ASHRAE Strategic Plan

Approved by Board of Directors March 20, 2006
Edited April 3, 2006
Strategies numbered June 25, 2006
Strategies in Direction 4 amended June 24, 2007

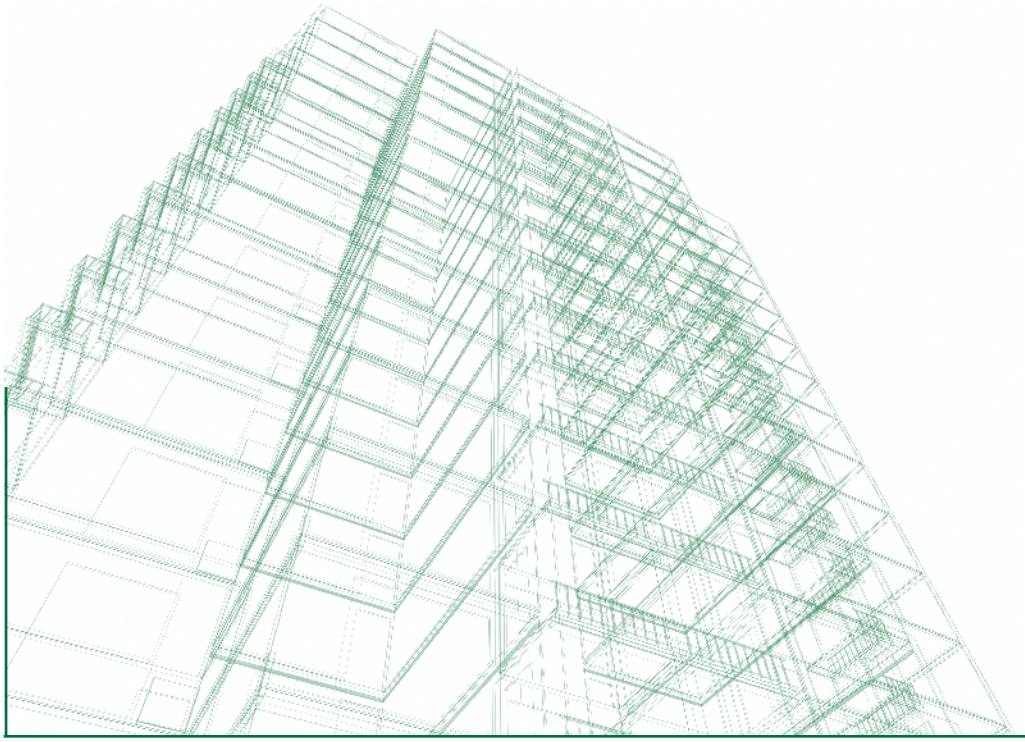
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

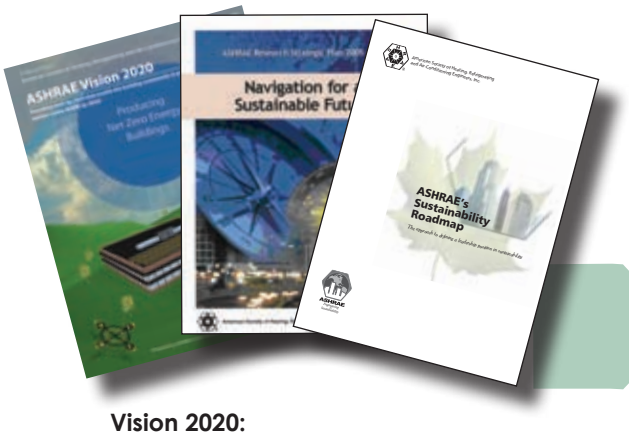
ASHRAE STRATEGIC PLAN

ASHRAE's Strategic Plan presents four strategic directions that define where ASHRAE will focus its efforts and resources in the next several years. The ASHRAE Board of Directors has approved several supporting documents that elaborate on specify ways to achieve the goals established in the Strategic Plan.

These other resources include the Research Strategic Plan 2005-2010, which promotes sustainability based on five, broad far-reaching opportunity theses; Strategies for a Global Environment, which outlines the Society's strategies for institutional change that leads to fully engaging members globally and sharing best practices worldwide; ASHRAE's Sustainability Roadmap, which outlines the approach to defining a leadership position in sustainability; and ASHRAE Vision 2020, which commits the Society to providing tools by 2020 that enable the building community to produce market-viable net-zero-energy buildings by 2030.

These resources, developed as separate documents, assist in fulfilling specific strategic directions in the plan by providing additional background information, accomplishments, recommendations and goals.





Direction 1:
ASHRAE will lead the advancement of sustainable building design and operations.

Technology Council responsible for the implementation of 8 Strategies under this direction.

Vision 2020:
Approved January 2008, contains a series of strategies and actions to support the tools needed to achieve Net Zero Energy Buildings.

Research Strategic Plan:
Approved June 2005, promotes sustainability based on five broad, far-reaching opportunity theses.

ASHRAE's Sustainability Roadmap:
Approved January 2006, outlines the approach to defining a leadership position in sustainability buildings.

Direction 2:
ASHRAE will be a world class provider of education and certification programs.

Publication/Education Council responsible for the implementation of 6 strategies under this direction.

Direction 3:
ASHRAE will position itself as a premier provider of HVAC&R expertise.

ASHRAE's Executive Committee responsible for the implementation of 4 strategies under this direction.

Direction 4:
ASHRAE will be a global leader in the HVAC&R community.

Responsibility for implementing these 14 strategies assigned to all 3 Councils and the Executive Committee.

Strategies For A Global Environment:
Approved June, 2007, replaced the Strategies in the 2006 Strategic Plan with an updated list of 14 strategies.

INTRODUCTION

ASHRAE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is the premier society for engineers and others who work in this complex and evolving field. The technical expertise of ASHRAE members positions it as a highly credible source of research, standards, publications, education, and other products.

Changing technologies, rising energy prices, and the increased focus on sustainability in the building industry have challenged ASHRAE to stay at the cutting edge of the field. At the same time, competition has increased and ASHRAE needs to focus its efforts to ensure that its products, services, and organization are timely, relevant, and appropriately positioned to serve the changing marketplace.

This strategic plan identifies four principal strategic directions that define where ASHRAE will focus its efforts and resources in the next several years, in addition to its commitment to ongoing programs and services. The plan also contains supporting strategies for these directions and the organizational commitment necessary to achieve them. Grounded on ASHRAE's core values and consistent with its mission, the plan not only addresses the challenges and changes occurring in the current environment, but will move ASHRAE forward towards fulfilling its vision of a better future.

ORGANIZATIONAL COMMITMENT

ASHRAE leadership will make organizational and governance changes to accomplish this Strategic Plan.

This plan calls on ASHRAE to move in some new and ambitious directions. Some ASHRAE governance processes are presently cumbersome, and the times require a more agile system of volunteer leadership to drive changes and new directions.

ASHRAE's organization and governance must be nimble and effective at all levels. This will require assessing and providing the necessary governance structures, systems, and processes. The structure and processes must foster effective use of volunteer time and leadership development. The Society must reallocate and develop the financial, volunteer and staff resources needed to implement the Strategic Plan. This may include redefining volunteer and staff roles to increase efficiency and effectiveness.

ASHRAE is committed to making the organizational and governance changes necessary to accomplish this Strategic Plan.

ASHRAE Mission

To advance the arts and sciences of heating, ventilating, air conditioning and refrigerating to serve humanity and promote a sustainable world.

ASHRAE Vision

ASHRAE will be the global leader, the foremost source of technical and educational information, and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air conditioning and refrigerating.

ASHRAE Core Values

Advancement

We are committed to the advancement of the arts and sciences of HVAC&R for the benefit of society through research, technology development and transfer, and education and training.

Leadership

We are committed to providing leadership within our industry, and developing leadership qualities in our members.

Integrity

We are committed to honesty in the practice of our profession as embodied in the ASHRAE Code of Ethics.

Service

We are committed to service to our members and to the public.

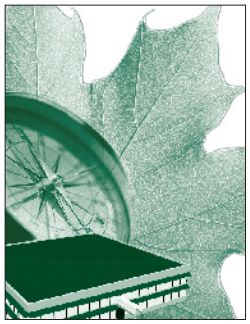
Excellence

We are committed to the achievement of technical quality and excellence in our programs, publications, courses and other activities.

DIRECTION 1

ASHRAE will lead the advancement of sustainable building design and operations.

Rationale



Building sustainability effort is critical to our global environment and society.

Leading the building sustainability effort is both competitively essential for ASHRAE members and will motivate the next generation of leaders in the field.

ASHRAE and its membership have unique building performance expertise that sets them apart from others.

The focus on energy efficient buildings continues to increase as energy costs rise, fossil fuel sources are depleted, and environmental impacts increase.

In general, building operation and maintenance account for 60-80% of total cost of ownership, and building performance typically decreases after the first year of operation.

Tools are needed to help owners operate and renew buildings in a sustainable manner thereby reducing their impact on the environment.

Strategies

1.1 Develop design guidance to integrate indoor environmental quality (IEQ), energy efficiency and other aspects of sustainable building performance.

1.2 Lead the drive toward the design, construction and operation of net-zero-energy buildings through research, publications and education.

1.3 Develop performance metrics and rating systems to certify operational performance of buildings for energy efficiency and IEQ.

1.4 Provide training, guidance and tools for building operators.

1.5 Conduct research and develop guidance to enhance the effectiveness of maintenance procedures.

1.6 Promote the use of life-cycle-cost analysis to building owners that will encourage sustainable building construction, operation, and renewal.

1.7 Collaborate with other organizations to integrate HVAC&R systems with other building systems to enhance the effectiveness of Total Building Design and Integrated Practice.

1.8 Promote research leading to the development of equipment and systems that support sustainable buildings.

DIRECTION 2

ASHRAE will be a world-class provider of education and certification programs.

Rationale

Education is an ongoing need of ASHRAE members and the industry and provides an opportunity for membership growth.

Membership and industry surveys show that there is a demand for ASHRAE certification programs.

ASHRAE has the expertise and the credibility to design and deliver education and certification programs.

Rapidly changing technology and issues such as sustainability, energy cost, and indoor environmental quality and security have created heightened expectations for timely delivery of diverse education content for life-long learning.

Strategies

2.1 Provide accessible on-demand education and distance learning to members and other customers.

2.2 Expand and sustain ASHRAE's education and certification delivery infrastructure.

2.3 Develop and promote certification programs for the HVAC&R industry.

2.4 Create educational programs that can be offered by ASHRAE chapters. 2.5 Partner with organizations that have expertise in the development and delivery of education and certification programs. 2.6 Promote the ASHRAE Learning Institute brand and the value of life-long learning.

DIRECTION 3

ASHRAE will position itself as a premier provider of HVAC&R expertise.

Rationale

Public interest in HVAC&R related issues is growing and ASHRAE has the technical knowledge to meet this need.

Policy makers and the general public need to be aware of ASHRAE's expertise.

Increasing competition requires ASHRAE to distinguish itself as the leader in the field.

Strategies

3.1 Aggressively market ASHRAE to enhance its image with the industry, policy makers, and the general public.

3.2 Create an effective communications infrastructure for marketing and public relations.

3.3 Make ASHRAE's products and services useful, desirable, and accessible to both existing and prospective customers.

3.4 Provide tools to enable chapters to become a local focus for education and community outreach.

DIRECTION 4

ASHRAE will be a global leader in the HVAC&R community.

Rationale

The world has evolved from independent national economies to an interdependent global economy.

Markets in developing countries present significant growth opportunities.

The developing global HVAC&R community is impacting ASHRAE members.

Technology developed outside North America can enhance ASHRAE's knowledge base.

Strategies

4.1 While ASHRAE's chapter and regional structure shall be the backbone of ASHRAE's structure globally, it shall be flexibly applied to serve our membership.

4.2 ASHRAE will cooperate with organizations with shared objectives and strengthen the ASHRAE Associate Societies Alliance.

4.3 The cost of annual membership dues will be balanced with the cost of providing membership benefits and services in different geographic regions.

4.4 Publications and educational products will be priced so they are within reach of ASHRAE's global membership but will not be priced at less than the cost of providing them.

4.5 ASHRAE will develop its expertise in HVAC&R technologies to embrace whole building sustainable design and be one of the most valuable global resources for publications and educational products related to sustainable HVAC&R technology.

4.6 ASHRAE will pursue opportunities and processes along with translation to publish its literature in various languages.

4.7 Volunteer participation obstacles will be overcome through meeting planning and organization that is sensitive to global participation and that benefits from electronic communication technologies.

4.8 ASHRAE will support, in cooperation with national associations, a uniform, international standard for credentialing in the disciplines and practices of HVAC&R.

4.9 ASHRAE will actively support and participate in international standard development activities.

4.10 ASHRAE will actively protect its intellectual property rights.

4.11 ASHRAE will provide enhanced staff support outside of the United States.

4.12 ASHRAE will align its business practices to better serve members globally.

4.13 ASHRAE, in cooperation with national societies or independently, will pursue conferences and exhibitions outside North America.

4.14 The ASHRAE Brand will be strengthened to reflect a global strategy that serves the needs of all members.

DEFINITIONS

Mission	The reason we exist as an organization; the purpose of the organization today
Core Values	Shared beliefs which energize action in a consistent manner.
Vision	The place we believe will be the desired state of the organization and what we believe its impact will be in the world in 5-10 years
Strategic Plan	Overall directions for achieving our mission and fulfilling our vision in the future; that should leverage our strengths, our resources and should pursue significant opportunities
Strategic Directions	High level focuses or key priorities that will drive the organization for the next 3-5 years; while keeping our mission and vision in clear view. These are sometimes called "goals".
Strategies	A list of strategies to support the strategic directions; these are assigned to specific bodies; who will be responsible to provide what by when. These are sometimes called "objectives".
Action Plans	A list of detailed activities required to accomplish the strategies; developed by councils / committees with staff assistance
Integrated Practice	Integrated practice leverages early contributions of knowledge through utilization of new technologies, allowing architects to better realize their highest potentials as designers and collaborators while expanding the value they provide.
Net-Zero-Energy Building	A building which, on an annual basis, uses no more energy than is provided by the building's on-site renewable energy sources. (Edited 2006-04-03)
Sustainability	Providing for the needs of the present without detracting from the ability to fulfill the needs of the future.
Total Building Design	Process in which the design and construction teams work together to produce a building that, not only meets the owner's time and budget requirements, but is socially and environmentally responsible as well.

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, N.E., Atlanta, GA 30329
www.ashrae.org

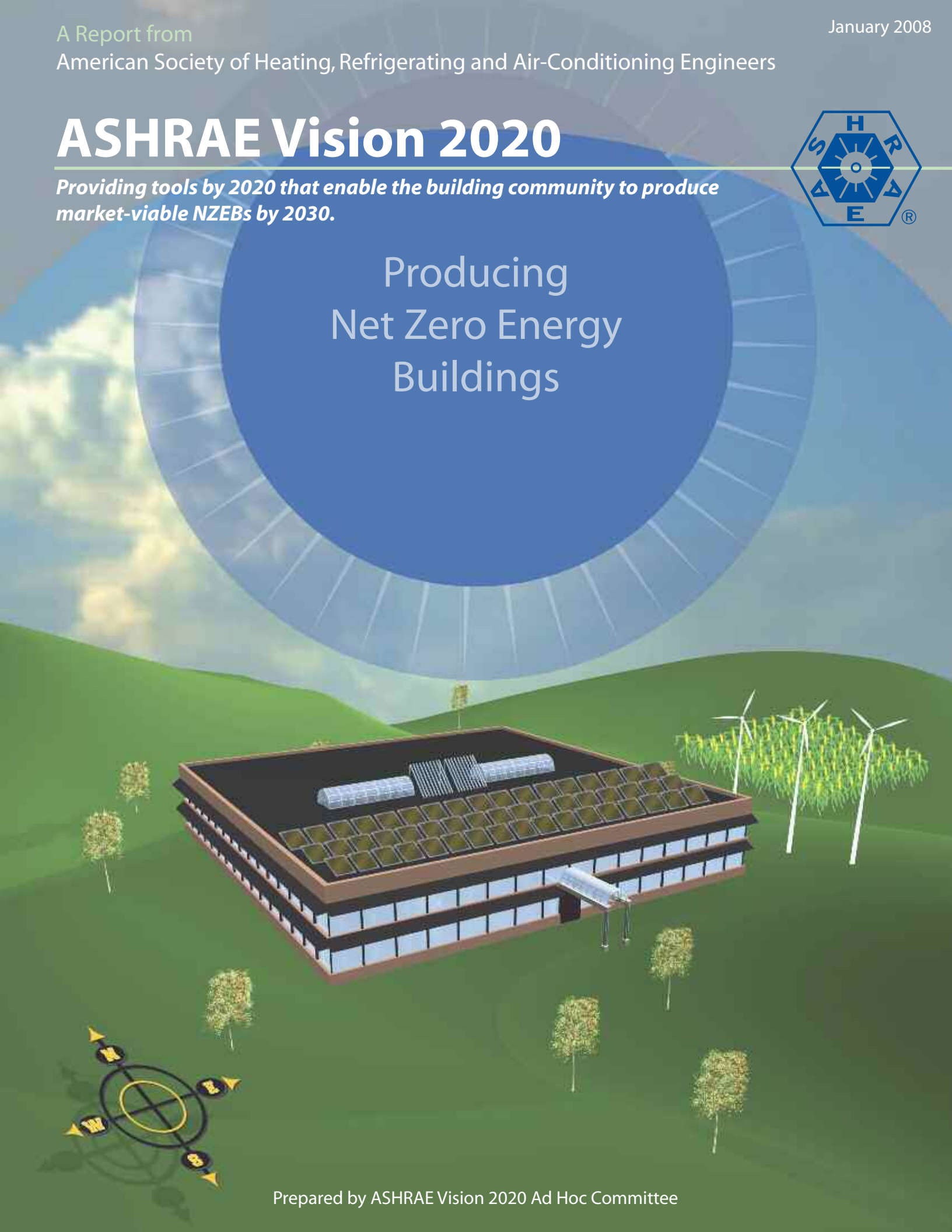
A Report from
American Society of Heating, Refrigerating and Air-Conditioning Engineers

January 2008

ASHRAE Vision 2020

Providing tools by 2020 that enable the building community to produce market-viable NZEBs by 2030.

Producing Net Zero Energy Buildings



Prepared by ASHRAE Vision 2020 Ad Hoc Committee

ASHRAE 2020 Ad Hoc Committee

ASHRAE Vision 2020
Producing Net Zero Energy Buildings

On December 1, 2007, ASHRAE President Terry Townsend, P.E., drew from the building design, research, owning, and supplier communities to appoint an ad hoc committee with the following charge:

Develop guidance and strategy for the development of energy-related products, the conducting of research in renewable energy systems, and the sequencing of the various identified activities that will produce net zero energy usage for all types of facilities by 2020.

The membership of the committee was as follows:

Ronald E. Jarnagin, Committee Chair, Pacific Northwest National Laboratory

Thomas E. Watson, P.E., Committee Vice-Chair, McQuay International

Lee W. Burgett, P.E., Trane

Dale E. Carter, Dec Design Mechanical Consultants Ltd

Dr. Donald G. Colliver, P.E., University of Kentucky

Hugh D. McMillan, III, P.E., ccrd partners

Mark S. Menzer, Air Conditioning, Heating and Refrigeration Institute

John Montgomery, Public Building Commission of Chicago

Victor Olgyay, A.I.A., Rocky Mountain Institute

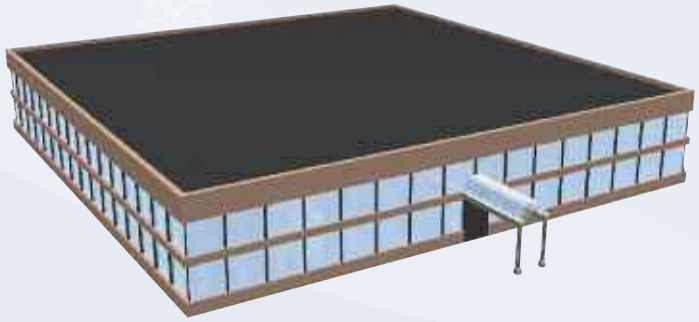
Dr. Andrew K. Persily, National Institute of Standards and Technology

Thomas H. Phoenix, P.E., Moser Mayer Phoenix Associates PA

Dr. Paul A. Torcellini, National Renewable Energy Laboratory

Dr. Constantinos A. Balaras, P.E., Group Energy Conservation IERSD

Dr. Bruce Hunn, Staff Liaison, ASHRAE Director of Technology



ASHRAE Vision 2020

Producing Net Zero Energy Buildings

Providing tools by 2020 that enable the building community to produce market-viable NZEBs by 2030.

Introduction

To create and recreate the world's building stock in a manner that sustains the well being of humanity requires planning, concerted effort, and bold action. Formed from our imagination, a single vision must be shared by all who design, build, and operate the structures that house life on our planet and that foster the productivity that defines our civilizations.

This report describes the vision held by members of the American Society of Heating, Refrigerating and Air-Conditioning Engineers. This vision is of a future when buildings will produce as much energy as they use. These are net zero energy buildings (NZEBs). We believe such buildings can be market-viable by the year 2030.

Our vision can be realized only if ASHRAE, working within the framework of the building community, provides to its members by 2020 the tools necessary to design, construct, and operate NZEBs. To achieve this critical milestone, now is the time to plan strategically and to act decisively.

NZEB Technology

Buildings consume 40% of the primary energy and 71% of the electrical energy in the US. Driven by economic expansion and population growth that require more and more facility space each year, energy use in the US commercial sector is expected to grow by 1.6% per year. This is resulting in an energy impact that is increasing faster than all of the energy conservation measures being taken and retrofits being made to buildings.

