Presidential Address

Sustaining Our Future By Rebuilding Our Past

Energy Efficiency in Existing Buildings—Our Greatest Opportunity for a Sustainable Future

By Gordon V.R. Holness, P.E., Fellow/Life Member ASHRAE

These last five or six years have seen tremendous changes, and this great Society has gone from a somewhat introspective body to a dynamic and exciting one, with major influence and recognition around the globe. We recognize that our industry can play a pivotal role in saving energy and reducing the collective carbon footprint of the world.

So, I am asking all members for their help in *Sustaining Our Future by Rebuilding Our Past*. I strongly believe that ensuring *Energy Efficiency in Existing Buildings Is Our Greatest Opportunity for a Sustainable Future.*

Sustainability is certainly not a new issue and certainly dates back to Roman times (although arguably even they were not fully successful). I like the way it was defined by the 1987 United Nation's Brundtland Commission as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Why should we be concerned about buildings at all? Well, we are all familiar with the numbers. Residential and commercial buildings consume over 40% of all our primary energy supply. They also represent over 72% of all electrical power generation and 55% of natural gas consumption. More importantly, they are responsible for more than a third of our total CO_2 emissions. We have the opportunity, through our efforts at ASHRAE, to significantly impact our overall national energy demand, reduce our dependence on imported oil and gas, while at the same time minimizing our carbon footprint. A key element to remember is that in the life cycle of a building, initial construction cost is only 2%, and operational and energy costs are only 6%. The major cost is that of the building occupants, and they represent over 92% of life-cycle cost. If you can improve the health, well-being and productivity of the building occupants by providing an efficient and sustainable environment, you can more than pay for the initial building costs. As we take on this challenge we should remember that only 2% of construction projects are new construction, over 86% of construction dollars go into existing buildings and over 150 billion ft^2 (139 billion m^2) of commercial buildings will need to be renovated over the next 30 years.

So, does the solution rest in developing high performance *new* buildings? We should remember that 75% to 85% of all of the buildings that will exist in urban areas in 2030 *exist today.* If we focus our technology solely on that 2% of new construction, it would probably not get us to the much needed worldwide reduction in energy consumption that we have been striving for. So, this year I want ASHRAE to concentrate on the other 98%.

Clearly, the greatest opportunity for overall reduction in our primary energy use is within the existing building stock. If ASHRAE is looking to build a sustainable future, we can see the foundations of that around us right now. They are the buildings we work in, our homes, our schools, our hospitals, hotels and even places of worship.

These existing buildings also present the greatest challenges, and while ASHRAE already has a significant number of initia-

About the President

Gordon V.R. Holness, P.E., is a consulting engineer, Grosse Pointe Shores, Mich. He is a member of the *Advanced Energy Design Guide* Steering Committee and the Headquarters Building Renovation Committee. He has served as chair of many committees and councils, most recently Members Council, the Advocacy Committee and the Steering Committee on Building Information Modeling and Interoperability. He formerly served on the Board of Directors as president-elect, vice president and director-at-large.

Holness has received the Exceptional Service Award, the Distinguished Service Award, the Journal Paper Award and three ASHRAE Technology Awards.

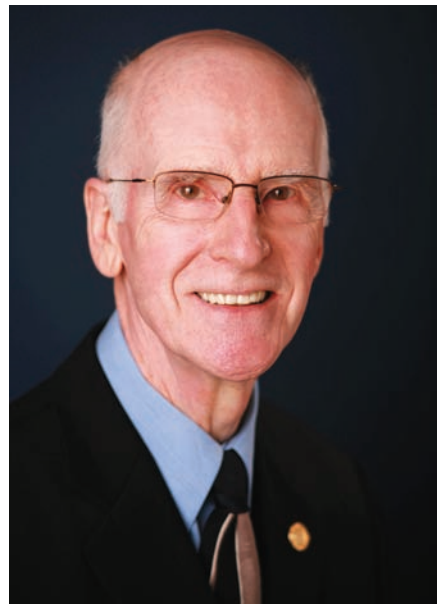
Born and educated in England, Holness worked in a London consulting engineering practice for many years before immigrating to Canada. There he worked in a mechanical/electrical consulting engineering company for several years before moving to Detroit, where he worked for the renown architectural and engineering organization, Albert Kahn Associates Inc., serving as chief mechanical engineer, vice president, treasurer and president, before retiring as chairman emeritus after 32 years with the company.

