International Cooperation to Scale Up Adoption of High-Performance Buildings: From Novel to Normal

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ABSTRACT

The seven partner countries of the Asia-Pacific Partnership on Clean Development and Climate (APP)—Australia, Canada, China, India, Japan, Korea, and the United States—are collaborating on a variety of projects to enhance their energy security and mitigate climate change. Among the goals of the Buildings and Appliances Task Force (one of the partnership's eight task forces) is to increase the percentage of high-performance buildings in the building stock of the APP countries. The project partners have agreed to build or enhance individual demonstration buildings, and also have developed a multi-pronged strategy to accelerate the wider uptake of advanced building technologies and practices throughout the APP economies: sharing information and experience; developing and disseminating tools; working on national-scale implementation in selected countries' commercial building sectors; and promoting the project's activities to a wider audience of buildings professionals. The main challenge in this collaboration has been aligning the partner countries' priorities and available resources to enable truly multilateral initiatives and consistent participation by key players. However, the APP partnership has provided a valuable mechanism for cooperation on high-performance buildings that has yielded promising results in its first two years. These successes will likely be enhanced by linking the APP activities to the burgeoning number of national initiatives to promote high-performance buildings in the APP partner countries.

Introduction

In the spring of 2006, six countries—Australia, China, India, Japan, Korea, and the United States—began collaborating on a variety of projects aimed at expanding investment and trade in cleaner energy technologies, goods, and services through the Asia-Pacific Partnership on Clean Development and Climate (APP).[1] In 2007, the addition of Canada brought the number of partners to seven. The formation of the APP was intended to meet the partners' goals for energy security and climate change mitigation in ways that promote sustainable economic growth and poverty reduction. Within the APP, eight task forces were created to focus on different market sectors. The goals of one of these, the Buildings and Appliances Task Force (BATF), are to build on existing bilateral and other collaborative initiatives in the buildings and appliances sector to: 1) support the uptake of more energy efficient appliances; 2) promote best practice and demonstrate energy efficient technologies and building design; 3) increase the uptake of energy efficient buildings and appliances into national efforts that support sustainable development,

[1] http://www.asiapacificpartnership.org

increase energy security, and reduce environmental impacts; and 4) address barriers to the implementation of end-use energy efficiency practices and technologies.[2]

One of the eleven projects within the BATF (see Figure 1), *High-Performance Buildings and Developments* (HPBAD), aims to increase the percentage of high-performance buildings in the building stock of the APP countries.

Figure 1. Organization of the Asia-Pacific Partnership on Clean Development and Climate (APP), and Projects of the Buildings and Appliances Task Force (BATF)

One part of the HPBAD strategy is to emulate and build on previous successes in bilateral high-performance buildings projects by collaborating to build or enhance individual high-profile buildings—thus demonstrating state-of-the-art building technologies and practices to the host countries' buildings communities. However, the HPBAD partners have agreed that showcasing iconic high-performance buildings will not be enough to meet the project's goals. In parallel with these activities, the partners have developed a multi-pronged strategy to accelerate the wider uptake of advanced buildings technologies and practices throughout the APP economies—with a particular focus on China and India, both of which are experiencing extremely high growth rates in the building sector. The strategy consists of 1) sharing information and experience; 2) developing and disseminating tools; 3) national-scale implementation in selected countries' commercial building sectors, beginning with India; and 4) promotion of the project's activities beyond the APP countries.

[2] http://www.asiapacificpartnership.org/Buildings-AppliancesTF.htm

This paper describes the preliminary results of the collaborative efforts of the seven countries to put in place processes for achieving large-scale adoption of advanced, energy-efficient building practices. The first section discusses three single-building demonstration projects in China, and then describes the HPBAD activities under the four-pronged strategy to accelerate the wider uptake of high-performance buildings in all of the APP countries. This section also includes descriptions of relevant activities being carried out under other BATF projects—the *Building Certification*, *Building Codes*, and *Improvements to Existing Buildings* projects—that contribute to the overall goal of the HPBAD project, in recognition of the inter-related nature of these topics and the importance of each of them to improving overall efficiency in the buildings sector.

