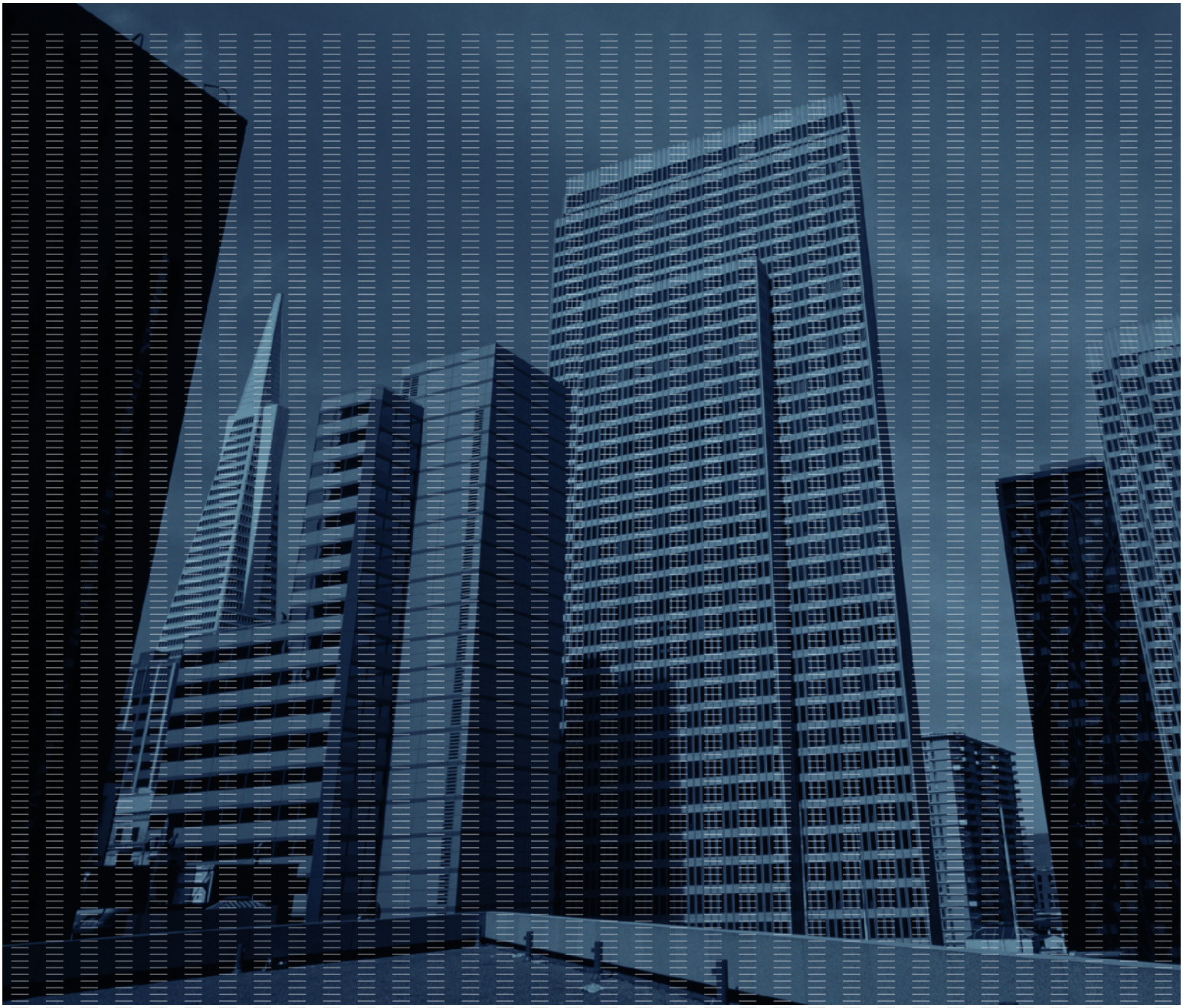
UNTAPPED POTENTIAL OF COMMERCIAL BUILDINGS
ENERGY USE AND EMISSIONS

NEXT 10

CAPTURING WASTED ENERGY: EFFICIENCY, RETROFITS, BARRIERS



NEXT 10 IS AN INDEPENDENT NONPARTISAN ORGANIZATION THAT EDUCATES, ENGAGES AND EMPOWERS CALIFORNIANS TO IMPROVE THE STATE'S FUTURE.

NEXT 10 WAS FOUNDED IN 2003 BY VENTURE CAPITALIST AND PHILANTHROPIST F. NOEL PERRY. NEXT 10 IS FOCUSED ON INNOVATION AND THE INTERSECTION BETWEEN THE ECONOMY, THE ENVIRONMENT, AND QUALITY OF LIFE ISSUES FOR ALL CALIFORNIANS. WE PROVIDE CRITICAL DATA TO HELP INFORM THE STATE'S EFFORTS TO GROW THE ECONOMY AND REDUCE GLOBAL WARMING EMISSIONS.

THIS REPORT ON COMMERCIAL BUILDING EFFICIENCY IS A NEXT 10 WHITE PAPER THAT EXAMINES THE UNTAPPED ENERGY EFFICIENCY POTENTIAL HELD BY COMMERCIAL BUILDINGS IN CALIFORNIA, ANALYZES OBSTACLES TO ACHIEVING WIDESPREAD ADOPTION OF BUILDING EFFICIENCIES AND EXPLORES APPROACHES TO REMOVING THESE BARRIERS.

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EXECUTIVE SUMMARY

In the midst of one of the worst recessions in California history, the state budget deficit and double-digit unemployment, there are no silver bullets. But there is a potential gold mine that could help generate jobs, state savings and economic growth. Today, commercial buildings in California account for 37 percent of primary energy usage—much of which is wasted. According to the United States Department of Energy, commercial buildings could be made 80 percent more efficient with new and existing technology. This represents both a significant drain on our economy and an untapped resource. Increasing commercial building energy efficiency would provide significant savings for California businesses and state government, reduce the need to build new power plants, and cut global warming pollution while generating jobs and economic growth.

Existing building stock represents the greatest opportunity for capturing the low-hanging fruit for energy efficiency gains. In the average building, upgrading building insulation results in energy savings of 30 percent. Advances in lighting technology offers energy savings of up to 20 percent.

Investment in low-cost technologies such as lighting, insulation and windows are cost effective not only because of the resulting cost savings, but also because LEED or Energy Star certified buildings command higher rents (between six and seven percent higher) and maintain higher occupancy rates than other buildings located within one-quarter mile radius of them. A 2008 Code Green survey reports that 79 percent of leaseholders would pay five percent higher rent for LEED Silver-rated space. And according to Building Owners and Managers Association International, simple energy efficiency improvements, such as insulating window films, yield three dollars in savings on average for every dollar invested.

New buildings in California do not reap the energy savings they could. With a minimal two percent increase in construction costs, new buildings can be designed to use one-third to one-half less energy than they use today.

In all, California businesses and government could save tremendously through energy efficiency, but real market barriers exist to achieving these energy efficiency benefits. This white paper examines the untapped energy efficiency potential held by commercial buildings in California, analyzes obstacles to achieving widespread adoption of building efficiencies and explores approaches to removing these barriers.

KEY FINDINGS

HUGE UNTAPPED POTENTIAL FOR ENERGY EFFICIENCY EXISTS TODAY IN COMMERCIAL BUILDINGS

- Electricity consumed by commercial office buildings represents 37 percent of California's total electricity consumption. Based on the U.S. average, energy efficiency improvements could cut that usage by 80 percent.
- Broad changes to the thermal envelope of existing buildings can dramatically improve efficiency. In the average building, a 30 percent savings could come from upgrading building insulation from current levels to the Department of Energy's recommended levels.
- Advances in lighting technology have created great potential for large negative-cost efficiency gains. Using CFL or LED technology offers average efficiency gains of 8–18 percent and 10–20 percent respectively.
- Behavioral changes in commercial energy use can provide very low-cost energy savings.

