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Cleantech Market Intelligence

Research Report

EXECUTIVE SUMMARY:
Energy Efficiency Retrofits for Commercial and Public Buildings

Energy Savings Potential, Retrofit Business Cases, Financing Structures, Policy and Regulatory Factors, Demand Drivers by Segment, and Market Forecasts

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Section 1

EXECUTIVE SUMMARY

1.1 Introduction

In public and private commercial buildings, energy savings of various percentages are technically feasible, from 10% to more than 50%. In the United States, retrofits in public buildings have clear policy objectives and financing, and the market is well developed. While retrofits in private buildings are attractive from a business perspective for cost reduction, green branding, and productivity, significant barriers exist in financing and market fragmentation. From a policy perspective, energy efficiency retrofits offer the most cost-effective means to address greenhouse gas (GHG) reductions and energy independence. This report explores these issues, suggests improvements to current government policy, and presents a scenario for market development over the next 5 years.

1.2 Energy Savings Potential

Retro-commissioning projects provide savings of 10% to 20% with an average payback slightly over 1 year. These projects are low-risk investment opportunities with an average cash-on-cash return on investment (ROI) of over 90%, and persistent cost-savings over 3 to 5 years. As the commissioning industry matures from fewer than 2,000 commissioners (at present) to more than 20,000, it will probably consolidate around successful marketing and sales strategies. When mature, most commercial space will be commissioned every 5 years, generating annual revenue of $4 billion.

Saving more than 20% of present energy usage is less lucrative than retro-commissioning, when evaluated strictly in terms of energy cost savings. Still, it is relatively straightforward and low risk from an engineering perspective, when financing is available. Renovation projects often target between 20% and 60% of energy savings, and may take place anyway for reasons besides cost savings, such as tenant improvements or HVAC equipment end-of-life. The incremental cost of energy efficiency is very low, when compared to the cost of a conventional renovation project without energy savings.

Saving more than 50% of existing energy usage requires innovative design and changes in behavior. A few net-zero energy (NZE) retrofits have been completed, and this will become more common in the next 10 to 15 years. Within the 5-year forecast period for this report, most NZE activity in the United States will be in the policy, planning, and research stages.

Table 1.1 Energy Savings and Payback from Energy Retrofits of Various Types

Energy Retrofit Type	% Energy Savings	Simple Payback from Energy Cost Savings	Cost $/SF*
Retro-commissioning	10 to 20	4 months to 2.4 years	$0.30
ESCO	20 to 40	3 to 12 years **	$2.50
Integrated Design	30 to 60	7 to 12 years ***	$2.50
Net Zero Energy	50 to 90	8 to 20 years?	$10?

(Sources: Pike Research and LBNL)

* The cost per square foot (PSF) varies widely, because the energy intensity of each building use is different. Compared to an office building, a warehouse of comparable area uses less than half the energy, and a hospital

uses more than twice the energy. The average energy cost in commercial space is $2.40 PSF. Across different sectors of building use with different energy intensities, the payback period is generally more consistent and more informative than the cost PSF.

** Typical simple payback is 7 to 12 years in public buildings and 3 to 7 years in private buildings (for less extensive work). When ongoing service/maintenance and financing are included, most government contracts are 10 to 20 years in duration.

*** Less than 5% incremental cost occur, when incorporated into projects occurring anyway, such as tenant improvements, HVAC component replacement at the end of useful life, or market repositioning by new owners. If a renovation project has not been planned for other reasons, then the payback from energy cost savings alone could be very long. However, the payback from total benefits, such as green branding, occupant productivity, and lower vacancy rates can easily be under 5 years.

1.3 Retrofits in Public Buildings

In government offices and K-12 schools, energy service companies (ESCOs) have a solid track record of obtaining energy savings in the range of 20% to 40%, driven by policy initiatives and energy cost reduction. Commercial Building Energy Consumption Survey (CBECS) data indicates that government-owned buildings comprised 21% of all commercial space in 2003 or 15 billion square feet (BSF)/72 BSF total, up from 18% in 1999 or 12 BSF/67 BSF total.