The final section discusses the lessons learned to date from the partners' efforts to accomplish the goals of the project, including challenges, opportunities, and next steps.

APP/BATF High-Performance Buildings and Developments Projects

Demonstration Projects (Green Building Flagships in China)

The HPBAD partners are providing technical support for several individual projects in Beijing to demonstrate advanced building technologies and practices that can significantly improve building energy efficiency. Taken together, the projects have been designated as APP "Flagship" activities, or high-profile projects that highlight the opportunities provided by the APP partnership's successful collaborations. The three demonstration projects are intended to provide education about state-of-the-art building technologies and practices to the buildings community within China and, by publicizing the results, throughout the international buildings community.

- Agenda 21 building and a proposed demonstration center: Between 1998 and 2004, China's Ministry of Science and Technology (MOST) and the U.S. Department of Energy (DOE) collaborated on the design and construction of the Agenda 21 energy-efficient demonstration office building in Beijing, with technical support from Lawrence Berkeley National Laboratory (LBNL) and the Natural Resources Defense Council (Zimmerman et al. 2000; Xu et al. 2007). The building was completed in early 2004, and became the first commercial building in China to be certified as LEED Gold according to the Leadership in Energy and Environmental Design (LEED) rating system developed by the US Green Building Council (USGBC). The HPBAD partners have agreed to build on the successful completion of this building by sponsoring a Center of Excellence in Sustainable Design and Technology (COE), which was to be located on the second floor of the building. The COE was intended to provide display, exhibition, and training opportunities in cutting-edge building technologies, database and benchmarking techniques, and buildings-related software tools. Subsequent to BATF endorsing the COE, MOST determined the Agenda 21 Building could not be used for this purpose. DOE is exploring other opportunities to establish a COE in a high visibility building in Beijing.
- Mayor's training center: Twice a year, mayors and other officials from the major cities in China receive training at the Mayor's Training Center in Beijing on various topics related to municipal governance. With DOE as the lead, the HPBAD partners have agreed to

work with China's Ministry of Construction and the China Academy of Building Research to: a) help make the current building more energy efficient; b) when a decision is made for a new facility, design a high-performance or zero-energy building to be used as the new Mayors Training Center, to challenge the municipal officials receiving training to build such buildings in their cities; and c) update the curriculum to include training on energy-efficiency policies and practices. The curriculum development is expected to begin in 2008.

- Olympic village micro-energy (near-zero energy) building: Over the last several years and as part of its APP collaboration, DOE has been working with the Beijing Olympic Village developer, Guo'Ao Development Company, to construct a near-zero-energy building in the Village to serve as an athletes' welcome center during the 2008 Olympic Games. The partnership was facilitated by the Beijing Science and Technology Development Commission. The building will be used to welcome 17,000 athletes from around the world and, after the Games, will be remodelled and used as a kindergarten. The building will generate the bulk of its power from renewable sources and will demonstrate water conservation and reuse, on-site waste processing, healthy indoor environment, and green building materials and technology. While plans to publicize the energy-efficient features of the building have not been finalized, the high visibility of the Olympics will ensure significant public exposure.

Beyond Demonstration: Accelerating Wider Uptake of High-Performance Building Technologies and Practices

The three projects described above are designed to be more than just iconic demonstration buildings—all of them include education components and two are focused on training. Nevertheless, the HPBAD partners recognize that a significant increase in the uptake of high-performance buildings and developments will require going beyond the demonstration project model. In their discussions at semi-annual BATF meetings and during an HPBAD project meeting in 2007, the project team has developed a strategy aimed at taking advantage of the collective market power and the collaborative arrangement among the APP countries to encourage the more mainstream uptake of energy efficient buildings. The strategy consists of the following four elements:

