

# Letters

# Standard 90 Energy Savings

The editor's commentary in the August issue of ASHRAE Journal heralds the estimated 40% savings in energy consumption in the first edition of Standard 90. It also touts an average increase in stringency since then of approximately 1.2% per year. The cumulative result would be  $1 - 0.60 \times 0.988^{(2006-1975)}$ , or approximately 59%.

The same issue includes the presidential address, which notes the *Advanced Energy Design Guide* goal to offer guidance for 30%, 50%, and 70% further efficiency improvements. ASHRAE's Standing Standards Project Committee (SSPC) 90.1, *Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings*, is now charged with additional improvement by at least 30% by the 2010 edition, or at least 71% lower energy consumption than before Standard 90-1975. My understanding is that the goal of proposed Standard 189, *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*, will be 30% greater stringency than 90.1, or at least an 80% improvement compared to pre-Standard 90-1975.

These numbers bother me. We were still responding to the 1973-1974 oil shock in the mid-1970s, so some conservation measures already had been implemented before completion of Standard 90-1975. Plug loads have increased radically in commercial buildings. Slide rules, manual typewriters, and carbon paper used less electricity than calculators, computers, copiers, and other office machinery. Lighting intensity has decreased for some building types, but increased for others. Overall energy use for lighting is lower, primarily due to broader application of fluorescent and halogen lighting as well as improvements in fixtures and lamp efficiencies. Building envelopes and mechanical systems are better. Typical chillers today, as an example, use 40% to 50% less power than their counterparts back then, though distribution and cooling tower burdens have not dropped as much. Performance gains have been less dramatic for other cooling equipment and typically only in the single-digit range for most heating systems for the same period. We are more conscious today of opaque fractions, ventilation and infiltration levels, vapor retarders, daylighting, orientation, and similar considerations. Still, 59% overall savings? 71%? I doubt it.

The U.S. Department of Energy Commercial Buildings Energy Consumption Survey (CBECS) data show that energy use per unit area (per ft<sup>2</sup> or per m<sup>2</sup>) increased from the 1960s through the 1980s and then dropped in recent years by 12% overall. The same data show a net increase of 16% per worker for the same

period. Moreover, these data exclude malls, which typically and increasingly include the most energy-intensive retailing areas. While building efficiency has improved, internal heat gains have increased and construction has shifted to climatic regions with increased cooling requirements. It is not clear how much of the performance improvements are attributable to competitive technology advances, how much to standards including 90.1, or how much each drives the other.

Does anyone have supporting data to demonstrate that:

- New commercial and institutional buildings today, even LEED®-certified buildings (for which the systems' efficiency component is small) actually achieve 59% or 71% savings over those of the early 1970s?
- The stringency requirements in 90.1 (or in the IECC) actually result in significant, measured energy savings over the life of buildings compared to the average of nonconforming buildings?
- Showcase buildings, for example those achieving LEED certification or those winning ASHRAE Technology Awards, actually yield 30% or higher savings by measurement than comparable 90.1-compliant buildings?

I am not suggesting that there is no need or margin for efficiency improvement. I think there is both clear need and opportunity. I am simply asking if anyone has objectively examined—with real data for a broad range of buildings and climates—the claims and progress thus far.

**James M. Calm, P.E., Fellow ASHRAE, Great Falls, Va.**

*Editor's note: Calm is vice chair of SSPC 90.1.*

## Re: Cool Thermal Energy Storage

I have just a few comments to add to the excellent article by Kurt Roth, Ph.D., Robert Zogg, P.E., and James Brodrick, Ph.D., entitled "Cool Thermal Energy Storage" in the September 2006 issue.

- The column notes the technologies of water TES, ice TES, and PCM TES. An additional significant TES technology, first used commercially in 1994 and growing rapidly in applications since 2000, is low-temperature fluid (LTF) TES. LTF TES is quite similar to conventional stratified chilled water TES but uses an aqueous fluid stored at a lower supply temperature and a larger supply-to-return Delta T for more compact storage volumes (thus addressing one of the authors' stated barriers to greater market penetration for water TES).
- The range of installed TES capacities is listed as 100 to 29,000 ton-hour (350 to 102,000 kWh). In fact there have been many

### Emerging Technologies

## Cool Thermal Energy Storage

By Kurt Roth, Ph.D., Associate Member ASHRAE; Robert Zogg, P.E., Member ASHRAE; and James Brodrick, Ph.D., Member ASHRAE

This technology article is inspired by several ASHRAE reports covering energy-saving HVAC technologies.

**T**hermal energy storage (TES) systems store a variable quantity of cool thermal energy that helps meet the cooling loads of a building. A typical system consists of a large vessel filled with water or another fluid that can store thermal energy. The vessel is insulated to minimize heat loss. The vessel is divided into two sections: a chilled water storage section and a hot water storage section. The chilled water storage section is used to store the chilled water produced by the chiller during off-peak hours. The hot water storage section is used to store the hot water produced by the boiler during off-peak hours.

Most TES systems are ice- or water-based, with only a few using phase-change material (PCM) other than water. Specific components (TES) are not listed in Chapter 14 of the 2005 ASHRAE Handbook—HVAC Applications (Singer and Elmer and the 2005 ASHRAE Handbook—Sustainable Design, but the 2005 ASHRAE Handbook—Sustainable Design lists the most detail.

**Energy Savings Potential** TES systems can store up to several days' worth of cooling capacity. This allows a building to operate at a lower peak cooling capacity than it would otherwise require. Lower peak capacity means that smaller chillers and pumps can be used, which reduces the initial cost of the system. Lower peak capacity also means that the system can be sized for a smaller building, which reduces the initial cost of the system.

cooled and water-cooled chiller energy consumption by an average of approximately 20% and 10%, respectively. These values vary significantly depending on climate and weather. The based power plants that operate at night typically have higher efficiency generation efficiencies than a power plant that operates during the day. The based power plants that operate at night typically have higher efficiency generation efficiencies than a power plant that operates during the day. The based power plants that operate at night typically have higher efficiency generation efficiencies than a power plant that operates during the day.

TES can be used to increase the number of hours that chillers operate at high efficiency by storing the chilled water produced during off-peak hours. This increases the chiller's operating hours and reduces the total energy consumption of the system. TES can also be used to reduce the peak cooling capacity of the system, which reduces the initial cost of the system.

94 ASHRAE Journal November 2006