ASHRAE's vision, as articulated in this report, is that the building community will produce market- viable net zero energy buildings (NZEBs) by the year 2030.

The concept of NZEBs includes only the energy flows of the building, not the overall sustainability of the building. It is a critical step toward achieving the objectives of building sustainability as articulated in *ASHRAE's Sustainability Roadmap*. The quality of the indoor environment must not be sacrificed in the pursuit of NZEBs. And while new buildings are the focus of ASHRAE's NZEB vision, existing buildings must be addressed as NZEB strategies are implemented.

Defining NZEBs

What qualifies a building as a NZEB can be determined using different metrics.

A **net zero site energy building** produces as much energy as it uses when measured at the site. Applying this definition is useful because verification can be achieved through on-site metering. This tends to encourage energy-efficient designs; however, it does not distinguish between fuel types or account for inefficiencies in the utility grid.

A **net zero source energy building** produces as much energy as it uses compared to the energy content at the energy source on an annual basis. The system boundary is drawn around the building, the transmission system, the power plant, and the energy consumed in getting the fuel source to the power plant. This tends to be a better representation of the total energy impact compared to a site definition. It is challenged, however, by difficulties in acquiring site-to-source conversions and by the limitations of these conversions.

Building owners are typically most interested in **net zero energy cost buildings** because they tend to use energy efficiency and renewable energy as part of their business plan. This definition, like the site NZEB definition, is easy to verify with utility bills. Market forces provide a good balance between fuel types based on fuel availability. Costs also tend to include the impact of the infrastructure. Getting to zero, however, may be difficult or even impossible because of utility rate structures. Many rate structures will give credit for energy returned to the grid but will not allow this number to go below zero on an annual basis. As a result, there is no way to recover costs incurred by fixed and demand charges.

The fourth definition, a **net zero energy emissions building**, looks at the emissions that were produced by the energy needs of the building. This is probably a better model for "green" energy sources; however, like the source NZEB definition, it can be difficult to calculate.

A Single Definition for NZEB

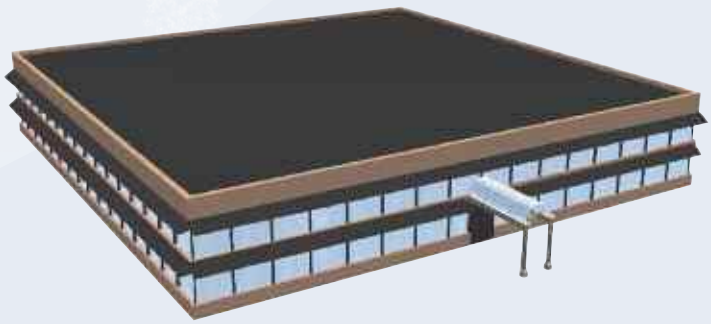
Based on today's building stock, each metric represents a positive direction toward achieving buildings that lessen their environmental impact and conserve nonrenewable resources.

There is still a need to create a single definition, however. Without this, there is a vacuum that leaves questions as to whether a building can be universally considered a NZEB.

Ultimately, the only way to measure if a building is a NZEB is to look at the energy crossing the boundary. Other definitions, including source, emissions, and cost, are based on this measured information and include weighing factors and algorithms to get to the metric of interest.

Because of the complications involved in making these computations, **site energy measurements** have been chosen through an agreement of understanding between ASHRAE, the American Institute of Architects (AIA), the U.S. Green Building Council (USGBC), and the Illuminating Engineering Society of North America (IESNA).

In this report, a NZEB is a building that produces as much energy as it uses when measured at the site. On an annual basis, it produces or consumes as much energy from renewable sources as it uses while maintaining an acceptable level of service and functionality. NZEBs can exchange energy with the power grid as long as the net energy balance is zero on an annual basis.



Strategies and Actions for Vision 2020

ASHRAE defines a NZEB as a building that produces as much energy as it uses when measured at the site.

Based on this definition, ASHRAE will drive NZEB technology by implementing strategies to provide the needed tools to its membership by 2020. ASHRAE will:

1. Develop new tools through research.
2. Facilitate use of new technologies through publishing and education.
3. Use public relations and marketing to energize the ASHRAE membership and to communicate NZEB technology and benefits to the global community of designers, builders, owners, and regulators.
4. Continually revise ASHRAE energy-related resources so that old and new products are complimentary.

Clearly defined actions will implement these strategies.

1. ASHRAE will develop a rating system and branding for buildings, considering design and operations.
2. ASHRAE's rating system and rating will apply to both new and existing buildings.
3. The schedule will be followed that was approved by the ASHRAE Board of Directors in approaching NZEBs.
4. Memorandums of Understanding will be drawn among AIA, IESNA, USGBC, and ASHRAE on NZEBs, with support from EPA and DOE.
5. ASHRAE's Associate Societies Alliance will examine the impact of NZEBs in light of the global sustain ability movement and ASHRAE's global strategies.
6. ASHRAE will identify key players within the larger context of the building environment community—such as computer equipment manufacturers— and will engage them in solutions to reduce standby loss and parasitic power use (plug loads and power transformers).
7. ASHRAE will host a leadership roundtable of owner/manager groups (such as BOMA, IFMA, HEC, ICS, CORENET, Heinz, Intl. Asset Management Council, REIT, and international organizations) to explore integrated design possibilities to reach NZEBs.
8. ASHRAE will swiftly address the highest priority research items working through the Society's Research Advisory Panel and the USGBC Research Committee.
9. The *ASHRAE Handbook* series will be revised and ASHRAE Learning Institute programs will be expanded to include content on how to achieve NZEBs.
10. ASHRAE standards and special publications will be reviewed to identify those with impact on energy.
11. Unregulated loads will be added to Standard 90.1, perhaps establishing a recommended level of W/ft2.
12. Target energy budgets by climate zones and building types in Standard 90.1 will be created.
13. Because the *Advanced Energy Design Guides* (AEDGs) provide the "above code guidance" essential for NZEBs, ASHRAE will develop alternative packages for reaching 30% energy savings in existing AEDGs guides by 2008, and ASHRAE will produce NZEB guides in place of the 70% savings guides planned for 2015.
14. ASHRAE will add emphasis to user-friendly energy modeling tools and interfaces included in *ASHRAE's Research Strategic Plan*.
15. E-Learning modules will be developed to include NZEB content.
16. A Certified Sustainability Design Expert program will be launched, including content on NZEBs.

Implications of NZEB Technology

While most of the responsibility of achieving NZEBs will fall on the shoulders of designers, there are considerable and important challenges for all sectors of the building community.

The Industry

If NZEBs are to become reality, manufacturers and designers must be better able to integrate systems into buildings that may be significantly different from most buildings constructed today. Designers will need the tools to design and apply better integrated equipment, manufacturers will need to produce ultra-high efficiency equipment and know how to best apply it to buildings, and both will have to be able to better monitor occupants' needs and provide comfortable conditions, taking advantage of everything that nature has to offer, including human ingenuity.

Integrated Systems
Equipment will have to be fully integrated so that waste energy and other "free" energy sources are used to their maximum possible extent. This is very different from the current practice, where discrete equipment performs independent, discrete tasks. Natural and mechanical ventilation will have to be optimally integrated where appropriate.

Higher Efficiency Equipment and Systems
With integrated systems, there will be a need for ultra-high-efficiency equipment and systems, for variable speed systems that minimize energy use throughout the seasons, and for varying cooling loads imposed by the building's users and the outdoor ambient. Manufacturers will have to make available smaller capacity equipment with better part-load profiles. Better dehumidification and moisture control also will be required to enable cooling to be separated from dehumidification. This could allow the saturated evaporator temperatures to be higher and, thus, have a higher COP. Equipment design rating points and designs may need to change.

Fundamentally, manufacturers will need to understand the potential market for NZEBs so they can design systems to meet that market. Planning decisions need to be made many years in advance of commercialization.

Design Tools
Architects, engineers and manufacturing companies will need refined tools for properly sizing and selecting HVAC equipment in NZEBs. Also needed are tools to better integrate building form and fabric as part of the heating, cooling, and lighting system—as well as balancing the remaining load with the HVAC and electric lighting systems—to satisfy the occupants' needs.

Tools will be needed to improve design of daylighting and hybrid ventilation, integrating low-energy solutions with traditional and next-generation equipment. Also, tools will be needed for comparing applications of different types of equipment and system arrangements to allow engineers and owners to select the most energy-effective approach for a given building.

Clear explanations of the advantages of various types of systems for particular building applications are needed to help designers and owners make educated choices.

Building simulation tools need to be refined for easier and less costly use, permitting low budget projects to take advantage of their capability. In addition, common building types should be "pre-simulated" such that common solutions can be readily accepted by industry.

Enhanced Building Automation Systems and Controls
Sensors are needed that are inexpensive and reliable for wide distribution in buildings to achieve better comfort control with less energy use. It is desirable to have these sensors perform multiple functions, such as sensing temperature, humidity and carbon dioxide concentration. Currently, the cost of installing sensors and programming them is a barrier to wide-scale adoption. Advanced sensor technology should be more interoperable, and technologies, such as wireless, may help in reducing the cost.

Better sensors are needed to detect when natural ventilation is the preferable option and when daylighting is available. Accurate occupancy sensors would all benefit energy impacts of buildings. Smart systems are needed that do not condition spaces that are not occupied, can sense/predict when a space will be occupied, and can avoid condensation during unoccupied periods.

Energy can be saved over time by self-commissioning systems that continuously monitor their performance against design intent and auto-tune as needed.

Indoor Air Quality
Tighter building envelopes make ventilation design more critical since a designer can rely less on infiltration. Improved design and installation will allow for better control of indoor air quality. Source control through selection of low-emitting materials and furnishings, along with advanced air filtration and treatment technologies, will reduce requirements for outdoor air ventilation. As a result, energy consumption of heating and cooling ventilation air will also be reduced. Air cleaners – gas, particulate and biological – are further ways of reducing energy use associated with ventilation.

Energy Storage and Performance Standards
Standards for measuring the performance of integrated systems within the building will be needed. For example, metrics and methods need to be developed to better use the energy resources available, both on site and off site. This would involve identifying methods of using energy storage.

Construction
Successful application of design tools, high-efficiency equipment, and integrated systems is dependent upon installation. Construction firms will need to train their employees in new construction techniques and quality control procedures. Trade coordination and cooperation will be required to meet the needs of providing a finished product for the building owner and manager that meet the objectives of NZEB technology.

ASHRAE's Worldwide Membership

The methods to achieve NZEBs will impact building designers and operators in varying degrees based on climatic conditions, demographic factors, and geographic location.

The worldwide view of being sustainable and energy efficient varies tremendously. For example, many European countries have made significant progress along the sustainability path. As another example, China is aggressively developing building energy standards. At the same time, many developing nations are struggling just to raise their basic standards of living.

ASHRAE's vision to achieve NZEBs is initially focused on North America. If, however, we are to make this an "initiative" for use globally, the ASHRAE membership worldwide will need to assist the Society by identifying the regional construction standards, climatic zone variations, economic viability, and other driving forces in their respective countries.

There will be challenges, such as the perception that engineers in one nation are imposing their standards on another. To address this, a "collaborative team effort" will need to be nurtured to achieve the goal of NZEBs worldwide.

Regardless, the intent of this report is to identify the actions by ASHRAE that will provide the tools and guidance to engineers that will lower building energy consumption while reaching achievable sustainability goals.

Outside the ASHRAE Community

The ASHRAE community, including ASHRAE's partners in the development of standards and guides, has a strong influence on energy consumption and consequent environmental impacts. Many other entities play an equally important role. It is important that ASHRAE recognize these entities and engage them in the process of change.

On the energy supply side, private enterprise is becoming increasingly involved with renewable energy. Regulated utilities are major factors in generating electrical power. Various governmental bodies (local/state/federal) have influence on the supply side, whether it is with incentives and/or regulations or rate setting. Also, industry is a major factor in the distribution of energy in the deregulated environment. Each of these entities has a role to play in the vision for NZEBs.

Alternative power generation methods and sources will be a major factor in the political arena and in terms of environmental impact. Nuclear power is a challenging political topic, but it has the potential to strongly reduce CO2 emissions; therefore, the Nuclear Regulatory Commission will play a role. Coal will have an important influence for a long time to come despite concerns about emissions. Gas and oil will continue to get the public's attention as the cost continues to increase. This means a host of organizations must be included in the 2020 vision.

Partnering Examples for ASHRAE
Groups such as the Institute of Electrical and Electronics Engineers (IEEE) can provide guidance concerning plug loads, such as computing equipment, since they have become a significant factor in the total energy picture.

AIA can be instrumental in providing guidance to minimize the impact on energy consumption by improving the form and fabric of the building.

The USGBC and others use ASHRAE standards as they pursue transforming the marketplace through building rating systems.

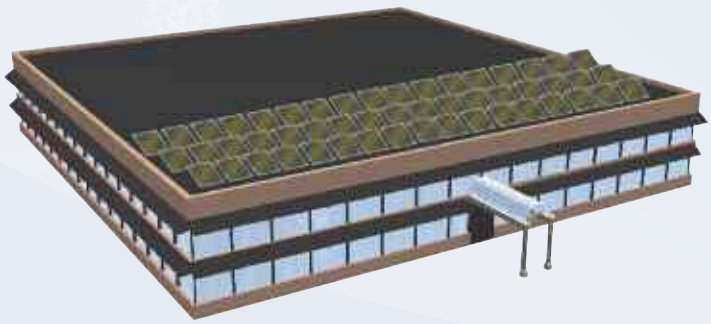
Model code organizations, such as the International Code Council (ICC), National Fire Protection Association (NFPA), and others, set the bar for a host of local jurisdictions across the country and are key disseminators of energy standards.

Trade associations, such as the Air-Conditioning, Heating and Refrigeration Institute (AHRI), representing suppliers of products that are the primary consumers of energy in buildings, participate in the regulation of energy consumption.

Building contractors need to implement and follow through with energy-efficient designs, including training trades people on the proper implementation of technologies.

A variety of governmental organizations, with the principal agencies being DOE, EPA and GSA, are active participants in conservation by conducting research, writing standards and implementing energy conservation in government facilities.

National laboratories in the U.S. should implement research plans to address major hurdles facing the building industry as it moves toward NZEBs.



NZEB Metrics and Recognition

ASHRAE Vision 2020
Producing Net Zero Energy Buildings

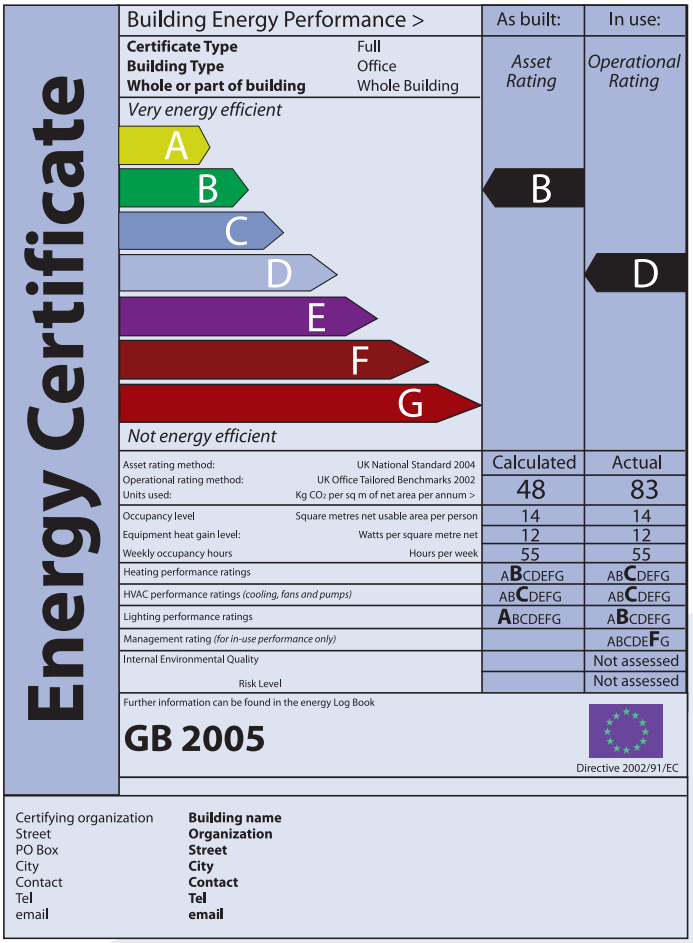
A number of initiatives should be pursued to encourage adoption of NZEB technology and also to support NZEB marketing activities.

The three primary options explored by the committee were building certification, accreditation of professionals, and labels or dashboards that highlight the energy consumption of a given building.

Building Certification

Certifying buildings for net zero energy consumption could serve to motivate building owners and designers. Some of the reasons to certify buildings include market leadership, credibility and visibility. Market leadership can establish a building, along with the owner and design team, as a top performer. And having an ASHRAE-certified building would provide the credibility to make such recognition meaningful in the marketplace.

Building certification could take the form of a plaque, label or certificate that could be displayed prominently in a building. There is a European program in place called *EP Label* (www.eplabel.org) that describes the overall energy efficiency of a building relative to benchmark values.



Building certification raises the issues of adjudication and the infrastructure necessary to support a rating program. If ASHRAE chooses not to pursue a labeling program on its own, the Society could focus on the required tools and collaborate with another organization on the actual labeling program.

Certification of Professionals

ASHRAE may certify individuals in the field of NZEB. This would encourage the practice of NZEB technology; however, ASHRAE must address the issue of adjudication and must provide the necessary infrastructure to support it.

The benefits of ASHRAE's certification programs are clear. They are developed by industry practitioners who understand the knowledge and experience that are expected for superior building design and system operation. The ASHRAE Learning Institute supports the certification effort, thereby providing a complete learning process. ASHRAE enjoys a worldwide reputation as a leader in providing guidance for HVAC&R design, and the Society's certification programs reinforce that reputation.

Measuring Actual Building Performance

While a building label provides a static indication of building performance, a dashboard is meant to describe a more dynamic or real-time indication.

Static dashboards provide a snapshot of building performance and are applicable to building certification, while dynamic or real-time dashboards involve data collection and reporting of the information. The objective is to provide feedback to building owners and occupants on the performance as well as to provide standardized metrics for reporting the building's performance to a larger audience.

Such dashboards have been developed for many other projects. The idea being presented here is to combine various meters and sensors with data logging software and a graphic display to show how the building is performing at a moment in time, over some recent time interval, or over the long term. Such performance can be compared graphically with design values, requirements from codes and standards, expected performance in similar buildings, and past performance of the building in question.

If such a dashboard was centrally administered it would have the advantage of allowing for the collection of energy use and energy production data for the spectrum of participating projects. This could become the framework for a very useful database, both for understanding the current performance of the monitored projects as well as for comparison to Energy Information Agency's Commercial Building Energy Consumption Survey (CBECS) data sets. In this way the dashboard would truly be analogous to the automobile's dashboard in that the information displayed would assist in driving the building industry toward the NZEB destination. Regardless, the objective of data collection is to document improvements in the building stock. One idea for presenting this information is to develop a high performance or green building subset of CBECS which could be referred to as the Green Building Energy Consumption Survey or GBECS.

Given an approach to displaying this information, the next question is what metrics to display. The specific parameters that are displayed on such a dashboard are always going to be building-specific to some degree, and if ASHRAE is going to propose a specific dashboard view, then additional discussion will be needed. The following list presents some of the options:

Energy consumption:
- Real-time, integrated over recent days/weeks/months, annual
- Broken down by use, e.g., fans, chillers, lighting, elevators, etc.
- Reference values: CBECS, design value, etc.
- Local utility demand; prices

System status:
- Airflow rates, including outdoor air intake
- Airstream temperatures

Level of service:
- Thermal comfort: dry-bulb temperature, RH, air speed; multiple locations in the building
- Indoor pollutant levels: e.g., carbon dioxide, fine and coarse particles
- Occupancy

Outdoor conditions:
- Air temperature
- Wind speed and direction
- Ambient pollutant levels: fine and coarse particles, ozone, etc. (this may available from EPA NAAQS monitoring locations)
- Non-energy building performance
- Water usage indoors and outdoors
- Sewage outflow

Energy Conservation in the Built Environment

Energy conservation in the built environment is something that ASHRAE can influence very directly.

It is somewhat problematic that most of our effort is directed at new construction, which constitutes only a small portion of the total energy usage. We have, however, an opportunity to highlight the relative contributions and have an impact on both design and operation. If CO2/Global Warming Potention emissions are the desired end result, perhaps it is not significant to try to segregate. Between energy consumption and emissions, there is the politics of power generation. ASHRAE's influence in this arena may be small, but the impact is huge (for example, consider nuclear power generation).

An initial list of attributes would include the following, each as a function of time:

- Energy consumption per area in new construction (without consideration of plug loads which ASHRAE does not presently influence)
- Energy consumption per area in existing building stock (again without plug loads)
- Energy consumption per area (new construction + existing stock)
- Emissions per unit of energy consumption vs. projected power generation policy
- Emissions per area (new construction + existing stock)

In addition to the attributes above, an assessment of the economics (where to get the "biggest bang for the buck") might be appropriate. Also some proposal to address the existing building stock would seem necessary, although not easy and not cheap. These may suggest additional metrics.

Products & Programs Needed for NZEBs

ASHRAE Vision 2020
Producing Net Zero Energy Buildings

A plan to reach NZEBs requires that good information be made available to motivated practitioners. Development of publications, research topics, and education programs identified below will promote this effort.

