Modeling a Sustainable World

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I'd like to take you back in time to your childhood. To a time when you were dreaming of making a difference in the world, of being a powerful influence for good. That time is now. Never in the history of our industry has there been a greater need or a better opportunity to change the world. And the global community is looking to us to lead the way, to be the role models for the 21st century.

"Every great dream begins with a dreamer. Always remember, you have within you the strength, the patience, and the passion to reach for the stars to change the world."

This marks the fifth consecutive year that the presidential theme has focused on sustainability. This focus should be so ingrained in our lives that our mission "to serve humanity and promote a sustainable world" inspires our daily decisions.

My presidential theme, *Modeling a Sustainable World* highlights the role ASHRAE members play as leaders in sustainable design. In energy simulation, daylight analysis, computational fluid dynamics and building information modeling software, we have powerful modeling tools that enable us to create and refine our vision of a building – its appearance, systems, operation and performance. Those resources, used effectively in an integrated design process for new buildings and in analyzing retrofit opportunities in existing buildings, will help us guide building owners, architects, developers and contractors in building orientation, shading and shape and in selecting materials, windows, equipment and systems that optimize building performance.

From Physical to Virtual Models

Years ago, designers constructed physical models of major projects to illustrate their concept of the building's form and appearance. These scale models took days and weeks to prepare and once completed, could only be changed with great difficulty.

Today, we have the tools to create a virtual model that can be completed more quickly and can be modified easily to consider options in size, shape and appearance. But more than just a visual representation, our models can simulate energy performance, assess daylighting options and predict thermal comfort.

Integrated Design

To exploit the full capability of these modeling tools, we must transform our design approach from a sequential process—where one discipline completes its work and hands off the design to the next—to a collaborative process—where all of the disciplines involved in the building design and construction work as team from the beginning to evaluate options and optimize the design.

Integrated building design requires thinking about the building and its elements as interlinked and interdependent systems, so that a single design refinement may simultaneously improve performance of several building systems.

Our biggest challenge is implementing integrated design in daily practice. The traditional approach, where the architect designs the building shape, orientation and envelope and then transmits the drawings to the mechanical and electrical engineers for their design, is a sequential approach that misses the rich opportunities for optimizing building performance through a collaborative approach throughout the design process. It is going to require a cultural shift in our industry to transform the design process, and it's a shift that has to occur if we are going to reach our goal of net zero energy buildings.

Numerous studies of unsuccessful projects can trace the project failure to a lack of communication between the architect and the engineer; between the mechanical engineer and the electrical engineer; between the engineer and the contractor. To succeed in the 21st century, it's imperative that we cultivate stronger communication skills and embrace collaboration with the design team as the only way to optimize building performance.

Existing Buildings

Optimizing the design of new buildings is an exciting and challenging goal as we move toward net zero energy buildings. But as President Gordon Holness reminded us this year, 98 percent of construction dollars in the U.S. are being spent on existing buildings. While that percentage varies around the globe, *Sustaining Our Future by Rebuilding Our Past* remains our strongest opportunity to make an immediate impact on worldwide energy consumption.

Consider where we are now and where we are headed. . . . .

Best Available Technology

Every four years, the Energy Information Agency conducts the Commercial Building Energy Consumption Survey. The 2003 survey of 4,820 buildings shows a national average energy use intensity of 90 kBtu/ft^2 for the existing commercial building stock in the United States.

An NREL study completed in 2007 created energy models for all 4,820 buildings in the CBECS database and then examined the results if these commercial buildings complied with Standard 90.1-2004, our minimum energy efficiency code. The results are an energy use intensity of 70.7 kBtu/ft^2 or savings of 10.7 percent.

What if those buildings used technologies and practices expected to be available by 2025? The average energy use intensity in this scenario is 40.3 kBtu/ft^2, or less than half the current energy consumption. Adding photovoltaics to half the roof area and exporting excess power takes us to 12.2 kBtu/ft^2, close to our goal of net zero energy buildings. And make no mistake, net zero energy buildings are being built today of all types and sizes in diverse climate zones around the world.

Here's a sample of net zero energy buildings presented at ASHRAE's Net Zero Energy Building conference in 2009: An off-grid nature center in Los Angeles; a 48,000 square foot office building in Los Altos; a business school in Germany; an energy research center in Australia; an office and shop near Albany, New York.

Plug Loads

As the envelope, lighting and HVAC loads diminish, the remaining loads take on increased significance. A realistic estimate of plug and process loads is critical in optimizing HVAC system sizing and performance during design; it also is essential to control after occupancy.

As an example, consider an office building that has a day time plug load of 1 W/ft^2. If 10 percent of the equipment remains on at night, then the annual energy use intensity for those plug loads is roughly 5 $kBtu/ft^2$. But if 30 percent of the equipment remains on during unoccupied hours, then that equipment energy use almost doubles.

In future zero energy buildings, plug and process loads are expected to be the largest energy end use. Building owners and occupants must understand the positive impact of converting to laptops and purchasing Energy Star equipment. And they have to understand the negative impact of failing to control plug and process loads during unoccupied hours.

Progress Last Year

ASHRAE is committed to developing the tools to design net zero energy buildings. Within the past year, the sixth and final guide in the 30 percent Advanced Energy Design Guide, or AEDG, series was completed, and over 250,000 guides have been downloaded. This collaborative effort with DOE, IES, USGBC and AIA is transforming the market. An independent assessment of the market impact showed widespread use for new buildings as well as major retrofit projects and on building types outside the small commercial market.

