TRANE

engineers newsletter

providing insights for today's hvac system designer

green, growing, here to stay

Energy and Environmental Initiatives

We know that clean air and soil, pure water, food reserves, and energy sources like fossil fuels and sunlight are fundamental to life on this planet. We also know that our way of life—the buildings we live in, the vehicles we drive, the modern conveniences on which we rely—jeopardizes these finite resources. But it is only recently that concerns about the environment have taken center stage in the political arena, both nationally and internationally.

This *EN* recaps the cause of these concerns and highlights several of the most prominent North American initiatives to address them. It also offers a "shortlist" of resources for more information and offers suggestions to help you do your part.

An Industrial Legacy

Mass production, widespread use of power-driven machinery, and urbanization—with the accompanying construction of buildings, transportation systems, and commercial agriculture—characterized the Industrial Revolution and laid the foundation for economic growth in developed countries. The resulting prosperity was "fueled" by the consumption of significant amounts of energy, most of it produced by burning coal and other fossil fuels. The consequences, pollution and resource depletion, have been cumulative and far-reaching.

One result of industrialization is a significant increase in the emission of greenhouse gases (GHG), particularly carbon dioxide. Some experts fear that the unnaturally high concentrations of GHG are "trapping excess heat in the Earth's atmosphere in much the same way that a windshield traps solar energy that enters a car."[1] The resulting global warming—one estimate is 2.5°F to 10.4°F (1.4°C to 5.8°C) over the next century—may affect weather patterns, sea levels, agricultural zones, and the quality of life for future generations.[2] Although these outcomes are uncertain, they are serious enough to garner the attention of governments and politicians.

Target: Energy Use

Commercial buildings account for more than one-third of the electricity consumed in the United States. About 70 percent of that supply is generated by burning nonrenewable fossil fuels, a process that releases billions of pounds of carbon dioxide into the atmosphere annually. That's why many of the public and private initiatives to preserve the environment focus on improvements in energy efficiency. After all, better efficiency reduces GHG emissions; it also lowers energy/operating costs, which ultimately improves competition in the global marketplace.

> "Energy bills for existing U.S. commercial space (about 78 billion square feet) total $110 billion annually. EPA estimates that increasing the energy efficiency of this space could save more than $25 billion." ~*ENERGY STAR Building Manual*

To date, the **Kyoto Protocol** is the broadest initiative to address climate change. Instituted in 1997, the protocol sets a range of reductions for greenhouse gas emissions that averages just over 5 percent for industrialized nations. The terms encourage participating nations to devise domestic policies and fiscal measures that discourage emissions and promote the best current and future technologies. Upon ratification by a sufficient number of developed countries, the Kyoto Protocol will become a legally binding treaty with enforcement commencing in 2012.

U.S. response. Rather than ratify the Kyoto Protocol, the United States is pursuing its own Clear Skies initiative and Global Climate Change strategy. If successful, the **Clear Skies** initiative will cut power plant emissions of nitrogen oxides, sulfur dioxides, and mercury by 70 percent. The complementary **Global Climate Change** strategy seeks to reduce the *intensity* of GHG emissions (the ratio of

[1] J. Weier, "Global Warming," *Earth Observatory,* 8 Apr 2002, NASA. [online; cited 18 Jul 2003] <http://earthobservatory.nasa.gov/Library/GlobalWarming/>

[2] *Understanding Climate Change: A Beginner's Guide to the UN Framework Convention and Its Kyoto Protocol,* July 2002, UN Environment Program and Climate Change Secretariat. [online; cited 24 Sep 2003] <http://unfccc.int/resource/beginner_02_en.pdf>

emissions to economic output) by 18 percent over the next 10 years.[3] To achieve these goals, the federal budget for fiscal year 2003 allocated more money for global climate change-related activities, including tax credits for renewable energy sources.

"HVAC and refrigeration systems account for 35 to 65 percent of the energy used in U.S. buildings." ~*ASHRAE Energy Position Document*

Impact on the building industry. Government initiatives often become policies or codes that affect how goods and services are built and delivered, and in the case of environmental initiatives, how buildings are constructed, used, operated, maintained, and demolished.

For example, the **Energy Policy Act** of 1992 requires states to certify that their energy codes meet or exceed the requirements of ASHRAE Standard 90.1-1989, *Energy Standard for Buildings Except Low-Rise Residential Buildings*. In July 2001, the DOE made a determination requiring all states to update their energy codes to be at least as stringent as ASHRAE 90.1-1999 by July 15, 2004. Much of the 1999 version of the standard is used by the International Code Council (ICC) in its **International Energy Conservation Code (IECC)**, which addresses the design of energy-efficient building envelopes and the installation of energy-efficient mechanical, lighting, and power systems. As of July 2003, 37 states and the District of Columbia have adopted a version of the IECC or its predecessor, the Model Energy Code.[4]

The U.S. Department of Energy (DOE) is working with ASHRAE and the ICC to further strengthen the nation's model energy codes through the **Building Energy Codes Program**. Under this program, DOE provides the financial and technical assistance necessary to help states adopt, implement, and enforce building energy codes. DOE also develops and distributes easy-to-use tools and materials to clarify commercial and high-rise residential energy code compliance.

