Designing Office Buildings to Perform Better Than Title 24

As designers and developers of new office buildings in California know, designing a building to meet the state's Energy Efficiency Building Standards isn't a goal—it's the law. The Standards, commonly referred to as Title 24, establish mandatory energy efficiency measures for all new buildings and major renovations, and include in their scope the building envelope, lighting, heating, ventilation and air conditioning (HVAC), and service water heating.

Why Design for High Performance?
Most building owners and designers, of course, have higher expectations than merely meeting code and complying with the law. Savvy developers, owners and designers of office buildings look for ways to reduce operating costs, attract and retain tenants, increase productivity and improve their return on investment. A key strategy for achieving these goals is to design for high performance, which could mean exceeding the minimum performance thresholds of Title 24 by as much as 10, 20 or even 40 percent.

Savings By Design and Title 24
Energy cost savings are one obvious benefit of high performance but there are more advantages. Savings By Design offers cash incentives of as much as $150,000 for the building owner and $50,000 for the design team if the new building's performance exceeds the program's minimum thresholds, which are tied to Title 24.

Funded by California utility customers and administered by Pacific Gas and Electric Company, Sacramento Municipal Utility District, San Diego Gas and Electric, Southern California Edison Company and the Southern California Gas Company, Savings By Design's incentives encourage owners to make energy efficiency a major goal in their new buildings, and help defray some of the costs of energy efficient building components.

LEED and Title 24
Performing better than Title 24 can also help a building earn certification under the U.S. Green Building Council's LEED Green Building Rating System. LEED certification is a distinction sought by increasing numbers of private sector building owners. In the public sector some jurisdictions now require LEED certification for municipal, state or federal buildings.

The current version of LEED for New Construction and Major Renovations (LEED-NC v2.2) references ASHRAE/IESNA Standard 90.1-2004 as the technical standard for certain energy performance credits, and for the purpose of these credits deems Title 24–2005 to be equivalent to ASHRAE. Under LEED's Energy and Atmosphere Credit 1: Optimize Energy Performance, as many as 10 points can by achieved by improving the building's energy performance beyond the baseline building performance established by ASHRAE or Title 24. To attain Platinum status, the highest LEED rating, a new office building needs at least 52 points out of a potential maximum of 69 points. Clearly, the 10 points available by performing better than Title 24 go a long way toward helping an office building earn LEED certification.

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If pursuing LEED certification, be sure to work with professionals experienced with the LEED documentation process, because the method for determining energy savings for LEED differs from the calculation method used for Savings By Design incentives.

**Integrated Design and Title 24**

Setting an energy performance goal—whether it’s performing better than Title 24 by 10 percent, 20 percent or more—can also help foster collaboration among members of the design team to identify efficient design strategies. This interaction, a process often referred to as integrated design, can lead to additional benefits beyond energy savings. The team, for instance, might identify building envelope and lighting measures that reduce heating and cooling loads. These load reductions could allow smaller HVAC systems, which could reduce initial construction costs.

**Showing That the Design Performs Better Than the Standards**

To demonstrate that a proposed design performs better than Title 24, the design team must use the building performance method of compliance and conduct computer simulations that compare the proposed design to the baseline building design. The California Energy Commission has approved two software programs for this purpose: EnergyPro and Perform 2005. For information about approved programs, go to [www.energy.ca.gov/title24/2005standards/2005_computer_prog_list.html](http://www.energy.ca.gov/title24/2005standards/2005_computer_prog_list.html).

When comparing the energy performance of a baseline building design and one that performs better than the Standards, Title 24 now requires that Time Dependent Valuation, or TDV, be used in the calculations. In previous versions of Title 24, energy use estimates had a constant value regardless of whether the use was during the day or at night. TDV, developed to help reduce the state’s peak electricity demand, assigns a higher value to measures that reduce electricity consumption during peak hours such as summer afternoons. TDV gives a lower value to measures that save electricity during off-peak times such as at night or on winter days, and is neutral for savings that occur during both on- and off-peak hours.

**Where to Look for Savings**

When designing a new office building to perform better than Title 24, what are the most promising cost-effective strategies? Specifics will vary depending on the project, but it’s possible to make some generalizations about the energy

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savings potential of interior lighting, building envelope and HVAC measures. The building diagram in Figure 1 illustrates a computer simulation model used to calculate savings for a variety of efficiency measures. Figure 2 shows the potential TDV savings for these individual measures, while Figure 3 shows the potential savings for combined packages of these measures. Through careful design, even greater savings can be achieved beyond the measures included in this simple example, and a few additional strategies are highlighted in the following sections.