Publications

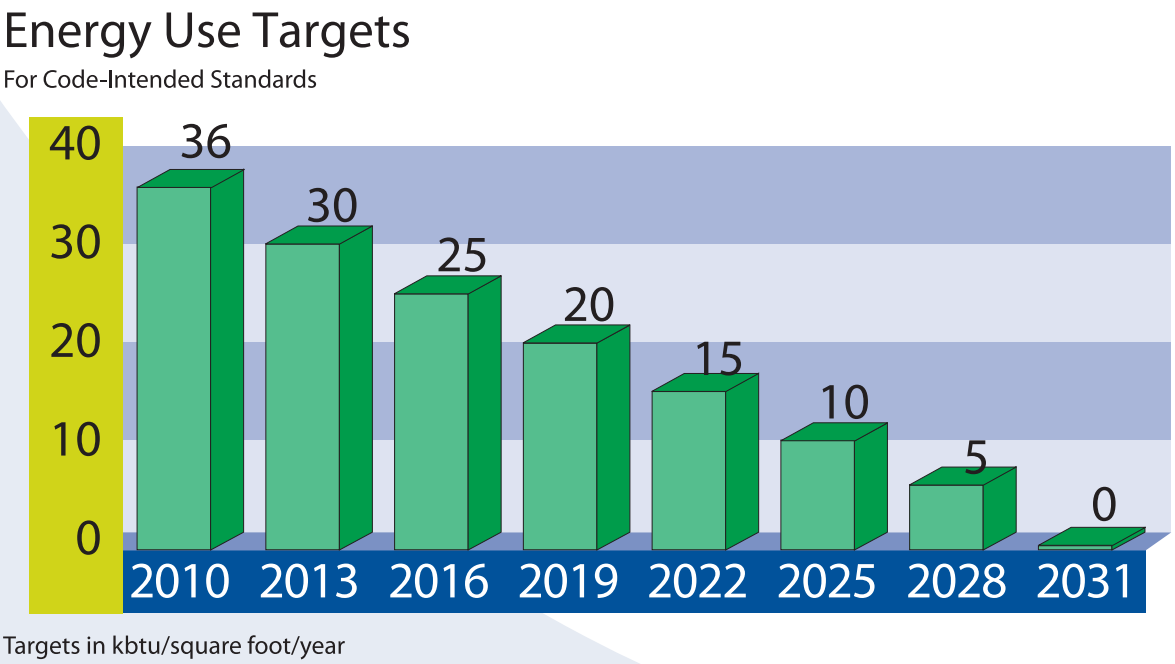
ASHRAE Handbook

The *ASHRAE Handbook* series and the *ASHRAE Terminology of HVAC&R* should be reviewed to ensure that terms relative to NZEBs are clearly defined. A chapter on "Fundamentals of Sustainability" should be added to the Handbook under the direction of ASHRAE Technical Committee 2.8, Buildings' Environmental Impacts and Sustainability. This chapter should include information on what it takes to create NZEBs, such as day-lighting strategies.

Standards and Guidelines

While it is acknowledged that NZEB technology is still developing, there are components of that body of knowledge whose aspects should be included in ASHRAE standards and guidelines. These include methods of testing for NZEBs. Additionally, the scopes of Standards 90.1 and 189P should be expanded to include plug loads, cooking equipment, and refrigeration loads.

ASHRAE's Board of Directors has approved Energy Use targets for its code-intended standards.



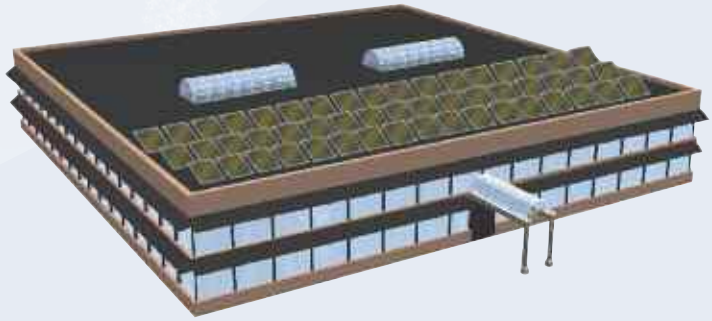
Advanced Energy Design Guides
Advanced Energy Design Guides (AEDGs) are currently planned to be a series of guides that provide 30% energy reduction guidance, 50% energy reduction guidance, and 70% energy guidance. The committee recommends that the 70% energy reduction guides scheduled for completion by 2015 be modified to become net zero energy design guides. These guides would offer strategies that provide design guidance for 70% energy savings and strategies for on-site renewable energy concepts that result in NZEBs.

Education

Continuing education for building designers, contractors, operators, owners, and occupants is necessary for NZEBs to become a reality. To that end, ASHRAE must expand its educational offerings to ensure that its members and others have the necessary tools to be the source for knowledge on NZEBs. In order for this to happen, ASHRAE's Technical Committees must continue to develop state-of-the-art content for its suite of educational tools. In order to ensure maximum coverage, NZEB offerings should be developed in the eLearning modules, short courses, and the professional development seminar series, and those new technologies for information dissemination, such as podcasts, should also be developed.

Certification

Certification will become an important aspect for ASHRAE members to market themselves as NZEB-certified designers. The certification for the High-Performance Building Design Professional program should be expanded to include certification for NZEB design professionals as the body of knowledge is formed and design guidance becomes available.



Research Needed for NZEBs

Research must be completed in support of NZEBs in order to provide design guidance by 2020. Topics span all aspects of the building industry, including the building envelope, mechanical equipment, lighting, service water heating, and all related controls. In addition to these building-related aspects, the design process must be carefully examined to ensure NZEB. ASHRAE must partner with other organizations, such as the USGBC Research Committee, to ensure the timely completion of these tasks. Additionally, within ASHRAE, this information will be important for the Research Advisory Panel as they prepare the next version of the Research Strategic Plan. Specific research topics are prioritized and listed in the appendix of this report. Following are examples of some of the highest priority research topics necessary to provide design guidance for NZEB.

Building Envelope

The building envelope should be designed to minimize buildings' HVAC and lighting loads. For example, on a residential scale, the U.S. Department of Energy Research toward Zero Energy Homes demonstrates methods to get to 70% efficiency and recommends roof areas with a given efficiency of solar domestic hot water (SDHW) and photovoltaics (PV) to meet the remaining loads. This methodology can be applied to commercial typologies as well. For buildings with high lighting requirements, daylighting needs to be a primary façade element; similarly, cooling or ventilation loads should influence envelope design.

Design Tools

There is a need for more accurate geometry for architectural models imported to energy simulation programs. The industry should actively pursue standardizing interoperability between software tools and developing software tools that can accurately model NZEBs. More specific recommendations are included in the appendix.

Small Power/Plug Loads/Miscellaneous Loads

Since these loads are not regulated in Standard 90.1 and also not under the control of the designer, they tend to be neglected. It is important that an evaluation of plug, process, cooking, and refrigeration loads is factored into the NZEB calculation. More specific recommendations are included in the appendix.

Operating Issues

There is a need to reduce constraints imposed by the structure of the current building industry. Maintainability, simplicity, ease of operation, and controllability are important considerations to ensure optimal operation of a NZEB.

Incentives & Restructuring Relationships

The following three sections discuss crucial items that are not building-specific but will impact the success of ASHRAE Vision 2020. They address restructuring professional relationships and incentives in the building industry to encourage energy efficiency, researching the relationship between building energy and source energy to effectively reduce overall environmental impact, and coordinating building systems with the operation of larger regional systems.

Alleviate Constraints Imposed by Current Industry Structure and Incentives

The numerous parties involved (architects, engineers, specifiers, purchasers, contractors, lenders, owners, and tenants) in building construction and operation have different and conflicting financial motivations that discourage investment in innovative energy-efficient building designs. This structure can favor the purchase and installation of oversized HVAC systems even after energy-efficient measures have been made in the design of the envelope and insulation. Identifying and understanding these opposing incentives are a high priority because they determine the ability of building professionals to champion energy-efficient changes.

How to change and motivate engineers, developers, design professionals, and clients to excel:

A. Establish a fee structure based on performance rather than equipment cost.

Bids may be structured in several parts: one component may cover the costs for designing a "baseline" efficiency system; other components can reward designers and engineers for incremental reductions in energy costs throughout the life of the system or in total life-cycle costs. Fees can be contingent on performance as projected by design specifications, and distributed after corroboration by commissioning documents or energy bills. Means may need to be developed to have accountability for the separate parts of the design, maintenance, and operation of the building.

Utilities often reward customers with rebates for installing efficient equipment. Consider a "built-in" design royalty that passes along a percentage of these "hardware" rebates to the engineer or architect as compensation for their "soft" design contributions.

B. Educate current students about emerging standards and issues.

Educate the next generation of practitioners to make high-performance standard practice.

Sponsor outreach and educational programs that promote the integration of building science and energy systems into the curricula of architecture and engineering schools. Support curricula that include energy-efficiency courses in the core requirements, and allow students the flexibility to take additional electives in energy efficiency.

C. Educate developers and financiers.

Developers and financiers have incentive to minimize capital costs and maximize resale potential. They are typically less motivated to invest in energy-efficient systems because they currently do not benefit from the future energy savings. Reform accounting methods so that discounted rates can accurately portray the capital costs of superior systems. Show lawyers, commercial lenders,

investment advisors, appraisers, and developers seminal issues such as:

i. Avoided operational energy costs can enhance retail market value.

ii. Capital costs reduced by proper HVAC sizing may be able to create cost neutral or capital cost savings through optimizing entire building systems. Building elements optimized in isolation tend to increase costs and have the opposite effect, whereas optimizing whole systems helps realize increased efficiencies while reducing cost.

iii. Any extra capital investments in superior HVAC systems can be paid back in savings from improved occupant productivity because the present value of capital costs for mechanical systems are dwarfed by the present value of employee salaries.

D. Educate maintenance staff on the intent of technically advanced systems and on managing and caring for systems accordingly.

Time, budget, training, and ease of operation (including simplicity of computerized interfaces) are considerations that should be factored into system cost calculations.

E. Promote interdisciplinary design, i.e., mechanical, electrical, and architectural.

Mechanical, electrical, and architectural expertise are typically provided by different sources, and HVAC systems are often designed as an afterthought to existing architectural plans. This disconnect is reinforced by lack of experience in integrated design, fear of taking on new financial risks by changing design processes that "work," and conflicting ideas and metrics for what makes a "high-performance" building.

One strategy to promote interdisciplinary design is to use total present-valued life-cycle occupancy cost as a financial objective. This can help to align design goals, make the case for early integration of mechanical and electrical input, and encourage communication between disciplines that currently emphasize exclusive "specialization" over transparency and information sharing.

F. Educate the client regarding net zero, thereby encouraging the demand.

i. Discourage oversizing of HVAC systems for the sake of accommodating possible future tenants who may (or may not) have higher load requirements. Provide for tenant flexibility and save money by specifying pads and stub-outs for future add-ons, thereby avoiding the initial capital and operating energy costs associated with unnecessarily oversized components.

ii. Raise awareness of different fee structures that can reward efficient designs.

G. Establish contracts that include a complete set of specifications, and provide for full commissioning, operations and maintenance training, and documentation.

Specifications should avoid ambiguous statements like "high-efficiency motor" or "low-emmissivity glass." Consultant fees and design schedules should be increased to accommodate the additional specification detail and editing required.

H. Encourage the adoption of Standard 90.1-based codes.

I. Design a "cost-neutral" high-performance building.

This may include a systems approach to LCA and bundling efficiency packages to optimize both cost and energy performance. It also implies active integrated engagement of the engineering team in the early schematic building design to coordinate building mechanical costs and building design optimization (i.e., investments in more efficient glazing can enable downsizing and reduced costs in the HVAC system).

J. Structure leases so energy-saving retrofits can benefit both tenant and owner.

Promote cost-effective sub-metering. Favor requirements to provide performance-based ASHRAE comfort conditions as opposed to support for outdated lighting and heating loads.

Establish the Boundaries of the Building

The following items may be addressed in collaboration with the USGBC.

A. Source energy should be included if the primary motivation is to reduce the impact of building energy consumption on global warming.

B. ASHRAE can develop a standard for quantifying regional greenhouse gas (GHG) emissions that enable individuals to:

i. Arrive at a figure for the amount of nonrenewable energy used by a building.
ii. Identify regional greenhouse gas intensity coefficients to determine a building's net carbon emissions as well as source energy impact. This coefficient should address distance/transmission loss issues as well as source energy type. It should also address time of day dependence on energy conservation rates. Use of this coefficient will allow conversion between energy use, source, and emissions.

C. ASHRAE to co-publish EIA energy generation fuel type data.

D. Renewable Energy Credits (RECs)

ASHRAE should promote demand-side reduction and the use of on-site renewable sources by stipulating that a minimum of 50% of building energy be brought to net zero through efficient building techniques and on-site generation. RECs should not be permitted to offset building nonrenewable energy use or carbon emissions for more than 50% of the building's net energy consumption.

i. ASHRAE should be clear about the motivations for purchasing RECs or offsets (i.e., promoting the use of renewable energy, offsetting carbon emissions, or both) and provide a defined method for converting units of energy used to the corresponding RECs or offset units.

Net nonrenewable energy use (calculated in kilowatt-hours) can be offset with RECs that are certified for "additionality" by acceptable authorities.

GHG emissions (calculated in tons of CO2 equivalent) can be brought to net zero by carbon offsets certified for additionality by acceptable authorities.

ii. Specify standards for offsets and RECs based on: demonstrated additionality, credible determination of offset project's baseline emissions, credible quantification of offset project's GHG emissions reductions, permanence of offsets, clear ownership of project reductions, and verification and registration of offsets (to reduce the possibility of multiple ownership and sales). Provide a list of acceptable certification programs (i.e., atmosphere, Carbon Neutral Co., Climate Care, Climate Trust, co2balance, etc.).

E. Potable water, wastewater, and utility connectivity: Water use for a building must be included in the building energy utilization index (EUI).

This is done by quantifying the water used or produced by the building and converting that amount to its energy equivalent. Buildings that generate potable water (or clean sewage) in excess of their use should be credited through net metering.

Currently, projects that include on-site wastewater treatment are essentially penalized (e.g., Oberlin's Lewis Center). Others use potable water and sewage systems and impose loads that are not ac counted for in a typical energy analysis.

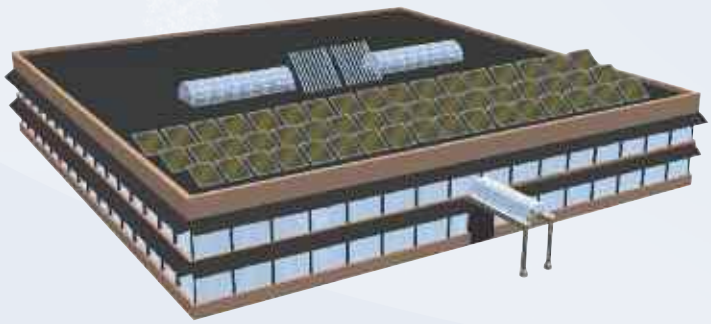
F. Embodied Energy

Effort should be made to account for and reduce the energy embodied through construction. Standardized databases should be expanded with applications created to assist designers in making decisions about embodied energy.

Integration of Building with Larger Systems

A. ASHRAE should target reduced base loads as well as peak utility loads.

i. Create real-time load shedding information systems capable of integrating demand and loads in a two-way condition. This includes the broader definition and generation of the "smart grid."
ii. Broadly adopt net metering systems that encourage distributed generation in a manner that is profitable for all parties.
iii. Development of building based electrical (or energy) storage systems that provide dispatchable energy (including the "plug-in hybrid" systems).
iv. Generation and adoption of policy at the utility level that encourages the above, including smart residential and commercial utility interface kit sets.



Marketing Communications Plan

ASHRAE and its activities are well known within the HVAC&R industry. As the circle of groups involved in the financing, development, design, construction, and operation of buildings expands, eventually including building occupants and government regulators, awareness of ASHRAE diminishes.

The strategy to promote NZEB technology, and ultimately the construction of NZEBs, will have four prongs:

- Raise awareness within the building community of the feasibility for and the benefits of constructing NZEBs.
- Establish demand for building certification and professional accreditation within the building community.
- Promote the sale of NZEB-related publications and educational products.
- Build general public awareness that the technologies of building heating and cooling and industrial processes can be compatible with sustainable buildings.

Raising Awareness in the Building Community

Audiences for this marketing strategy will be communities consisting of architects, code officials, building developers, design-build professionals, and manufacturers.

The two major vehicles used to reach these audiences will be news and articles in trade publications and a Green Team Resource Group that will serve as a speakers' bureau for conferences and association meetings in the industry. This response team will also be prepared to share messaging when opportunities arise in the media.

A major initiative that will be explored is the creation of an NZEB Technology Conference. This conference will present invited speakers rather than assembling a program through a call for papers. The purpose of the conference will be to educate practitioners, government officials, and developers on the benefits of NZEBs. Both the technical side of NZEBs as well as financing and construction will be explored.

Establishing Demand for Certification

The most important and challenging aspect of the marketing communications effort will be to create demand for building certification and accreditation of professional NZEB services. This needs to be accomplished by building value in these programs and effectively communicating this value. Successful completion of this effort will support execution of the three other prongs of the strategy.

The steps to be followed for execution are:

a. Identification of market segments that make purchasing decisions related to NZEB construction and services.
b. Placement of "success" stories in communication vehicles that serve those audiences.
c. Targeted advertising campaigns in communication vehicles that serve those audiences.
d. Development of tools that can be used by owners of NZEB-certified buildings and by accredited professionals that will allow them to bring attention to the respective programs.
e. Promotion by ASHRAE that will result in business opportunities for persons earning certification, and promotion by ASHRAE to the general public that will draw attention to building owners and developers who support NZEB technology.

Promote Publications and Educational Products

A full suite of publications and educational products will be developed in support on NZEB technology. Promotion plans will be developed for these products, grouping them for efficient use of the marketing budget.

A key objective of the marketing communication strategy is to make the effort revenue neutral to ASHRAE through increased sales.

The primary market will be the ASHRAE membership. But professionals in all related disciplines will also be targeted with special emphasis on:

- Lighting designers
- Architects
- Contractors
- Owner's operating staffs

A concerted effort will be made to engage in cooperative marketing efforts with the associations serving these non-ASHRAE audiences.

Within ASHRAE, a program track promoting use of and engaging in discussion about NEZB products will be held at ASHRAE meeting. Other association partners will be encouraged to organize similar tracks at their meetings.

Build Public Awareness

It may be questioned whether any investment to reach the general public is an efficient use of resources. The ultimate beneficiary of NZEBs, however, is the public, and the public—as building occupants and through government—should be recognized as a force for the implementation of NZEBs.

Because the effort to reach the public will be so large, it is essential that ASHRAE not undertake this effort alone. An effort should be made to obtain funding from a foundation interested in advancing technology for environmental benefit. This also should be done in partnership with the other associations contributing to the effort, such as USGBC, AIA, BOMA, and IESNA.

Activities that will be pursued include:

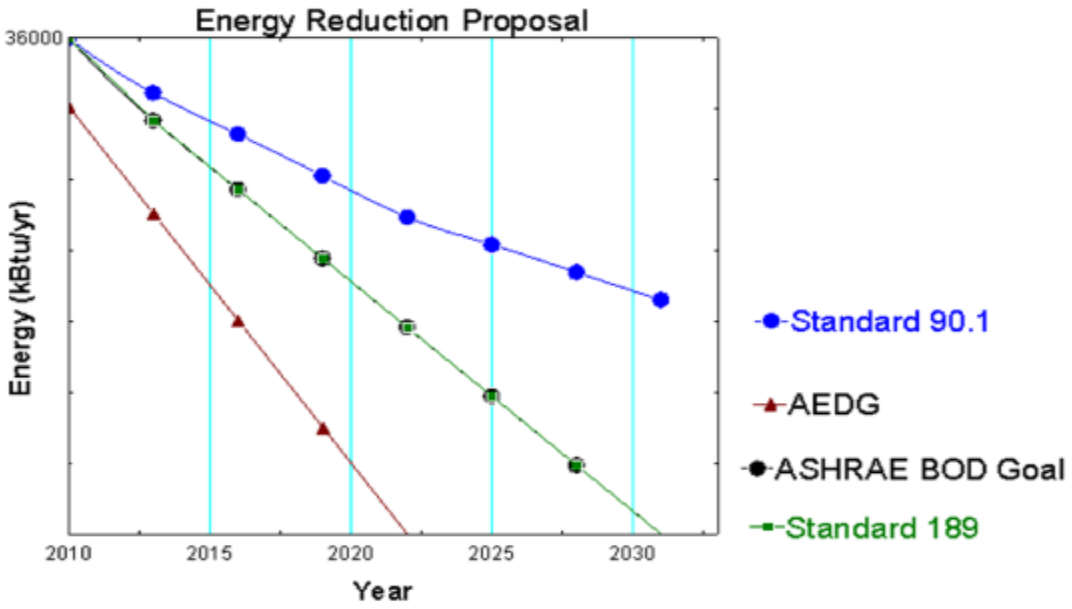
- PBS or NPR underwriting;
- Development of educational programming for secondary schools, perhaps based on adaptation of the ASHRAE eLearning module for NZEBs;
- Placement of articles in media dealing with office environments, such as the publications for chief financial officers, human resource managers, office administrators, etc.

The Plan for Existing Products

The code arena has many different versions (issue dates) of codes being used in different jurisdictions. Similarly, ASHRAE will likely need to have various versions available for an indefinite period of time of its publications related to NZEBs.