WHILE CALIFORNIA IS LEADING THE NATION IN BUILDING EFFICIENCY POLICY, MORE CAN BE DONE

- California has led the nation in the establishment of building efficiency standards, as well as increasing those standards.
- California has the largest-scale Property Assessed Clean Energy (PACE) programs in the nation. With PACE, public entities in the state can partner with residential and commercial property owners to finance energy efficiency and energy generation projects using low-interest loans that are repaid through annual property tax payments.
- California has no standards for existing building stock.
- Current standards for new buildings are well below what is possible.
- Commercial electricity consumption has grown over time, but energy efficiency gains have been relatively incremental.
- Sectors vary by their energy intensity. While energy efficiency for some has remained flat or decreased over the last two decades, hospitals have become more energy intensive with the increased use of new technology.

ENERGY EFFICIENCY IN COMMERCIAL OFFICE BUILDINGS OFFERS AN IMMENSE, LOW-COST ENERGY RESOURCE THAT PROVIDES REAL COST SAVINGS FOR BUSINESSES TO REDIRECT TOWARD NEW EMPLOYEES OR CAPITAL INVESTMENTS

- Simple improvements to window insulation on average can yield three dollars in savings for every dollar invested.
- Energy efficiency firms have attracted the largest number of venture capital deals in the first half of 2010, and these firms are set to generate new jobs.

MARKET BARRIERS PREVENT THE FULL REALIZATION OF ENERGY EFFICIENCY POTENTIAL

- In existing buildings, split incentives, elevated hurdle rates, upfront capital costs, and an information gap diminish large-scale adoption of energy retrofits.
- In new commercial construction, a lack of incentives for developers and ineffective installation and inspection methods are barriers to energy efficiency efforts.

MUCH CAN BE ACHIEVED THROUGH ACTIONS TAKEN AT THE FEDERAL, STATE AND LOCAL LEVELS THAT RAISE STANDARDS, ALIGN INCENTIVES, AND SUPPORT THE BROAD-BASED APPLICATION OF HIGH-EFFICIENCY PRODUCTS AND PRACTICES

- Informing consumers and businesses on the opportunities for efficiency improvements and their real cost savings is crucial. Also crucial is ensuring the proper use of equipment.
- The removal of structural impediments is key. For example, proper solutions to the split incentive problems between tenants and property owners will greatly increase efficiency retrofits and installations.
- More widespread adoption of PACE programs across the state will allow property owners to more easily afford investments in efficiency.

INTRODUCTION

COMMERCIAL BUILDINGS ACCOUNT FOR NEARLY 40 PERCENT OF U.S. PRIMARY ENERGY USAGE, AND THIS ENERGY CONSUMPTION IS RESPONSIBLE FOR MORE THAN 25 PERCENT OF THE TOTAL CO2 EMISSIONS PROJECTED IN 2009[1]. ENERGY EFFICIENCY IMPROVEMENTS ARE THE SINGLE GREATEST OPPORTUNITY FOR DECREASING GREENHOUSE GAS EMISSIONS AND INCREASING ENERGY SAVINGS IN THE UNITED STATES. ACCORDING TO A 2007 MCKINSEY & COMPANY REPORT, ENERGY EFFICIENCY CAN PROVIDE NEARLY HALF OF ALL NEEDED CARBON DIOXIDE EMISSIONS REDUCTIONS AND OFFER A NET BENEFIT TO TAXPAYERS AT THE SAME TIME[2].

HISTORICALLY, CALIFORNIA HAS BEEN AT THE FOREFRONT OF ENERGY EFFICIENCY POLICY WITH THE IMPLEMENTATION OF BUILDING AND APPLIANCE EFFICIENCY STANDARDS FOLLOWING THE ENERGY CRISIS OF THE 1970S. AS FEDERAL POLICY SLOWLY MOVES FORWARD, CALIFORNIA'S ACTIONS WILL PROVIDE THE NEEDED DIRECTION FOR IMPLEMENTING SUCCESSFUL EMISSIONS REDUCTIONS AND ENERGY SAVINGS PROGRAMS.

THIS WHITE PAPER EXPLORES THE CONTRIBUTION OF COMMERCIAL BUILDINGS TO GREENHOUSE GAS EMISSIONS AND WHAT CAN BE DONE TO IMPROVE THE ENERGY EFFICIENCY OF THESE BUILDINGS. WE EXAMINE SOME OF THE FUNDING AND SUPPORT AVAILABLE TO CALIFORNIA BUSINESSES FOR ENERGY AUDITS, RETROFITS, INSULATION, LIGHTING, NEW MATERIALS, SMART METERING, AND OTHER EFFICIENCY IMPROVEMENTS. WE DESCRIBE THE BARRIERS PREVENTING MORE WIDESPREAD ADOPTION OF BUILDING EFFICIENCIES SUCH AS TENANT AND LANDLORD RELATIONSHIPS AND NET METERING. AND FINALLY, WE DESCRIBE EXAMPLES THAT SHOW HOW SMALL ACTIONS CAN ADD UP TO MAJOR SAVINGS.

CALIFORNIA IS DRIVING NATIONAL POLICY MOMENTUM IN EMISSIONS REDUCTIONS AND ENERGY EFFICIENCY. Historically, California has pioneered energy efficiency policy that has been taken up by other states and eventually the nation. Since the implementation of building and appliance efficiency standards following the energy crisis of the 1970s, these standards have continued to be raised, new incentives crafted and consciousness raised concerning conservation. Under the Scoping Plan for California's Global Warming Solutions Act (AB 32), the California Air Resources Board plans to reduce CO 2E by 4.3 million metric tons by 2020 through energy efficiency in commercial and residential buildings.3 Furthermore, with the implementation of Property Assessed Clean Energy (PACE)4 financing, the state is poised to continue leading the nation in emissions reductions.

These innovative policies not only help the state achieve its environmental goals, they also help create new markets for products that improve energy efficiency. Between 1995 and 2008, employment in businesses providing products and services in energy efficiency expanded 63 percent to nearly 20,000.[5] These businesses provide products and services such as energy conservation consulting, metering devices, and high-efficiency lighting and appliances.

In 2001, California experienced a series of rolling blackouts and spikes in energy costs. Following the crisis, energy efficiency technologies and behaviors adopted by residents and businesses alike during the crisis reduced annual statewide energy consumption by 1000MW (comparable to two large power plants), while policy makers worked to implement new statewide energy efficiency programs.[6]

However, despite efficiency improvements from the energy crisis, several major obstacles remained in realizing potential commercial energy efficiency savings. In 2007, the Building Owners and Managers Association of California (BOMA California) brought suit against a 1962 decision by the California Public Utilities Commission (CPUC) known as Rule 18. Under Rule 18, landlords of high-rise commercial buildings were not allowed to use submetering to bill tenants. Instead, electricity costs were spread evenly among property tenants, creating a third party payer system for electricity consumption and removing direct cost incentives from electricity users. In 2008, BOMA California, the CPUC and Pacific Gas & Electric reached a settlement rescinding Rule 18. Following this decision, similar agreements were reached with Southern California Edison and San Diego Gas & Electric to allow the installation submetering equipment in commercial high-rises across the state.[7] Additionally, the CPUC recently mandated that Investor Owned Utilities in California all offer on-bill financing for energy efficiency improvements. This is, in effect, a five year zero interest loan opportunity, to be repaid as part of a monthly utility bill.

In 2008, California passed AB 811 into law, which allows property owners to receive public financing of renewable energy generation and energy efficiency projects (these financing programs are generally known as PACE programs). After entering into contractual assessments with public entities, property owners repay borrowed money through increased property taxes. This loan structure allows property owners to immediately reap the gains of new technologies while not leaving them tied to the property while the loan is paid off.