He is a registered mechanical engineer, licensed to practice in 42 states and four Canadian provinces. He also is a chartered engineer in the United Kingdom.

tives already under way, we need to develop an overall, cohesive program aimed specifically at promoting energy efficiency in existing buildings.

Even as the dynamics of building operation have become better understood, the complexity of their systems has increased. Today, we are not just in the era of HVAC&R design technology, but also wireless digital controls, electronics, telecommunication systems, etc., and we are entering the era of smart meters, smart grids, smart systems, and smart equipment.

Architects, designers, HVAC engineers, lighting specialists, electrical designers, plumbing, fire protection, life safety, builders, developers, contractors, trade organizations, commissioning agents, etc., are all trying to respond to what they believe are the owner's project requirements and deliver the project on time and within budget. So, pity the poor operating engineers, three years down the track, who never knew what the design intent was in the first place, yet are challenged to make it all work.



Gordon V.R. Holness
2009–10 ASHRAE President

Over the past 100 years, we in this country have enjoyed a steady and significant increase in manufacturing technology and productivity and, with that, a substantial improvement in the quality of life. We have come to take these things for granted as the U.S. has led the world economically and, arguably, politically. But, at the same time, we have developed a culture of waste, a throwaway mentality that cannot be sustained.

There are huge global divergences in economics, culture and climate, and we can learn a lot from other countries. There are significant differences between Europe and the United States, not the least of which is the fact that we use almost three times as much energy, per capita, as they do. They have long faced the need for sustainable building design and operation and have learned what it takes to be successful. More significantly, in Europe energy prices are taxed as a valuable commodity.

We were lucky in the 1970s energy crisis in that it only impacted us for a relatively short period of time. Even so, ASHRAE responded magnificently to the crisis in developing the first energy conservation standard, now the basis of nationally used energy codes.

The situation we find ourselves in today is far more pervasive where we face the dual crises of energy shortages in the face of rapidly growing world demand and the recognition of the impact of energy use on the environment we rely on to live, breathe, and raise our families.

Yes, we have managed to keep our energy costs low, but at what price? Our infrastructure is antiquated and vulnerable to failure; it is overloaded and inadequate to meet the continually growing demand. The current escalation in gasoline and fuel oil prices is only the tip of the iceberg. We will see parallel increases in the price of natural gas, due not only to worldwide demand, but also as we expand our own use of this energy source for peak power generation. We will also see the cost of our primary electrical energy source, coal, escalate as we institute necessary environmental limits on greenhouse gas emissions.

Once again, ASHRAE is responding to this new crisis at hand. In fact, the very mission of this great Society is centered around our serving mankind and promoting a sustainable world. The end goal of our strategic plan and sustainability efforts is the development of net-zero energy buildings and the corresponding reduction in our carbon footprint.

Can you even begin to imagine the long-term impact we can have if we can achieve these goals? The decisions you and I make as ASHRAE members today can influence the energy future and climate of the world.

ASHRAE's role is to serve the needs of our members and those of the global society in which we live. It is great to have long-range "sexy" goals like net zero, but the truth is that it is the shorter term goals of greater energy efficiency in our existing buildings that represent the real challenge.

While I can set goals for this year, the immediate future is up to you, our dedicated volunteer membership, to see the fulfillment of this effort. It will not be easy, but as Winston Churchill once said, "difficulties mastered are opportunities won." ASHRAE cannot, and will not, let this opportunity of influencing our energy future and the climate of the world pass us by.

A major client base and partner to ASHRAE are the federal agencies.