The following are fundamental points regarding ASHRAE NZEB documents:

- The ASHRAE documents should be referenced to a fixed baseline, ANSI/ASHRAE/IESNA Standard 90.1-1999.
- The document name should be tied to our ASHRAE baseline. AEDGs should give a percentage reduction from the baseline and the year of issue. For example, the title of an AEDG will not change once it is published, so a 30% AEDG remains a 30% guide. The next version would be more stringent—say, 40% or 50%. Each guide would be referenced to Standard 90.1-1999 as representing the "turn of the millennium." Thus, as new versions of Standard 90.1 (and Standard 189) are published, there will be a conversion given that identifies the percentage relative to the new version of the standard. For example, the 30% small retail guide savings relative to Standard 90.1-2004 are seven percentage points less than when compared to Standard 90.1-1999. Older versions will be made available in digital format with the recommendation that the user update to current versions.
- When the new versions of Standards 90.1 and 189 are issued, the AEDGs and other energy-related documents need to be updated. The older versions would still be available even if printed by demand (downloadable from the Web and in print)—this is how you buy ISO standards today. This also saves on mailing cost.
- The Standard 90.1 and 189 Energy Target Direction approved by the ASHRAE Board of Directors in March 2007 as shown below should be followed.
- Technology Council should take the lead in making sure that NZEB design documents are technical-content coordinated and coherent. This will require a review of *ASHRAE Handbook*, special publications, standards, and guidelines.
- Products should be made available in the market as an integrated suite of products—for example, the Commercial Energy-Efficiency Suite (Standard 90.1, 90.1 Users Manual, and five 50% AEDGs and e-Learning modules).



Volunteer Coordination

Strategic Direction 1 of the ASHRAE Strategic Plan states that ASHRAE will lead the advancement in sustainable building design and operation. Further, strategy 1.2 states that ASHRAE will lead the drive toward the design, construction, and operation of NZEBs through research, publications, and education.

To accomplish this, coordination strategies will need to cut across all councils. Technology Council and its committees have the research point in the strategy stating that ASHRAE will lead the drive toward the design, construction, and operation of NZEBs through research, publications, and education. The Publication and Education Council (PEC) has the responsibility for the publishing of the technical information related to net zero energy and for producing education programs for training of building professionals.

In order to stay ahead of developments, Technology Council and Publishing and Education Council should communicate regularly regarding strategy 1.2 actions plans, schedules, and results. To ensure this communication, both councils should consider appointing a champion for this strategy that reports progress to their respective councils. These champions would work together and establish routine communication so that both councils are aware of work being done by both councils and their respective standing technical and project committees.

Members Council and the Chapter Technology Transfer Committee (CTTC) will also play a vital role in the move to net zero energy use in facilities. CTTC should be on point for outreach to ASHRAE chapter members regarding progress being made in NZEB design, construction, and operation. The first need will be to convince ASHRAE members and other stakeholders of the importance of this work. Working with the Publications Committee, this outreach, including progress, should be done through publication of articles in *ASHRAE Journal* and other periodicals and through chapter meeting materials designed to get the message across.

All three councils will need to work together to develop the materials required to deliver this message. To that end, both Technology Council and Publishing and Education Council should appoint liaisons to CTTC and Members Council whose responsibility is to keep CTTC informed of the progress being made toward net zero energy usage in facilities.

Appendix ASHRAE Vision 2020: NZEB Research Topics

Following is a more detailed listing of possible research topics needs to provide net zero energy design guidance:

ASHRAE Research Topics—Priority 1

Topics listed as Priority 1 fall within ASHRAE's core competency.

Building Envelope
The building envelope should be designed to match buildings loads and resources. For example, on a residential scale the U.S. Department of Energy Research Toward Zero Energy Homes demonstrates methods to get to 70% efficiency and recommends roof areas with a given efficiency of solar domestic hot water (SDHW) and photovoltaics (PV) to meet the remaining loads. This methodology can be applied to commercial typologies as well. For buildings with high lighting requirements, daylighting needs to be a primary façade element; similarly, cooling or ventilation loads should influence envelope design. Some areas to develop include:

a. Dynamic "advanced" facades
b. Glazing
c. Frames
d. Daylight devices
e. Envelope airtightness

Design Tools
There is a need for more accurate geometry for architectural models imported into energy simulation programs. Actively pursue standardizing interoperability between software tools and developing software tools that can accurately model net zero energy buildings (NZEBs).

Small Power/Plug Loads/Miscellaneous Loads
Since these loads are not regulated in Standard 90.1 and also not under the control of the designer, they tend to be neglected. It is important that an evaluation of process, cooking, and refrigeration loads are factored in to the NZEB calculation.

Operating Issues
There is a need to reduce constraints imposed by the structure of the current building industry. Maintainability, simplicity, ease of operation, and controllability are important considerations to ensure optimal operation of a NZEB.

ASHRAE Research Topics—Priority 2

Some Priority 2 research topics do not fall under ASHRAE's core expertise. They should be addressed by working with the indicated organizations.

Design Tools
The following may be pursued with assistance from IESNA.

a. Daylighting simulation and evaluation tools
b. Ability to size HVAC systems accounting for daylighting technologies including thermal storage
c. Renewable energy integration tools

Electrical Power
ASHRAE should work with IEEE and others to address these issues.

a. Demand control and load shedding
b. Electrical equipment efficiency
c. Integrating renewable generation (DC current) in building electrical systems
d. Small scale cogeneration integration
e. Electrical storage
f. Net metering standards

Service Water Heating
These items are not addressed by the Research Strategic Plan (RSP) but will impact NZEBs.

a. Research projects/new standards
b. Domestic Hot Water (DHW) conserving fixtures
c. Instantaneous DHW systems

ASHRAE Research Topics—Priority 3

Some Priority 3 research topics do not fall under ASHRAE's core expertise. They should be addressed by working with the indicated organizations.

Climate Typology
Co-publish solar and wind data with NREL solar databases. There is a need for a better index of clear/cloudy skies and to understand the implications for design.

Topics Addressed Outside of ASHRAE Research

The following topics are important to the ASHRAE Vision 2020 initiative and are being pursued, or should be pursued, by other committees within ASHRAE, such as the Research Advisory Panel impaneled to development the next-generation Research Strategic Plan and the Advanced Energy Design Guide Steering Committee. Continued attention should be given to these topics to enhance net zero energy design guidance.

Climate Typology

a. Develop basic recommendations for each of the ASHRAE climate zones to simplify "packages" of recommendations for designers (currently being addressed by the AEDG committee).
b. "Advanced Energy Design Guide" approach for larger facilities to hit efficiency improvements of 70% relative to baseline (currently being addressed by the AEDG committee).
c. Better envelope standards guidance per location and orientation (currently being addressed by Standing Standard Project Committee 90.1).
d. Consider the extension of the comfort zone (should be addressed by Standing Standard Project Committee 55).

Design Tools

a. Provide building balance point tools for use in the schematic design stage to match building envelope to climate conditions (currently addressed in the ASHRAE Research Strategic Plan).
b. Energy simulation for Standard 90.1 evaluation.

HVAC

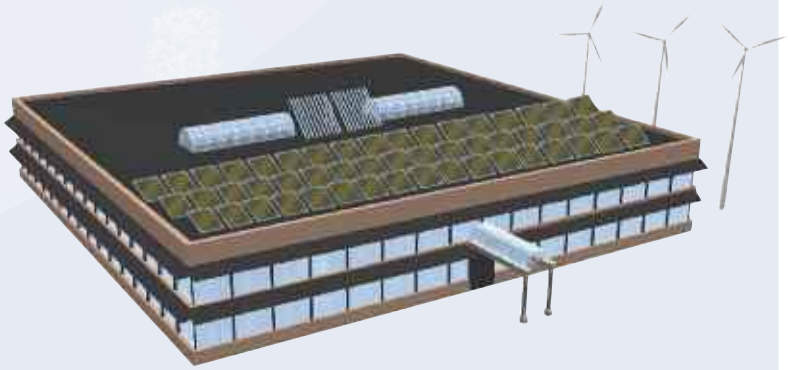
HVAC is currently addressed in the ASHRAE Research Strategic Plan.

a. Natural ventilation design standards and guidance
b. Alternative HVAC distribution
c. Boiler efficiency
d. Chiller efficiency
e. Increase the delivered efficiency of heating, cooling, and ventilation, perhaps with a shift from air to water as the medium for energy
f. Consider total combined energy efficiency: fan energy, electrical distribution, and gas distribution

Lighting

Lighting is currently addressed by IESNA.

a. Lighting system design with emphasis on lighting quality, task lighting, and sample packages of lighting system designs that reduce the required lighting power density
b. Lighting controls
c. Lamp technology
d. New lamp materials (photonic crystals)



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ASHRAE Research Strategic Plan 2005-2010

Navigation for a Sustainable Future

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Overview and Vision

The ASHRAE Research Strategic Plan centers on the concept of sustainability. The world has finite resources, so it is essential to effectively utilize those resources to accomplish the mission of ASHRAE, which is to *advance the arts and sciences of HVAC&R to serve humanity and promote a sustainable world.* Sustainability is the concept of maximizing the effectiveness of resource use while minimizing the impact of that use on the environment. In terms of the thrust of ASHRAE activities, measures that reduce energy use should additionally minimize the negative impacts of carbon and other emissions, ozone depletion, noise, and other detrimental effects. ASHRAE's Research Plan resulted from this consideration and is based on five broad, far reaching research opportunity themes:

- Energy and Resources
- Indoor Environmental Quality
- Tools and Applications
- Equipment, Components and Materials
- Education and Outreach

Who is ASHRAE?

ASHRAE, founded in 1894, is an international organization of 55,000 persons. It is the world's foremost technical society in the fields of HVAC&R. Through its meetings, research, standards writing, publishing and continuing education, the Society helps keep indoor environments comfortable and productive, deliver healthy food to consumers and preserve the outdoor environment.

ASHRAE's Research Vision

ASHRAE will conduct timely research to remain the foremost, authoritative and responsive international source of technical and educational information, standards and guides on the interaction between people and the indoor and outdoor environment through the operation of HVAC&R systems in buildings and other applications.

Development of the Plan

The plan was developed collaboratively over a three-year period by ASHRAE's Research Advisory Panel, which was chaired by John Mitchell. Input was provided by ASHRAE chapter members, technical committee (TC) members, research fund contributors and representatives from HVAC&R-related organizations throughout the process via workshops, forums, e-mails and letters. The plan provides outcome-based goals so that rather than specifying the exact type of research to be conducted, projects are solicited to meet broad performance goals. Implementation of the plan will be through ASHRAE's TCs as they develop specific research topics that support the plan's goals. The Research Administration Committee in turn will evaluate and prioritize these topics against the plan so the topics that best address these goals are funded first. The plan will be updated every five years following the same broad input collection process so that it remains pertinent in a rapidly changing HVAC&R research environment.

Navigating the Plan

Specific goals for each of these research opportunity themes were developed. These goals are outcome-based, which means that rather than specifying the type of research that should be conducted, the outcomes in terms of performance are specified. This approach will provide flexibility and encourage innovation in research. Many of the goals are measurable, meaning that progress toward reaching the goals can be determined to assess the success of the research. Each of the research opportunity themes has under it a number of topical areas and example projects that could be undertaken to meet the goals. These lists are neither exclusive nor all-inclusive. The topics listed are intended to provide examples of research that might be undertaken to meet the goals.

ASHRAE
Engineering for Sustainability

A. Energy and Resources

Goals

A1• Provide guidance on techniques to achieve 30, 50 and 70% reduction of building energy usage based upon the energy codes in place at the turn of the millennium. The goals are to move 30% toward net zero-energy use buildings by 2008, 50% by 2012 and 70% by 2015. (Net zero-energy use buildings consume equal or less energy than they produce on an annual basis.)

A2• Produce by 2015 new residential and light commercial buildings that have 70% less energy use than buildings built at the turn of the millennium according to ASHRAE Standard 90.2, *Energy-Efficient Design of Low-Rise Residential Buildings*.

A3• Develop economically viable applications of renewable energy that produce 25% reductions in conventional energy use by 2015.

A4• Develop systems and components that reduce energy use in supermarkets by 30% by 2015.

A5• Optimize and make consistent ASHRAE Standards 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* 62.1, *Ventilation for Acceptable Indoor Air Quality*, and 55, *Thermal Environmental Conditions for Human Occupancy*, to achieve measured and verified high system energy efficiency with high indoor environmental quality (IEQ) for indoor built environments.

A6• Develop integrated, best practice design methods that will allow energy consumption, life cycle cost and environmental impact to be minimized, and that will allow system life span and IEQ to be maximized.

A7• Develop evaluation methods that allow reductions in energy, cost and emission as well as improvements in comfort, health and productivity to be quantitatively measured.

A8• Establish benchmark data on energy use in industrial refrigeration.

Possible Research Projects

Energy and Resource Efficiency
- Develop guides for energy efficiency by building and system type
- Generate baseline data and ratings that quantify the performance of existing buildings and systems
- Develop methods for resource conservation and recycling of building components
- Determine the environmental impact of buildings and their materials
- Determine the cost of energy resources: buildings, systems, transportation, power generation and distribution

Integrated Design for High Performance Buildings and Systems
- Develop energy, health and comfort rating systems (analysis tools and simulation, lifecycle analysis, sensors, understanding of health issues, quantification of comfort in micro-climates)
- Advance integrated design principles and processes
- Optimize application of ASHRAE Standards 90.1, 62.1 and 55
- Integrate normal and extraordinary building controls with smoke/fire alarm systems
- Design controls for serviceability (fault detection and diagnosis, self correction, auto-call for maintenance)
- Develop performance metrics and rating systems for buildings, systems and components
- Develop optimized system design and simulation tools for conventional and innovative systems
- Develop methods for whole building design that include, for example automatic fault detection and diagnostics, self-continuous commissioning, extraordinary incident response, integration of lighting and recycled materials

Building and System Operation
- Continue development of standards and measurement techniques for performance
- Develop optimized, reliable, and practical control and diagnostic techniques
- Develop peak load management: operations, design and controls methods
- Optimize commissioning and operation

Environmental Impact
- Generate sustainable design concepts to support innovative design guides
- Transform the *ASHRAE GreenGuide* into multiple guides for specific applications
- Evaluate use of low environmental impact materials and construction techniques
- Advance the application of natural refrigerants
- Assess the environmental impact and sustainability of engineering activities within and linked to ASHRAE

Renewable Energy Applications for Buildings
- Develop integrated solar/renewable heating and cooling technologies
- Provide performance data, risk information and design guides for renewable energy techniques
- Overcome barriers to the widespread implementation of ground source heat pumps
- Address distributed energy system and utility interconnection regulation issues
- Develop daylighting system design guides
- Develop designs for net zero energy buildings

B. Indoor Environmental Quality

Goals

B1• Make improvements in occupant health and comfort that can yield a 20% increase in productivity by 2015.

B2• Provide an optimal indoor environment for buildings, vehicles and facilities with respect to comfort, productivity, health and safety.

B3• Provide better understanding of how contagious viruses, such as SARS, influenza, tuberculosis, hemorrhagic fevers and other respiratory diseases, are transmitted in an indoor environment and develop remediation techniques and equipment to minimize exposure.

B4• Develop self-diagnostic inspection methods for HVAC&R systems that minimize negative impacts on comfort, health and productivity.

Possible Research Projects

Comfort, Health, Productivity

- Quantify IEQ for buildings by developing baseline data, determining acceptable levels and improving measurements for comfort, health and productivity
- Characterize non-human environments
- Determine the effects of extraordinary incidents on buildings, facilities and mass transit vehicles
- Develop methods to control airborne viruses through transmission, exposure minimization and remediation
- Determine the cost of providing a comfortable, healthy and productive environment
- Develop quantitative relationships among variables impacting comfort, health and productivity
- Develop a "knowledge base" of measurable effects on IEQ from the comfort, health and productivity variables (showing different building types)
- Establish criteria for determining integrated effects of light, IEQ, noise, thermal occupant comfort-odors and well-being on productivity
- Establish criteria for determining integrated occupant clinical health and disease on health
- Identify acceptable comfort and health baselines for new and existing residential, commercial, institutional and industrial buildings

Moisture and Mold

- Develop improved methods for moisture management in buildings
- Develop more energy efficient and environmentally acceptable methods for dehumidification
- Develop measurement tools to detect moisture and mold accumulation or levels of concentration in building envelopes

Ventilation System Design

- Develop design methods for mixed (natural and mechanical) mode ventilation
- Develop design tools, especially for natural ventilation
- Improve filtration and air treatment technologies for particulates and smoke
- Develop methods to evaluate building envelope infiltration, internal building air leakage and pressure distribution

Innovative and Alternative Ventilation Strategies

- Improve displacement ventilation
- Improve underfloor air distribution
- Improve disinfection and filtration methods
- Evaluate demand controlled ventilation strategies

C. Tools and Applications

Goals

C1• Develop more effective tools that will improve the productivity of the design process by 25% by 2015.
C2• Develop dual path standards where paths are prescriptive based and performance based.
C3• Develop methods allowing designers to accurately and confidently model a building in virtual reality in no more than one week by 2010.
C4• Develop a measurement-based rating system to establish the environmental performance of a building and its system.
C5• Develop self-calibrating and inexpensive sensor systems that allow measurement of control variables, comfort, health and productivity.
C6• Establish design tools to improve the installed energy efficiency of HVAC&R systems and their components.
C7• Provide design guidance for buildings and systems to address the past and expected change in climatic conditions.

Possible Research Projects

Design Tools
- Develop design tools for improving the energy efficiency of HVAC&R systems
- Develop design tools for improving IEQ in buildings
- Develop simplified tools to evaluate HVAC&R system options
- Improve and simplify design and simulation tools for HVAC&R systems
- Integrate the design, construction, operation and maintenance processes
- Improve interdisciplinary coordination and communication during design
- Develop visualization tools for HVAC&R industry that enable architects and engineers to work together more effectively
- Develop designs for extraordinary incidents
- Develop prescriptive/performance based design standards
- Develop a multifaceted tool to evaluate all of a building's energy and environmental impact parameters
- Develop design tools to address emerging industry trends and new building techniques

Performance Evaluation Tools
- Develop energy use and performance metrics evaluation tools for HVAC&R systems
- Assess the performance benefits of system and component improvements
- Develop multi-disciplinary performance tools
- Develop methods to evaluate the environmental footprint of a building
- Develop microprocessor-based tools/devices to measure system and equipment energy use
- Determine diversity factors for internally loaded buildings
- Develop self contained wireless sensors for performance evaluation
- Develop onsite tools to compare performance to design

Performance Metrics
- Develop building and system performance rating systems
- Develop tools for real time measurement of system operating parameters
- Develop improved building and process load monitoring
- Develop repeatable building performance procedure for energy use, carbon rating and IEQ
- Develop building and system certification that recognizes exceptional operation
- Develop methods to measure performance and verify design ratings
- Generate a data base to verify building performance (energy and IEQ) with reduced ventilation
- Develop means for automated collection and transfer of building, system and component data

Operation and Maintenance
- Develop operating plans for buildings under extraordinary incidents
- Develop tools for reliability-centered maintenance
- Develop sensors for environmental control including cleaning/maintenance, fault detection and diagnostics and physiological parameters (health and comfort)
- Determine standard methods of predictive and preventive maintenance procedures

New Applications for HVAC&R
- Identify appropriate nanotechnology manufacturing processes and end-use applications
- Identify appropriate nanotechnology mechanisms for operation and control
- Explore cryosurgery applications
- Assess electronic equipment cooling and super conductivity
- Evaluate methods for natural gas and hydrogen liquefaction

D. Equipment, Components and Materials

Goals

D1• Establish techniques to improve the energy efficiency and reliability of heating, ventilating, cooling and refrigeration system components.

D2• Continue research into new alternative and natural refrigerants.

D3• Improve performance and reliability and minimize the environmental impacts of working fluids and materials.

D4• Advance ASHRAE's role in the safety and security of food distribution.

D5• Develop reliable, durable and self-correcting sensor technology for monitoring indoor environmental quality, pollutants, energy conservation, and fault detection and diagnosis.

D6• Move one or more of the non-traditional technologies that has comparable performance and cost to traditional vapor compression systems to market readiness by 2010.

D7• Develop techniques that reduce the installed energy use of HVAC&R system auxiliary equipment by 50% by 2015.

Possible Research Projects

Sensors and Controls

- Develop new and wireless sensing and control technologies for comfort, lighting and building load
- Identify and develop nanotechnology applications for HVAC&R
- Develop specifications for properly selecting sensors and systems based on performance, reliability and dependability

Equipment

- Improve performance (including humidity control and mold prevention) and energy efficiency in refrigeration equipment
- Improve safety, security and integrity of refrigeration systems with emphasis on those for food and water supplies
- Develop performance rating systems for HVAC&R equipment
- Develop guides that define best practices and best designs for HVAC&R applications
- Develop techniques to address safety and environmental impact of fuels and combustion equipment
- Develop techniques to improve installed heating system efficiencies
- Develop techniques to improve installed ventilation system efficiencies

Materials

- Develop information for CO_2 and other alternative and natural refrigerants comparable to that for current, conventional refrigerants
- Develop long-term reliability, safety and performance property data for alternative and natural refrigerants and secondary coolants
- Advance fundamental heat transfer research
- Develop information on the interactions between refrigeration materials

Alternative Technologies

- Develop performance models of alternative cooling systems and the appropriate property data needed
- Characterize performance and cost of alternative cooling system as a function of climate
- Develop performance models of alternative heating and ventilation systems
- Develop the materials needed for these systems (working materials, components, optimization, design techniques)

E. Education and Outreach

Goals

E1• Make the results of ASHRAE sponsored and cooperative research available to the technical community.

E2• Ensure that ASHRAE research has an international impact.