ENERGY STAR. Perhaps the best-known national promotion for energy efficiency is the **ENERGY STAR®** program. Administered by the Environmental Protection Agency and (since the mid-1990s) DOE, ENERGY STAR relies on the voluntary partnership between government, business, and consumers. The program initially recognized energy-efficient computers but now rates more than 35 product categories, as well as new homes and buildings.

What does ENERGY STAR mean for businesses and consumers? Residential and commercial products bearing the ENERGY STAR label are 10 to 25 percent more efficient than required by federal standard, while providing top performance and innovative features.

"In 2002 alone, ENERGY STAR-qualifying buildings spent $130 million less in energy bills and reduced carbon dioxide emissions by 2.6 billion pounds compared to average buildings." ~*EPA National News, 09 May 2003*

The savings are even more dramatic for ENERGY STAR-labeled buildings, which typically are 20 to 40 percent more efficient than average buildings of comparable size and use. To help put this savings into perspective, it costs $1.90 to $3.00 per square foot to operate an average U.S. office building; an ENERGY STAR office building costs $0.86 *less* to operate.[5]

Under ENERGY STAR, the EPA and DOE provide building designers, facility managers, and business owners/operators with various software tools, free of charge, to aid performance evaluations and goal-setting. For example, *Portfolio Manager* tracks and benchmarks a building's energy use before and after upgrades, while *Target Finder* provides architects and building designers with an energy budget for new construction and major retrofits. There's also a *Financial Value Calculator* that estimates increased earnings from energy reductions.

"Every dollar invested in an energy-efficient upgrade can produce between $2 and $3 in increased asset value." ~*ENERGY STAR Building Manual*

Another invaluable resource is the *ENERGY STAR Building Manual* (www.energystar.gov/ia/business/bum.pdf). Following the manual's integrated, five-step approach to building upgrades can produce energy savings of 35 percent or more and yield a return on investment of 20 percent with comparatively low risk. The success of this approach hinges on the sequence of the steps: First, reduce the building's heating, cooling, and electrical loads (recommission, upgrade lights, reduce supplemental loads). *Then* upgrade the HVAC system so that the equipment can be properly sized to handle the smaller loads.

Rebuild America. The DOE administers the **Rebuild America** program, which was created in 1994 to help communities accelerate energy-efficiency improvements in five categories of existing buildings: commercial; state and local government; public and multifamily

[3] "Executive Summary–The Clear Skies Initiative," 14 Feb 2002, White House. [online; cited 22 Sep 2003] <http://www.whitehouse.gov/news/releases/2002/02/20020214.html>

[4] "Commercial Energy Code Status," Jul 2003, Building Codes Assistance Project. [online; cited 09 Oct 2003] <http://www.bcap-energy.org/commap_0703.pdf>

[5] *The Top Performing Buildings in America at a Glance* [online], US EPA. [online; cited 22 Sep 2003] <http://www.energystar.gov/ia/business/bus_factsheet.pdf>

housing; colleges and universities; and K–12 schools.

With the help of state energy offices, the program seeks to increase the number of high-performance buildings, and to help partnerships implement community-wide improvements in energy efficiency and renewable energy by:

- Establishing energy-saving goals and determining how much to invest
- Determining the number and type of buildings to retrofit
- Developing and implementing an action plan
- Arranging financing
- Managing building retrofits
- Tracking building energy performance

Renovating the nation's K–12 schools is a particular priority of Rebuild America. The average age of these buildings is 42 years, and many of them are equipped with inefficient systems that, according to the DOE, result in annual energy costs of $6 billion … about 25 percent higher than necessary.[6] Consequently, this sector also is the target of the **EnergySmart Schools** program, which works with school districts to introduce energy-saving improvements to the physical environment and proactively promote energy education in schools.

According to the nonprofit Sustainable Buildings Industry Council, school districts can save 30 to 40 percent on utility costs each year for new schools and 20 to 30 percent on renovated schools by applying high-performance design and construction concepts.[7]

The Bigger Picture

"High-performance" building practices look beyond the energy costs of operating a building. Alternatively dubbed as "green," "whole building," or "sustainable," high-performance buildings attempt to optimize cradle-to-grave performance of the *entire* building. Economic, environmental, and sociocultural effects receive as much weight as operating costs and initial investment. Performance goals for the building address occupant productivity, comfort, and well-being, along with the use of land, energy, and materials. Waste production and transportation are considered, as is the adaptability of the building over time.

