owned buildings and non-profit organizations, the tax deduction can be assigned to the designer of the building. In other words, the public agency could assign the credit to the person or company primarily responsible for the retrofit, thereby negotiating a fee reduction, realizing the benefit of the tax deduction in that way. Eligible “designers” may include an architect, engineer, contractor, environmental consultant or energy services provider.

This federal incentive is valuable and can measurably help those contemplating or undergoing a retrofit save some of the initial costs of the retrofit or new construction. There are accounting firms available that will help building owners understand the process of applying for this tax deduction.

The National Electrical Manufacturers Association has sought support from members of Congress to enlarge the Energy Efficient Commercial Building Tax Deduction, described above, from \$1.80 per square foot to \$3.00 per square foot in order to help stimulate immediate job creation. In December 2009, a bipartisan group of House members introduced a comprehensive energy efficiency incentives package, which included the \$3.00 increase.

State Incentives

Many state energy offices and utilities across the nation offer incentives which are meant to help building owners and businesses cover a port of the cost to replace aging, inefficient equipment and implement energy efficient technologies and systems. Many states and utilities offer incentives that can be applied to high efficiency

lighting, HVAC and the associated controls. Traditional, most energy efficiency rebate programs were targeted towards prescriptive measures, which are predefined, common energy efficiency measures (or technologies) that have pre-determined incentives and do not require complex engineering analysis. An example would be a rebate for the installation of an occupancy sensor, which often ranges from between \$20 and \$80 per sensor installed.

Today, we are seeing more and more programs that account for custom measures as well. Custom incentives are based on resultant energy savings achieved from the installation of a lighting control system, which can be anywhere from 25 to 40 percent. Typically, state programs expect the project to achieve documented results of 20 percent energy savings. Other programs, for example, might offer an incentive of 20 cents per watt reduced in a technology retrofit.

Each state is different and the programs are constantly changing. For updated information about the rebates and incentives you can receive in your area, please visit www.dsireusa.org.

A REAL WORLD EXAMPLE: DAYLIGHT HARVESTING AND INCENTIVES

A 2008 article published in Corporate Business Taxation Monthly, written by C. Goulding, J. Goldman and T. Goulding⁸, provides an excellent example of how an energy management strategy, daylight harvesting, can garnish tax incentives. Daylight harvesting utilizes light sensitive sensors and smart ballasts to balance incoming natural light with the building's artificial lighting⁹. A daylight harvesting system would include energy harvesting lighting controls that can adjust lighting levels by dimming lighting, or turning lights off, when appropriate. The lighting controls aspect to a daylighting system saves substantial lighting energy costs.

For projects completed before January 1st, 2014, EAct's Commercial Building Tax Deduction

(CBTD) can be claimed that covers up to the entire deductible cost of investing in the installation of energy efficient building property, which includes lighting controls. The total amount can be between \$0.30 and \$0.60 and is based on a reduction in the allowable lighting power density, or watts per square foot. Daylight harvesting projects that achieve a 25 percent lighting power density reduction beyond the Standard ASHRAE 90.1-2001 are eligible for a tax deduction of \$0.30 per square foot. Daylight harvesting projects, or lighting control strategy projects in general that achieve a 40 percent reduction in lighting power density beyond Standard 90.1-2001 are eligible for the maximum tax deduction, equal to \$0.60 per square foot¹⁰.

According to Goulding et al 2008, numerous utilities also offer rebates for daylighting equipment. Some of the rebates are prescriptive, meaning the utility will provide a fixed dollar reimbursement per equipment component, while others are KW based. States with lighting control rebates include: Arizona, Colorado, Idaho, New Jersey, New York and Wisconsin, just to name a few.

The combination of an effective energy reduction strategy i.e. daylight harvesting and utilization of EAct's Commercial Building Tax Deduction, enhances the attractiveness of investment in energy efficient lighting controls and other building technologies. Hopefully, more building owners and business operators will invest in energy efficiency improvements, resulting in money saved, carbon emissions avoided and the addition of valuable jobs, many of which have been lost since the economic recession started.

JOB CREATION

One of Bill Clinton's suggestions on how to create jobs in the U.S. involves changing over

⁸ <http://business.highbeam.com/410203/article-1G1-204320513/tax-aspects-daylight-harvesting>

⁹ http://en.wikipedia.org/wiki/Daylight_harvesting

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http://www.lightingtaxdeduction.org/tax_deduction.html

our buildings to be green¹¹. The reality is, however, that financing and public policy must go hand in hand with education about technology. Although electricity rates in the United States have been historically affordable, they are expected to rise. The EIA expects the average US residential electricity price to rise from 11.58 cents per KWh in 2010 to 11.83 cents per KWh this year, an increase of 2.2 percent¹².

To spur further investments in retrofits, many utilities are evaluating new and innovative technologies, like energy harvesting, to better improve the incentive programs they offer. As a result, programs are being modified and added all the time. Given the crisis in the commercial real estate market, the introduction of new tax incentives will provide building owners with a substantial impetus to make immediate investments in efficiency. Retrofitting homes and businesses with smart building technology will lower consumer energy costs, increase real estate values and reduce greenhouse gas emissions. Deep deployment of off-the-shelf smart building technologies can cut energy use by at least 30 percent. Outreach, coupled with the help of focused incentives, will allow the building automation and control industry to see the growth that it has been waiting for.

CONCLUSION

Energy efficiency and conservation in buildings is a key component of energy policy. This is partly because energy efficiency can be addressed now, with available and proven technologies. Investment in renewable technology is important, but renewables are still very expensive. Energy efficiency is a resource that we can tap into today. Often overlooked for sexier renewable sources like investments in

wind and solar, energy efficiency is in fact the “first” fuel. But like any investment in this economy, energy efficiency retrofits need a push and incentives, at the federal, state level and utility level, can help consumers realize substantial energy and cost savings. Understanding the technology available, like self powered, EnOcean enabled wireless technology and the incentives that match them, is an important piece of the puzzle.

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<http://thinkprogress.org/romm/2011/06/23/251577/bill-clinton-on-green-jobs-its-still-the-economy-stupid/>

¹²
<http://webcache.googleusercontent.com/search?q=cac he:a-0xu6pog88J:www.eia.gov/steo/+electricity+rates+and+rise&cd=3&hl=en&ct=clnk&gl=us&client=firefox-a&source=www.google.com>

