# Worldwide status of energy standards for buildings: a 2009 update

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## Keywords

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## Abstract

This paper describes the worldwide status of energy standards for buildings in 81 countries keyed to the legal status (i.e. mandatory, voluntary, proposed) and building sector coverage (i.e. residential, commercial, or both) of such standards in different countries. It describes which countries have added new energy standards since 1994, when a similar study gathered information on this topic from 57 countries. The 1994 study used a literature review and a 15-page mail survey distributed via post and fax; the current study relies on a literature review and online survey to gather data. The paper presents an international profile of activities and research issues related to energy standards for buildings. It includes a snapshot of the contents, development, and use of energy standards for buildings, with a particular focus on non-residential buildings in developing countries and economies in transition. Finally, it discusses options for sharing the survey data online so that other users can: (1) query the data gathered for their own purposes; and (2) contribute updates and additional information.

## Introduction

In countries without effective energy-efficiency programs for their buildings, current building energy use trends are (or should be) cause for concern. The building sector consumes roughly one-third of the final energy used in most countries, and it absorbs an even more significant share of electricity. Electricity use in commercial buildings is driving peak demand in the United States, Japan, and in some of the wealthier developing countries in the global south. As countries in the global south raise their standards of living and services, building electricity use is expected to continue to increase, especially in the non-residential sector.

During the past three decades, governments in both industrialized countries and the global south have initiated policies to reduce energy consumption in buildings. Most of these policies can be grouped into one of the following three categories: economic incentives (e.g. taxes, energy pricing), informational programs (e.g. energy awareness campaigns, energy audits), or regulatory requirements (e.g., codes or standards). More recently, growth in voluntary public-private partnerships (e.g. Energy Star in the US and the Carbon Trust Standard in the UK) and recognition programs from non-governmental organizations (e.g. the US Green Building Council) have changed the landscape for improvement by setting stretch goals for the building industry and its clients.

In this paper, we focus mainly on energy standards for buildings[1], which are a widely pursued but sparsely documented approach to limiting energy consumption in buildings. Existing energy standards range from voluntary guidelines to mandatory requirements and may apply to one or many building types. Although energy standard activities are frequently mentioned in the literature, the standards themselves are rarely de-

1. We use the word "standard" to refer interchangeably to what also might be called codes, criteria, guidelines, norms, laws, protocols, provisions, recommendations, requirements, regulations, rules, or standards. Depending on the country, the "standard" may be contained in one document, be part of another larger document (such as a general building code), or comprise several documents.

scribed in any detail. Only a handful of studies pull together information about energy standards for buildings across national boundaries. The World Energy Council conducted a survey of 63 countries and found that there were mandatory efficiency standards for new dwellings and buildings in all European countries (Moisan 2005). In other regions, it found that few countries had standards for new dwellings, but approximately 60% had mandatory or voluntary standards in the non-residential sector. Thomsen, Wittchen & EuroACE (2008) conducted an international comparative study of standards for very low energy buildings in the European Union that usefully describes both governmental and non-governmental activities. Other authors, like Hitchin (2008) and Lausten (2008), set their work in an international context, but their goal is to assess the utility of energy standards as a policy instrument rather than articulating the content in particular countries. For non-European countries, it is difficult to learn which standards have been adopted in what countries, and what they are supposed to cover. The lack of basic information about the contents of standards reflects and perpetuates an international information gap surrounding the development, use, and effectiveness of energy standards for buildings.

There are a number of intricacies that pose serious barriers to building energy research and complicate comparative assessments of energy standards. Energy standards are difficult to classify because no established nomenclature clearly identifies policies that might be considered "energy standards". A single country may have several such standards published by different entities, and they may be self-contained or subsumed within another document (such as a general building code). Whereas a standard set for efficient refrigerators in the U.S. could be used in Singapore or Sweden, standards for energy-efficient buildings are much less transferable. Building energy standards that are stringent for one country may be ineffective in another country, depending on climate conditions, occupant behavior, existing building stock, and construction practices. To make reasonable judgments about the impact of existing standards in different countries, all of these variables plus the turnover of old buildings and rate of new construction would need to be gathered, normalized and compared. Such an analysis would be valuable, but it is beyond the scope of most studies, including ours.