Sharing information and experience: The project team agreed that the first critical step in the collaborative project to promote efficient buildings was to establish a base of relevant technical and economic information to broadly share the experience of each partner. To accomplish this, the partnership is carrying out three activities: Creating an *APP Sustainable Building Database* for information on high-performance buildings; supporting the design of *Regional Energy Efficiency Centers* in India, and carrying out a pilot project to disseminate information about data center efficiency in India. The first is designed to provide easy public access to information about the experience of the APP countries (and eventually, perhaps, a broader range of countries) with high-performance buildings. The other two activities have a more proactive focus on India and are designed to provide in-depth information to the broad range of actors in the buildings sectors in India and the other APP countries.

- APP sustainable building database: Led by Japan, the HPBAD partners agreed to develop an internet portal featuring examples of high-performance buildings and developments,

their technologies, and their operational performance. The resulting database, expected to become active in summer 2008, will provide links to APP partner country websites with information on high-performance buildings, and guidance on the content of these sites.

- Regional energy efficiency centers in India: The HPBAD partners plan to support the development of a series of *Regional Energy Efficiency Centers* (REECs) in India, each of which will concentrate on a priority area of energy efficiency. The REECs are intended to help transform the market for energy efficiency in India by enhancing awareness among residential and commercial consumers about end-use energy efficiency; showcasing energy efficient products; promoting technology development through cooperation with other APP countries; and catalyzing the growth of the energy efficiency market and businesses in India. Each REEC is expected to be part of an existing institution. Funding for the first phase of this project was awarded in September 2007 from the US Department of State, which is working with the Government of India to establish criteria for REEC proposals. Once a REEC proposal is selected, the United States (led by the US Agency for International Development, USAID) and other APP partners will provide support for the design and implementation of the first Center. Technical assistance and training partnerships will be fostered between REEC promoters in India and US institutions.
- Indian high-tech buildings initiative: data centers pilot: This project aims to help transform the market and build capacity for energy efficiency in Indian buildings for high-tech industries, starting with data centers. Led by the United States, in collaboration with India's Bureau of Energy Efficiency (BEE) and Indian industry partners, the first phase of the data centers pilot project was carried out in January, 2008. The project leads gathered information on the current status of Indian data centers through visits to several data centers, a charrette-type meeting, and a workshop on improving data center efficiency in India. Recommendations stemming from these efforts include developing information materials and workshops for the Indian high-tech industry; capacity building and training; peer-to-peer information exchange; developing performance indicators and a benchmarking framework; and creating a regulatory, standards, and incentives framework. The next steps in this project are still under discussion.

These activities complement several initiatives being planned and carried out under other BATF projects that also are designed to share information and experience among the APP partners on aspects of building energy efficiency. These initiatives include various surveys under the *Building Codes* project to gather information about technologies, policies, and practices in APP countries; a *Building Certification* project survey of energy rating and labelling systems for buildings; and a U.S. effort to share its experiences on data and benchmarking.

Developing and disseminating tools: The second critical component of the HPBAD project strategy for encouraging the more mainstream uptake of energy efficient buildings is to develop tools (or adapt existing tools for use by all the APP partners) that enable building designers to design energy-efficient buildings, or that assist building operators in accurately measuring building energy use. As a first step, Australia and China are developing a Chinese operational rating tool, based on the Australian Building Greenhouse Rating tool, that will recognize "better than code" building performance.

In addition, the HPBAD project activities are able to build on the dissemination of building energy simulation and measurement tools by other BATF projects. The *Building Codes* project, for example, has carried out trainings (and "train the trainer" programs) in India, China, and Australia in the use of three building energy simulation tools:

- EnergyPlus—a simulation program that allows building designers to estimate the energy impacts of using various heating, cooling, ventilating, and lighting systems, and different types of windows.[3]
- THERM—a computer program that models heat-transfer effects in windows, walls, foundations, roofs, doors, and other building components.[4]
- WINDOW—a computer program for calculating total window thermal performance indices that can be used to design new products or help policymakers develop building energy codes.[5]

The *Building Codes* project plans to translate THERM and WINDOW into Chinese and Korean. In addition, the *Improvements to Existing Buildings* project is developing tools to help ensure proper building energy monitoring, as well as operations and maintenance (i.e., US EPA's Chinese-language eeBuildings Energy Performance Monitoring Tool (EPMT)).