The federal government has set extremely aggressive goals for all federal buildings. EISA 2007 Section 431 also requires a 30% reduction in actual fossil fuel use for the entire existing federal building inventory by 2015 (relative to the energy use in 2003) on an agency by agency basis. EISA 2007 Section 433 requires all new federal buildings to follow a schedule for reduction in fossil fuel use below CBECS 2003 (91,000 Btu/ft^2·yr [1033 mJ/m^2·yr]), including plug and process loads to the point of net zero by 2030.

There is also an existing requirement in EPAct 2005 that is still in effect for new federal buildings to be designed to be 30% more energy efficient than Standard 90.1-2004.

As challenging as the charges are for new buildings, bringing the existing federal building portfolio to that 30% reduction target is a huge undertaking.

Federal buildings come in a significant range of types, sizes, and occupancies, and they operate under a wide range of climatic conditions. Over 80% of those buildings are under 20,000 ft^2 (1858 m^2), but that actually only represents around 15% of the occupied space. 20% of the buildings represent 85% of the occupied space. The other important statistic to keep in mind

is that GSA estimates that 70% of its buildings that will exist in 2030, exist today. So upgrading of existing buildings will also be a key element of the federal program.

We must provide the tools to help them achieve these goals, and we must provide the design guidance and standards that meet the needs of the entire construction industry. We should aim for nothing short of transformation of the marketplace, i.e., having the greatest impact on the broadest area of commercial construction.

ASHRAE's path forward on existing buildings via our Roadmap to Sustainability and Vision 2020 Plan is really centered on six key elements:

1. The *Advanced Energy Design Guide* series (AEDG);
2. Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings;*
3. Standard 189.1, *Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings;*
4. Standard 100, *Energy Conservation in Existing Buildings;*
5. Our commissioning and retrocommissioning guidance; and
6. Operations and maintenance guidance.

We have a great opportunity with these six key vehicles to provide sequential guidance over the life cycle of buildings if we plan this right and provide the tools to keep our green buildings green.

Advanced Energy Design Guides

The AEDG series has been a hugely successful tool in providing fundamental guidance for a 30% energy efficiency improvement over Standard 90.1 that is practical, cost effective and uses off-the-shelf technologies. More importantly, they target a segment of the market, small buildings, which are not normally reached by design engineers.

The intent is that the AEDGs, as nonconsensus guide documents, lead the way in providing design guidance for energy-efficient and sustainable buildings.

To date, we have five of the guides already published with the last in this initial series for health-care facilities out shortly. My thanks and compliments to the AEDG steering committee and to all of the guide project teams for a great job, well done.

Of all of these efforts, the most important in my mind is the development of the three-part *Advanced Energy Efficiency Guides*: *Existing Building Guide* (AEEG) series. The first in this series will show the business case as to why owners should improve the energy efficiency in their buildings, the technical guide will show what those improvements should be, and the operation and maintenance guide will show how to keep those buildings operating efficiently.

These *Advanced Energy Efficiency Guides* identify the potential energy savings measures for existing buildings based on a number of renovation scenarios. They also identify specific energy conservation measures and show how to determine the economic viability based on life-cycle cost analysis.

So, our path forward for the AEDG/AEEG series is clear, and we must maintain our momentum and leadership in this area by taking these steps:

- Complete the 30% AEDG series by publishing the *Small Hospital and Health Care Facilities Guide;*
- Complete the AEEG series for existing buildings that covers the business case, technical guidance, and operations and maintenance guidance;
- Initiate the 50% AEDG series guides targeted for completion 2009–12; and
- Plan for the net zero AEDG series guides targeted for completion 2013–15.

Strategically, ASHRAE's board determined these guides were of such importance that they decided to make them available for free download in pdf format. To date, more than 185,000 copies have been distributed in some 180 countries around the globe.

Standard 90.1

Standard 90.1 is our critical baseline energy-efficiency standard intended for code adoption as a *minimum* compliance standard. It is the cornerstone driving our efforts towards energy-efficient buildings. It is also the basis of national and, growingly, international energy-efficiency building codes.

