U.S. Department of Energy

Tomorrow's Energy Today

for Cities and Counties

Commercial Energy Codes Lay Foundation for Saving Money

Making commercial buildings more energy efficient calls for more thinking, not necessarily more money.

Few investments offer as attractive a return to local communities as improving the energy efficiency of new and renovated commercial buildings. Building owners and tenants both profit from lower utility bills, and owners reap the additional benefit of the building's increased market value. Buildings that use less energy are more "rentable," especially in tight markets. Lowering the demand for electricity also reduces local utilities' need to build expensive power plants, and investment in energy efficiency keeps money in the community.

Improving commercial building codes leads to substantial energy savings. One California Energy Commission study estimates that commercial building retrofits with simple paybacks of 3 years or less could reduce energy use by about 36%.

One of the most effective ways to assure a minimum level of energy efficiency in commercial buildings is to adopt and enforce energy standards. In general, building codes and standards are developed on the national level and administered and enforced at the local level. Most commercial building energy codes are based at least in part on standards developed jointly by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) and the Illuminating Engineering Society (IES).

Long Branch Community Center, Montgomery County, Maryland, uses about 57% less energy annually than a typical community center its size.

John Sullivan, Sullivan & Almy, Inc. Architects

Saving Money and Energy in Maryland

But don't energy efficiency measures add to the cost of construction? Not according to Ron Balon, Montgomery County, Maryland. "Energy-efficient new buildings cost no more to build than 'energy hog' buildings, and energy-efficient retrofits cost an average of only 2% more than a standard renovation to complete," says Balon, Project Manager of the Capital Projects Management Division. "Even after including all costs—extra costs of retrofits, increased design fees, extra personnel—68% of our costs

"The technical means to reduce the burden of commercial energy consumption is simple, effective, and readily available today."

— Terry O'Sullivan
Senior Energy Specialist
San Francisco, California

were recovered one year after the investment, and a positive ratio of savings-to-investment occurred in our commercial code program's second year. Energy-efficient design provides a very attractive rate of return for local governments."

Montgomery County enacted regulations for energy-efficient design of commercial buildings in July 1986 on the basis of extensive research into cost-effective energy efficiency measures. The regulations are based on the ASHRAE/IES Standard 90.1, *Energy-Efficient Design of New Buildings Except Low-Rise Residential Buildings*, but are much more comprehensive. New and retrofit buildings using the county's regulations **consume 30% to 50% less energy** than existing county buildings (see table below).

"The key to achieving energy and cost savings is to improve the design process, integrate all the disciplines involved, and take advantage of the cost trade-offs available in energy-efficient construction," explains Balon. "In many cases, a reduction in initial building cost is even possible. Making buildings energy efficient," Balon contends, "requires more thinking, not more money."

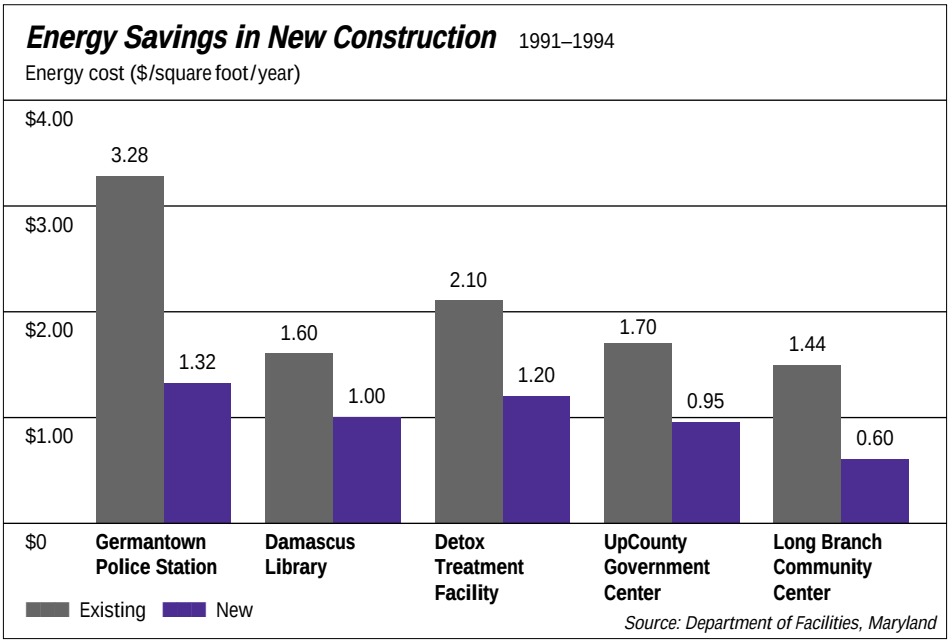
Balon cites many examples of such reductions, but the most cost-effective is upgrading the lighting system. Interior fluorescent lighting typically uses 40% of the energy consumed in a large office building, and that same lighting system often produces enough waste heat to account for 40% of the air-conditioning demand. By specifying an efficient lighting system (fluorescent fixtures with electronic ballasts, T-8 lamps, and deep-cell parabolic diffusers), and following current IES design recommendations for lighting levels, the designer can reduce energy usage by 55%. In addition, this system will provide illumination the same as or better than that from standard fixtures. Using a more efficient lighting system can also allow the designer to reduce the size and cost of the air-conditioning system, typically by 20% to 30%.