To explore these under-represented areas of research, in the early 1990s we used a literature review and a mail survey to gather more detailed information about activities undertaken to increase the energy-efficiency of buildings, particularly non-residential buildings (Kathryn B. Janda and Busch 1993; Kathryn B. Janda and Busch 1994). This paper reviews the original survey results and presents current findings of an ongoing update. The original study provided a snapshot of the legal status and coverage of energy standards in 57 countries and used results of the survey to characterize the contents, development, implementation, and assessments of specific countries. The 2009 update expands the coverage of the original study, using a literature review and an online survey to gather information on standards in 81 countries. Due to space constraints, we are unable to fully characterize the standards here. However, this paper identifies and discusses trends over the past 15 years in their development, orientation, and governance. We conclude with a summary discussion of the comparative advantages of the various approaches to increasing efficiency of energy use in buildings through standards.

## 1994 Survey: Review of Past Trends

As a possible framework for an international descriptive reference, and in response to the highly variable published information available on energy standards, in the early 1990s we developed a 15 page survey to gather information about activities undertaken specifically for the purpose of increasing energy efficiency in buildings.

To broadly characterize the worldwide status of energy standards for buildings, we combined previously published information with results of the survey. Figure 1 shows a general overview of the legal status and coverage of energy standards in 57 countries. At that time, 13 of the countries for which information was gathered had no energy standards for any building sector; four countries had standards only for the residential sector; nine countries developed standards exclusively for non-residential buildings; and 31 countries had standards for both. At the national level, 27 countries had mandatory energy standards for at least one building sector, and 11 had voluntary standards. Three of the 11 voluntary standards were "mixed," meaning that they are voluntary guidelines but mandatory in limited regions or for specific building types. [2] Six more countries had proposed but not yet adopted energy standards; half of these were non-residential standards and the rest were for both or all buildings.

Summaries of energy standards from each country did not fit easily even into these simple categories. Many countries have more than one kind of standard, depending on the building sector and issuing organization. Each of these standards may have different legal applicability and original versions may have been updated and changed several times since their introduction. We attempted to include the most up-to-date information available for this table, but we did not project into the future.

Because of these complexities, we did not ask survey respondents to attempt a synthesis of the entire energy standard situation in their country. Instead, respondents from countries with existing (or proposed) energy standards named a specific standard and answered several sections of the survey with respect to this standard. They were asked to: specify the standard's geographic coverage and legal status; identify the applicable building types and vintages; and note its provisions for specific building elements. Respondents were also asked to indicate the entities involved in the process of developing and revising this standard, and to describe issues pertaining to its implementation and enforcement.

The survey was sent to approximately 175 contacts in government, research, and professional positions in 65 countries. The number and distribution of these contacts reflects recommendations solicited from researchers knowledgeable about energy standards rather than a specific selection criteria or sampling methodology. Contacts in countries where published information about energy standards does not exist were pursued more vigorously than contacts in countries covered by previ-

2. "Mixed" means that the standard is not mandatory at the federal level; it may be mandatory in some regions but voluntary in others.