National-scale implementation: Alongside its information gathering and tool development efforts, the HPBAD team has initiated several activities to actively encourage the adoption of high-performance building practices at a national level through training, capacity building, and policy development. Many of the following activities have focused on India, with the aim of making measurable progress in this one economy, and at the same time providing a model for success for the other APP countries.

- High-performance commercial buildings in India: This activity aims to facilitate advanced design strategies, energy efficiency measures, and financial initiatives to encourage the widespread construction of high-performance Energy Conservation Building Code (ECBC)-compliant commercial buildings in India. The project targets air-conditioned, new commercial buildings, and has several components: establishment of benchmarks of pre-energy code buildings, analysis of energy saving potential using passive architectural strategies, energy audits, information sharing and awareness building, and work on a policy framework to facilitate implementation of the ECBC in Indian commercial buildings. This project is led by the United States and managed by India's The Energy and Resources Institute (TERI). India's BEE also is involved in an advisory role.
- Promotional framework for passive design and solar energy technologies in energy-efficient buildings: Led by India's Ministry for New and Renewable Energy, the aim of this activity is to develop a policy framework for promotion of energy efficient buildings in India—particularly those that incorporate solar passive designs and renewable energy technologies. This activity is designed to build on recent legislation in some Indian states mandating that future construction use passive design features.

[3] http://www.eere.energy.gov/buildings/energyplus/
[4] http://windows.lbl.gov/software/therm/therm.html
[5] http://windows.lbl.gov/software/window/window.html

- Workshops: A series of workshops and other programs also are being planned in 2008 to disseminate information about high-performance buildings throughout India. These include a Building Energy Efficiency Workshop, a Continuing Professional Development Program, and a Sustainable Housing Communities Workshop.

Similar HPBAD initiatives to promote widespread adoption of high-performance buildings in China are likely to begin later in 2008 and 2009. The HPBAD partners are working to coordinate its initiatives in both countries with the activities of other BATF projects, including the establishment of a building simulation laboratory at the Center for Environmental Planning and Technology (CEPT) University in Ahmedabad, India; assistance in the development of educational and support guideline documents for the Indian ECBC; participation in the development of insulating glass standards in China; training on tracking building energy performance and implementing no-cost/low-cost energy efficiency measures; training in spectral data testing and analysis; and demonstration of the potential of energy-efficiency upgrades (or "tune-ups") to significantly decrease energy use in existing commercial buildings.

Promotion beyond APP: The final component of the HPBAD strategy is to publicize the activities of the partnership in a wider context, to facilitate coordination of the APP activities with other international efforts and enhance synergies that may exist with other high-performance buildings trends and initiatives. Promotional efforts to date have focused on informal contacts with industry representatives in each APP country, a series of BATF industry fora in the United States, periodic updates about BATF activities to a continuously growing mailing list, and reports (such as this one) in appropriate peer-laden venues. Despite these efforts, it has been a difficult task to inform and engage the many actors who make up the building industry in the APP countries. While continuing their informal communications with other organizations and buildings professionals, the HPBAD partners also aim to reach a wider audience by participating in the promotional efforts—including an APP e-newsletter launched in March 2008—of the APP Administrative Support Group, managed by the US Department of State (contact ReachAPP@state.gov).

In addition, the APP partners are hoping to increase the scale of information exchange by co-sponsoring the upcoming *SB08—6th World Sustainable Building Conference* in Melbourne, Australia (21–25 September 2008).[6] Led by the Australian APP delegation, this sponsorship will ensure a high profile for the APP/BATF as a conference partner. The BATF partners speaking at the conference will have the opportunity to report the results of the HPBAD initiatives to an audience of 2000–3000 international buildings experts, solicit feedback on the future directions of the project, gather information on similar and potentially complementary initiatives, and hopefully engage the participation of a wider group of stakeholders in the APP activities.