"These reductions will not happen automatically," Balon cautions. "The design team must collaborate so that the heating, ventilating, and air-conditioning (HVAC) designer uses the actual lighting wattage in the final cooling load calculations rather than assuming standard values. Although maintaining this level of cooperation throughout the design process requires time, coordination, and technical diligence, the financial returns are well worth the effort."

The benefit-to-cost ratios (ratio of present worth of all future utility savings to the initial cost) of incorporating Montgomery County's energy regulations into the construction of county buildings are impressive. For new energy-efficient construction, Balon calculates the benefit-to-cost ratio to be 8 to 1, and for energy-efficient retrofits, the ratio is 5 to 1.

As Balon points out, "It is easier and more cost effective to design energy-efficient buildings than to retrofit poor designs after they're built." But the benefits of improving the energy efficiency of both new and renovated buildings make the effort worth the time and trouble.

This table shows the relative size of energy savings for five different facilities in Montgomery County, Maryland—both existing buildings and new additions. Local governments can save substantial operating-budget dollars through smart building design.



Jon Cosner/VL1106

Energy-efficient office buildings can produce generous energy savings for owners and users. In San Francisco, for example, office buildings account for 47% of commercial electricity use.

Energy-Efficient Lighting Pays

Energy-efficient lighting systems have far lower energy costs and require less cooling equipment because efficient lighting produces less waste heat. They also have fewer maintenance costs because of the lesser number of lamps and ballasts.

	Standard System	Efficient System
Initial Capital Costs*		
Lighting Equipment	$ 96,000	$119,880
Cooling Equipment	$167,200	$ 51,200
Total	**$263,200**	**$171,080**
Lighting Energy Use	**294 kW**	**90 kW**
This assumes:		
Lamp	T12	T8
Ballast	Standard	Electronic
Diffuser	Prismatic	Parabolic
Cost per fixture	$ 60	$ 11
Number of fixtures	1600	1080

*Costs based on 100,000-square-foot (9300-square-meter) office building.

San Francisco's Commercial Energy Conservation Code

Because Montgomery County's regulations apply only to county buildings and because the energy standards were designed specifically for commercial buildings, implementing them has been relatively smooth. The story of San Francisco's Commercial Energy Conservation Ordinance (CECO), on the other hand, illustrates the complexities of designing energy standards for use in a competitive commercial real estate market.

In 1981, San Francisco adopted the Residential Energy Conservation Code (RECO), a prescriptive code designed to improve the energy efficiency of existing housing. RECO is simple to understand and easy and inexpensive to enforce. In spite of initial sharp opposition from the real estate community, the ordinance has become a routine part of doing business in San Francisco. RECO established the political and administrative basis for CECO, which took effect in July 1989.

As Terry O'Sullivan, Bureau of Energy Conservation in San Francisco explains, "Title 24 [state building energy efficiency standards] mandates energy efficiency standards for all new buildings in California, but does little to improve the performance of buildings already built." Theoretically, old, inefficient buildings will gradually be replaced by new Title 24-conforming buildings. But this is a slow process that is further hindered in San Francisco by limits on commercial development and regulations restricting changes to historic buildings.