Since the law's inception, several large scale PACE programs, such as the Sonoma County Energy Independence Program (SCEIP), have begun in the state. SCEIP is currently the largest PACE program in the U.S., with $100 million in financing for energy efficiency, water efficiency, and renewable energy projects in Sonoma County.[8] While the recession has brought about the worst unemployment rates in recent history, SCEIP has encouraged the creation of green construction jobs and a 9.4 percent increase in construction jobs over a nine month period in 2009.[9] CaliforniaFIRST is another similar PACE program currently in the state with $16.5 million awarded from the California Energy Commission under the State Energy Program for statewide pilot programs in competing cities and counties.[10] These PACE programs have proven that not only can we reduce emissions and save energy, but that we can create green jobs and grow the economy at the same time. However, PACE does have an unresolved issue surrounding efforts to create municipal liens on commercial and residential properties that would trump existing mortgage holders. In the current system, municipal interests are secondary to mortgage holders, subjecting taxpayers to possible risk. Recently, Fannie Mae and Freddie Mac indicated that they may not accept loans for homes using PACE programs due to these concerns. While this only directly impacts residential PACE programs, it stands to add uncertainty to these programs and impede the potential adoption of PACE programs by the commercial sector.[11]

California's first PACE Program was implemented by the City of Berkeley in January 2009. Since then, other states have passed legislation allowing communities to issue PACE Bonds. Nationally, legislation was introduced in October 2009 that would support the development of PACE Programs by providing 100 percent loan guarantees through the Department of Energy. Separately, California has been awarded $1.6 billion in competitive energy grants from the Department of Energy. This funding will be used to support existing energy efficiency and renewable energy programs and develop the state's smart grid.[12] On the federal level, the U.S. HOME STAR legislation is

the largest scale energy efficiency program before Congress, with bills introduced in the Senate and passed in the House. This legislation would provide $6 billion dollars of funding for rebates on the purchase of energy efficient appliances for use in residential buildings.[13]

I.2 ENERGY EFFICIENCY IMPROVEMENTS IN COMMERCIAL BUILDINGS REPRESENT AN IMPORTANT PATH TO SAVING ENERGY, CUTTING COSTS AND REDUCING GREENHOUSE GAS EMISSIONS. Commercial buildings account for nearly 40 percent of U.S. primary energy usage, and this energy consumption is responsible for more than 25 percent of the total CO2 emissions projected in 2009.[14] According to the U.S. Department of Energy, "Building efficiency represents one of the easiest, most immediate and most cost effective ways to reduce carbon emissions while creating new jobs. With the application of new and existing technologies, buildings can be made up to 80 percent more efficient or even become 'net zero' energy buildings with the incorporation of on-site renewable generation."[15]

Making efficiency improvements to existing and new buildings can reduce electricity consumption and enable more effective heating and cooling throughout the building's lifetime and occupancy.[16]

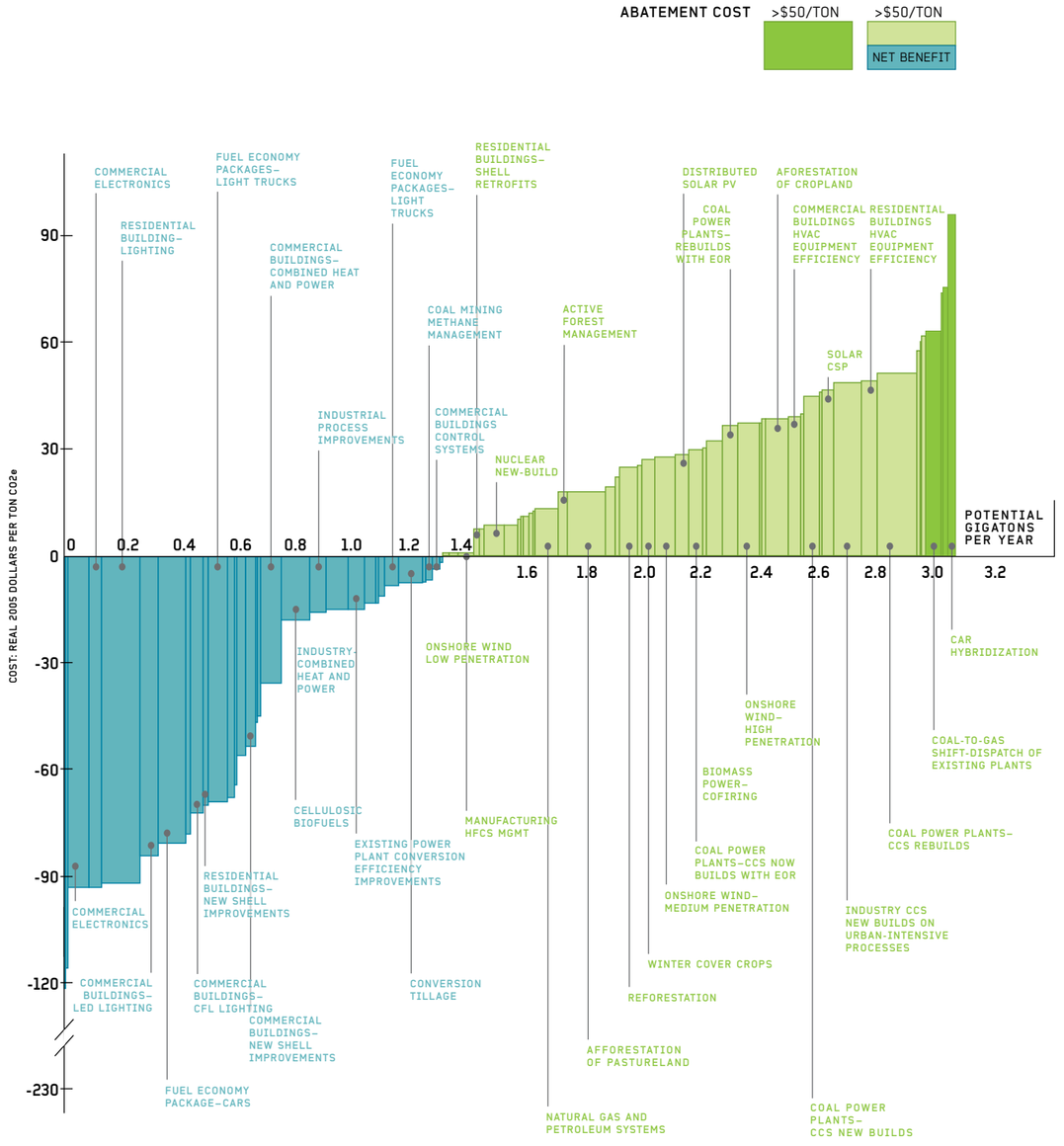
Currently, many new buildings commissioned do not meet basic efficiency requirements, even though the investment required to provide large-scale energy provision and carbon reduction through building efficiency is a "fraction of the investment required for new electricity generation."[17]

With a minimal two percent increase in construction costs, new buildings can be designed to use one-third to one-half less energy than they use today.[18] While new commercial construction offers great opportunities to improve on average efficiency, only three percent of all buildings are newly constructed or renovated each year in the U.S.[19]

As a result, focusing on new construction alone is insufficient to achieve the potential efficiency gains in the commercial building sector. Californians can realize more of the untapped efficiency potential in existing commercial buildings by investing in low-cost, high-return technologies such as more efficient lighting, insulation and windows. Though the upfront investment is high, each of these building upgrades will accrue substantial savings over time, quickly surpassing the initial expense and thus creating cost-negative investments.[20] According to the Building Owners and Managers Association International (BOMA International), simple energy efficiency improvements such as insulating window films on average yield three dollars in savings for every dollar invested.[21] More generally, the average annual return on investment for energy efficiency retrofits is over 20 percent when coupled with savings guarantees through performance contracting.[22]

Developed by McKinsey & Company, Chart 1 illustrates a wide range of possible actions for reducing GHG emissions and the marginal cost and abatement potential associated with each. The width of each bar represents the abatement potential (CO2e per year) estimated for the year 2030. Examples of high-potential options include afforestation of pastureland, and lighting in residential buildings. The height (vertical axis) displays the average cost of avoiding one ton of CO2e, and the green bars all have an abatement cost below $50 per ton of CO2e. The options on the left side of the curve below zero indicate a net benefit. The low-cost actions on the left side include efficiency improvements primarily to electronics, lighting and buildings. These actions could produce a positive return on investment due to savings in energy costs. The bars increasing toward the right depict progressively higher cost abatement measures.