The best-funded opportunities for energy retrofits today are major upgrades in institutional buildings, especially in federal buildings. This market, already strong because of federal policy mandates and creditworthiness, received a boost from the American Recovery and Reinvestment Act (ARRA). Growth is focused on the 16 existing Super ESPCs (Energy Saving Performance Contracts) and with subcontractors for these 16 contract holders. The institutional market is booming now, and activity initiated in the next few years will continue through 2014 and beyond. However, federal non-industrial buildings comprise less than 3% of existing commercial space. Note that while all branches of the military are taking energy independence seriously, most military space is classified as “industrial,” which is not addressed in this report.

The energy retrofit market in higher education is less developed than K-12. For instance, most college campuses do not have utility submetering for individual buildings, except in new construction. Energy use that cannot be measured is difficult to conserve.

This sector will continue to grow. In buildings that were upgraded as recently as 10 years ago, new opportunities exist for additional energy cost savings, based on new technologies. Performance will continue to improve beyond 2014, until eventually most public buildings meet or exceed NZE.

1.4 Retrofits in Private Buildings

Most commercial space is privately owned, so the largest potential for long-term, sustained growth in commercial building energy retrofits, is in privately owned space. Although relatively small at present, this market will experience strong growth through 2014 and beyond. In the private sector, ESCOs are less active, due to challenges with private financing, short time horizons, and competing priorities. This market is expected to grow, with recent financial innovations, such as Energy Service Agreements (ESAs) and Property Assessed Clean Energy (PACE) bonds, and increasing pressure for green branding that includes GHG reduction.

1.4.1 Building Retrofit Benefits

In private buildings, cost savings support is available in the market for "low-hanging fruit" with quick payback (less than 3 years) for activities, such as lighting retrofits, energy control management systems (ECMSs), and retro-commissioning, especially in regions with high utility prices and/or excellent incentive programs.

Comprehensive green retrofits with longer paybacks can often be justified indirectly by the increased productivity of healthier, happier occupants; for instance, a 3% to 25% increase for office workers, and 10% to 40% higher retail sales. In some market segments, cost savings on utility bills are welcome side effects, rather than the primary purpose for a green retrofit.

ENERGY STAR labeled buildings and Leadership in Energy and Environmental Design (LEED) are brands that are expanding very rapidly, with more and more studies documenting the market differentiation advantages of certified buildings. Compared to conventional space, high performance space is vacant less often. When vacant, it fills more quickly (by lease or sale), often at premium prices. Because of this, owners of empty commercial buildings are adopting green retrofits as a market differentiator. Unlike utility incentives and tax credits that come and go, this market driver will apply steady pressure until most commercial building space has been retrofitted for energy efficiency and also for other measures of building performance, such as thermal comfort.

1.4.2 Cost-Effective GHG Reduction

Commercial buildings use almost 20% of all energy in the United States and are a significant contributor to GHG emissions. From a policy perspective, energy efficiency in buildings is the most lucrative potential source of GHG reductions. Rather than a net cost to reduce emissions (as in the case of renewable energy at $10/ton cost, or carbon capture at $30/ton cost), energy efficiency actually saves $40 in the process of eliminating each ton of CO_2 equivalent emissions. If the U.S. market for carbon credits develops similarly to the European market, with valuations around $20/ton, then energy efficiency projects could generate $60 of combined cost savings and revenue, for each ton of CO_2 eliminated.

In 2000, American commercial buildings used 17 quadrillion BTUs (quads) of energy, up from 11 quads in 1980. Over the past decade, this demand has grown by 1% annually, so that, in 2010, 19 quads will be used. In order for total commercial space to continue increasing, while total energy use decreases due to GHG emission constraints, energy intensities in existing commercial buildings will need to drop at unprecedented rates. The emerging scientific consensus is that the United States will need to reduce GHG emissions by 70%-90% before 2030, possibly even by 2020, in order to avoid significant climate disruption.

Most energy utilities are required by regulations to sponsor energy efficiency programs, spending about 2% of gross revenue, and saving 0.5% of annual energy use. Commercial buildings will use 19 quads in 2010, while saving 0.1 quads through utility-sponsored energy efficiency programs. If utilities invested 6% of gross revenue in energy efficiency (comparable to 5% already invested cost-effectively in Vermont), then this would halt the growth of energy demand in this sector. In the United States, the build rate for coal-fired power plants has been rising since 2005, with 39 new plants coming online between 2009 and 2012. The power generated by these new coal plants could have been sourced more cost-effectively with energy efficiency measures, while reducing GHG emissions in the process.