**Interior Lighting Strategies**

Interior lighting, often the largest energy end-use in office buildings, is a prime target for energy savings. Some of the most promising strategies for performing better than Title 24 include limiting the amount of power used for lighting and using automatic lighting controls. Lighting energy-efficiency measures to consider in a typical office building include:

- High efficiency lighting systems to reduce power from 1.1 watts per square foot (W/ft²) to 0.9 W/ft². Task/ambient lighting design is one useful strategy to meet this lower lighting power target.
- Occupancy sensors in private offices and conference rooms
- Step or dimming daylighting controls in perimeter offices

In the example building, this package of measures could reduce TDV energy by as much as 10 percent (Figure 3). There is potential for even greater savings through measures such as better daylighting design. For example, a building form with a narrower floorplan and good solar orientation that optimizes the daylit area will significantly add to the savings provided by automatic daylighting controls.

**Building Envelope Strategies**

Building envelope measures eligible for compliance credit under Title 24 include exterior shading devices such as overhangs and sidefins, high performance windows with a lower U-factor or lower solar heat gain coefficient (SHGC) than required by the Standards, additional insulation in the walls and roof, and advanced framing strategies.

Figure 2 shows the impact of the following building envelope measures:

- R-5 rigid insulation added to the baseline R-13 walls
- Roof insulation increased from R-19 to R-30
- High performance glazing, reducing solar heat gain coefficient (SHGC) from 0.36 to 0.26 (while ensuring that the visible light transmittance, or VLT, of the selected glazing is high enough to provide adequate daylight and views).

However, these three measures have a much lower potential TDV energy savings compared to the interior lighting measures described above. In the example building, these three measures combined would only reduce TDV energy by 2.2 percent (Figure 3). Good window orientation is an important energy-saving strategy not represented by this example; an ideal design would minimize west- and east-facing glass and provide overhangs on the south side.

**HVAC Strategies**

HVAC measures eligible for compliance credit under Title 24 include efficient equipment, thermal energy storage (TES) and evaporative cooling. Specific HVAC measures to consider include these four shown in the building example:

- Efficient chiller (from 0.64 to 0.48 kilowatts per ton)
- Condensing boiler to increase efficiency from 80 percent to 90 percent

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Put on the entire building energy design process, even greater savings can be realized. This seminar now provides an extended, in-depth discussion of how to achieve the energy savings required to qualify for incentives offered by various California utilities. For more information on dates, locations, and registration please visit: https://seminars.sdge.com/

Advanced Lighting Technologies
This intermediate-level course—created for any business customer with a basic knowledge of lighting—explores the operation, performance and issues associated with advanced lighting technologies. This course gives attendees a basis to evaluate new technologies as they emerge in the marketplace. For more information on dates, locations, and registration please visit: https://www.sce.com/ECR/

Putting It All Together
For new office building design, significant cost-effective savings can be realized through careful design of the building envelope, and in particular, through proper design and utilization of daylighting and natural ventilation. As California’s energy efficiency standards become more stringent in the coming years, it will become even more important to consider the design of passive systems in the overall approach to high performance office building design.

Beyond those fundamentals, in general the most cost-effective measures for performing better than Title 24 are high efficiency interior lighting systems and controls, and high efficiency HVAC systems. The packages of efficiency measures discussed above bring the savings for this example building to more than 23 percent. With a collaborative team effort from the beginning of the design process, even greater savings can be realized.

To achieve savings in your new building designs and learn about potential financial incentives, contact your utility to find out if assistance is available in identifying and evaluating appropriate efficiency strategies. ■

Building Operator Certification - Level I (2 day course)
This course focuses on operation and maintenance of equipment and components typically found in commercial buildings, including central heating, cooling, air and ventilating systems in buildings. Provides introduction to automatic control systems and equipment, particularly for central air systems. Emphasis placed on group problem solving and exercises with respect to preventive maintenance. For more information on dates, locations, and registration please visit: https://seminars.sdge.com/

Building Science for Building Professionals
In this era of escalating energy and insurance costs, widespread mold problems, and other pervasive building performance risks, every building professional needs to take the principles of building science and apply them to the design, specification, and construction of high performance buildings. This seminar will cover building science principles from this perspective and then use both case studies and teamwork on one or more practice projects to move building science from the classroom to your projects and job sites. The emphasis will be on wood frame construction. For more information on dates, locations, and registration please visit: http://www.pge.com/education_training/classes/energy_efficiency/

For more valuable course offerings please visit: http://www.smud.org/education/