U.S. MID-RANGE ABATEMENT CURVE



Source: Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?, Executive Report, McKinsey & Company, December 2007

TRENDS IN COMMERCIAL ELECTRICITY CONSUMPTION

Progress in raising efficiencies is patchy across the diverse mix of commercial buildings. Targeting key areas of consumption and implementing new incentive structures are yielding some success. Five trends in commercial electricity consumption are presented below.

2.1 TREND 1: COMMERCIAL ELECTRICITY CONSUMPTION HAS GROWN OVER TIME, BUT EFFICIENCY HAS BEEN RELATIVELY STABLE.

California's existing commercial space accounts for more than 100,000 gigawatt hours (GWh) of electricity consumption, about 37 percent of total statewide electricity consumption in 2008. These buildings cover a range of types from restaurants and food stores to schools and colleges to refrigerated and non-refrigerated warehouses. Floor space in the commercial sector totals about 6,788 million square feet. Commercial sector end-uses include indoor lighting, heating, cooling, ventilation, cooking, refrigeration and office equipment.

Due to increases in energy efficiency, California's commercial electricity consumption rose in total consumption while declining slightly in per square foot consumption.[23] Total commercial electricity consumption continued to increase in 2008 (+1.5 percent), following steady growth over the 17-year period from 1990 through 2007. Commercial electricity efficiency improved during the 2007-08 period as per square foot consumption declined by -0.2 percent. The California Energy Commission (CEC) attributes the drop in total consumption to the slowdown in the economy. As a result, the CEC is revising its consumption projections downward in the 2009 period and assumes that efficiency programs will marginally reduce electricity consumption over this period.[24]

2.2 TREND 2: COMMERCIAL BUILDING ELECTRICITY CONSUMPTION PER SQUARE FOOT IS IMPROVING OVER TIME WITH A FEW NOTICEABLE EXCEPTIONS.

Industries consume electricity at different rates. Restaurants, food stores and hospitals have the greatest intensity of electricity consumption per square foot of actual floor space. Retail space, schools and warehouses have the lowest rates of electricity consumption per square foot.

Over time, from the first period (1990-1995) to the latest (2002-2007) energy efficiency improved in all but two types of space. Hospitals and colleges became less efficient as the rate of energy consumption outpaced increases in floor space. Efficiency in schools and warehouses remained about the same over this period.

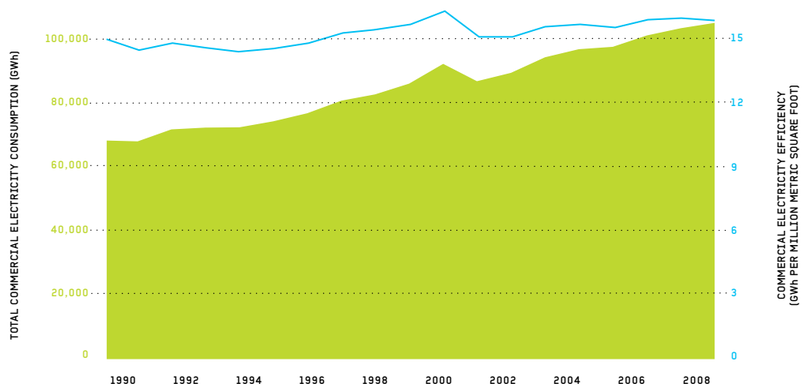
Building occupants can be big energy consumers and contribute substantially to a building's overall energy use. The energy intensity of restaurants and food stores derives from the use of specialized equipment such as commercial ovens and industrial refrigeration units. Over the years, the increasing use of new technology in hospitals, such as MRI, X-ray and other machines, has resulted in higher demands for power.

2.3 TREND 3: LIGHTING AND HEATING, VENTILATION AND COOLING SYSTEMS REPRESENT THE MAJORITY OF ELECTRICITY CONSUMPTION IN COMMERCIAL BUILDINGS.

End-uses such as indoor lighting, combined heating, ventilation and cooling (HVAC), and refrigeration account for the highest rates of electricity consumption per square foot. Since the 1990-1995 period, the efficiency of indoor lighting per square foot improved by 17 percent, refrigeration by eight percent, and cooling efficiency improved by two percent. Despite incremental efficiency improvements to new equipment (which eventually replaces the old), no aggregate efficiency improvements were measured in heating, cooking, office equipment and water heating at the state level.

COMMERCIAL ELECTRICITY CONSUMPTION AND EFFICIENCY

TOTAL CONSUMPTION AND CONSUMPTION PER MILLION METRIC SQUARE FOOT / CALIFORNIA

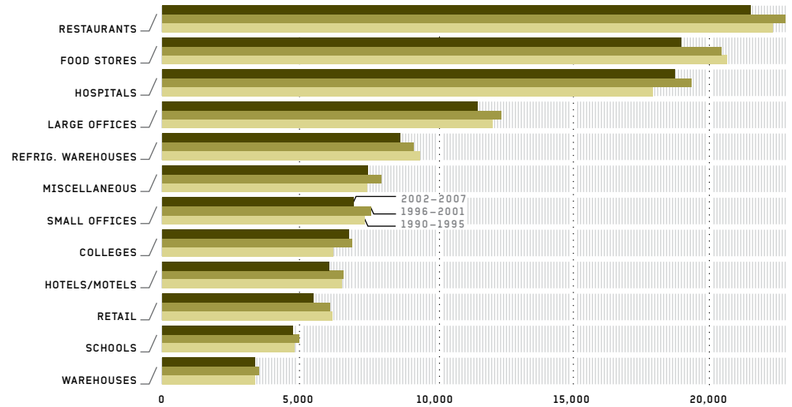


Data Source: California Energy Commission
Analysis: Collaborative Economics

COMMERCIAL ELECTRICITY CONSUMPTION PERCENT CHANGE 2006-2007	
TOTAL	+15%
PER SQUARE FOOT	-0.2%

COMMERCIAL OFFICE BUILDING ELECTRICITY CONSUMPTION BY INDUSTRY

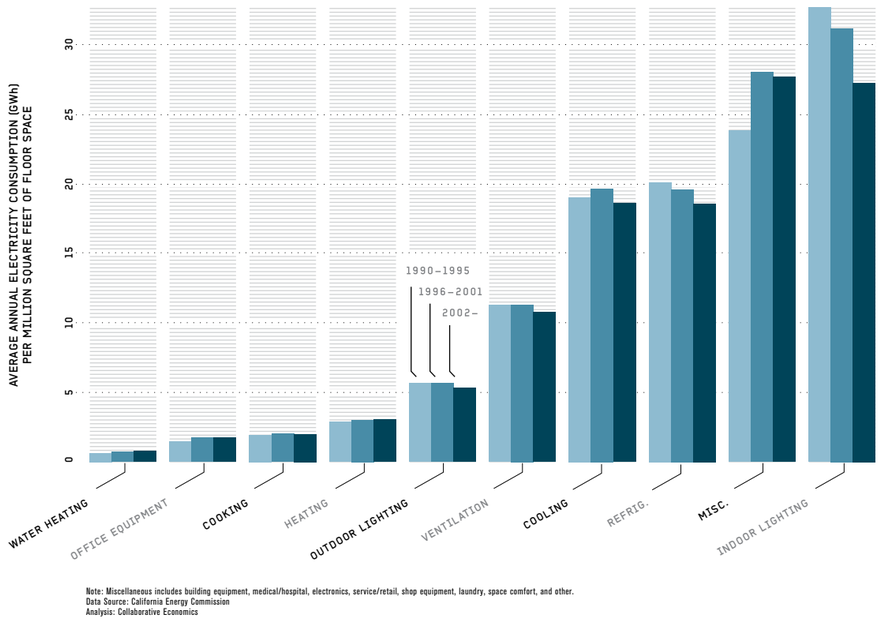
AVERAGE ANNUAL ELECTRICITY CONSUMPTION PER SQUARE FOOT OF FLOOR SPACE / CALIFORNIA