Energy efficiency in existing buildings presents a challenge at the forefront of national and global security. Support for energy efficiency retrofits, from public policy and from the market, is growing and changing to reflect this prominent position.

1.4.3 Financial Barriers

Most potential energy retrofit projects in private commercial buildings do not receive external financing because:

- Liens on newly-installed equipment would require the unlikely consent of the primary mortgage holder.
- Many private commercial buildings are held by shell LLCs with no credit-worthiness.
- No contractual mechanism ensures that cost savings from lowered energy bills will be applied to loan repayment.
- A hard cap on total business debt puts potential retrofit projects in intense competition with investment opportunities that would foster business growth.
- The premium market value of high performance buildings has not yet been fully incorporated into the appraisal process.

Many potential energy retrofit projects in private commercial buildings are not financed internally because:

- Even though ROIs are high, many retrofit projects are small in size, compared to other investment opportunities—not worth the trouble and effort, especially if occupants would be inconvenienced by the work in progress.
- Internal capital is not available, primarily for small and medium-sized businesses, especially in the present economic downturn.
- When retrofit costs and energy cost savings are passed from landlord to tenant, some capital improvement costs are amortized over a long period. Even if the project has a theoretical 5-year simple payback, the landlord might see an actual payback of 8 years for a full lease term, or even 20 years over the full expected life of the new equipment. This is an incentive for the tenant, but a disincentive for the landlord.

Recent developments, such as ESAs, PACE bonds, and on-bill financing can address many of these barriers.

1.4.4 Market Fragmentation

Successful public policies and marketing strategies for energy efficiency retrofits must address the barriers in each market niche appropriately.

The commercial real estate market can be divided into segments based on building application and ownership. The primary uses of retail, offices, warehousing/storage, education, and lodging together account for 75% of the floor space of existing buildings. This space can also be divided by ownership: private owner occupied (33%), private leased (43%), government-owned (21%), and unoccupied (3%), according to the 2003 CBECS.

Another division involves location; the market is significantly affected by state and local geographic climate, energy prices, regulations, and incentives. As if these divisions were not enough, the scale of control varies widely across each market segment. A few large, centralized players control a substantial portion of the total floor space at one end of a spectrum, while myriad small, local players each control a relatively small portion.

This report examines some of the primary challenges in each market segment, and presents best practices that are addressing these barriers successfully.

1.4.5 Economic Downturn and Oversupply of Commercial Space

In April 2010, the U.S. Department of Labor reported that unemployment was almost 10%, but unemployment in construction was almost 25%. More than 1.6 million construction jobs have been lost since the recession began, and the overall economy is down by 9 million jobs.

In the next 5 years, an unusually large number of commercial foreclosures will occur because of declines in market value of more than 30% since the cyclical peak of the commercial real estate boom in 2007. When these properties are purchased by new owners and renovated for new tenants, integrated design for energy efficiency could be incorporated at minimal cost, if public and private marketing campaigns and policies seize the opportunity.

Table 1.1 describes the order-of-magnitude scope of the national market for energy efficiency retrofits of existing commercial buildings. Each year, the money spent on new construction is comparable to the money spent on energy in existing buildings. In most years, the total new space constructed is comparable to the total existing space renovated. This space (newly constructed and newly renovated) is small compared to the total existing space, which is equivalent to more than 30 years of new construction. One-third to one-half of the existing space is clearly due for a major retrofit to address deferred maintenance, while most of the remaining space would benefit from energy efficiency measures integrated into ongoing maintenance and upgrades. In the narrow terms of cost savings from reduced energy costs, on average, the cost saved by minor retrofits is an insignificant portion of most organizations' budgets, while the cost of major retrofits must be recovered over many years.

Table 1.2 Quantitative Overview of the Commercial Building Retrofit Market

U.S. Commercial Buildings, New and Existing	Approximate Value
Annual new commercial building construction, cost	$240B to $420B
Annual energy used in commercial buildings, cost	$150B to $200B
Annual new commercial building construction, space	1 to 2 BSF
Annual major renovation, space	1 to 2 BSF
Existing building space in 2010	79 BSF
Existing space older than 10 years	65 BSF
Examples of annual cost per occupant (mostly labor)	$300/SF office $100/SF public K-12
Annual energy cost (<5% of budget for each building) (Range -60% to +250%, varies by region & building use)	$2.00/SF
Cost of comprehensive green retrofit, when not incorporated into tenant improvements or other projects	$20/SF
Cost of typical major renovation for tenant improvements	$40/SF
% of national energy consumed and CO_2 emitted in the United States, by commercial buildings	19%
% of national CO_2 emissions in the United States that needs to disappear within 5 to 40 years	80%
Five states that together account for 40% of national energy expenditures in commercial buildings	CA, FL, NJ, NY, TX