SSPC 90.1 has done a terrific job in getting us to this point, and I truly appreciate the efforts of the committee in working towards our 2010 goal of 30% reduction in energy use below 90.1-2004.

As tough as this has been, the real challenge will be the next milestone, looking ahead to 2015 and the target of average

On the Cover

The General Motors Building in Detroit was built in 1919–1923 as the world headquarters for General Motors Corporation. At the time, this 15-story building was the world's largest corporate office building at 1,395,000 ft^2 (129 600 m^2). Designed by architect Albert Kahn prior to the widespread use of air conditioning, the building provided more than 1,800 exterior private offices, each with daylighting and natural ventilation. Over the years thousands of window air-conditioning units were installed to enhance the internal building environment.

Sold in 2000 and renamed Cadillac Place, the building was totally renovated as a modern open plan office building, housing State of Michigan offices and the State Court of Appeals. The window air-conditioning units were removed, windows renovated and resealed, and high-efficiency centralized modular air-conditioning systems installed. New high-efficiency lighting was installed throughout, while the open landscape design brought daylighting into the interior of the building.

The building provides another example of adaptive reuse and sustainable design. President Gordon Holness served as chairman and CEO of Albert Kahn Associates during the retrofit of this building by the company.

Year	ASHRAE Standard 90.1*	ASHRAE Standard 90.1†	ASHRAE Standard 189.1		ASHRAE Advanced Energy Design Guides#	CBECS Survey Data	AIA 2030	Federal Targets EISA 433
			1**	2§				
1999	52.95	–	–	–	–	85.1	–	–
2001	51.6	–	–	–	–	–	–	–
2003	–	–	–	–	–	91.0	–	–
2004	43.75	70.70	–	–	–	–	51	–
2007	40.60	–	33.1	49.00	37.3	–	–	–
2010	30.6*	49.0	28.2	40.95	26.7	–	36	40.95
2013	27.0*	42.0	24.7	36.10	24.0	–	–	–
2015	23.0*	36.0	18.0	31.85	18.0	–	27	31.85
2020	18.0*	24.0	12.6	18.20	0.0	–	18	18.20
2025	14.0*	18.0	6.3	9.10	0.0	–	9	9.10
2030	10.0*	16.0	0.0	0.00	0.0	–	0	0.00

*Excludes plug and process loads. †Including plug and process loads. **Targeted at 30% below Standard 90.1-2004 (excludes plug and process loads). §Targeted at 30% below Standard 90.1-2004 (includes plug and process loads). #Targeted at 30% below Standard 90.1 for 2007–09; 50% for 2009–11; and net zero 2013–15.

Table 1: Comparison chart of energy site EUI goals kBtu/ft^2·year.

aggregate energy usages of 23,000 Btu/ft^2·yr and to the 2020 target of 18,000 Btu/ft^2·yr based upon building types and climate zones. I frankly cannot believe that you can get there by incremental changes to the building envelope or system components. Such targets will dictate things like building orientation, use of daylighting and natural ventilation. They will almost assuredly dictate system selection such as GSHP, DOAS and radiant heating/cooling.

So, our path forward for Standard 90.1 is challenging, to say the least, if we are to maintain our momentum and leadership in this area. But we can get there by taking these steps:

- Revise the standard to include plug and process loads for consistency with CBECS and other benchmarks;
- Consider performance-based analysis for determining prescriptive options;
- Consider cost-based site EUIs, perhaps using the energy budgets developed by DOE for the 18 building types and representative cities in eight climate zones; and
- Develop the *User's Manual* so that it can be published simultaneously with the standard.

Standard 189.1

While Standard 90.1 will remain our preeminent baseline tool as a minimum code basis for energy conservation, the big emphasis today is on high performance buildings; and, here again, we need to lead the way with Standard 189.1 for high performance sustainable building design and construction.