Data Source: California Energy Commission
Analysis: Collaborative Economics

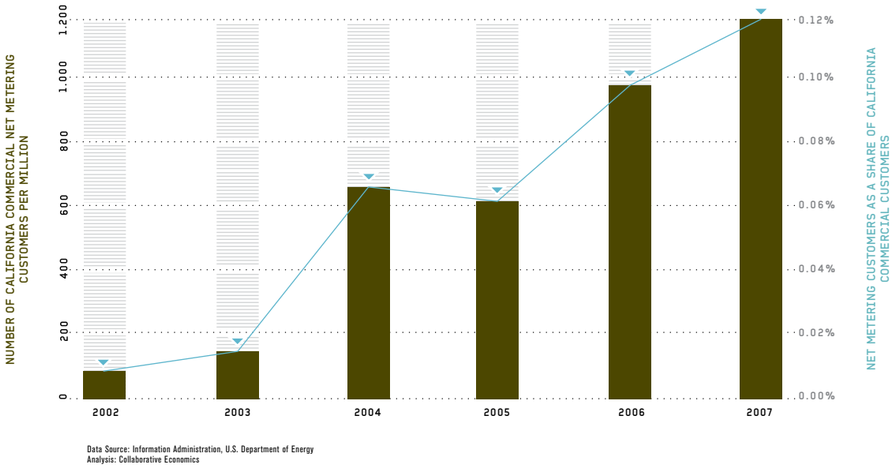
2007 FLOORSPACE STOCK (MM SQ. FT.)	
REFRIG. WAREHOUSE	52
RESTAURANT	173
GROCERY	282
HOTEL	308
HOSPITAL	316
COLLEGE	317
SMALL OFFICE	365
SCHOOL	520
WAREHOUSE	942
RETAIL	1064
MISC	1150
LARGE OFFICE	1187

COMMERCIAL BUILDING ELECTRICITY CONSUMPTION BY END USE CATEGORY
CALIFORNIA



Note: Miscellaneous includes building equipment, medical/hospital, electronics, service/retail, shop equipment, laundry, space comfort, and other.
Data Source: California Energy Commission
Analysis: Collaborative Economics

NUMBER OF CALIFORNIA COMMERCIAL NET METERING CUSTOMERS PER MILLION AND PERCENTAGE OF CALIFORNIA COMMERCIAL CUSTOMERS



Data Source: Information Administration, U.S. Department of Energy
Analysis: Collaborative Economics

2.4 TREND 4: ENERGY STAR APPLIANCES HAVE GAINED SIGNIFICANT MARKET SHARE IN CALIFORNIA OVER THE LAST DECADE.

The market share of Energy Star appliances in California grew consistently until 2007. However, as a result of an upward revision to the minimum Energy Star efficiency criteria effective January 1, 2007, the market share of dishwashers declined by nearly 44 percent in 2007. The decline seen in the chart is a typical market response following the introduction of new, more stringent Energy Star efficiency standards—as fewer products on the market will actually meet the new, more discriminating standard. More stringent Energy Star criteria were also applicable to refrigerators and clothes washers; as a result, the market sales of these items declined by three percent and six percent, respectively.

The Energy Star program is a nationwide, voluntary standards and labeling program providing key consumer information on the energy efficiency of more than 60 products. The program is jointly run by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA).

CALIFORNIA MARKET SHARE OF ENERGY STAR QUALIFIED UNITS

	1998	2007	GROWTH 1998-2007
CLOTHES WASHERS	12%	52%	+40%
DISHWASHERS	17%	95%	+78%
REFRIGERATORS	17%	49%	+32%

2.5 TREND 5: A SMALL, BUT GROWING, PERCENTAGE OF CALIFORNIA COMMERCIAL ELECTRICITY CUSTOMERS SELL POWER BACK TO THE GRID.

Net metering programs allow customers to use self-generation technologies (e.g. solar panels) to generate electricity and sell excess power back to the electrical grid to offset consumption. With 1,145 commercial net metering customers per million, California ranks first among the 50 states and D.C. in the concentration of commercial net-metering customers. Montana follows second with 1,069 net metering customers per million. California had a total of 2,068 commercial net metering customers in 2007 up from 1,680 in the prior year and 134 commercial customers in 2002, the first year data was available.

The percentage of commercial customers using net metering is a tiny but growing fraction of all commercial customers in California. In 2007, a mere 0.11 percent (about one-tenth of one percent) of commercial customers used net metering; this represents a more than 12-fold increase in the share of commercial net metering customers in 2002, which was 0.01 percent.

The downside of net metering is that it does not directly affect the energy usage efficiency of the business. The big benefit of net metering programs is that they enable reduced greenhouse gas (GHG) emissions through two primary channels: 1) local generation (e.g. a rooftop solar generator) improves overall energy distribution efficiency by reducing the energy losses due to transmission and distribution (about seven percent on average), and 2) they reduce the building's own demand for utility-generated energy.

DRIVERS, BARRIERS AND INCENTIVES

The drivers behind improving the energy efficiency of buildings are diverse. They include technological advances in building design and materials and in new types of consumption monitoring devices. And important drivers also include public policy in the form of standards, incentives and regulation.

3.1 UNTAPPED COMMERCIAL ENERGY EFFICIENCY COMES FROM RETROFITTING OLD BUILDINGS AND INCORPORATING ENERGY EFFICIENCY IN THE DESIGN AND CONSTRUCTION OF NEW BUILDINGS. There are three primary ways in which Californians can realize more of the untapped efficiency potential in existing commercial buildings using no and low-cost modifications: 1) climate controls and equipment, 2) lighting, and 3) changes to the buildings' thermal envelope. The deeper the energy retrofit, the higher the cost.

In new commercial buildings, incorporating energy efficiencies early in the design and construction of new buildings is less expensive than adding efficiency improvements later; the earlier energy efficiencies are incorporated into the project, the lower the cost. Estimates suggest that new buildings meeting the U.S. Green Business Council's LEED standards will experience a 25-30 percent reduction in annual energy consumption.[25] The next stage of commercial energy efficiency is the "net-zero" building. Net-zero buildings combine energy efficiency improvements with on-site renewable generation to attain net-zero CO2 emissions. The California Energy Commission's 2007 annual report recommends "net-zero" commercial construction by 2030.

However, there is also room for improvement in LEED standards. Currently it is possible to achieve Silver and Gold level by merely meeting minimum building code requirements. The U.S. Green Business Council has an opportunity to strengthen LEED standards and encourage contractors to design buildings that surpass code minimums by withholding LEED certification.