Possible Research Projects

Dissemination of ASHRAE research results

- Generate symposia that convey new results in a given research theme
- Develop Web-based "state-of-the-art" research theme summaries
- Develop Web-based compilations of new results in a given research theme
- Develop Web-based or hard copy materials to educate building owners about new and current ideas in energy use and conservation
- Develop peak load and load shifting techniques and guides
- Develop technician training modules
- Develop online interactive educational materials on ASHRAE research results, especially for use by ASHRAE chapters

ASHRAE Outreach Activities

- Modify ASHRAE standards to appropriately meet needs of members in developing nations
- Monitor and evaluate research by other organizations
- Disseminate appropriate research results to other organizations
- Develop materials to support a "technical peace corps" for developing nations
- Develop materials to support new and proposed codes and standards
- Develop on-line interactive educational materials on ASHRAE research results aimed at other organizations

ASHRAE International Dimensions

- Monitor and evaluate research by other international organizations
- Disseminate appropriate research results to other international organizations
- Develop cooperative outreach and dissemination activities with international organizations

To download the plan or for more information about ASHRAE's research program click www.ashrae.org/research

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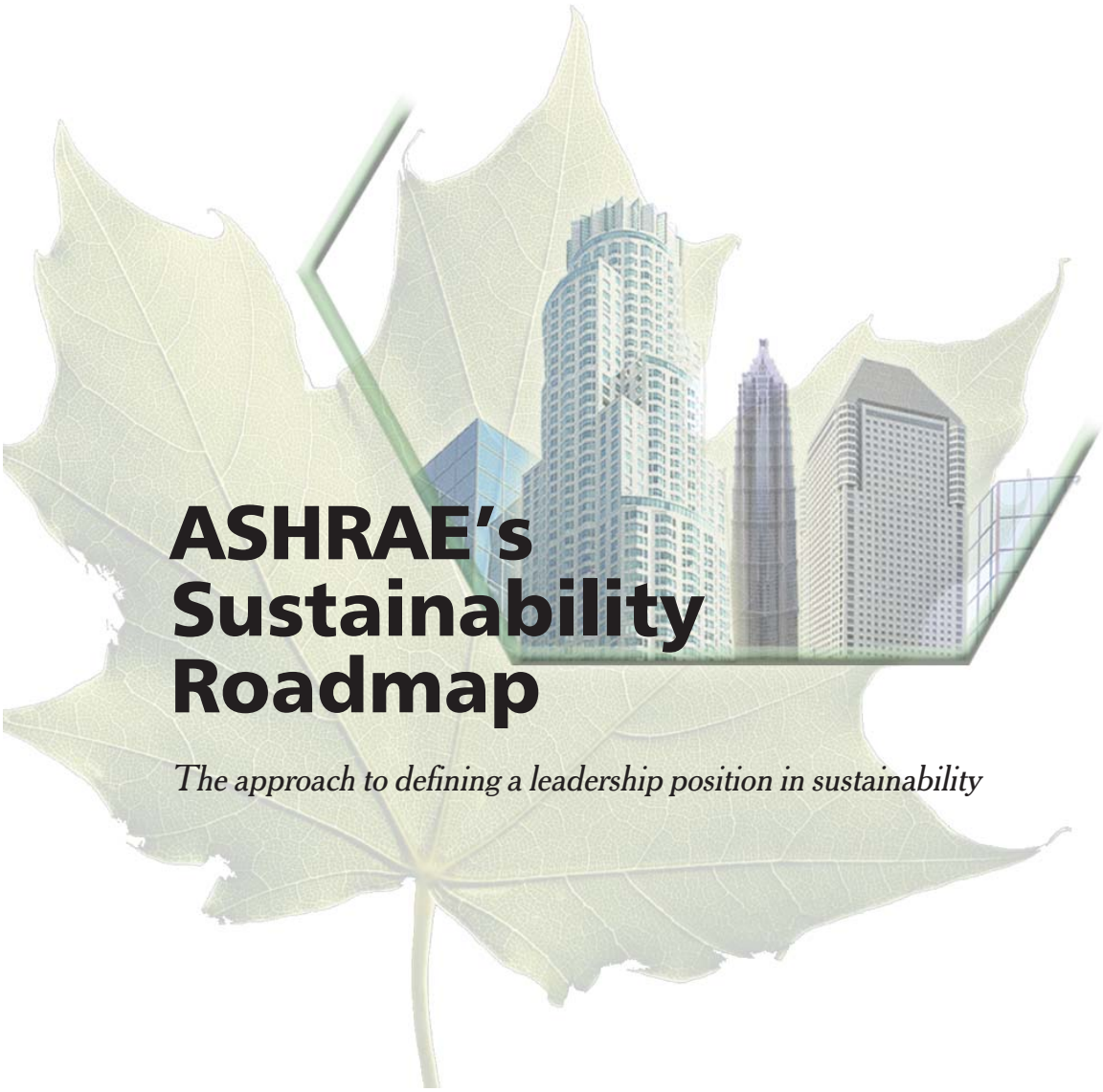

ASHRAE's Sustainability Roadmap

The approach to defining a leadership position in sustainability

Approved by ASHRAE Board of Directors
January 22, 2006

ASHRAE
Engineering for Sustainability

Presidential Ad Hoc Committee

ASHRAE's Sustainability Roadmap

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Executive Summary

This document guides the Society's efforts in defining a leadership role in sustainability.

ASHRAE's Sustainability Roadmap follows a set of overarching goals:

- Expand our efforts to foster sustainable buildings.
- Conduct our own affairs in a sustainable manner.
- Lead in researching technologies that enable the design and application of sustainable HVAC&R equipment and systems.
- Integrate building sustainability principles, effective practices and emerging concepts into all appropriate ASHRAE standards, guidelines, research, Handbook chapters and publications.
- Partner with appropriate sustainability advocacy organizations where our strengths are complementary.
- Develop materials and programs related to sustainability to educate and inspire the current and next generation of members.

The Roadmap identifies and quantifies ASHRAE's sustainability impacts, beginning with the process of setting goals and continuing through implementing strategies for improving those impacts in the years ahead.

The Roadmap makes several key recommendations:

- Develop and maintain productive relationships with other organizations in the sustainability field.
- Raise public awareness of ASHRAE's contributions to sustainability.
- Aggressively market ASHRAE's sustainability profile in the industry.
- "Walk the talk" by practicing what we preach.
- Develop educational products that assist in sustainable building design, building operation and evaluation.
- Implement the sustainability-oriented objectives in the Society's Research Strategic Plan.
- Accelerate development of the *Advanced Energy Design Guide* series.
- Implement sustainability certification.
- Act on sustainability-related strategic directions included in the Society's Strategic Plan.

To ensure the success of Roadmap implementation, the following milestones have been established:

- 2006 ASHRAE Winter Meeting – Liaisons appointed from the Society to organizations with whom ASHRAE partners on sustainability initiatives.
- Calendar Year 2006 – Implement various public relations and marketing initiatives, including creating the Green Team, exploring sustainability as a component of the AHR Expo, re-focusing the ASHRAE Technology Awards on sustainability achievements, and writing articles for related industry publications describing sustainability practices and which provide ASHRAE guidance.
- 2006 ASHRAE Annual Meeting – Conduct this meeting as a sustainable meeting, conforming to accepted sustainability guidelines for meeting organization and operation.
- 2006 ASHRAE Annual Meeting – Make the ASHRAE Headquarters renovation project a LEED EB project.

- 2006 ASHRAE Annual Meeting – Technology Council to move sustainability-related research projects up in priority and monitor their implementation to ensure timely completion.
- 2007 ASHRAE Winter Meeting – ASHRAE Technical Committee 2.8 "Building Environmental Impacts and Sustainability" to review ASHRAE materials and literature and make recommendations to the Society's Technology Council and Publishing and Education Council regarding needed projects and publications.
- 2007 ASHRAE Annual Meeting – Offer online based learning for sustainability and certification program.
- 2007 ASHRAE Annual Meeting – Funding provided such that publication of the *Advanced Energy Design Guide* series is accelerated by one year from originally scheduled completion dates.
- 2008 ASHRAE Winter Meeting – Develop rating systems to certify building operational performance for sustainability.
- 2008 ASHRAE Annual Meeting – Offer a full complement of publications that provide sustainable design guidance for all types of buildings and that make available life cycle cost analysis information of building components and systems.
- 2009 ASHRAE Winter Meeting – Partner with other organizations to develop standards on all aspects of sustainable building design and operation, including recyclability as well as a standard articulating a sustainability performance metric.
- 2009 ASHRAE Winter Meeting – Publish guides for building owners that emphasize the benefits of decision making based on life-cycle-cost analysis.

Overview of the Roadmap

ASHRAE's Sustainability Roadmap provides goals and guidance necessary to assist the Society in defining a leadership position in sustainability. The Roadmap includes:

- Background for Roadmap Development
- Market Demand for Sustainability Leadership
- What is Sustainability?
- ASHRAE's Goals for Sustainability
- ASHRAE's Impact on Sustainability
- ASHRAE's Relationship with Other Organizations
- Implementation Plan: Recommendations for Achieving "Engineering for Sustainability" Leadership
- Sustainability Roadmap Milestones

Background for Roadmap Development

In August, 2005, ASHRAE President Lee Burgett appointed a Sustainability Roadmap Ad Hoc Committee with the following charge: *"Develop a roadmap for ASHRAE's involvement in sustainability. The issue of sustainability is broad, and ASHRAE is deep and strong in some aspects such as energy conservation. The thrust is to identify new areas of involvement, including relationships with other organizations. The outlook should be both short-term and long-term."*
The committee began its work by examining the Society's Position Statement on Sustainability.

That document, approved in June 2002 by the ASHRAE Board of Directors, pledges the Society's support of building sustainability as a means to provide a safe, healthy, comfortable indoor environment while simultaneously limiting the impact on the Earth's natural resources. Specifically, the position statement calls for ASHRAE to:

- Consider integrating sustainability principles into all appropriate ASHRAE standards, guidelines, Handbook chapters and publications.
- Actively participate with internationally recognized building sustainability groups where deemed appropriate.
- Promote and provide education on sustainability to its members and society through the ASHRAE Learning Institute and grassroots chapter activities.

In the years since adoption of the position statement, ASHRAE has made significant progress in achieving these objectives. *Advanced Energy Design Guides* have been initiated, sustainability-focused educational programs have been developed, and partnerships with building sustainability groups have been initiated.

Market Demand for Sustainability Leadership

In 2005, ASHRAE completed a broad-based, comprehensive market research study of members and potential members. The primary objectives of the research were to examine growth opportunities and to identify how ASHRAE can make its business practices more customer and member focused.

This research indicated strong desire among members and non-members of all ages for products and services on green building topics, Based on this opportunity, the Board Planning Committee in June 2005

recommended and the ASHRAE Board of Directors endorsed "Engineering for Sustainability" as a Society priority. It further recommended that this priority be communicated to all levels within the Society with the commitment of appropriate resources.

The intent of this Roadmap is to guide ASHRAE to achievement of that vision: A leadership position in sustainability. The Roadmap will stimulate and guide the process of "doing things differently" within ASHRAE. The result will be an ASHRAE, which by responding to its membership, better enables its members to make a profound impact on what it means to design, build and operate sustainable buildings.

If implementation of this Roadmap is successful, buildings employing sustainable technologies will be in greater demand, the critical need for contributions by ASHRAE members will be better understood, and the quality of life will be enhanced in the present and long into the future.

Through the direction and focus established by ASHRAE's Sustainability Roadmap, ASHRAE members, through application of advanced technologies, can lead the march towards a sustainable built environment, giving substance to the "Engineering for Sustainability" initiative.

What is Sustainability?

The *ASHRAE GreenGuide* defines sustainability as "providing for the needs of the present without detracting from the ability to fulfill the needs of the future."

A green building is one that achieves high performance over the full life cycle in the following areas:

- Minimal **energy consumption** due to reduction of need and more efficient utilization of both renewable and non-renewable natural resources;
- Minimal **atmospheric emissions** having negative environmental impacts;
- Minimal discharge of **harmful liquid effluents and solid wastes**;
- Minimal negative impacts of **site ecosystems**;
- Maximum **quality of the indoor environment**.

This Roadmap guides ASHRAE's efforts in helping its members in building sustainability and green building design, construction and operation.

Why is Sustainability Important?

Buildings fundamentally impact people's lives and the health of the planet. In the U.S., buildings use one third of our total energy, two-thirds of our electricity, one-eighth of our water, and transform land that may provide a valuable ecological function. The worldwide market for environmental goods and services is estimated to be $600 billion annually.

In accordance with the definitions of sustainability and green, what society does today impacts what happens to future generations. Efficient energy use is of prime importance but so are the materials used, what is emitted

and disposed of, and how we impact existing ecosystems. We cannot do these things at the expense of health and well-being so it is vital to maintain excellent indoor environmental quality. ASHRAE, as the organization of professionals who are responsible for the total life cycle cost of the building – design, operation and evaluation – has expertise that impacts elements related to sustainability. These elements include building materials, indoor environmental quality, land use, water use, and waste management and disposal, as well as:

Energy Use

Buildings consume approximately 37% of the total energy and 68% of the electricity produced in the United States annually, according to the U.S. Department of Energy. Implementing energy saving technologies reduces the cost to maintain a building. In addition, environmental concerns and the impact of energy consumption must be considered, along with the need to design energy-efficient buildings.

Atmospheric Emissions

The use of HVAC&R technologies is an essential element of contemporary life. Yet, HVAC&R systems contribute to greenhouse gas releases directly and indirectly through energy-related effects and directly through the effect of refrigerant losses. Worldwide concern for the global climate has emerged with the recognition of increasing concentrations of greenhouse gases in the atmosphere and with reports of increased average global temperatures. Scientific evidence clearly suggests that responsible, cost-effective measures should be adopted in the building industry. Both release-related and energy-related effects must be considered in a life-cycle environmental approach.

Engineering Design and Architecture

As the world has increased in population and developed technologically, the consequences of uncontrolled growth are being recognized: pollution, toxic waste creation, waste disposal, global climate change, ozone depletion, deforestation and resource depletion, and water and energy shortages. The built environment contributes significantly to these effects. The building industry's recognition of the impacts of its activities is changing the way it approaches the design, construction, operation, maintenance, reuse and demolition of what it creates – toward addressing the environmental and long-term economic consequences of its actions.

Facility Management, Commissioning

Commissioning typically helps to ensure good indoor environmental quality, reduce energy and water consumption, and improves how well the building is operated.

Other justifications for green design, according to the *ASHRAE GreenGuide*, include:

Doing the Right Thing

The motivations and reasons for implementing green buildings are diverse but can be condensed into essentially wanting to do the right thing to protect the earth's resources. For some, a wakeup call occurred in 1973 with the oil embargo–and with it a realization that there may be a need to manage our planet's finite resources.

Regulations

Society has recognized that previous industrial and developmental actions caused long-term damage to our environment, resulting in loss of food sources and plant and animal species, and changes to the earth's climate. As a result of learning from past mistakes and studying the environment, the international community identified certain actions that threaten our ecosystem's bio-diversity–and consequently it developed several governmental regulations designed to protect our environment. Thus, in this sense, the green design initiative began with the implementation of building regulations. An example is the regulated phasing out of chlorofluorocarbons.

Lowering Ownership Costs

A third driver for green design is lowering the total cost of ownership in terms of resource management and energy efficiency. Examples include controlling site storm water for use in irrigation, incorporating energy efficiency measures in HVAC design, or developing maintenance strategies to ensure continued high-level building performance.

Increased Productivity

Another driver for green design is the recognition of increased productivity from a building that is comfortable and enjoyable and provides healthy conditions. Comfortable occupants are less distracted, able to focus better on their tasks/activities, and appreciate the physiological benefits good green design provides.

Filling A Design Need

There are increasing numbers of building owners and developers asking for green design services. As a result, there is considerable business for design professionals who can master the principles of green design and provide leadership in this arena.

ASHRAE's Goals for Sustainability

To achieve and maintain a position of leadership, ASHRAE will:

- Expand our efforts to foster sustainable buildings.
- Conduct our own affairs of the Society in a sustainable manner.
- Lead in researching technologies that enable the design and application of sustainable HVAC&R equipment and systems.
- Integrate building sustainability principles, effective practices and emerging concepts into all appropriate ASHRAE standards, guidelines, research, Handbook chapters, and other publications.

- Partner with appropriate sustainability advocacy organizations where our strengths are complementary.
- Develop materials and programs related to sustainability to educate and inspire the current and future generation of members.

ASHRAE's Impacts on Sustainability

ASHRAE has an enormous impact on many aspects of the economy, and consequently, on the environment. Its spheres of influence can be divided into three major categories:

- The Society as an organization.
- The members of the Society.
- The publications, research and standards produced by the Society.

ASHRAE as an Organization

As an organization with more than 100 employees, 55,000 members and an annual budget of $17 million, ASHRAE conducts many activities that have environmental impacts and which could be the focus of efforts to improve their sustainability, as shown in the left column of Figure 1. These activities are the direct actions of the Society, and their sustainability can be *directly* affected by policies and decisions of the Society.

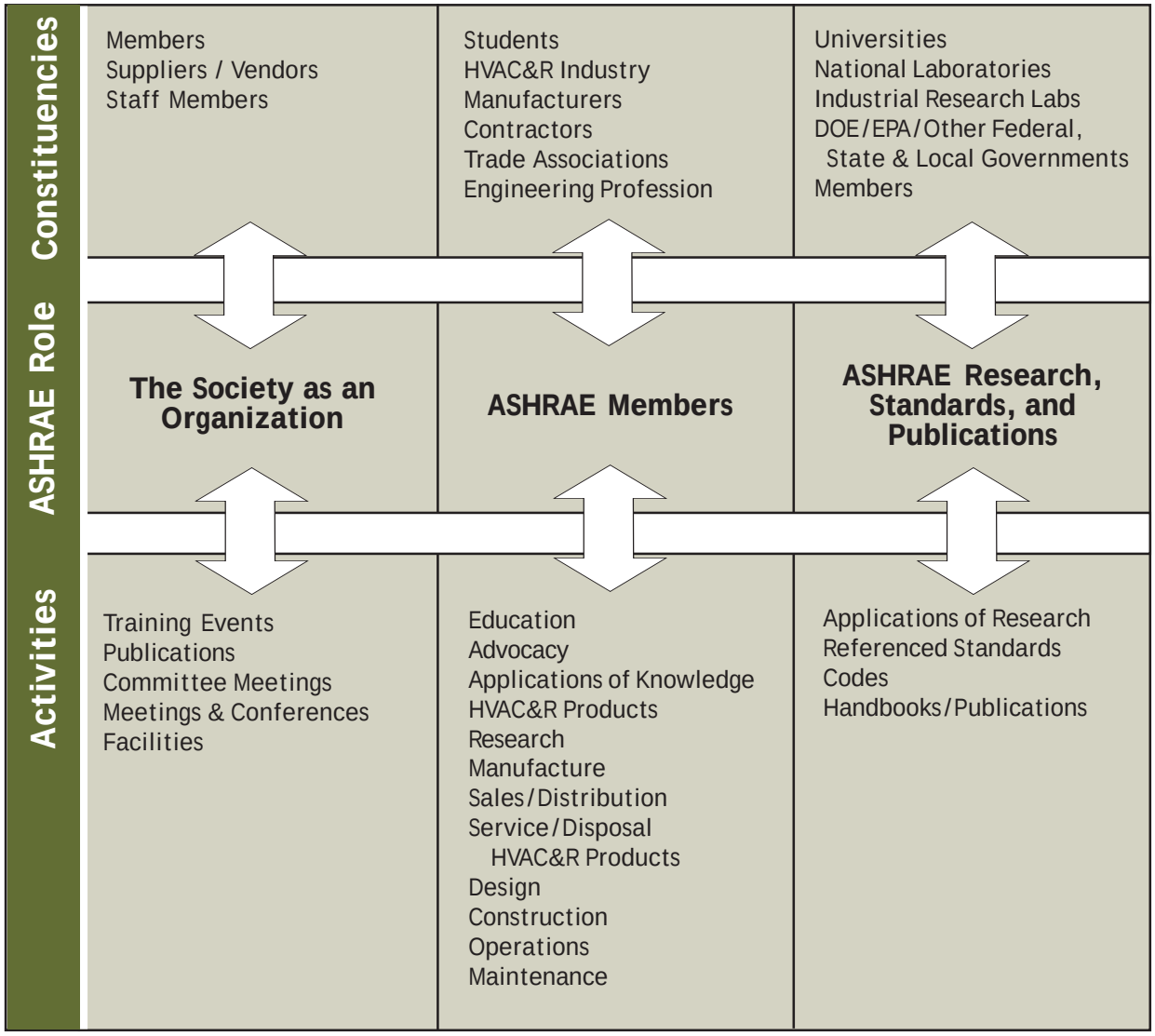
A critical element in deciding to reduce these direct impacts is to develop quantitative metrics of the impacts, tracking them as mitigation measures are implemented. The process for this is that ASHRAE would establish policies for sustainability, with quantified goals for impact reduction and methods for measuring and tracking progress toward the reduction goals. This could be done internally or externally in the context of becoming certified under ISO 14001, which would be a clear statement and commitment to the public of ASHRAE's goals regarding sustainability.

Society Members

As a membership organization dedicated to the advancement of technology through educational opportunities and technical resources, ASHRAE has a unique opportunity to influence global sustainability *indirectly* through its members and others in affected industries by increasing their knowledge of sustainability so that they can make their own activities more sustainable. (See center column of Figure 1).

In contrast to the direct impacts of the Society as an organization, these *indirect* impacts are the result of the actions of ASHRAE members. The Society's ability to influence and control those actions is *indirect*. However, through effective programs of education and advocacy, the Society can profoundly influence its constituents to make their activities more sustainable. The environmental magnitude of these *indirect* impacts is many times that of the direct actions of the Society, so it is critical to establish metrics and track them to improve ASHRAE's impact on global sustainability.

Figure 1-ASHRAE Constituencies and Activities



ASHRAE Publications, Research and Standards

Undoubtedly the most extensive impact which ASHRAE has had on sustainability is through its development and dissemination of intellectual work products.