[6] http://www.sb08.org/

Lessons Learned

The first two years of the APP Buildings and Appliances Task Force's HPBAD project provide a case study of international collaboration on a complex issue. The seven APP countries have broad economic and institutional differences. The officials and other participants who attend the BATF meetings from each country are from a wide variety of agencies and institutions (public and private) and have varying levels of authority. This situation, which is true of all the APP task forces, is further complicated by the wide range of topics covered by the BATF, resulting in a correspondingly large number of interested stakeholders.

From this mix of players and viewpoints has emerged the collaborative strategy detailed on the previous pages. A number of lessons can be extracted from the experience to date, regarding the challenges inherent in this type of collaboration, the valuable opportunities that the APP collaboration offers, and possible next steps for promoting the adoption of high-performance buildings.

Challenges: The HPBAD team has faced two challenges in its efforts to formulate a seven-country collaboration for promoting high-performance buildings:

- *Truly multilateral initiatives are difficult*. Despite the collaborative nature of the APP, the majority of the activities under the HPBAD project are (at least in the beginning) bilateral. This is, perhaps, inevitable, since the APP is designed to build on existing bilateral relationships among the participating countries, and the different priorities of the member countries mean that the initial resources allocated by each country for the HPBAD project are directed into different activities. As the HPBAD project continues to mature, it will be a key goal of the project team to broaden participation in each of the project activities to ensure that all of the partner countries have the opportunity to enhance the success of, and benefit from, each activity.
- *Getting the right people in the room is difficult*. The wide range of topics covered by the BATF and travel distances make it difficult for the APP countries to ensure attendance at task force meetings by experts in all of the 11 BATF project areas. This can result in a lack of consistency in attendees from meeting to meeting, making forward progress on each project difficult. It also means that task force members may not represent the appropriate agency—or be at the appropriate level of authority—to be able to make critical project decisions (e.g., endorsing a new activity). To some extent, these problems can be addressed through email communication among the appropriate players between task force meetings, and by holding occasional project-level meetings (e.g., with a single focus on HPBAD).

Opportunities: Despite these challenges, the HPBAD project offers unique opportunities for successful collaboration in promoting high-performance buildings in the APP countries. These are:

- *Open channels for information exchange*. The periodic project-level and task force meetings provide formal, periodic opportunities for each country to update their APP partners about their HPBAD project activities; this is important for broadening the collaborative nature of each project activity. The regular information exchange also

allows each partner to brief the others on national trends and accomplishments. This is critical for keeping all of the partner countries informed of quickly evolving developments in the high-performance buildings sector, and promotes discussion of potential ways for the other APP partners to build on these trends and on other international collaborations.

- *Mechanism for disseminating best practices*. Even in the case of projects that begin as bilateral efforts, the collaboration provides a mechanism for ensuring that the experiences and lessons learned from building demonstrations and other high-performance building projects performed under the auspices of the APP are received in all seven countries. This information flow occurs through project updates at task force meetings, site visits during project-level meetings, ministerial-level APP meetings, and publicity events.
- *Coordination with related project activities in the buildings sector*. The HPBAD goal of promoting high-performance buildings is closely tied to the activities of several other BATF projects. The international buildings community recognizes that successfully increasing the efficiency of buildings requires attention to multiple areas—e.g., codes, certification, financial incentives, technology development—all of which are addressed by the various BATF projects (see Figure 1). Because the BATF structure allows information sharing about these projects in a common forum, the HPBAD project is able to coordinate with and build on the efforts of the other projects in a way that would not be possible through an isolated international project to promote high-performance buildings. In a similar way, BATF is considering ways to collaborate with other APP Task Forces, particularly the Renewable Energy and Distributed Generation (REDG) Task Force.