Adding further value, consumers are willing to pay a premium rent for green buildings, and such buildings have less turnover. Recent U.S. research shows that green-buildings (those that are LEED or Energy Star certified) command higher rents (between six to seven percent higher) and maintain higher occupancy rates than other buildings located within one-quarter mile radius of them.[26] This is consistent with a 2008 CodeGreen survey that reported 79 percent of leaseholders would pay five percent higher rent for LEED-Silver rated space.[27]

Venture capital firms have also recognized the economic opportunity provided by energy efficiency products and services, and have begun investing heavily in new technologies. Energy efficiency firms raised $1 billion in 2009 and are set to become the second largest segment of venture capital investment in 2010.[28]

THERMAL ENVELOPE: BROAD CHANGES TO THE THERMAL ENVELOPE OF EXISTING BUILDINGS CAN IMPROVE EFFICIENCY AND CREATE JOBS. A building's envelope is the barrier between its internal and external space; its construction is a key mechanism of efficient climate control. Substantial energy loss accompanies heat transfer from the exterior to the interior of climate-controlled spaces and vice-versa, reducing the effectiveness of winter heating and summer cooling.

A 30 percent savings could come from upgrading building insulation to the DOE's recommended levels from current levels in the average building.[29] The cost of insulating a building varies depending on building type and the kind of insulation required in the local climate. Insulation innovation will likely come from materials enhancements leading to more effective, less voluminous, and less costly insulation. Examples of innovative building materials include wall panels with built-in insulation and vacuum panels using thermos technology (evacuation of heat-transporting molecules from space within the panel). In buildings, such panels require a core (comprised of Perlite, mineral powder, mineral fiber, fiberglass, silica or even aerogels) and a protective, exterior membrane to prevent moisture penetration. Research is focused on expanding the lifetime usage of the panels from about ten years to more than 50. Innovation is also required to improve core and membrane materials. Prefabricated structural insulated panels, composed of a wood veneer and insulated foam core, have also been used in newer buildings. Research efforts to improve conventional insulation are also underway.

Replacing old windows with newer models can increase efficiency up to three times. More energy-efficient windows enable more natural light to enter a building without concurrent heat or energy loss. Natural light decreases demand for electrical lighting and makes the working environment more pleasant. Window replacement costs vary depending on whether the frame material is vinyl, wood, or metal. Currently, more efficient windows are roughly three times as expensive as standard windows, as a result of differences in manufacturing costs (primarily from a lack of scale in the industry).

The payback period for energy-efficient window-installation in new buildings is short; about two years. However, developers—who do not benefit from decreased utility bills—have little incentive to install these windows. Requiring changes via the building code may be essential to achieve more scale in the commercial sector.[30] Innovation in window technology is currently focused on coatings to prevent additional heat transfer; for example, an added coating can improve air-cooling efficiency of a window by reducing the heat transfer from sunlight.

Retrofitting existing windows with more efficient replacements, and enhancing insulation in ceilings, walls and floors could increase building efficiency by nine percent and 32 percent, respectively.[31] Retro-fits and energy-efficient design are also labor-intensive and therefore, job-creating processes. One estimate suggests an additional one million jobs per year for construction workers, retrofitters, and other trained building professionals if the U.S. undertook a major efficiency program.[32]

THE PUBLIC GOOD PROBLEM: IMPROVING ENERGY EFFICIENCY REQUIRES WIDESPREAD PARTICIPATION TO HAVE MAXIMUM IMPACT

If the use of incandescent bulbs were completely phased-out by 2020, the result would be a 40 percent decline in worldwide CO2 emissions according to Claire Daniel Tomkins of Stanford University and the Gigaton Throwdown Initiative.* The individual choice to replace incandescent light bulbs with less energy-intensive CFLs or LEDs benefits both the individual and society as a whole. But to actually see the desired decline in GHG-emissions, a high level of penetration must be achieved by this relatively low-cost intervention. In general, it will be easier for low-cost to high-return technologies to achieve the necessary level of penetration to see widespread GHG reductions.

With similar aims, federal lighting standards adopted in December of 2007 also encourage the phase out of incandescent lighting. Under the standards, there will be 70 percent reduction in electricity consumption per lumen by 2020.

Attaining scale in the adoption of energy efficient technologies is necessary to achieve the desired society-wide reduction on GHG emissions. Yet, the choice to retrofit a building is typically made by an individual who fails to incorporate the social marginal benefit of lower GHG emissions into his/her calculus. As a result, consumers typically underestimate the benefit of incorporating energy efficiencies into building design and construction and in energy retrofit decisions. Without seeing this additional benefit, consumers may be less inclined to make the energy-saving choice.

* Claire Daniel Tomkins. 2009. "Building Efficiency." Stanford University and Gigaton Throwdown Initiative, pp. 50.

LIGHTING: ADVANCES IN LIGHTING TECHNOLOGY HAVE CREATED LARGE NEGATIVE COST EFFICIENCY GAINS. Lighting accounts for 19 percent of building emissions, 27 percent of California commercial building energy consumption and represents one of the most cost-effective means of reducing electricity consumption.[33] Current compact fluorescent light (CFL) and light emitting diode (LED) bulbs are more efficient than incandescent bulbs and last longer. Using CFL or LED technology offers average efficiency gains of 8-18 percent and 10-20 percent respectively.[34] "To produce the same amount of light, a CFL uses approximately 30 percent of the power an incandescent bulb requires and lasts almost eight times longer. An LED consumes twelve percent of the energy an incandescent uses and lasts more than 40 times longer. Though CFLs today cost several times more than an equivalent incandescent bulb, long life and high efficiency make these lighting changes potentially very attractive abatement options."[35]

Over the lifetime of the product, the discounted cost of these energy-saving bulbs outweighs the upfront purchase cost. LEDs are five to ten times the cost of CFL bulbs. CFLs contain mercury which means that disposing of them poses environmental risk. While LED technology resolves the disposal problem, LEDs are not as cheap as they could be. Material innovation in the substrate used in LED lighting would significantly reduce the current cost.[36]

HABITS: BEHAVIORAL CHANGES IN COMMERCIAL ENERGY USE CAN PROVIDE VERY LOW COST ENERGY SAVINGS. Improved climate control equipment and ensuring that existing systems are properly installed and operated can yield substantial energy savings at little or no cost.[37] Using occupancy-sensor lighting fixtures and controls in office buildings, classrooms, and other spaces can help reduce commercial lighting costs by up to 45 percent.[38] Additionally, tools such as the Cool California can help consumers measure their impact on the climate as well as learn ways to save money while reducing energy usage.

Energy audits can identify ways to improve climate controls and improve maintenance. The U.S. government's Energy Star program for buildings and manufacturing plants helps owners analyze their energy efficiency. Energy Star's "Portfolio Manager" is a free rating tool enabling owners and managers to compare their total energy consumption against buildings of similar use and size. The program also helps those responsible for improving building energy efficiency to identify areas where they can improve.[39]

STANDARDS: CHANGES TO BUILDING CODES AND STANDARDS HAVE LONG-TERM EFFECTS. Building codes define required standards in new building construction and major renovation at the jurisdictional level. Codes can be applied in new construction, at resale and in major renovations. In general, they can set very specific thermal efficiency requirements for building envelopes: including, heating, ventilation, cooling, boiler systems and for other variables affecting building energy efficiency. Energy efficiency requirements mandated at the time of construction such as insulation, windows and major heating and cooling systems yield energy savings throughout the building's lifetime.

The primary limitations of relying on building codes to improve energy efficiency are; 1) infrequent code updates lead to building codes that lag behind technology changes; 2) reliable enforcement can be costly and challenging; and 3) high marginal costs may inhibit new construction. The advantage of modifying building codes is that society reaps the benefits of locking in higher new building standards for decades to come.