ASHRAE publications, supported in part through an annual research expenditure of more than $2 million, define practice within the environmental control industry. Its technical information includes Standards 90.1 and 90.2 for energy efficiency, Standards 62.1 and 62.2 for indoor air quality, and Standard 55 for thermal comfort. ASHRAE standards along with other ASHRAE publications, such as the ASHRAE Handbook, Advanced Energy Design Guides, and *ASHRAE GreenGuide,* are indispensable resources in engineering offices. Society standards are the basis for codes adopted by many governmental jurisdictions and provide design procedures and methods of testing and rating that are adopted by many industry groups. The right column of Figure 1 shows examples of the constituents of these intellectual products and the ASHRAE activities which they both rely upon and influence.

As broad and positive as the impact of these products has been, there has been no systematic effort to integrate sustainability where applicable into all of the intellectual efforts of the Society. One could imagine that the impacts could be even greater if such an effort were to occur. For example, an analysis of the nearly 2,400 pages of technical content in the ASHRAE Handbook reveals that there is little mention of "sustainability," but relatively extensive mention of "energy." When a similar analysis of the ASHRAE Handbook relative to "energy" was done 30 years ago, there were few mentions of "energy." However, through systematic efforts by the Society to integrate "energy" where applicable into all sections of the Handbook, this has completely changed.

It will be hard to develop appropriate direct metrics of these impacts, since they are at such a large scale (literally, the energy and environmental performance of buildings and other HVAC&R-related systems worldwide). Yet, there may be goals that could be set and metrics that could be monitored toward those goals.

The general objectives of this Roadmap are to identify and quantify ASHRAE's sustainability impacts. The start of the process is to set goals and in the years ahead implement strategies for improving those impacts. As this process occurs, each of the spheres of influence discussed above will be affected and will be critical to the success of this initiative.

ASHRAE's Relationship to Other Organizations

ASHRAE plays a unique role as the developer of intellectual products upon which sustainable building design and operation rests. Other organizations are potential users of ASHRAE's intellectual products and beneficiaries of ASHRAE's educational outreach. Sustainability advocacy organizations include:

- US Green Building Council
- Sustainable Buildings Industry Council
- Green Building Initiative

In addition, ASHRAE interacts with the U.S. Department of Energy and the U.S. Environmental Protection Agency on sustainability initiatives, and interacts with national HVAC&R organizations globally through the Associate Society Alliance.

It is important for ASHRAE to define its role relative to other players in the sustainability field. In particular, ASHRAE must develop guidelines on how it will interact with, support or assist other organizations to maximize the effectiveness of assets. While the relationships must be mutually beneficial, ASHRAE needs to recognize situations where other organizations may be in competition and structure the organizational relationships in such a way as to avoid the appearance of picking winners and losers.

The relationships in sustainability might mirror the relationships in the codes and standards arena where ASHRAE works with organizations such as the International Code Council, National Fire Protection Association, Illuminating Engineering Society of North America, International Organization for Standardization and others. In essence, ASHRAE provides its technical resources to all of these organizations in order to further its mission.

Some of the recommended activities with other organizations are:

- Develop standards, guidelines, and publications in areas of mutual interest.
- Initiate research in areas of sustainability that help enhances the technical quality of products and services of other organizations.
- Make major contributions to programs of other organizations programs when ASHRAE has unique expertise.
- Assume a leadership role in bringing other organizations together to advance sustainability in the built environment.
- Develop memorandums of understanding that describe areas for collaboration.
- Contribute technical speakers for conferences and meetings from the ranks of ASHRAE experts.
- Serve on technical panels and committees that guide the technical development of the organizational programs.

The Implementation Plan

Recommendations for Achieving "Engineering for Sustainability" Leadership

The recommendations included in ASHRAE's Sustainability Roadmap are driven to accomplish the following:

- Raise the awareness among all ASHRAE members that it is an ethic of engineering to practice and promote sustainability.
- Convince building owners, government and those in related professions that total building design and performance over the life of a building must drive the construction and building operation decisions.
- Provide ASHRAE members with the tools necessary to achieve sustainability in new and existing buildings.

Implementing the following strategies should achieve the above objectives:

Raise public awareness of ASHRAE's contributions

ASHRAE has long provided "Engineering for Sustainability" by applying its diverse technology assets to the sustainability movement in energy efficiency, indoor environment and industrial processes. With growing focus in the industry on the green movement, we need to emphasize that ASHRAE is the engineering engine that drives sustainability.

Appoint Spokespeople: The Green Team

ASHRAE should identify and provide media training to members who are well-versed in ASHRAE's work in sustainability. This "green team" would be used for media interviews regarding sustainability and related areas, such as energy efficiency and the *Advanced Energy Design Guide*. In addition, media briefings or media tours could be scheduled to promote bigger efforts by ASHRAE, such as publication of new books related to sustainability, research, etc. Using the selected members would ensure that ASHRAE's message – we are the engineering engine that drives sustainability – gets out.

Create a Green Speakers Bureau

Speakers to discuss aspects of sustainability that would be of interest to the general public, such as indoor air quality and energy savings, should be identified. These speakers would identify speaking opportunities in their area, such as local radio stations or civic clubs, and be responsible for arranging interviews. They also could speak to ASHRAE chapters and student branches or chapter meetings of other industry organizations. Guidelines would be established, explaining that the speakers are speaking as individuals and not as representatives of ASHRAE; however, the objective would be for speakers to promote and make the public aware of the activities of ASHRAE. They should not offer ASHRAE's opinion on matters of public interest except for the opinions contained in position documents, standards and other Board-approved documents.

Develop Consumer-Based Green Resources

Resources in the form of kits to assist speakers and be used for other outreach to the general public and related professions should be developed. Such materials could include consumer-oriented brochures to distribute on relevant issues, such as how to improve energy savings in your home.

ASHRAE
Engineering for Sustainability

Exploit www.engineeringforsustainabilty.org

To make it easier for members and others to locate ASHRAE's products and services related to sustainability, ASHRAE has created a Website, www.engineeringforsustainability.org.

Creation of the micro-site supports the goal of the Planning Committee that ASHRAE should "aggressively re-package its existing sustainability activity" to not only attract new members but to send the message to existing members that ASHRAE is setting a new course in the area of sustainability.

The site highlights ASHRAE's position statement on sustainability, GreenTips from the *ASHRAE GreenGuide*, the upcoming sustainability broadcast in April 2006 and a link back to ASHRAE.org home page.

The site can be easily adjusted to incorporate other green efforts by ASHRAE, such as adoption of the roadmap or development of new products.

Increase marketing to enhance ASHRAE's sustainability profile

ASHRAE's establishing and maintaining a leadership position in the sustainability marketplace depends upon our ability to communicate the value of intellectual products needs to members, potential members, related professionals and other customers.

ASHRAE will add focus to its efforts through use of the positioning phrase "Engineering for Sustainability."

Specific goals will be to increase membership among younger candidates and to offer new products and services meeting needs of the sustainability marketplace.

Identify Our Target Audience

There are many groups in the sustainability marketplace, but those that stand out include:

- Young engineers
- Construction professionals in related fields who are involved in various aspects of integrated building design
- Architects
- Engineers and other construction professionals in countries where energy costs are high or where the energy efficiency ethic is prominent because of culture or governmental regulation.

Develop a Positioning Strategy

ASHRAE should be positioned as the 'total building" resource, whose members are responsible for integrated building design, operation and evaluation. To establish a leadership position in the marketplace ASHRAE should:

- Communicate the recommendations in the Roadmap identifying what could and should be done in the HVAC&R/building space.
- Review the Society's suite of sustainable-related products and services to ensure each reinforces ASHRAE's role as being a leader in the sustainability market.
- Demonstrate the collective expertise that ASHRAE offers in sustainability through technical committees and chapter programming. Personalize it through use of testimonials and examples.
- Demonstrate how easy it is to access ASHRAE's technical data on sustainability and how many formats are available – print, download, live instruction web-based and physically, on demand e-Learning, satellite broadcast and DVD.
- Demonstrate the value ASHRAE technology brings to a building and industrial process and relate that value to the engineer's ability to provide this while meeting sustainability and fiscal objectives – through use of new technologies and guidance from ASHRAE resources.

Employ Marketing Driven Tactics

Various tactics to accomplish the Society's positioning strategy should be used:

- Partner with other groups to communicate how our sustainability resources can assist others in reaching their objectives;
- Explore development of new sustainability tools, such as software, considering partnership with other commercial and non-commercial entities in these activities.
- Develop a Sustainability for Engineering presentation that highlights ASHRAE resources to be given at related meetings and conferences of related organizations.
- Develop a Sustainability for Engineering presentation that highlights how building professionals are achieving sustainable building design and operation to be given at business meetings and at meetings attended by end users of HVAC&R services.
- Use the Engineering for Sustainability logo and positioning phrase on every ASHRAE product and communication device that is appropriate.
- Create awareness in the ASHRAE Technology Awards program through honoring sustainable building design and highlighting use of the ASHRAE resources that should be followed to achieve sustainable buildings.
- Create a section of the AHR Expo or create a companion show that focuses on green technologies and use of alternative energy resources in buildings.
- Effectively use existing ASHRAE periodicals to promote ASHRAE as a source of sustainability information and to consider development of new, focused communication vehicles for this purpose as can be supported by business models.

Walk the talk

ASHRAE's direct impacts on sustainability can be characterized as the extent to which the Society is willing to "walk the talk" of sustainability in the ways it conducts its business.

If ASHRAE adopts lofty goals for sustainability in its programs and publications but does not work to mitigate the environmental impacts of the ways it operates as a business, it sends a mixed message.

It seems likely that the three most significant impacts which the Society's activities have on sustainability are those related to travel, printing, and facilities use. (See Figure 2) These impacts are common to many of the different ASHRAE activities, even though the quantities and methods of mitigation may need to be different.

Sustainable Meetings

One approach to travel mitigation would be to encourage the use of video-conferencing and other virtual meeting techniques for training and committee meetings. However, this would not be applicable in cases like the semi-annual Society meetings in which the physical presence of participants is a fundamental aspect of meeting success. For physical meetings, an appropriate mitigation measure might be the purchase of carbon offsets for the transportation miles traveled by all meeting participants (a carbon offset purchases a source of CO_2 sequestration, such as a tree planted, equivalent to the CO_2 emitted to the atmosphere by the travel).

Sustainable Products

For printing, the Society can take a leadership position in working with its printers and paper suppliers to find sources and types of papers and inks which will minimize impacts on the environment. It can also accelerate the path it is already pursuing to offer its publications in digital form, thereby eliminating the need for paper and inks. This also radically reduces or eliminates the transportation impacts associated with shipping the publications.

Sustainable Facilities

For facilities, the Society has two major impacts: the operation of ASHRAE Headquarters facility in Atlanta, and the operations of the hotels and convention venues in which it stages its meetings.

In the case of ASHRAE Headquarters, there is the very real opportunity to make the facility an example of energy efficiency and sustainability. This could include such things as certification under Leadership in Energy and Environmental Design (LEED) for Existing Buildings, retro-commissioning of the building systems, implementation of performance monitoring and verification (of energy, indoor environmental quality, water, etc.). Given ASHRAE's area of professional activity, this is truly the closest thing to

Figure 2-Environmental Impacts of ASHRAE-Related Activities

ASHRAE Role	The Society as an Organization	ASHRAE Members	ASHRAE Research, Standards, and Publications
Activities	Training Events Publications Committee Meetings Meetings & Conferences Facilities	Education Advocacy Applications of Knowledge HVAC&R Products Research Manufacture Sales/Distribution Service/Disposal HVAC&R Products Design Construction Operations Maintenance	Applications of Research Referenced Standards Codes Handbooks/Publications
Environmental Impacts	Travel (energy, global warming) Printing (deforestation, water, solid waste) Facilities (energy, global warming, water, IEQ)	Energy Performance (energy, global warming) Refrigerant Impacts Materials Useage IEQ Impacts (IAQ, thermal comfort)	Energy Efficieny of Building Stock Environmental Performance of Building Stock
Mitigation Meausres	Virtual Meetings Digital/Online Publications Greening of HQ Facility Greening of ASHRAE Operations Procurement Standards	Education of Members Setting Goals for Improvement Implementing Metrics of Impacts	Integration of Sustainability as a Key Component Setting Goals for Improvement Implementing Metrics of Impact

"walking the talk" that the Society could do. However, it could go well beyond that to include establishing carpooling policies, solid waste recycling programs, "green" janitorial and landscaping practices, etc.

For the meetings venues, there are well-established set of guidelines for "sustainable approaches to meetings," which could be adopted and implemented by ASHRAE. This would involve setting standards for the convention centers and hotels to assure that they are operating in energy efficient and sustainable manner. It could also involve setting standards for the materials used in displays in the AHR Exposition, to encourage use of recycled materials and reduction of VOC off-gassing by the display. ASHRAE's role in this would help to educate its vendors and the show management company on matters of sustainability, which would most likely impact the ways that those same entities display elsewhere. Use of recycling bins and purchase of "Green Power" would also be vehicles to demonstrate to attendees ASHRAE's commitment to sustainability.

Lead by example

ASHRAE should establish policies for sustainability in each of its areas of direct activity, with quantified goals for impact reduction and methods for measuring and tracking progress towards the reduction goals. The responsibility for this can be distributed among the various operating groups within the ASHRAE organization.

Adopting Sustainability Standards

If the Society is serious about "leading by example," it will be necessary to follow sustainability standards or guidelines. Without doing so, it will be impossible to determine if the Society is now conducting its activities in a manner that has positively affected sustainability.

One of the existing frameworks for this sustainability process is the development of an environmental management system, which can be certified under ISO 14001. This is a process by which an organization does a self-assessment of its environmental goals, setting policies which it intends to follow and establishing metrics to track its performance. It then submits to annual external assessment of the degree to which it is adhering to those policies and meeting its goals. Doing this would be a clear statement and commitment to the public of ASHRAE's serious intent to meets its goals regarding sustainability.

Deliver educational products that assist in sustainable building design, operation and evaluation

Through the ASHRAE Learning Institute, its grass roots structure, and its organization of specialized and international conferences, ASHRAE has an extensive educational infrastructure in place to move sustainable building design, construction and operation forward.

eLearning and seminars

ASHRAE is now launching an on-demand learning program. The Society should explore including Fundamentals of Sustainability with perhaps separate courses on design, building operation, and building evaluation and commissioning.

Consideration also should be given to expanding live seminar, webinars, and short courses on sustainability topics.

Provide chapters with sustainability programming

One resource that sets ASHRAE apart from other organizations is its grass roots communication opportunities. ASHRAE should consider scheduling of seminars in cooperation with chapters and ensure adequate suitability-related topics in the Distinguished Lecturers program. The latter identifies "best of class" speakers and makes them available to Society chapters for their monthly meetings.

Satellite broadcasts

One of ASHRAE's most successful chapter support programs has been its series of satellite broadcasts. These broadcasts provide chapters and other groups within the industry two- to four-hour educational sessions at no charge. Sustainability and the Building Environment is the subject of the April 2006 satellite broadcast. Because of their ability to focus the sustainability message to thousands of members worldwide in real time, more broadcasts on sustainability topics should be organized.

Implement the sustainability-oriented objectives in the ASHRAE Strategic Plan for Research

ASHRAE has adopted a strategic plan for its research program. It outlines ASHRAE's research goals for the next five years, centering on sustainability, which is defined as "the concept of maximizing the effectiveness of resource use while minimizing the impact of that use on the environment."

The plan contains goals in five targeted areas. These include energy and resources, indoor environmental quality, tools and applications, equipment, components and materials, and education and outreach. The initiatives in the plan must be pursued and the results of that research made available through ASHRAE's body of knowledge.

Maintain efforts to produce Advanced Energy Design Guide series as rapidly as possible

ASHRAE's has partnered with other design team organizations to produce the *Advanced Energy Design Guide for Small Office Buildings*. ASHRAE needs to push forward with similar design guides that address other building types and which move the industry towards achieving net zero energy buildings.

Focus on producing design tools and resources, such as standards and publications

ASHRAE standards for energy efficiency and indoor environmental quality, along with other ASHRAE publications, form the basis for engineering for sustainability. ASHRAE must expand these standards and publications as needed and should deliver support tools, such as software and users manuals, to promote their use.

In particular, ASHRAE should use its expertise in quality standards development to initiate new standards in partnership with others to address sustainability metrics for buildings and sustainable deconstruction of buildings.

Standards to Enhance Recycling Potential for HVAC Equipment

Recycling of post-consumer hard goods is an important factor in decreasing the environmental impacts of today's industrialized society. One of the major impediments to increased recycling is the difficulty in identifying the constituents of products so that their materials can be reclaimed for the highest order of re-use. ASHRAE should work with manufacturer associations to establish or improve standards that identify materials used in HVAC&R products and equipment to enhance recycling potential.

European auto manufacturers are at the forefront of facilitating the deconstruction of their consumer products by materials identification. For example, components in German cars must be permanently labeled so

that when the car is deconstructed, individual components can be sorted by material for recycling. This labeling is very specific, differentiating among types of plastics, between thermoplastics and thermo-setting plastics, types of metals, and constituencies of composite materials. Manufacturers are made responsible for labeling the component parts of their automobiles and, in the future, may be responsible for the deconstruction and recycling of the cars. Ultimately, this program could drastically reduce the amount of new raw materials necessary to produce a new automobile.

HVAC&R equipment is similar to the automobile in that it is constructed of a variety of materials in close proximity to one another. This characteristic makes efficient recycling of the equipment difficult. New standards would facilitate recycling by classifying materials related to their ability to be recycled and by their compatibility with other recycled materials. For example, certain thermoplastics may be recycled together, while others should be separated. Certain materials may not be recycled at all, but may require special disposal to avoid environmental damage. This classification could be used with a census of product composition to establish projections and goals for materials recycling for the HVAC&R industry. The program could serve as a demonstration project to American industry in how to maintain economic vitality while reducing consumption of the limited amount of raw materials available on the earth.

Implement sustainability certification

ASHRAE should consider a certification program built around Engineering for Sustainability, certifying buildings that have achieved sustainable performance and the design, operational and evaluation personnel who make sustainable buildings possible.

For example, ASHRAE's on demand eLearning modules could form the basis of individual certification and quantifiable sustainability measures could be developed to support LEED certification.

ASHRAE could develop these certification programs independently or in cooperation with others.

Act on sustainability-related strategic directions included in the Society's Strategic Plan.

Many of the initiatives and recommendations identified in ASHRAE's Roadmap for Sustainability have also been identified as key concepts in ASHRAE's Strategic Plan. In order to coordinate all of ASHRAE activities as they relate to sustainability, the Strategic Plan, when approved by the Board of Directors, should be examined with an eye towards identifying sustainability directions and coordinating supporting activities with other endeavors undertaken as a result of the Roadmap.

Sustainability Roadmap Milestones

Implementation of the recommendations should be accomplished by existing ASHRAE committees and councils. It is not the desire to create additional bureaucracy to manage the sustainability initiative. However, the Society should maintain at least an ad hoc function for the first several years to oversee the sustainability efforts and to serve as internal champion to guide sustainability implementation.

To ensure the success of Roadmap implementation, the following milestones have been established:

- 2006 ASHRAE Winter Meeting – Liaisons appointed from the Society to organizations with whom ASHRAE partners on sustainability initiatives.
- Calendar Year 2006 – Implement various public relations and marketing initiatives, including creating the Green Team, exploring sustainability as a component of the AHR Expo, re-focusing the ASHRAE Technology Awards on sustainability achievements, and writing articles for related industry publications describing sustainability practices and which provide ASHRAE guidance.
- 2006 ASHRAE Annual Meeting – Conduct this meeting as a sustainable meeting, conforming to accepted sustainability guidelines for meeting organization and operation.
- 2006 ASHRAE Annual Meeting – Make the ASHRAE Headquarters renovation project a LEED EB project.
- 2006 ASHRAE Annual Meeting – Technology Council to move sustainability-related research projects up in priority and monitor their implementation to ensure timely completion.
- 2007 ASHRAE Winter Meeting – ASHRAE Technical Committee 2.8 "Building Environmental Impacts and Sustainability" review ASHRAE materials and literature and make recommendations to the Society's Technology Council and Publishing and Education Council regarding needed projects and publications.
- 2007 ASHRAE Annual Meeting – Offer online based learning for sustainability and certification program for building operators.
- 2007 ASHRAE Annual Meeting – Funding provided such that publication of the *Advanced Energy Design Guide* series is accelerated by one year from originally scheduled completion dates.
- 2008 ASHRAE Winter Meeting – Develop rating systems to certify building operational performance for sustainability.
- 2008 ASHRAE Annual Meeting – Offer a full complement of publications that provide sustainable design guidance for all types of buildings and that make available life cycle cost analysis information of building components and systems.
- 2009 ASHRAE Winter Meeting – Partner with other organizations to develop standards on all aspects of sustainable building design and operation, including recyclability as well as a standard articulating a sustainability performance metric.
- 2009 ASHRAE Winter Meeting – Publish guides for building owners that emphasize the benefits of decision making based on life-cycle-cost analysis.