Next steps: Based on the HPBAD experience and lessons learned to date, the following are likely next steps to move the project forward and expand its impact:

- Continue to broaden participation by each of the APP member countries in the current project activities, to make the activities truly multilateral and expand their benefits throughout the APP region.
- Through coordination with other BATF projects, support the adoption of policies (e.g., consistent, high-quality building codes) and technologies (e.g., smart systems) that would benefit from more active promotion in all seven APP countries.
- Widely promote and discuss the HPBAD activities internationally with the aim of both coordinating more closely with other international efforts, and engaging more private sector partners to ensure the faster uptake of new ideas in the APP countries. The promotion will continue to take the form of informal contacts with industry representatives, outreach through the APP communications infrastructure, and active participation in international events such as SB08.
- Coordinate with ongoing national efforts. Initiatives to promote high-performance buildings are becoming increasingly common in all of the APP countries. As the HPBAD project continues to pursue its multi-pronged strategy to promote high-performance buildings through collaboration, it will try to build its initiatives on the foundation of these national efforts, and will look for opportunities to publicize their successes and spread the lessons learned to the other APP countries and beyond. Table 1 lists some of the national programs that the HPBAD team will consider and track in the formulation of its future efforts.

These steps can help the HPBAD team address some of the challenges encountered to date and will support the partnership's ultimate goal of increasing the percentage of high-performance buildings in the building stock of the APP countries.

Table 1. National Programs to Promote High-Performance Buildings in APP Countries

Program	Description
Australia	
National Framework for Energy Efficiency	Launched in 2004 to promote energy efficiency throughout the economy. Measures for energy efficient buildings include high-efficiency HVAC systems, green leases, and smart meters. (http://www.nfee.gov.au)
Green Building Fund	AU$90 million committed in 2008 to help Australian businesses implement energy and water efficiency measures through the retrofitting and retro-commissioning of existing commercial buildings (Australian Labor Party 2008).
Canada	
ecoENERGY Efficiency Initiative	Launched in 2007. Includes incentives for building retrofits and promotion of efficient new construction through provision of tools, modeling software, training, information, stakeholder networks, and validation of new building designs. (http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/index-eng.cfm)
LEED Canada Initiative	Canada Green Building Council (CaGBC) aims to certify100,000 commercial buildings by 2015. (http://www.cagbc.org)
Canada GBC performance-based certification	To be launched in 2009. CaGBC will incorporate performance-driven element into evaluation of LEED buildings. (http://www.cagbc.org/leed/initiative/index/articles252.htm)
China	
National building codes	Building codes for residential and commercial buildings have been adopted and demonstrations are being carried out in six cities (Energy Foundation 2008).
Building energy savings targets	MOC has called for a 65 percent energy savings target for buildings in Beijing, Shanghai, Chongqing, Tianjin, and other major cities (Energy Foundation 2008).
India	
CII-Godrej Green Business Centre and Indian Green Building Council (IGBC)	CII-Godrej Green Business Centre is a public-private partnership launched in 2000 in Hyderabad to promote green buildings. Partners are the Confederation of Indian Industry (CII), Government of Andhra Pradesh, Godrej Foundation, and USAID. The CII-Godrej GBC launched the IGBC, which is facilitating construction of LEED buildings and training of LEED professionals throughout India. (http://www.igbc.in)
Energy Conservation Building Codes	The BEE was empowered to mandate the ECBC, to provide minimum requirements for the energy-efficient design and construction of buildings. The code is expected to be mandatory for all new buildings with a connected load of 500 kW or more, a demand of 600 kVA or more, or a conditioned floor area of at least 1,000 m^2. (http://www.bee-india.nic.in/sidelinks/ECBC.html)
National Green Building Rating System	The Ministry of New and Renewable Energy and The Energy and Resources Institute, New Delhi, launched the Green Rating for Integrated Habitat Assessment (GRIHA) (TERI 2006).
Japan	
Energy Conservation Law	Includes energy efficiency standards for non-residential buildings and housing. (http://www.eccj.or.jp/law/rational_use_of_energy.html)
Financing for EE buildings	Low interest loans (Development Bank of Japan) and mortgages (Japan Housing Finance Agency), and subsidies (by national and local governments) (Hirano 2007).
Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)	A rating system developed by the Japan Sustainable Building Consortium (academia, industry, government consortium), CASBEE is based on building environmental efficiency. Corresponding to the four stages of building life cycle—Pre-design, New Construction, Existing Building, and Renovation—seven