_3.2 THE BARRIERS ARE DIFFERENT FOR EFFICIENCY IMPROVEMENTS IN EXISTING AND NEW COMMERCIAL BUILDINGS. In existing buildings, the cost of an energy retrofit can be prohibitively high whereas new design and construction can incorporate the latest energy efficiency advances at little additional cost per square foot. However, only about three percent of all commercial space is newly-built or renovated in a given year and, as a result, there are great potential increases in energy efficiency in existing buildings as well.

MONUMENTAL RETROFITS: TRANSAMERICA PYRAMID AND EMPIRE STATE BUILDING

In 2007, the Transamerica pyramid in San Francisco began a green renovation, with the addition of a 1.1 megawatt combined heat and power (CHP) system made of two 560-kilowatt natural gas fired reciprocating engine generators. This co-generation plant provides approximately 70 percent of the electrical needs of the 530,000 ft2 building, and recovered heat from the engines is used to chill tap water, by driving a 320-ton absorption chiller, and heat the building, completely replacing the steam-powered system previously used.[1] The building has made other green progress, including a 50 percent decrease in water consumption from a water-use reduction program, the recycling or composting of 70 percent of the building's consumables and the use of green cleaning products. The building's renovations have lowered its carbon footprint by 20 percent, utility costs by 25 percent, and earned the building LEED Gold EB certification.[2]

The Empire State Building is drawing national attention as it begins its own green retrofit. While more passive than the Transamerica approach, the efficiency-focused renovation plan is expected to cut energy use by 38 percent and garner LEED EB Gold certification when it is complete in 2013. The plan will reduce the kilowatt-hour and therm loads of the 2.77 million ft2 building by means of self-regulating equipment, temperature-loss reduction, and low-energy equipment, which will consequently allow for decreased infrastructure in the building. The plan emphasizes integrating projects that complement each other. All windows, for example, were refurbished to increase thermal resistance; the increased insulation allowed the planners to renovate the building's chillers rather than installing new ones, a major cost-cutter. Though the plan is expected to increase the building's profit by $4.4 million per year, the planners could not maximize both profit and CO2 reduction, sacrificing 30 percent of projected profit to deliver more CO2 reduction.[3]

[1] "San Francisco's Landmark Transamerica Pyramid Building To Add $3.4 Million Cogeneration Power System" Northern Power. May 4, 2006. Web. January 6, 2010. <http://www.google.com/url?sa=t&source=web&ct=res&cd=3&ved=0CAoQFjAC&url=http%3A%2F%2Fmasstech.org%2FRenewableEnergy%2Fpublic_policy%2FDG%2Fresources%2F2006_Northern_Transamerica_Network_CHP.pdf&ei=91lLS4GHOo3gswOV1uX1Dw&usg=AFQjCNFmN7SfOVXNoinjfZpLveMTSp6eoQ&sig2=OBCDgJsFeG_wQUTHyjFCkQ>

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[3] Empire State Building Sustainability Team. "A Case Study: Retrofitting America's Favorite Skyscraper." Lessons Learned: Existing Buildings. Vol. 6. (2009): 17-24.

The tables below highlight the different barriers to the large-scale adoption of energy efficiency retrofitting. In existing commercial buildings, the incentives of the building owner and the tenant are often not aligned to support efficiency measures, the return on investment is considered too long and the upfront capital costs too high for the owner, and often owners do not realize how inefficient a building is.

_3.3 A combination of federal, state, and utility-specific programs provide incentives for commercial building efficiency improvements. California businesses can take advantage of a wide array of federal, state, local and utility-level energy efficiency financial incentives, including tax deductions, rebates, grants and loans. For example, California was awarded $351.5 million in Department of Energy Energy Efficiency Block Grants for local governments to use for projects and programs to reduce total energy use. About $302 million goes directly to large cities and counties. The Energy Commission was awarded $49.6 million and is making 70 percent of these funds available to 265 small cities and 44 small counties on a per capita basis with an unemployment adjustment.[40] California was awarded over $354 million accounting for 13 percent of the total allocated dollars from the Energy Efficiency block grants.[41]

The tables below highlight examples of incentive programs for commercial building retrofits offered by different levels of government. Most incentives in California are concentrated at the local government level or are programs administered by specific utilities.

EXISTING BUILDINGS
BARRIERS THAT DIMINISH LARGE-SCALE ADOPTION OF ENERGY RETROFITTING

AGENCY ISSUES: THE PROBLEM OF THE SPLIT INCENTIVE	Agency issues arise from incompatibility in the economic incentives driving the behavior of two parties bound by a contract. In commercial buildings, tenants may lack the authority to install energy efficient technologies in a building they do not own. A tenant may relocate (either by choice, or not) before the new technology has paid for itself in savings, thus bearing the cost of the upgrade without gaining from its payoff over the long term. Similarly, energy efficiency investments are borne by the landlord but benefit the tenant, who enjoys lower utility bills. As a result, landlords see little financial incentive to make energy efficiency investments when their returns seem uncertain. However, according to the Building Owners and Managers Association International, simple energy efficiency improvements such as insulating window films on average yield three dollars in savings for every dollar invested.[42] An additional hurdle resulting from a split incentive is that legislation likely affects landlords and not building occupants, even though occupant energy use is a large share of a building's total energy consumption. Public policies can affect changes to a building's thermal envelope but without "green leases" or other energy tracking, energy intensive tenants, e.g. those operating a restaurant with industrial refrigerators and ovens have little incentive (other than minimizing their utility bills) to improve energy performance. With the recent changes to Rule 18, programs need to be put in place to encourage landlords to install submeters, which restore cost incentives to tenants for responsible energy use.
ELEVATED HURDLE RATE	The benefits of efficiency investments in existing commercial buildings accrue over the long term. If the return on investment is longer than what the building owner expects, he/she will not be willing to bear the upfront cost.
UPFRONT CAPITAL CONSTRAINTS	Access to capital to conduct an energy retrofit can be a major constraint and many owners may wish to avoid debt. Financiers may be unwilling to bear the credit risk of privately-owned buildings because the chances of default are higher, relative to municipal and public-building risk. From the building–owners perspective, the opportunity cost of capital–that another application may see a greater return on investment–could create further disincentives for building owners to undertake a costly retrofit.
INFORMATION GAP	Building owners do not know how inefficient their buildings are, how they can improve efficiency and the cost of doing so, or how much they could save and when they might break even. The price signal, which should function as a mechanism of consumer choice, fails when consumers can't assess the true cost of behavioral changes. For example, a consumer is unlikely to relocate a refrigeration unit from a hot garage to a cool basement unless the marginal cost of doing so is calculable.

NEW COMMERCIAL CONSTRUCTION
BARRIERS TO IMPLEMENTING ENERGY EFFICIENCY

LACK OF DEVELOPER INCENTIVES	Developers do not receive future energy savings from energy efficient buildings and may be unaware of the premium price an efficient building can command. As a result, they're more likely to meet minimum required energy standards and focus on amenity upgrades instead.
INEFFECTIVE INSTALLATION AND INSPECTION	When a new building is commissioned for use, it has undergone a systematic inspection for ensuring that the building's structure and systems operate properly. Passing this final inspection does not always include the proper review of energy efficiency standards and the proper functioning of related equipment. Further, developers have little incentive to ensure that contractors install equipment properly or that the buildings are properly commissioned. It is estimated by McKinsey & Company that 40 percent of new building commissions are not in compliance with minimum California efficiency standards.[43]