> "Buildings are long-lived, so built-in energy efficiencies can remain for 50 years or more. While it is often economical to retrofit buildings for greater energy efficiency, it is always cheaper to make them more efficient at the time they are designed and constructed." *~New Buildings Institute*

Realizing such ambitious goals requires a very different approach to the building process—one that is collaborative, integrated, and comprehensive rather than fragmented and linear. The predesign phase for a high-performance building brings together planners, architects, engineers, landscapers, hydrologists, builders, facility managers, and building users. Working together, they set the purpose, scope, and performance goals for the building. Subsequent design decisions are based on their effect on the *entire* building rather than a single component. For example, meeting the building goal for energy efficiency requires more than the selection of energy-efficient equipment. It also entails consideration of siting, envelope, window placement, glazing methods, and shading.

The results of the whole-building design process are compelling. According to DOE, benefits include:

- Reductions in energy use of 50 percent or more
- Reduced maintenance and capital costs
- Reduced environmental impact
- Increased occupant comfort and health
- Increased employee productivity[8]

Several obstacles must be overcome before these benefits will be realized on a widespread basis. Stimulating commercial demand requires a well-documented economic case, financial incentives, and code changes that favor high-performance buildings. New process models and tools that support collaborative decision-making must be developed, along with valid performance metrics.

LEED. The **U.S. Green Building Council**, a building industry coalition, is attempting to eliminate these hurdles through its LEED Green Building Rating System™. **LEED**, which stands for Leadership in Energy and Environmental Design, is a voluntary national standard for developing high-performance, sustainable buildings. In addition to defining common metrics for "green building," the LEED system offers third-party project certification,

[6] *EnergySmart Schools,* U.S. DOE. [online; cited 6 Jul 2003] <http://www.rebuild.org/sectors/k12.asp>

[7] *Return on Investment: High Performance Buildings,* Jan 2002, Minnesota Planning. [online; cited 18 Sep 2003] <http://www.mnplan.state.mn.us/pdf/2002/buildingsreport.pdf>

[8] "Design Approach," 29 May 2003, U.S. DOE Office of Energy Efficiency and Renewable Energy. [online; cited 30 Sep 2003] <http://www.eere.energy.gov/buildings/highperformance/design_approach.html>

professional accreditation, training, and resources.

The comprehensive, point-based system encourages building professionals to practice integrated, whole-building design. Rating categories assess the extent to which a project meets the sustainability goals for site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

> "Commercial new construction can achieve 50 percent energy savings if an integrated design approach and energy strategies are carefully implemented." *~ESource*

Since the system was introduced in 2000, nearly 3 percent (91 million square feet) of all new commercial construction projects in the United States have registered for LEED certification. (To date, fewer than 75 of these projects have completed the certification process.) Projects range from manufacturing plants and convention centers to firehouses and schools, and are scattered across 50 states and nine countries.

States such as New York, Maryland, and Oregon, now offer tax credits for LEED-certified buildings to encourage expansion of green building practices. Local governments are getting into the act, too: Portland (OR) and Seattle (WA) offer grants for energy modeling, commissioning, and related costs.[9]

Meanwhile, USGBC is attempting to broaden the use of LEED by developing versions for commercial interiors, existing buildings, new core-and-shell construction, and homes.

What Can You Do?

Making commercial buildings more energy- and resource-efficient represents an enormous opportunity to save money and reduce pollution. Capitalizing on this opportunity will require public and private sector commitment, policy changes, and investments in research and development. It will also require members of the building industry to practice their professions collaboratively and holistically.

The challenge is enormous but not impossible … provided that all of us do our part.

- Become familiar with whole-building design practices, and visit "10 Shades of Green" at www.archleague.org/tenshadesofgreen, for examples of what's possible.
- Take advantage of the training and resources that are available through ENERGY STAR and LEED. If you haven't already done so, consider becoming a member of your local LEED chapter (www.usgbc.org/Chapters/chapters_main.asp).
- Contact your state energy office and local utilities to find out what incentives exist for energy-efficient and/or high-performance building designs.
- Critically review product data to assure that life-cycle performance aligns with design goals.
- Help your clients focus on the long-term effects of their design decisions—that means environmental as well as financial. Consider the entire building from a life-cycle perspective, and aim to minimize overall environmental impacts while optimizing performance.
- Stay informed about the green building movement and its effect on standards and codes. The Internet makes it easy. (See the end of this *EN* for a shortlist of places to start.)
- Incorporate a few meaningful "green/sustainable" selections in every design. ■

By Chris Hsieh, systems marketing engineer, and Brenda Bradley, information designer, Trane.

You can find this and other issues of the Engineers Newsletter at http://www.trane.com/commercial/library/newsletters.asp. To comment, e-mail us at comfort@trane.com.

[9] *Building Momentum: National Trends and Prospects for High-Performance Green Buildings,* Feb 2003, U.S. Green Building Council. [online; cited 24 Sep 2003] <http://www.rebuild.org/attachments/pdf/buildingmomentum.pdf>

Trane
A business of American Standard Companies
www.trane.com

For more information, contact your local district office or e-mail us at comfort@trane.com