(Source: Pike Research)

1.5 Policy Recommendations

1.5.1 Overview

If the goal of the energy retrofit industry is to spend a little money on efficiency, while total national demand for energy continues to grow, then present policy is functioning well. However, if the goal is to reduce the total demand for energy in buildings over time, by the 50% or more needed to address international competitiveness, global warming, and energy independence, then present energy policy needs a substantial retrofit.

If code policy, design tools, financial incentives, and regulations focus on energy efficiency at the following intervention points, the incremental cost of efficiency will be very small:

- "Building design – schematic design, material and building systems selection
- Existing building purchases
- Leasing/tenant improvements
- Building renovation cycles
- Rebuilding (after a natural disaster)"[1]

Programs that do not recognize these intervention points or take advantage of them face unnecessary obstacles, costs, and potential failure.

A national carbon trading system could have a major effect on the retrofit market. If national carbon-emissions legislation addressed energy use in commercial buildings with a combination of high energy prices and reinvested incentives, then the market for energy efficiency retrofits (and for educating the workers in this market) would explode with activity. However, reinvested incentives appear unlikely.

Policy in this area is developing very quickly. In May 2010, the Kerry-Lieberman American Power Act (APA) was being negotiated, and the EPA has unveiled new regulations for major GHG sources. The APA would create a national cap-and-trade system for carbon emissions, while removing the EPA's authority to regulate GHG emissions, and suspend state and regional cap-and-trade programs. Most of the money raised from auctioned credits will be returned to individuals through their utility bills—minimizing the incentive for energy conservation. Minor support exists for energy efficiency programs—enough to prevent higher energy bills from cap-and-trade, but not enough to reduce those bills.[2]

Many of the energy efficiency provisions in the Waxman-Markey House bill were removed from the Kerry-Lieberman Senate bill.

1.5.2 Federal Buildings

Of all the sectors of the energy retrofit industry, federal buildings need the least help. The largest opportunities and the largest market barriers are in privately owned buildings, so policy should focus on those. Energy policy should establish a predictable progression of incentives, followed by requirements so that business owners can plan with certainty. In

[1] http://www.architecture2030.org/pdfs/intervention_points_WP.pdf

[2] http://www.aceee.org/press/1005kl.htm,
http://daily.sightline.org/daily_score/archive/2010/05/12/kerry-lieberman-climate-bill-the-details

multi-tenant spaces, an electricity submeter for each tenant should be incented, and eventually required. CB Richard Ellis (CBRE) has shown that this single measure cuts electricity use by over 20%.

Building energy performance labels should be incented, and eventually required at the time of sale or lease. Public disclosure, as in Washington, DC, is particularly promising for low-cost regulatory leverage. This policy is already enacted in some parts of Europe.

A program for periodic retro-commissioning has an annual ROI above 90%, with persistent cost savings over more than 3 years. This is true at various scales, from a few buildings to the entire national building stock. Retro-commissioning in commercial buildings every 5 years should be incented. After sufficient financing programs are in place to provide convenient, no-first-cost, no-net-cost upgrade financing for all commercial buildings, then retro-commissioning could be required.

Colleges spend $3 billion annually on energy. If every college building in the nation received a new submeter, this would cost $85 million total, with payback in under a year.

When foreclosed properties are purchased by new owners and renovated for new tenants, integrated design for energy efficiency could be incorporated at minimal cost, if public marketing campaigns and policies seize the opportunity. On a similar note, the recent report “The Imminent Commercial Real Estate Crisis and The CRE Solution” from Architecture 2030, recommends a 3-year, tiered tax incentive for energy retrofits, to raise property values while creating construction jobs. For instance, at an 8.5% cap rate, well-documented annual energy savings of $1/sf can increase the property value by $11.76/sf.

All 79 BSF of existing commercial space could be upgraded over 10 years for an average 30% energy savings at an annual investment of $22 billion. This would include 25% energy savings in most buildings, and 50% savings in the 1 BSF to 2 BSF of major renovations that occur each year anyway. When complete, this work would save $41 billion annually in national energy costs.