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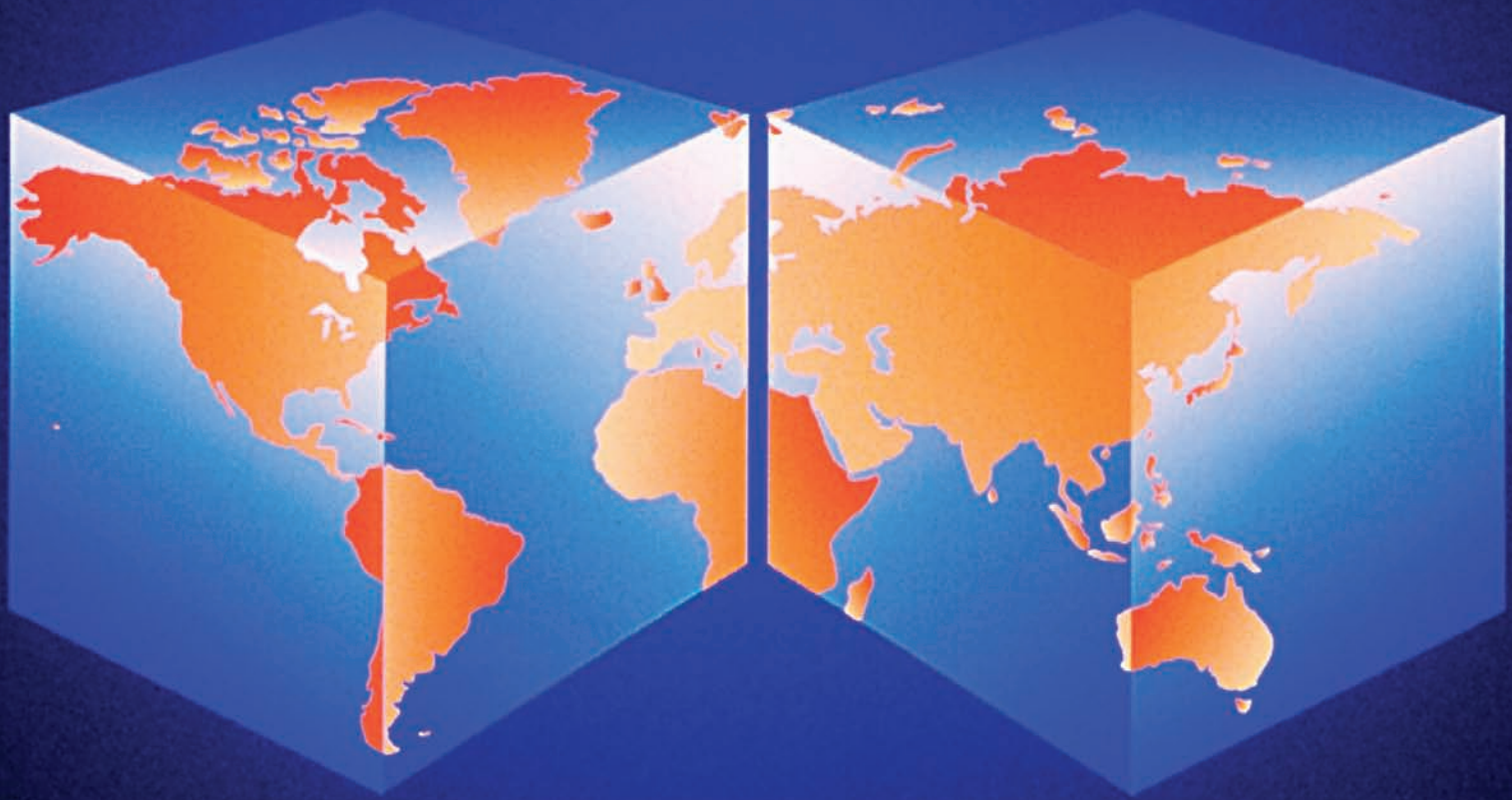
Strategies for a Global Environment

ASHRAE's strategies for institutional change that lead to fully engaging members globally and sharing best practices worldwide



Approved by ASHRAE Board of Directors, June 24, 2007

1.0 Introduction

ASHRAE's Strategies for a Global Environment set a path for institutional change.

The objective of that change is to fully engage members globally so that a worldwide best practices databank of innovative and successful technologies can serve the HVAC&R community.

These strategies recognize and cultivate opportunities that will create a forum for idea exchange among a multi-national array of HVAC&R practitioners. An analogy can be made to the Internet where each member is a node in an information network.

Global interaction results in a multi-level exchange of ideas, information, technology, services and products, creating a global structure for product development, product delivery, and individual interaction.

By its nature, globalization will expose ASHRAE members to new technologies because HVAC&R technology differs due to particular geographic, environmental, cultural and economic requirements.

ASHRAE's Strategies for a Global Environment understands and appreciates the impact that globalization has on trade, business, technology and communication. ASHRAE's approach to this phenomenon respects national and international membership organizations, partnering to create resources that are more than the sum of their parts and delivering them beyond where they were available previously.

Effectively implementing global strategies enables ASHRAE to arrive at a destination that benefits all ASHRAE members. Critical to success is partnership with other HVAC&R societies worldwide and especially Associate Societies, those national associations that share the same objectives as ASHRAE and with whom ASHRAE extends rights and privileges). The goal is to expand the amount and the quality of information that is available to members everywhere.

The benefits of adopting global strategies must be weighed against the costs. But just as importantly, *the cost of failing to achieve these strategies squanders opportunities for the community of HVAC&R practitioners to contribute to a sustainable built environment worldwide.*

2.0 The Ad Hoc Committee

ASHRAE's Strategies for a Global Environment were prepared by an ad hoc committee appointed by ASHRAE President Lee Burgett on May 25, 2006 and reappointed by President Terry Townsend on August 16, 2006 with the charge, "Define broad initiatives required for the globalization of ASHRAE and action plans that are needed for implementation."

The committee's membership is as follows:

Thomas E. Watson, P.E., Member ASHRAE, chair (USA); David Arnold, Ph.D., FR Eng, Fellow ASHRAE (UK); Harley W. Goodman, Jr., P.E., Presidential Member/Fellow/Life Member ASHRAE (USA); Sheila J. Hayter, P.E., Member ASHRAE (USA); Gordon V.R. Holness, P.E., Fellow/Life Member ASHRAE (USA); Prem C. Jain, Ph.D., Fellow/Life Member ASHRAE (India); Ronald E. Jarnagin, Member ASHRAE (USA); Samir R. Traboulsi, P.Eng., Member ASHRAE (Lebanon); Vincent K.C. Tse, Fellow ASHRAE (Hong Kong); Ronald P. Vallort, P.E., Presidential Member/Fellow ASHRAE (USA); William A. Harrison, Member ASHRAE, consultant (USA); W. Stephen Comstock, Associate Member ASHRAE, staff liaison (USA).

The following individuals served on regional subcommittees and contributed to the recommendations formulated by the committee:

European Subcommittee: Tim Dwyer, Member ASHRAE (UK); Costas Balaras, P.E., Member ASHRAE (Greece); Irene Reichert, Associate Member ASHRAE (Germany); Maciek Sobczyk, Member ASHRAE (Poland).

Indian Subcontinent Subcommittee: Ashok Virmani, Member ASHRAE (India); Ashish Rakheja, Member ASHRAE (India); Pankaj Shah, Member ASHRAE (India); Farooq Mahboob, Member ASHRAE (Pakistan); Pandu Amarsinghe, Member ASHRAE (Sri Lanka).

Middle East Subcommittee: Walid Chakroun, Ph.D, Member ASHRAE (Kuwait); Bassel Anbari, P.E., Associate Member ASHRAE (UAE); Mahmoud Fouad, P.E., Member ASHRAE (Egypt).

China Subcommittee: Robert Hu, Member ASHRAE (Taiwan); Edward Tsui, Member ASHRAE (Hong Kong); Philip Yu, Member ASHRAE (Hong Kong); W.K. Pau, Member ASHRAE (Hong Kong); Raymond Man-Hung Yau, Ph.D., Member ASHRAE (Hong Kong).

Southeast Asia Subcommittee: Raymond Wong, Member ASHRAE (Singapore); C.S. Ow, Ph.D., Fellow ASHRAE (Malaysia).

Australia-Oceania Subcommittee: Pradeep Bansal, P.E., Member ASHRAE (New Zealand).

Others, representing organizations in the Associate Societies Alliance and the European HVAC Federation, REHVA, also provided information in the the document.

3.0 Impetus for Developing Global Strategies

ASHRAE, like many other corporate and institutional entities, has been impacted by globalization. New technologies allow information and ideas to flow more freely than before. People meet more easily whether in person or virtually. The notion of companies serving multi-national or international markets has achieved prominence in the marketplace.

As ASHRAE's membership growth accelerated outside the US and Canada, ASHRAE made efforts to serve these members. However, these efforts merely extended membership services developed for the North American market rather than adapting them to meet the needs of HVAC&R practitioners in other parts of the world. Of greater importance, an infrastructure was not developed to support the flow of information about innovative technologies throughout the ASHRAE network, no matter where those technologies were developed and practiced.

> *We are entering a phase where we are going to see the digitization, virtualization, and automation of more and more of everything. The gains in productivity will be staggering for those countries, companies and individuals who can absorb the new technological tools. And we are entering a phase where more people than ever before in the history of the world are going to have access to these tools …the world has gone from round to flat. Everywhere you turn, hierarchies are being challenged from below or are transforming themselves from top-down structures to more horizontal and collaborative ones….It is not simply about how governments, business and people communicate, not just how organizations interact, but it is about the emergence of completely new social, political and business models…..The flattening of the world, if it continues, will be seen in time as one of those fundamental shifts or inflection points, like Gutenberg's invention of the printing press, the rise of the nation-state, or the Industrial Revolution.*
>
> Thomas L. Friedman
> The World Is Flat: A Brief History of
> The Twenty-First Century

The impetus for developing ASHRAE's Strategies for a Global Environment came from a desire by ASHRAE's leadership to embrace service and product development and delivery models that meet the unique requirements of all members. The work of the Globalization Ad Hoc Committee is intended to bring global best practices to all ASHRAE members, enabling the Society and its members to thrive in a flat world.

4.0 ASHRAE's Strategic Plan And the Global Environment

With its adoption in 2006 of a new Strategic Plan, ASHRAE made a significant commitment to becoming a truly global society. The four strategic directions in the plan are:

1. ASHRAE will be one of the global leaders in the advancement of sustainable building design and operations.
2. ASHRAE will be a world-class provider of education and certification programs.
3. ASHRAE will position itself as a premier provider of HVAC&R expertise.
4. ASHRAE will be a global leader in the HVAC&R community.

A moment's reflection will confirm that the first three directions can only be achieved if ASHRAE becomes a truly global society. And to be a leader globally, ASHRAE must understand and be responsive to needs and tendencies in all HVAC&R constituencies. This means building the infrastructure which enables member participation globally, while at the same time working more closely and cooperatively with Associate Societies and other associations in the HVAC&R field.

For example, advanced practice and leadership in some sustainable technologies is found outside of the United States and Canada. To be a world class provider of education and certification programs, ASHRAE's products must be developed so that they are meaningful globally and able to be applied locally. Similarly, if ASHRAE is to be recognized as a leading provider of HVAC&R expertise, that recognition must be global instead of regional.

ASHRAE members – no matter where they reside – should have access to technologies and products that draw upon the knowledge of all individuals involved in these advanced efforts. Additionally, ASHRAE members should have forums at which they can engage in peer exchange with all leaders of HVAC&R technologies to develop the technologies and create the best products.

Because of its size, resources, and existing international presence, ASHRAE with its Associate Societies can build bridges to span gaps between and among individuals and organizations that will create a global network for sustainable HVAC&R technologies. This network will result in service, design and product development that provides "best practice" guidance and "building block" research.

Strategies for a Global Environment

ASHRAE's operating rules, programs and products for the past hundred years have been tailored to meet the needs of its US and Canadian members while carefully balancing the costs and revenues of attracting and serving members, chapters and regions within the United States and Canada. These programs and products were developed primarily through the voluntary effort of members from the United States and Canada being engaged in the Society. While volunteers from outside of the United States and Canada also contributed, their ability to participate was more difficult and opportunities not as widely known as in the United States and Canada.

Using or mimicking the tools and processes elsewhere in the world that are, and have been, successful in North America without evaluating their appropriateness would endanger the entire process of globalization. To develop the infrastructure that allows for multi-directional and multi-level exchange with full engagement of members from all parts of the world and enhanced partnership with Associate Societies and others, a wide range of strategies focused on the needs, challenges and opportunities presented by a global environment need to be pursued.

It should be noted that assumption of an advocacy role with governmental bodies has been omitted from ASHRAE's Strategies for a Global Environment by design. This might change as ASHRAE's global posture expands and a balanced collection of volunteers step forward to drive the effort. For the present, however, ASHRAE's advocacy effort will be U.S. based.

Finally, implementing many if not all of these strategies will require that member and market research be conducted for the purpose of determining local needs and methods of product and service delivery. It is envisioned that such research would be budgeted for and commissioned by the ASHRAE groups responsible for measures to be implemented.

The following are recommended strategies that ASHRAE should pursue to implement Strategic Direction 4 of the Strategic Plan.

Strategy 4.1

While ASHRAE's chapter and regional structure shall be the backbone of ASHRAE's structure globally, it shall be flexibly applied to serve our membership.

The most effective way that ASHRAE has found to promote member growth, exchange among members, and member participation in the governance process is through formation of chapters and their alignment into regions.

Within ASHRAE, the chapter is the structure by which members within a geographic area meet regularly to share information and voluntarily engage in activities that advance the HVAC&R industry. This includes interaction with companies to support ASHRAE Research, serving as a resource to colleges and universities offering engineering studies, and promoting technically sound codes and regulations by local government. Chapters do not receive funding from ASHRAE but receive volunteer training and support materials.

Grouping chapters into regions is how ASHRAE delivers training to members who volunteer in chapters. It also provides a structure through which recommendations from chapter members can be made to the Board of Directors for new ASHRAE activities, improved membership services, or policy changes.

At the time of this document's development, ASHRAE's regional alignment of chapters is as follows:

- Regions I to XI are North American Chapters, which includes chapters in Canada, Mexico and the United States.
- Region XII consists of chapters in Florida and Central/South America
- Region XIII is the Asia Pacific grouping of Chapters
- Region at Large is the grouping of chapters in the Middle East, Western Asia, and Europe.

The fundamental process for chapter and regional formation that has lead to this alignment should be maintained for the foreseeable future. It is the basic backbone of ASHRAE's organization in future growth. A major benefit of this process is that it draws members into volunteer roles and provides a process by which a steady stream of volunteers are assigned roles of increasing responsibility.

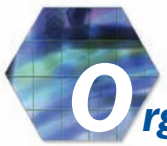
Chapter threshold requirements, alignment of chapters into regions, and chapter activity guidelines, however, must be flexible as ASHRAE responds to needs of members throughout the world. Creativity can be applied in expanding or sustaining the chapter and regional structure globally, keeping to the principles that sections, chapters and regions are comprised of ASHRAE members; sections, chapter and regions provide a voice for members within the governance process; chapters and regions spur ASHRAE interaction with local communities; and that chapters and regions are communication vehicles for best practices information.

At present, several geographic areas represent potential opportunities for major growth in number of ASHRAE members in the coming decade:

- China;
- Indian Subcontinent;
- Middle East;
- South America; and
- Developed countries with existing HVAC&R societies.

ASHRAE's global growth will likely create further impetus to realign regions and the chapters they serve. As long as chapters and regions can be structured so they serve the needs of the members they comprise and contribute to the well being of the Society as a whole, ASHRAE should nurture their creation.

Implementation Assignment: Members Council should examine potential hurdles in each of these areas — annual ASHRAE membership fees, governmental policies, required support for chapters and regions – to make structural and procedural changes as needed to promote chapter creation and to respond to member desires in those areas. Fiscal impacts need to be carefully analyzed, taking into account cost of providing membership services with modified and expanded chapter and regional structures along with potential for income growth. It is essential that there be dialogue with existing national associations many of whom are Associate Societies of ASHRAE whenever applicable so that the most effective means of technological development, dissemination and service to individual engineers is achieved.



Organizational Relationships

Strategy 4.2

ASHRAE will cooperate with organizations with shared objectives and strengthen the ASHRAE Associate Societies Alliance.

National HVAC&R technical societies respond to the cultural, governmental, economic, and geographic needs of HVAC&R practitioners and industry in a way that differs from ASHRAE as an international organization.

ASHRAE's Global Strategy 4.2 emphasizes respect for these organizations, encouraging partnerships to create shared resources that deliver added value to ASHRAE members and members of national societies.

Effective partnerships with Associate Societies and with other national organizations

that share ASHRAE's purpose establish bridges for new information to flow between ASHRAE and these organizations and for this body of information to have a greater impact on worldwide engineering practices.

ASHRAE's Associate Societies Alliance provides a framework for these partnerships. While the chapter and regional structure franchises ASHRAE members, the Associate Societies Alliance provides for inter-organizational relationships, often establishing business relationships whereby resources can be shared and communication enhanced. Umbrella organizations, such as the European Federation REHVA, governmental bodies, such as IIR, and groups with international memberships, such as CIBSE based in the UK, provide other opportunities.

Activities that could be initiated through the Associate Societies Alliance include the following:

- Organize conferences and other learning events.
- Engage in copublishing activities.
- Share staffing resources.
- Enlist assistance to develop regional versions of ASHRAE Handbook, ASHRAE Journal, and other publications as appropriate, particularly for non-English speaking regions.
- Participate in national or regional expositions.
- Develop standards and guidelines in areas of mutual interest.
- Survey technical needs and resources.
- Participate on technical panels and committees that guide the development of mutually beneficial programs.
- Provide a worldwide library or directory on international HVAC&R events and conferences.

A strengthened Associate Societies Alliance does not preclude interaction between ASHRAE and individual national or international organizations. It provides a framework for discussion and activity within ASHRAE that fosters global cooperation and the sharing of technical information.

Implementation Assignment: The Executive Committee of ASHRAE's Board of Directors should identify where the Associate Societies Alliance can have permanent and more prominent and visible standing within ASHRAE's committee structure so that resources available through the Alliance can be effectively utilized and business relationships explored.

Strategy 4.3

The cost of annual membership dues will be balanced with the cost of providing membership benefits and services in different geographic regions.

ASHRAE annual membership fees will be priced to serve all global areas and not necessarily uniformly. ASHRAE can only reach its global potential if the dues structure is affordable.

While all members are equal, membership services provided do not need to be equal if the dues paid are not equal. In adopting a principle that the cost of membership will be evaluated with the cost of providing services, ASHRAE will not price membership at less than the cost of providing it.

ASHRAE's primary membership benefits are:

- Annual volumes of the ASHRAE Handbook;
- Monthly issues of ASHRAE Journal;
- Support of chapter activities through educational programs, volunteer training

resources, and out-reach materials;
- Discounted pricing of publications and educational services and reduced conference registration fees;
- Digital access to selected technical information through the ASHRAE web site.

To serve members in a global environment with a multi-tiered dues structure, ASHRAE will need to balance benefits and costs by considering various benefit development and delivery options, for example:

- Provide ASHRAE Handbook and ASHRAE Journal access in print or digital form;
- Offer regionalized publications or regional editions of existing publications;
- Globalize ASHRAE Handbook and ASHRAE Journal so that ASHRAE's principal membership benefits and reference vehicles can lead the effort to globalize ASHRAE;
- Offer regionalized periodicals as a substitute for or a variation of ASHRAE Journal;
- Deliver Internet-based programs for chapters;
- Establish Internet-based membership grade providing web access to information on demand as the sole membership benefit;
- Establish a base membership fee allowing purchase of publications at reduced prices, such as ASHRAE Handbook and ASHRAE Journal and purchase of Internet-based access to information.

Implementation Assignment: Members Council and Publishing and Education Council need to establish the benefit/cost balance points that reach established membership growth targets within fiscal budgets. Such a process will support ASHRAE's transition to a global organization, fulfilling objectives of membership growth, fostering free flow of technical information, and treating all members fairly.

Product and Services Pricing

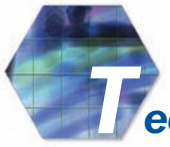
Strategy 4.4

Publications and educational products will be priced so they are within reach of ASHRAE's global membership but will not be priced at less than the cost of providing them.

If individuals cannot afford access to the products and services that establish the value of ASHRAE as a technical resource, ASHRAE will not achieve true global significance. At the same time, it is unfair to expect one group of members to subsidize another. As in determining the fees and services associated with membership globally, an equitable balance between affordability and expense must be determined.

In adopting this strategy, it is understood that pricing flexibility is required for various marketing and promotional efforts. For example, products, from time to time, may be priced below cost to stimulate sales or to increase interest in ASHRAE membership

Implementation Assignment: The Publishing and Education Council will determine differential pricing formulas and the mechanisms by which they can be implemented.



Technology Access

Strategy 4.5

ASHRAE will develop its expertise in HVAC&R technologies to embrace whole building sustainable design and be one of the most valuable global resources for publications and educational products related to sustainable HVAC&R technology.

ASHRAE provides the HVAC&R community—members and nonmembers—with access to technology through a variety of vehicles:

- ASHRAE Handbook
- HVAC&R Research, ASHRAE's archival research journal
- ASHRAE Journal
- Standards and Guidelines
- Research reports and topical publications
- Classroom texts
- Interactive on-demand web-based learning systems
- Instructor-led programs, face-to-face and online
- Conference proceedings
- Design guides
- Data compilations
- Digital tools and programs
- Self-Directed Learning Courses
- www.ASHRAE.org

As impressive and extensive as these resources are, they represent only a fraction of the knowledge sources that are available globally. As technology advances in different parts of the world at different speeds and as new technologies emerge regionally, complementing ASHRAE resources with those of others becomes a prime objective in the Society's efforts to bring best practices to its members.

Establishing a Worldwide Bookstore at www.ashrae.org for the global HVAC&R community would be one way to address this strategy. ASHRAE currently makes products available from other organizations when those products are the most appropriate for a given technological or geographical area. The Society has joint publication sales and discounting agreements in effect covering standards, guidelines and publications. This effort should be expanded so that practitioners can go to a single source to find ASHRAE literature and literature of Associate Societies and other organizations in the field.

Much of this Worldwide Bookstore's capability might be achieved by digital distribution of products or re-directing visitors to other global web sources. Also through www.ashrae.org, advanced educational program technology could be utilized to allow for global participation through digital distribution of learning products, expanded on-demand web-based learning, and on-line courses that are scheduled at convenient times for all viable markets. Satellite broadcasting should be considered to achieve this objective as well. The Associate Societies Alliance should be an ally in establishing the Worldwide Bookstore and distributing learning products as business enterprises.