"Office buildings in San Francisco are responsible for 47% of commercial electricity use," says O'Sullivan, Senior Energy Specialist. "This energy is consumed by mechanical systems such as lights, water heaters, chillers, air-conditioners, and boilers. This is not astrophysics—the technical means to reduce the burden of commercial energy use is simple, effective, and readily available today."

Translating that technical know-how into a workable ordinance, however, presents some challenges. Experience has shown that commercial codes are more complicated than residential ones. "One lesson is that commercial building energy ordinances must address a much wider variety of building uses and system types than we find in the residential sector," O'Sullivan claims.

In spite of these difficulties, support is strong in San Francisco to find ways to conserve energy. The city is examining the commercial ordinance to simplify its requirements and streamline its enforcement. Presently, the events that can trigger CECO review and enforcement include the transfer of a building's title, an addition to a building that increases the heated space by more than 10%, and renovation and improvements valued at more than $50,000.

When CECO review is required, a private inspector conducts an inspection for a fee, and identifies the areas of the building that do not comply with the ordinance. The building owner must then implement prescribed energy efficiency measures up to an established cost limit, unless they are not deemed cost-effective. Only those measures with a simple payback of 4 years or less must be implemented.

Adopting Codes and Standards

If you'd like to start saving money and energy in your area, you can count on support from the federal government. The Energy Policy Act of 1992 (EPACT) required all states to review their building energy codes and certify to the Secretary of Energy by October 24, 1994, that they meet the provisions of EPACT. For commercial buildings, EPACT specifies that new commercial construction must meet or exceed ASHRAE/IES Standard 90.1-89 by that date.

At the request of the U.S. Department of Energy, ASHRAE codified this standard and published the resulting code language in October 1993. This effort is designed to avoid a scenario in which states develop multiple code versions of the ASHRAE/IES Standard 90.1-89 as they work to meet the energy efficiency requirements of EPACT. Because the standard is already translated into code language, localities can adopt a commercial energy code by simple reference.

As San Francisco's experience shows, to be successful, an energy efficiency program must be easy to understand and inexpensive to administer. Studies have shown that simple standards are far more likely to result in high levels of compliance. One study by David Baylon of Ecotope, Inc., found that Oregon's relatively simple mechanical-system codes result in 96% compliance, while Washington state's more complex codes averaged only about 72%.

Education is another critical component of any successful energy efficiency program. Because of the many different sizes and types of commercial buildings, and the complexities of commercial construction, lack of compliance with energy codes is a serious problem. Check with your state energy office about code training and assistance programs; these offices often conduct excellent training programs or know of such programs.

In addition, many commercial codes rely on architects and engineers to help assure compliance. One useful strategy is to develop a local design guide and distribute it to commercial architects and engineers. As Ron Balon emphasizes, it is important that energy considerations be integrated into a project when it is conceived, rather than as an afterthought—waiting until the design process begins causes disruption and delay. Establishing and maintaining good communication with the design and building communities through clear and concise local standards and education programs may offset the resistance that these professionals often have to new (and especially government-mandated) regulations.

Another important criterion for success is to establish the cost-effectiveness of the energy efficiency measures under consideration. Researchers in Montgomery County, for instance, found that the most efficient lighting system was less expensive than standard lighting in initial cost when reduced HVAC and electrical costs were included in the analysis. You can use this kind of information as a marketing tool to make adoption of new standards easier (see table p. 3).

Because existing buildings account for such a high percentage of energy use, adopting energy efficiency regulations can save a substantial amount of money and energy in your community. These programs have proven well worth the time and effort they require at the outset. ■

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"Energy Retrofits Can Cut Use and Costs," *Mechanical Engineering*, August 1994
This article presents an informative summary of energy savings achievements and potential in commercial buildings.

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Marketing Energy-Efficiency Programs to Commercial and Industrial Firms, and *Energy-Efficient Building Design: A Transfer Guide for Local Governments*.

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The U.S. Department of Energy (DOE) establishes energy-efficiency standards and develops software to assist building professionals in incorporating the standards into commercial buildings.

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Funded by DOE, this program encourages information exchange among building industry professionals and organizations, state and local code officials, and researchers.

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