The energy retrofit market would grow rapidly if a carbon trading system increased the real price of electricity by more than 20%, and reinvested the extra revenue from commercial building utility bills into retrofits. However, mandatory reinvestment into energy efficiency appears unlikely.

Political and scientific debates concerning the exact timeframe for energy independence, combined with 80% reduction in GHG emissions are needed. Most policy about energy efficiency is based on achieving these milestones between 2030 and 2050. If an entire change is needed before 2020, which is plausible from some scientific and national security perspectives, then policy changes would need to be accelerated. This acceleration could make the United States a leading producer of cleantech goods and services.

When buildings are rebuilt with federal funds after disasters, at least 50% energy reduction versus conventional practice, should be required. The incremental cost is nominal when requirements are incorporated early in the design process.

Supporting the reduction and energy independence cost-effectively with federal loan guarantees or loan loss reserves for PACE programs, and other energy efficiency measures is included in the Waxman-Markey bill. A follow-up Senate bill specifically addressing energy efficiency may be needed, after a law passes for carbon trading.

A national program to retrofit schools for high performance occupant productivity and NZE energy independence would cost $8 billion per year over 10 years, with a simple payback of 10 years. This would support the policy goals of energy independence, student performance, teacher retention, GHG reduction, job creation, and disaster preparedness, while creating local models of high-performance buildings, for other sectors to copy. When complete, the program would generate $8 billion annually in ongoing cost savings.

If federal NZE goals were aligned more closely with the European timeline (e.g., all new construction being NZE by 2019), this would support domestic providers of clean (efficient and renewable) energy goods and services in global competition.

1.5.3 State Buildings

Least Cost Procurement has been successfully implemented in Vermont, California, and other states. More states should copy these examples, with aggressive energy efficiency goals updated every few years. This practice is arguably more effective and politically feasible than utility rate decoupling, and more practical than setting statewide efficiency goals without programs for implementation. State legislators and regulators can encourage utilities to cooperate with on-bill financing programs for energy retrofits.

Support PACE on two levels: state legislation should permit municipal programs, and statewide PACE programs, such as CalFIRST, should be easy to join for smaller municipalities. If local PACE programs were to follow federal guidelines, they would be well positioned to take advantage of any future federal loan guarantees, and/or standardized bond ratings, which enable bonds from multiple small local programs to be easily bundled.

In commercial buildings, the contractual agreements facilitated by PACE may be more valuable than investment money from municipal bonds. For instance, an existing primary mortgage holder might extend further credit to a building owner through a PACE program, in order to convert the entire mortgage to a “green” investment. Without a PACE program, this financial contract could be difficult to arrange. A municipality could rely on commercial building owners to bring their own financing partners (for instance, the primary mortgage holder). With this program design, a city or county could launch a PACE program for commercial buildings without public funding, except administrative startup costs, which would be reimbursed by program fees.

Section 2 of this report contains a table of the various programs that promote energy efficiency in the states most active in energy efficiency. In every state, opportunities exist to copy successful programs found in other states.

1.6 Definition of Commercial Buildings

The body of this report uses the definition for “commercial buildings” as defined by the CBECS of the U.S. Energy Information Administration (EIA):

“Commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural, so they include building types that might not traditionally be considered "commercial," such as schools, correctional institutions, and buildings used for religious worship.”[3]

In other words, public buildings are included, but multi-family residential buildings are not. This definition differs from common usage in some sectors of the real estate market.

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[3] http://www.eia.doe.gov/emeu/cbecs/

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SCOPE OF STUDY

Pike Research has prepared this report to provide participants at all levels of the energy efficiency retrofit market in commercial buildings in the United States with a practical study of the market. Participants include manufacturers and vendors of hardware and software; providers of design, installation, service, education, and certification; building owners, builders, and advisors; policy makers and analysts. Its major objective is to determine the state of the industry and likely future growth of the market. The report provides a review of major market segments, demand drivers, market barriers, and opportunities. The report's purpose is not to provide an exhaustive technical or competitive assessment of the technologies and industries covered, but rather a strategic examination from an overall tactical business perspective. Pike Research strives to identify and examine new market segments to aid readers in the development of their business models. The forecast period extends through 2014.

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 = (End Year Value ÷ Start Year Value)(1/steps) – 1.

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

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2010 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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