FEDERAL PROGRAMS

INCENTIVES FOR OWNERS & TENANTS OF COMMERCIAL BUILDINGS	Building owners can benefit from monetary incentives to help overcome elevated hurdles and high capitalization costs of deep energy retrofitting. These can be offered by governments and non-government entities and in several forms including tax credits, tax deductions, rebates or accelerated depreciation. The Federal Energy Policy Act of 2005 enables owners and tenants of commercial buildings to receive a tax deduction for energy retrofits. Incentive amounts range from $0.30 to $1.80 per square foot and depend on the technology and amount of energy reduced. Subsequent legislation has extended the original deadline by five years to December 31, 2013.
RURAL CONSUMERS	The Rural Energy for America Program (REAP) is a grant and loan guarantee program for agricultural producers and rural small businesses to make energy efficiency improvements and develop renewable energy systems.
FEDERAL STIMULUS	The American Recovery and Reinvestment stimulus package allocates unprecedented sums in support of energy efficiency improvements: • $2.5 billion for research on energy efficiency and renewable energy sources. • $4.5 billion for repair of federal buildings to increase energy efficiency and more incentives for residential weatherization and efficiency improvements. • One percent loans for particular types of energy efficiency retrofits. • California has been awarded $1.6 billion in competitive grants to support existing energy efficiency and renewable energy programs and develop the state's smart grid.
INFORMATION GAP	Building owners do not know how inefficient their buildings are, how they can improve efficiency and the cost of doing so, or how much they could save and when they might break even. The price signal, which should function as a mechanism of consumer choice, fails when consumers can't assess the true cost of behavioral changes. For example, a consumer is unlikely to relocate a refrigeration unit from a hot garage to a cool basement unless the marginal cost of doing so is calculable.

CALIFORNIA STATE AND LOCAL PROGRAMS

PROPERTY ASSESSED CLEAN ENERGY (PACE) PROGRAM	Programs under way in the state, such as the Sonoma County Energy Independence Program and CaliforniaFIRST, are helping property owners finance energy efficiency, water efficiency, and clean energy generation projects. These PACE programs remove the barriers of high upfront costs by loaning funds for property improvements, which are repaid over time through increased property taxes.
SOLAR REBATES	San Francisco city and county currently provide rebates of up to $1,500 per kW of photovoltaic (PV) power generation installed on a commercial building. Rebates for non-profit commercial spaces are uncapped, but for others the maximum is $10,000. However, these rebates may be combined with incentives from the California Solar Initiative, which provides rebates on a sliding scaled based on the amount of statewide PV capacity.
ENERGY EFFICIENCY REBATES	Throughout the state, there are more than 25 utility rebate programs for businesses to improve energy efficiency. Eligible efficiency technologies include lighting, heating, ventilation, air conditioning, insulation, roofing, windows, and appliances. In addition, there are more than ten utility and local government grant and loan programs that assist businesses with energy efficiency improvements.

In addition to these existing state and utility-level programs, the DOE has allocated to the CEC $226 million to implement the State Energy Plan. The CEC intends to use these funds to promote building and industrial efficiency programs and provide financial incentives for energy efficient technology, among other goals. Once these funds are released by DOE, the CEC will create additional avenues for commercial buildings to reduce energy consumption. Combining these rebates and programs with low-interest loans and other available tax incentives can drastically reduce the payback period for commercial retrofits.

CALIFORNIA UTILITY PROGRAMS	
COMPREHENSIVE EFFICIENCY PROGRAM	Most of the major utilities in the state (e.g. Pacific Gas and Electric, Southern California Edison, San Diego Gas and Electric, Southern California Gas Company) administer efficiency programs offering energy audits, retrofit guidance, and rebates for installation of energy efficient technologies ranging from CFL and LED light fixtures, to wall insulation and variable speed motors for HVAC systems. The size and structure of the rebate (e.g. per unit versus per kWh savings) vary by utility, as do the specific technologies that are covered. PG&E offers rebates for installation of occupancy sensors in commercial office spaces. These range in size from $7 to $44 based on the mounting type and energy intensity of monitored space.
FINANCIAL INCENTIVES FOR ENERGY SAVINGS	Commercial entities, regardless of size, who regularly pay the "public purpose program surcharge" on their energy bills are eligible for a program administered by the California Public Utilities Commission, called the Standard Performance Contract (SPC). Financial incentives under the SPC are based on the kWh savings that result from efficiency upgrades and the total kW savings over a twelve-month period. This program can be customized for each applicant's needs and goals, and may provide as much as 50 percent of the installation cost (up to $2.4 million per site) until the program's funding is exhausted.

CAPITAL IMPROVEMENTS: THE SACRAMENTO AREA VOLUNTARY ENERGY SAVINGS PROGRAM

Enabled by AB 811, the Sacramento Area Voluntary Energy Savings (SAVES) program is currently under development in the state's capital. While this Property Assessed Clean Energy (PACE) program is not yet fully implemented, its inception would lower demand for energy, reduce pollution and greenhouse gases, increase property values, save consumers money on utility bills, and create green jobs. According to a study conducted for the Green Capital Alliance assessing the economic impact in the initial two years, work based on property improvements put forward by AB 811 would create 725 green jobs, increase economic output by $170 million, and add nearly $30 million of employee compensation to the Sacramento Area region. Additionally, state and local governments would receive $10 million in tax revenue generated from the program.

* "Sacramento Area Voluntary Energy Savings (SAVES): AB 811" http://www.greencapitalalliance.org/docs/SAVES%20Brochure.pdf

LEAPING FORWARD

_4 Improving energy efficiency in commercial office buildings offers an immense, low cost energy resource that not only will result in real cost-savings for businesses but will also boost competitiveness by reducing resource demands. The economywide opportunities of efficiency improvements cannot be fully realized until several real obstructions are overcome. Much can be achieved through actions taken at the federal, state and local levels that raise standards, align incentives, and support the broad-based application of high-efficiency products and practices.

IN EXISTING BUILDINGS, split incentives between landlords and tenants must be solved. While many tenants are willing to pay higher rents for more efficient properties, landlords currently are either unaware of these possibilities or cannot recoup their investments fast enough. Moreover, recent revisions to Rule 18 allow for submetering in high-rise commercial building, but more must be done now to incentivize the adoption of these technologies by landlords. Other issues such as elevated hurdle rates and high upfront capital costs continue to discourage landlords from implementing beneficial efficiency retrofits. While PACE programs would solve many of these problems, overall these programs are still in their pilot phase and not available to many property owners in the state. The last problem continues to be the information gap between property owners and available energy efficiency programs in California. The adoption of new programs or changes in regulation will continue to require a strong push from public and private actors to be effective.

IN NEW COMMERCIAL CONSTRUCTION, a lack of developer incentives, and ineffective installation and inspection methods are barriers to energy efficiency measures. Commercial developers need to be better encouraged to build more efficient buildings through outreach and incentives. Additionally, better inspection practices are needed to ensure that new constructed buildings pass basic building code minimums and that efficiency equipment has been installed properly.

California needs to continue its leadership in building efficiency policy and its demonstration that improving energy efficiency is good for business, communities, and the environment. Setting efficiency standards and offering innovative financing models to encourage investment in energy efficiency retrofits and equipment can have big payoffs by reducing cost barriers and spurring demand for better, cleaner products and services.

To this point, California should implement its own version of U.S. Department of Energy Commercial Building Initiative (CBI), which aims to significantly improve the energy efficiency of new and existing commercial buildings through technologies and strategies research and deployment. This multi-sector alliance would push for quicker adoption of incentive programs, better outreach to property owners and tenants, more stringent adherence to building codes, research and support of new products and services, and improved mechanism and strategy for solutions deployment. Through sustained effort and collaboration, this new initiative would drive energy efficiency improvements in commercial buildings forward as California works to increase energy savings and reduce greenhouse gas emissions in the years and decades to come.

ENDNOTES

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[22] EIA CBECS 2003, Table B9

[23] While total commercial electricity consumption grew in 2008, commercial floor space grew at a greater pace.

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California cities received 68 percent of the state's total funds, and counties and the state received 17 and 14 percent. The California counties that received the most in grants were Los Angeles ($15,412,400), Riverside ($6,591,600), Sacramento ($5,364,600), San Diego ($5,140,200), and Kern ($4,050,800).

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