High performance green building Standard 189.1 was targeted to be 30% higher efficiency in 2007 and a further 15% or so by 2010 with similar reductions in energy use for 2015 and 2020. The standard is based on total energy use, including plug and process loads.

We need to publish this standard and continue its development to lead the way for code intended standards and to be progressively more efficient than 90.1-2010 and continuing until we achieve net zero by 2030.

So, our path forward for Standard 189.1 is clear:

- It is critical that we publish 189.1 in 2009 to provide this essential guidance for high performance green and sustainable buildings;
- We already need to be working on the second edition of 189.1 so that it maintains its leadership role ahead of 90.1 and towards our net-zero energy target;
- We may need to consider two tiers of energy requirements within the standard (one aimed at minimum compliance levels to maximize market acceptance and transformation and the other an aggressive high performance level);
- We must develop a clear timeline towards our goal of net zero by 2030 with, perhaps, the high performance level achieving that goal in 2020;
- We need to be working on a user's manual to support the standard.

If you put these goals for the AEDGs, Standard 90.1 and Standard 189.1 together into graphical form you get a clear picture of the path that we are on.

As an organization we need to set clear targets for these three energy efficiency vehicles: AEDGs, 90.1 and 189.1 since these will certainly impact system design and selection. *Table 1* indicates suggested provisional numbers for these standards.

There are three key numbers on this table that determine all others.

- Under Standard 90.1, the 2004 *43.75 kBtu/ft^2·year* is based on the newly released DOE determination numbers.
- Under Standard 90.1, the 2010 *49.0 kBtu/ft^2·year* is based on the NREL adaptation of the 90.1 data into the CBECS format including plug and process loads.
- Under the CBECS Survey Data, the *91.0 kBtu/ft^2·year* is based on the 2003 survey results including plug and process loads.

Standard 100

While Standards 90.1 and 189.1 address elements of major renovations for existing buildings, only Standard 100 pro-

vides the overall guidance necessary for developing major retrofit programs.

Standard 100 needs to establish the basics of energy auditing and then the process and procedures to move through any energy retrofit program. That (on larger buildings), in my mind, does entail full energy modeling of current building performance that can be reconciled with metered data, with the appropriate modeling rule sets following either 90.1 energy cost budget method or those of California's Title 24. The standard then needs to identify energy conservation measures and the related procedures for evaluation, not only for performance, but also for life-cycle cost and return on investment. Energy conservation measures should be evaluated individually and collectively. A final preconstruction energy model should then be established. Commissioning should certainly be part of the process.

The standard should identify the potential energy savings measures for existing buildings based on a number of renovation scenarios. It should also identify specific energy conservation measures and show how to determine the economic viability based on life-cycle cost analysis.

So, our path forward on Standard 100 is clear:

- ASHRAE SPC 100 should be reestablished to further develop the standard;
- The revised standard should include requirements to do energy modeling and load simulation using EnergyPlus or eQUEST; and
- The standard should include energy conservation measures (ECMs) for existing buildings and life-cycle cost analysis techniques.

Commissioning and Retrocommissioning

While we can build the seemingly most efficient buildings, that means nothing if we cannot keep them operating efficiently. We need to learn why building performances typically deteriorate as much as 30% in the first three to four years of operation and the role that commissioning and retrocommissioning can play to reduce that performance decay. We do know that commissioning is a quality focused process that if implemented early in the design can save time and money and improve the quality of the end product: a healthy and productive building.

According to studies, retrocommissioning of existing buildings can save 10% to 40% simply by improving operational strategies. Certainly, we know that the 20 to 50 cent per square foot cost can be returned in less than one year through energy savings of at least 15%, according to the Building Commissioning Association (www.bcxa.org).

So, our path forward for commissioning is clear:

- Promote the value of commissioning;
- Provide training through the chapters;
- Provide educational programs;
- Provide certification programs; and
- Continue the development of commissioning guidelines.

But we also know that regardless of the quality of design and construction, even with commissioning, building performance cannot be sustained without proper operation and maintenance.