Development of the 50 percent AEDG series is underway, with completion targeted for 2012, and net zero guides will follow.

Standard 189.1

In collaboration with our partners, USGBC and IES, ASHRAE published Standard 189.1, the first high performance green building standard. Representing almost four years of intense effort, the project committee has produced an excellent document that already has been widely recognized for its value in our industry. Standard 189.1 is an alternate compliance path for the International Code Council's International Green Construction Code and is being published and marketed as part of that document.

Standard 90.1

ASHRAE developed Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, in 1975, so the emphasis on energy efficiency and using resources wisely isn't anything new. You might say it has been an underground movement for three decades and has come to the forefront in recent years.

This year marks the 35th anniversary of our flagship energy conservation standard, and the 2010 version of 90.1 will be published later this year. Working within the constraints of strict economic justification and a prescriptive format, the committee has achieved remarkable energy savings across all building types and U.S. climate zones.

In a relentless quest for improving our minimum energy conservation standard, they have processed 116 addenda. Eighty-seven of those will be incorporated in the 2010 version and 29 more are in public review or comment resolution. The 90.1 project committee has done a terrific job and deserves our praise and thanks.

We have other standards dealing with energy efficiency. Standard 90.2, our residential energy conservation standard, was adapted for use in Kuwait through a collaborative effort between ASHRAE and Kuwait University, and a similar effort is underway for Standard 90.1. And Standard 100, our energy conservation standard for existing buildings, is undergoing an extensive re-write.

The Winter Meeting in Orlando saw the launch of our certification for Building Energy Modeling Professionals, and a new certification for Energy Assessors is in progress and should be ready by our January Winter Meeting in Las Vegas.

During his presidential year, Bill Harrison's theme was *Maintain to Sustain*, recognizing the vital role of building owners and operators in achieving and maintaining building performance. We now have a working draft of Guideline 32, *Sustainable, High Performance Operations & Maintenance*, which will go out for public review later this year.

Research Strategic Plan

At this meeting, Tech Council will approve a new Research Strategic Plan written by an expert panel of volunteers. This guidance document was developed collaboratively over a three year period with input from ASHRAE chapter members, technical committee members and others in our industry.

Each of the 11 strategic goals includes objectives, a description of technical challenges, and a list of needed research. Here's a sample of a few of the 92 research projects proposed in the plan that relate to modeling: Develop more accurate methods to relate building energy simulation models to actual building energy use; continue to develop BIM to automate the creation of energy models from architectural/mechanical/electrical BIM data files; update existing energy analysis calculation engines to model building components and systems that will be needed to meet current and future; energy Standards, including the ultimate NZEB goals; develop models and design procedures for natural and hybrid ventilation systems.

What Our Members Need

Building modeling is a growing segment of our industry, with modeling projects often assigned to men and women just entering the field. Those few of us who have been modeling for decades must share our expertise with a new generation. And the most valuable lesson we can share is that buildings operate as systems rather than a collection of components.

Our members need educational programs on how to accurately and efficiently model new and existing buildings and how to interpret the results. We must provide training on modeling existing buildings and calibrating those models without compromising integrity. We have to develop techniques to model innovative HVAC systems. And, above all, we must look at buildings as systems, and expand our understanding of building science beyond HVAC&R. To become experts in high performance buildings, we must improve our knowledge of building envelope performance, thermal mass effects in buildings, passive solar, daylighting, human comfort and much more.

This next generation of modelers is intelligent, enthusiastic and passionate about changing the world. We must to equip them with the tools and resources they need and then watch out as they design net zero energy buildings—like these homes that college students built and exhibited at the 2009 Solar Decathlon!

Technical Committees

We also must harness the talent of the Millennium Generation in our technical committees. Our 103 TCs and Task Resource Groups are a rich resource of information on specialized, cutting edge technology. Over 3,200 men and women, or 6.5 percent of our members, participate in the vital activities of the TCs in initiating and supervising research, sponsoring programs and authoring our handbooks.

We communicate these accomplishments through research reports, seminars and symposiums and publications, and also through our TC websites and newsletters. We need to revitalize our TC websites and use the enthusiasm and expertise of our young engineers in ASHRAE to explore new avenues of communication such as Facebook and Google Groups.

We've talked about the need for integrated building design, with early and close cooperation among members of the design team. We also need to encourage and support interaction between our technical committees and, if appropriate, integrate their activities to increase and leverage their effectiveness.

We also need to energize some TCs to produce design guidance that is robust and clear in months, rather than years. And then communicate that information to our members and others in the design community so they can put this expert knowledge to use in designing, retrofitting and commissioning buildings that will perform reliably, efficiently and effectively for decades to come.

What You Need to Do

I spoke earlier of the cultural shift that must occur to implement integrated design. We must embrace change, push the boundaries and engage all of the stakeholders in building design, construction and operation.

Our challenge is to approach every project with innovation, not repetition, and to challenge ourselves to find the elegant solutions that will minimize energy use and provide exceptional indoor environmental quality. People will judge us on our performance, not our promises.

Closing

In our centennial year, President Billy Manning said we are *Building on the Shoulders of Giants*. Today, we are called to become the giants of our industry, to set the example of innovation and dedication that

future generations will remember when they look back on the time when buildings ceased being net consumers of energy and became net zero energy, and even producers of energy.

People need heroes; we admire excellence; we respect courage; we long for the expression of these qualities in our own lives and we cherish them wherever we find them. Today, this month, this year, I'm calling on you to be the heroes. To set the example in energy efficiency, in elegant, innovative solutions to meeting the energy needs of today and the future. To model a sustainable world.