Implementation Assignment: The pursuit of this objective falls to Publishing and Education Council. Investigated will be the benefits to members through access to an expanded knowledge base and the costs associated with inventory, administration of cooperative sales agreements, and creation or acceptance of digital collections.

Strategy 4.6

ASHRAE will pursue opportunities and processes along with translation to publish its literature in various languages.

The new ASHRAE membership demographic will require ASHRAE be multi-lingual. With that fact stated, ASHRAE's language strategy must address the practical and economic realities involved. Copublishing opportunities along with translations by ASHRAE volunteers should be considered.

In geographic areas where there is significant demand for ASHRAE literature, it is important to develop a process for providing ASHRAE documents in languages other than English that balances speed to market, investment and pay-back without compromising technical accuracy.

Some of the issues involved in determining whether to publish a document in a language other than English include:

- Market size and sales projections;
- Copyright;
- Liability;
- Costs, including initial investment and ongoing marketing and distribution;
- Use of volunteer effort in exchange for regional use of ASHRAE literature royalty free or at reduced pricing;
- Availability of comparable non-English literature from other sources;
- System of units to be used;
- Time to develop;
- Opportunities for publishing partnerships.

The language strategy does not state that ASHRAE must undertake or fund translations. It requires consideration of all processes that can achieve similar results. The Publishing and Education Council is to explore these options on a case-by-case basis, with the Associate Societies Alliance potentially providing strategic partners.

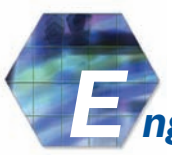
More broadly, ASHRAE will review other elements of its business operation, such as its web site and dues invoices, to determine where benefits can be achieved from a multi-lingual approach.

Essentially, ASHRAE requires a flexible language strategy to allow a variety of approaches to suit each circumstance and country for each document type.

In addressing this strategy in the implementation plan, the broader issue must be considered of whether ASHRAE's publications, educational products and technical resources adequately meet the needs of members globally and if they successfully draw upon knowledge sources worldwide.

The end result of implementing this strategy is that ASHRAE membership is broadened. Within this broadened or "flat ASHRAE," ASHRAE members must be able to understand and interact with one another and be able to use ASHRAE literature in ways that suit their localized needs.

Implementation Assignment: Publishing and Education Council will examine making ASHRAE's English literature in other languages. As ASHRAE becomes a truly global society, the Publishing and Education Council and Technology Council will together need to explore such questions as whether ASHRAE should publish or distribute literature when the original version is not in English, undertake translations of such literature into English and whether the ASHRAE Handbook should prepared not just in multiple languages but from material written in multiple languages?



Strategy 4.7

Volunteer participation obstacles will be overcome through meeting planning and organization that is sensitive to global participation and that benefits from electronic communication technologies.

Individuals join ASHRAE to increase their technical knowledge. They achieve this by participating in an infrastructure that fosters the sharing of experiences, identifies common concerns, and responds to those concerns through research, standards writing, publishing and credentialing.

To be successful in a global environment, ASHRAE's infrastructure must give members from all countries opportunities to become engaged—if not physically, at least virtually—such that their participation offers equivalent member value. This infrastructure must allow for the global exchange of technology addressing widely

diverse climatic conditions and occupational environments.

The key to providing valued member benefits in a global environment is the breaking down of participation barriers to volunteer involvement and peer exchange. Opportunities must exist for members to contribute to the knowledge base and to influence the Society's decision-making process. Fully engaging members throughout the world can only be achieved and maintained by active and continuous interaction. This means a continuous two way, multi-level flow of technical knowledge, ideas and experiences.

Communication technology offers a partial solution. Members can now meet in conferences and on committees without traveling. While face-to-face contact for learning and committee planning cannot be completely replaced, logistics of travel time and expense require ASHRAE use alternative meeting methods. New meeting formats will attract greater volunteer participation and conference attendance from different countries.

An example is provided by ASHRAE's Annual and Winter Meetings. They are the Society's premier events in terms of engaging members. Examples of what could be offered are delivery of poster sessions to members via the Internet. Members could pose questions by e-mail to authors. Subsequent steps might be to air web casts of selected meeting speakers. Similarly, Standing Committee and Technical Committee meetings with high international interest could be offered by Web casts to increase the involvement of members outside (and even inside) North America.

Another approach would be to organize meetings in various geographic regions aimed at attracting global participation. These meetings could be theme-based, drawing attention to a technology that is developing or has matured in the hosting region. Because the current structure of ASHRAE's Region-at-Large limits personal contact with officers and other colleagues in the region, distance meeting and interaction should be pursued for volunteer training and chapter activities.

It is critical that a member anywhere in the world have personal contact with ASHRAE volunteers so that he or she feels adequately represented in ASHRAE and concludes that this Global ASHRAE is "My ASHRAE." Opportunities of being engaged will lead to opportunities for members to take ownership of and pride in ASHRAE, fostering their volunteer participation. Policies adopted by ASHRAE must enable members to put a "face" on ASHRAE, to have contact with individuals who work on their behalf within the volunteer structure of ASHRAE.

Implementation Assignment: To initiate a staged process of engaging members globally through the meeting structure, all three councils—Members, Publishing and Education, and Technology—and the Board of Directors should expand use of the Internet to conduct meetings.

Strategy 4.8

ASHRAE will support, in cooperation with national associations, a uniform, international standard for credentialing in the disciplines and practices of HVAC&R.

As in other areas, the challenge in applying globally relevant objectives in education and credentialing is to create an operational infrastructure that addresses widely diverse cultures, climatic conditions and occupational environments. In-depth market research will assist ASHRAE to work in cooperation with national associations to globally address this need.

ASHRAE is currently implementing credentialing programs in specific HVAC&R related disciplines such as health care facility design. Once the body of knowledge for each desired program is determined and the needed content developed, distance-based

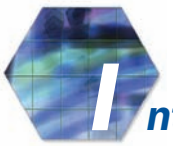
delivery technology must be used to allow for global participation. And, as with all ASHRAE products and services in the global environment, different pricing schedules must be considered to encourage widespread use.

ASHRAE can utilize credentialing standards that are uniform and that draw upon a single, expanded body of knowledge. But that does not mean that examinations in various geographic areas can be identical.

The fact ASHRAE's credentialing program are intended to be applied locally by those who sit for them requires local consideration and judgment by qualified practitioners. Such is the value and benefit of creating a global credential.

What ASHRAE, in cooperation with national associations, can do is standardize a process of developing and delivering credentialing programs maintaining a constant objective: To verify what is an acceptable demonstration of knowledge based on local need.

Implementation Assignment: Publishing and Education Council will direct programs that fulfill this strategy, identifying local bodies and working with national associations and the Associate Societies Alliance to assist in promoting the value of credentials.



International Standards

Strategy 4.9

ASHRAE will actively support and participate in international standard development activities.

Internationally recognized standards and their adoption and utilization play an increasingly crucial role in the HVAC&R industry. ASHRAE recognizes their importance to its membership by participating in various international standards development activities. The Society is committed to achieving a set of internationally recognized standards that improve the ability of its membership to serve globally.

To further increase the Society's role in international standards and to continue to serve and provide leadership, the following direction on international standards is recommended:

Relationships: ASHRAE will establish and maintain formal relationships with international standards developers.

Participation: ASHRAE will actively support and participate in international standards development activities for the benefit of its membership and Society. Participation should begin early in the standards development or adoption process and at a level to maximize the Society's ability to add value to the process.

Adoption: ASHRAE will pursue the adoption of international standards for use in the United States and will promote ASHRAE's standards internationally in accordance with the following principles:

1. Adopt an existing or proposed international standard for use in the U.S. where there is no equivalent ASHRAE standard.
2. Harmonize standards when ASHRAE and international standards both already exist and there is a need for harmonization.
3. Promote ASHRAE standards internationally and in other countries or regions where:
   - The ASHRAE standard is the industry's standard of first choice with global relevance, or
   - There is no equivalent international, national or regional standard, or
   - It is in the best interest of the HVAC&R community.

Implementation Assignment: Technology Council is charged with implementing ASHRAE's international standards program.

Strategy 4.10

ASHRAE will actively protect its intellectual property rights.

ASHRAE's most important asset is the collective knowledge of its membership as represented in its publications and educational products.

As ASHRAE initiates commercial partnerships, engages in cooperative activity with Associate Societies and others, and as ASHRAE publications are developed and formatted for widespread usage around the world, it becomes increasingly important that ASHRAE protect its assets.

Unauthorized uses of ASHRAE's knowledge base allow others to unfairly benefit from the labors of volunteers who contribute their understanding, their time and talent to benefit ASHRAE. It also weakens ASHRAE's position in the marketplace and jeopardizes the technical integrity of the ASHRAE brand.

To satisfy this demand while preserving the value of ASHRAE literature, the following principles must be followed with regard to Intellectual Property protection:

1. Dissemination of information in digital formats must be protected from unauthorized use whenever feasible without unduly making ASHRAE products difficult to access.
2. Use of any ASHRAE product or portion thereof must be licensed in accordance with international copyright law, recognizing fair use provisions.
3. ASHRAE must strive to reach agreement with reputable publishers, associations and distributors so that demand for ASHRAE products is satisfied to the greatest extent possible through legitimate and approved endeavors.
4. ASHRAE must protect its trademark and copyright of its products internationally.
5. ASHRAE must pursue violations of its trademark and copyright to protect the reputation of the ASHRAE brand; the integrity of its volunteer contributions; and the value of its products.

Implementation Assignment: Publishing and Education Council establishes the policies that staff administer to implement the global strategy for intellectual property.

Strategy 4.11

ASHRAE will provide enhanced staff support outside of the United States.

Increased membership outside the United States and Canada and increased cooperative activity with non-US based organizations requires accompanying staff presence. ASHRAE members must feel as if ASHRAE, and its products and services, are within easy reach to them.

A staff presence can be achieved in a number of ways. For example:

1. Use of an association management service to provide membership database access and phone and e-mail support in strategic locations during business hours at those locations.
2. Cooperative office arrangement and staff support through an American association or collection of associations that have an existing global presence.
3. Cooperative office arrangement and staff support through a non-North American association or a collection of associations not based in the United States. For

example, ASHRAE may wish to add dedicated staff in the offices of an Associate Society or other association in Europe, like REHVA, in India and in China, in the Middle East, and in South America.

4. Begin staff operations in selected cities that are fully run and operated by ASHRAE.

The objective of creating a non-North American staff presence will be to provide local language staffing support during normal business hours in locations where concentrations of ASHRAE members and ongoing business activities justify the investment.

Implementation Assignment: The Executive Committee of ASHRAE's Board of Directors will explore various alternatives and locations to establish a staff presence outside of North America.

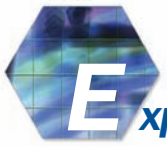
Strategy 4.12

ASHRAE will align its business practices to better serve members globally.

As ASHRAE expands its operations multi-nationally, it is important to address business issues along with language concerns. Credit card transactions, invoicing, documentation for governmental bodies are several examples of issues requiring consideration.

This strategy is a good business practices issue as well as a member service issue. If ASHRAE's business practices are such that members have difficulty purchasing ASHRAE products and services, ASHRAE's business performance will suffer. For ASHRAE to achieve its global membership aspirations and for it to maximize the income potential that membership growth offers, business practices must be audited and changes made as needed to function in a global economy.

Implementation Assignment: The Society's Finance Committee will examine ASHRAE's business practices and improve them as required.



Strategy 4.13

ASHRAE, in cooperation with national societies or independently, will pursue conferences and exhibitions outside North America.

Expositions and conferences promote ASHRAE member interaction and interaction with members of Associate Societies. At expositions, manufacturers meet with designers, installers and operators. Conferences enable peer-to-peer exchange and learning opportunities. Both have been essential to the success of the ASHRAE model in the United States and are essential to the success of ASHRAE in many regions of the world.. Because they bring members together, expositions and conferences enable members to put a "face" on ASHRAE's international involvement.

ASHRAE may seek to partner with national societies or with exposition management firms and conference organizers to develop international expositions. If ASHRAE chapters engage in expositions, it must be under arrangements where the financial benefit is shared by the Society and where the ASHRAE brand is carefully protected.

There are many avenues that can lead to the same destination. Also, existing expositions and conferences will be considered in ASHRAE's planning. For the HVAC&R industry to truly become global, however, there needs to be a coordinated exposition and conference landscape on a global scale that includes ASHRAE.

Implementation Assignment: The Executive Committee of the ASHRAE Board of Directors will address this strategy.

Strategy 4.14

The ASHRAE Brand will be strengthened to reflect a global strategy that serves the needs of all members.

The name "American Society of Heating, Refrigerating and Air-Conditioning Engineers" forms the Society's legal basis for existence. It serves to identify the foundation upon which ASHRAE was built, and to change it would have extensive legal ramifications.

The name "ASHRAE," however, is a trademark; a brand that can be changed or modified to reflect what best describes the Society in the global environment.

For example, the brand could be extended to state "ASHRAE International" or "ASHRAE Global," and the logo itself, a hexagon based on the shape of ice crystal capturing the rays of the sun, may be in need of updating to appeal not only to a more geographically diverse membership but to attract attention from a younger potential membership.

Implementation Assignment: The Executive Committee of the ASHRAE Board of Directors will engage a marketing and branding consultant to examine the ASHRAE brand with specific attention paid to branding that reflects a global strategy and represents the wishes and desires of all ASHRAE members.

5.0 The Business Plan for a Global Society

Operating as a global society requires that ASHRAE invest fiscal resources and monitor fiscal return. If ASHRAE does not make this investment, ASHRAE will become irrelevant to an engineer's practice and therefore irrelevant in the global economy. To not have a business plan in place that demands economic viability and that is based on sound business policies is equally irresponsible.

The fiscal impacts of pursuing strategies presented in ASHRAE's Strategies for a Global Environment must be estimated and approved in accordance with ASHRAE's operating procedures. The adoption of a global strategy by the Board of Directors does not constitute funding approval of specific activities. The merits of those activities must be weighed against the cost by the appropriate approving body for policies and fiscal impacts.

To provide for thorough fiscal analysis, ASHRAE will require that business plans be developed for execution of each global strategy. The basic premise of these business plans within this global framework is that the cost of implementing the programs will be balanced against resulting revenue and membership benefit.

While individual programs may not be self-supporting, the overall cost of global participation will not exceed the cost of providing the services and benefits on a long-term basis. The Society's Finance Committee will provide this overall financial review of implementing the global strategies.

Each business plan should have, but depending on the nature of and scope of the strategy is not required to have, the following components:

1. Definition of the Strategy
2. Identification of the Outcome(s) that Will Result from the Strategy.
3. Benchmarks against which Progress Will Be Measured
4. Keys to Success
5. Market Analysis including Market Segmentation
6. Main Competitors with Strengths/Weaknesses
7. Description of Services or Products to Be Offered
8. Competitive Comparison (if relevant)
9. Immediate Infrastructure Requirements
10. Future Infrastructure Needs
11. Activity Partners and Strategic Alliances

12. Pricing Strategy
13. Sales Strategy
14. How Products or Services Will Be Fulfilled
15. Communication Strategy and Plan
16. Projected Income and Expense
17. Milestones
18. Assumptions for the Business Plan
19. Key Financial Indicators

Investing in global initiatives is to invest in ASHRAE members. Since globalization should benefit all members, ASHRAE dues income should be used to support execution of global strategies. However, implementation requires that the ASHRAE business enterprise be able to be sustained. Developing well-conceived business plans and monitoring them will ensure this.

Ad Hoc Committee Recommendation 1: That the Board of Directors assign to the Finance Committee overall financial review of pursuing Strategies for a Global Environment under Strategic Direction 4 of ASHRAE's Strategic Plan.

6.0 Implementing Strategies for a Global Environment

Implementing ASHRAE's Strategies for a Global Environment will require close cooperation and coordination by ASHRAE's councils and committees across the entire breadth of ASHRAE. The results of a successful implementation will be added value for all members of ASHRAE, without regard for their geographic location. While implementation will occur over a three-year period, market research and planning should begin immediately upon approval of by the Board of Directors of ASHRAE's Strategies for a Global Environment.

The Ad Hoc Committee does not recommend creating additional bureaucracy to manage the global initiative. Existing ASHRAE committees and councils should be charged with developing and recommending for approval as required actions which execute global strategies. The Society, however, should maintain a means to provide guidance on implementing the strategies and to champion efforts that make ASHRAE more global in its perspectives, programs and services. It is critical that actions be carefully scheduled so that prerequisites will not delay downstream activities.

Ad Hoc Committee Recommendation 2: A means to provide guidance on implementing ASHRAE's Strategies for a Global Environment and to champion efforts that create a more global ASHRAE should be established.

Assignments and Implementation Period

Strategy	Responsible Councils or Committees	Implementation Period
1. While ASHRAE's chapter and regional structure shall be the backbone of ASHRAE's structure globally, it shall be flexibly applied to serve our membership.	Members Council	2007/2008
Study the unique needs of ASHRAE members who do not have access to a chapter and develop methods to allow them to benefit from ASHRAE value-producing services without a chapter.		
Review the existing regional structure and the rules for formation of chapters, sections, student branches, and regions to determine if they meet the needs of a global organization. More specifically, the current structure—with two non-North American regions and two North American regions having non US/Canadian chapters – may need to change to adequately serve the more than 10,000 members outside of North America.		
2. ASHRAE will cooperate with organizations with shared objectives and strengthen the ASHRAE Associate Societies Alliance.	Executive Committee	2007/2010
Immediately begin to strengthen and formalize the Associate Societies Alliance to develop shared objectives that promote cooperation between broad based groups of member organizations.		
3. The cost of annual membership dues will be balanced with the cost of providing membership benefits and services in different geographic regions.	Members Council; Publishing and Education Council	2007/2008
Evaluate ASHRAE's dues structure and its impact on members in developing countries. Develop member services that can be delivered at lower costs than ASHRAE's traditional methods.		
4. Publications and educational products will be priced so they are within reach of ASHRAE's global membership but will not be priced at less than the cost of providing them.	Publishing and Education Council	2007/2009
Conduct market research to look for regional trends and to determine the immediate needs of members in centers of ASHRAE activity around the world.		
5. ASHRAE will develop its expertise in HVAC&R technologies to embrace whole building sustainable design and be one of the most valuable global resources for publications and educational products related to sustainable HVAC&R technology.	Publishing and Education Council	2007/2010
Conduct market research to look for regional trends and to determine the most immediate needs of members in centers of ASHRAE activity around the world.		
Create a Worldwide Bookstore.		
Create educational products that serve the needs of members outside of the United States and Canada and develop suitable delivery mechanisms and pricing that encourages wide-spread use.		
Promote greater use of ASHRAE publications and educational products.		
Evaluate the publication of regional ASHRAE Journal editions with local language and advertising.		

6. ASHRAE will pursue opportunities and processes along with translation to publish its literature in various languages. Develop a plan to reduce language barriers so that non-ASHRAE literature is considered in developing ASHRAE publications and so ASHRAE's English language content is more accessible to members whose first language is not English. Expand cooperative efforts on ASHRAE research such that more institutions outside the United States and Canada conduct ASHRAE sponsored research. This includes the identification of research that satisfies specific needs of members in regions other than the United States and Canada. Expedite the development of metrics and tools for building performance evaluation and insure that they are applicable globally.	Publishing and Education Council; Technology Council	2007/2010
7. Volunteer participation barriers will be overcome through meeting planning and organization that is sensitive to global participation and that benefits from electronic communication technologies. Publicize ASHRAE honors and awards globally to stimulate submissions from outside the United States and Canada. Task the Electronic Communication Committee with preparing a report on available interactive communication technology that can allow members to participate globally in Society activities.	Members Council; Publishing and Education Council; Technology Council	2007/2010
8. ASHRAE will support, in cooperation with national associations, a uniform, international standard for credentialing in the disciplines and practices of HVAC&R. Conduct market research to look for regional trends and to determine the most immediate needs of members in centers of ASHRAE activity around the world. Ensure that certification produces programs that are applicable globally.	Publishing and Education Council	2007/2010
9. ASHRAE will actively support and participate in international standard development activities. Evaluate International Standards and their applicability in the American market.	Technology Council	2007/2010
10. ASHRAE will actively protect its intellectual property rights. Monitor non-authorized use of the ASHRAE logo and brand and protect ASHRAE's intellectual property rights. Monitor non-authorized use of the ASHRAE logo and brand and protect ASHRAE's intellectual property rights.	Publishing and Education Council	2007/2010
11. ASHRAE will provide enhanced staff support outside of the United States. Cooperate with Associate Societies or other associations to explore providing a staffing and administrative presence for ASHRAE in strategic and key locations outside of the United States.	Executive Committee	2007/2009

12. ASHRAE will align business practices to better serve members globally. Develop the ability to do business globally with regard to accepting and disbursing currencies across national borders and implement other business practices that facilitate participation of non-US members in ASHRAE.	Finance Committee	2007/2010
13. ASHRAE, in cooperation with national societies or independently, will pursue conferences and exhibitions outside North America. Contribute to the process of globalizing trade fairs for the HVAC&R industry. This entails actively soliciting attendance and exhibitors from outside the United States in the AHR Exposition, encouraging U.S. participation in trade shows outside of the United States when such participation benefits ASHRAE members locally and regionally, and creating through partnerships when advantageous to do so new trade shows that will bridge gaps between technology development, product availability, and systems application.	Executive Committee	2007/2010
14. The ASHRAE Brand will be strengthened to reflect a global strategy that serves the needs of all members. Retain a competent firm to advise ASHRAE regarding developing a global brand.	Executive Committee	2007/2010

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