Operation and Maintenance

We must continue to develop the technology, tools and educational programs to support the operation and maintenance of the buildings we design. That includes determining the right building performance metrics to help consumers understand and support these efforts and the training required for building operators. This is not a challenge that we can undertake on our own, and we need to work with owner's organizations as well as with service organizations to develop educational and training programs.

So our path forward for operation and maintenance is clear:

- Complete the work of the TRGs;
- Provide training through the chapters;
- Provide educational programs; and
- Provide certification programs.

Other Initiatives

While I have focused on six key elements, I would be remiss if I did not mention other important initiatives that ASHRAE is working on.

Integrated Building Design (IBD). This is an essential tool if we are to achieve our goals, and ASHRAE is developing an IBD section for the Handbook.

Building Information Modeling. This is another important tool that can significantly enhance the design and construction process. ASHRAE is developing a BIM guide and recommending the development of Smart Documents.

Building Performance Metrics. We all recognize the need for consistent and understandable energy performance metrics and the tools to determine carbon equivalency. I have recommended that we further develop Standard 105, *Standard Methods of Measuring, Expressing and Comparing Building Energy Performance*, as a series, to address these.

ASHRAE Building Energy Labeling Program. Key to any long-term success is an informed consumer. The ABEL program provides another exciting opportunity for ASHRAE to provide leadership in this area.

Conclusions

Just one small piece of caution as we move forward: We need to remind ourselves that today we are in a virtual world. We are in the era of iPhones and Yahoo, of Google Earth and Wikipedia, of Facebook, MySpace and Twitter. If we want to continue to be leaders in this industry, we must deliver the goods today. Tomorrow is not good enough.

We have moved strongly into the development of relationships in Washington, not only with our governmental agencies but also our partner organizations, aimed at raising the awareness of the technology that only ASHRAE can bring to the table. Our timing was great, and the resourcefulness and initiative of our staff has been tremendous. We need to go beyond this and accept the fact that we have the responsibility to provide global leadership in the redevelopment of the built environment.

ASHRAE is the acknowledged leader in HVAC&R design technology, but we must look beyond basic design. We serve

the public and the greater world as a whole. That means we must gear our perspective not only to developing the built environment but also to its entire life cycle—including design, construction, commissioning, facility management, and operation and maintenance. This is not a challenge we can tackle on our own. We need to continue to partner with other organizations. Together, we can make the world a better place.

The issues we face are as much political and sociological as they are technical. They are also economic, and while we have let others carry the message in the past, we must now lead the charge. ASHRAE can not only provide the technology but also be the voice of the people, the voice of reason, the voice for change. We can and must reduce our carbon dioxide emissions, and to do that our best opportunity is to reduce energy use in our existing buildings.

So, now I am asking your help. We have an enormous challenge ahead of us, and at the same time, a tremendous opportunity. We can lead this great Society as the driving force for change and help bring all the parties together: owners, developers, contractors, designers, environmentalists, governmental agencies, here and around the world in a concerted effort. We can't do it alone, but with our partner organizations, together we can help build a better world that will serve our children and our children's children.

We are close to bringing our vision to reality in full recognition that the work we do today is not just for us but for the generations to come. For each of us who have contributed to this effort, there is fulfillment in knowing that we have indeed made a difference. May that satisfaction drive us to even greater heights to meet the challenges of tomorrow, which will surely come. We have the potential to change how our existing buildings use energy to the point of zero-energy buildings in the coming decades.

I look forward to the challenges of the coming year knowing that I have you, this great volunteer resource and staff, behind me. Together, we can make a difference; together, we can *sustain our future by rebuilding our past.*

So, let me finish by asking for your continued dedication and support in developing the innovative ideas and technology that makes all this possible, as demonstrated by our research, our handbooks, standards, design guides and educational programs. It is these tools that will guide us to a better and more sustainable future.

As we do so, let us remember the words of John Ruskin, English Philosopher, 1875:

"When we build, let it not be for present use alone. Let it be such work as our descendants will thank us."

Thank you again for this opportunity to serve.