	"CASBEE" family" tools have been developed. (http://www.ibec.or.jp/CASBEE/english/overviewE.htm)
Sustainable Building Reporting System	13 local governments are required to report and publish building performance results based on the CASBEE. The Tokyo Metropolitan Government must comply with its own performance indication scheme (Hirano 2007). (http://www.ibec.or.jp/CASBEE/english/statistics.htm)
Korea	
Mandatory building standards	Standards for building insulation and energy efficient design are regulated by the Ministry of Land, Transport, and Maritime Affairs (Lee 2008).
EE certification program	The building energy efficiency certification program is regulated by the Ministry of Knowledge Economy, and managed by Korea Energy Management Corporation (KEMCO) (Lee 2008). (http://kemco.or.kr/building/v2/)
Green building certification program	Regulated by Ministry of Construction and Transportation, and Ministry of Environment (Lee 2008).
United States	
Energy Policy Act of 2005	Provides tax incentives for buildings designed to use 50 percent or less of the energy of typical code buildings (U.S. Congress 2005).
U.S. Green Building Council (USGBC)	Developers of the LEED building rating system, fund green building research. (http://www.usgbc.org)
Green Building Initiative	Green Globes software—Guide for integrating environmentally friendly design into new or existing buildings. Includes assessment protocol and rating system. (http://www.thegbi.org)
Energy Star Challenge	In 2005, the USEPA (along with 20 states, groups, and businesses) challenged commercial and institutional building owners to improve energy efficiency by 10% or more. (http://www.energystar.gov/index.cfm?c=challenge.bus_challenge) Energy Star is a joint EPA-DOE program.
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Advanced Energy Design Guides	Provide recommendations for achieving energy savings over the minimum code requirements of American National Standards Institute (ANSI)/ASHRAE/ Illuminating Engineering Society of North America (IESNA) Standard 90.1-1999. Developed in collaboration with American Institute of Architects (AIA), IESNA, USGBC, and DOE. (http://www.ashrae.org/technology/page/938)
ASHRAE Standard 90.1-2010	Goal of improving commercial building codes by 30% by 2010. (http://www.ashrae.org)
ASHRAE proposed Standard 189.1	*Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*. Will define high-performing buildings in code-intended language; under review. (http://www.ashrae.org/pressroom/detail/16656)
ASHRAE Vision 2020	Goal of providing tools for producing market-viable net-zero-energy buildings by 2030. Will develop a rating system and branding for all buildings, considering design and operations (ASHRAE 2008).
American Institute of Architects 2030 Challenge	Calls for immediate energy reduction of all new and renovated buildings to half the national average for that building type, with increased reductions of 10% every five years so that all buildings designed by the year 2030 will be carbon-neutral. (http://www.architecture2030.org/2030_challenge/index.html)
New Buildings Institute (NBI) "Getting to Fifty"	Offers practical guidance to help designers, architects, owners, and contractors achieve buildings that are 50% more efficient than standard practice/code. (http://www.newbuildings.org/gtf/index.htm)
Zero Net Energy Commercial Buildings Initiative	The Energy Independence and Security Act of 2007 authorized funds to develop and disseminate technologies, practices, and policies for the development and establishment of zero-net-energy buildings. Applies to commercial buildings newly constructed in the U.S. 2030; 50% of commercial building stock of the U.S. by 2040; and all commercial buildings in the U.S. by 2050 (U.S. Congress 2007).

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