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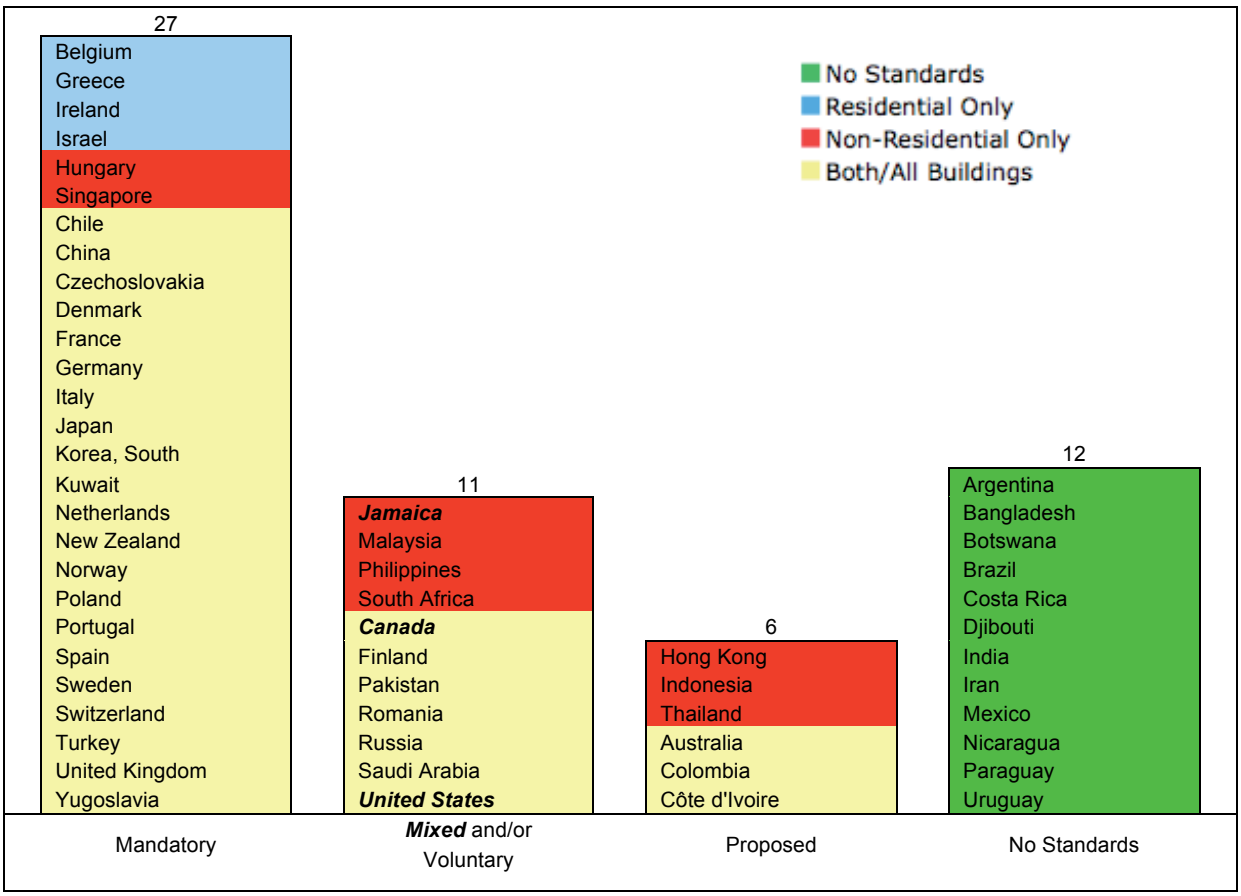


*Figure 1. Worldwide Status of Standards, 1994 (after Janda & Busch 1994)*

ous reports. Given the survey's length and the need for specific expertise in several areas, the response rate of 33% (59 surveys from 42 countries) was better than anticipated.

Information from survey respondents' countries was organized into a database of information containing: (1) the status of energy standards for buildings in each country; (2) basic provisions of existing energy standards; (3) approaches to standards development; (4) implementation and compliance; and (5) other methods of increasing energy-efficiency in buildings. Coverage of the topics in the database depends upon the extent to which respondents in individual countries filled out our surveys. We reiterate that the database itself and information gathered is not definitive. Although efforts were made to define the researcher's sense of what an "energy standard for buildings" is, a few respondents answered with respect to a different type of standard than expected, such as a national electric code; if determined, these responses were not used for further analysis. In most cases only one survey from each country was received, but in cases where multiple surveys were returned we did not attempt to verify the information given or "correct" discrepancies between respondents from the same country[3]. Instead, we selected the survey which seemed to contain the most detailed and complete information for our comparative analysis set. The results below cover only a few highlights from the database of surveyed information.

## 2009 Update: Review of Current Trends

In 2009, we found that 61 countries have some form of mandatory and/or voluntary existing standard, eleven countries had proposed standards, and nine countries did not have standards. Figure 2 shows the status of standards in these 81 countries. This growth in the number of standards is due to a number of factors, including geopolitical transitions, international agreements, international assistance, and concerns about development, energy security, and climate change.

Since the original survey, which was started in 1992, many geopolitical changes have occurred. Some countries have divided (e.g. Czechoslovakia into the Czech Republic and Slovakia in 1993, Yugoslavia into six different countries over the period 1991-2006) and others have changed their political affiliations (e.g. Hong Kong from crown colony of the United Kingdom to special administrative region of China). It is important to note that a few of the increases in the number of countries with standards has to do with this redistribution of nation-states.

Primary data for the update was gathered through an online survey, reports and websites (e.g. RICS 2007; CLASP 2005; Koeppel and Ürge-Vorsatz 2007; IEA 2006; Deringer 2006). The online survey reproduced the original mail survey as faithfully as possible, although some questions were adjusted to better fit the new delivery method and capabilities of the

3. In South Africa, for instance, two respondents said there were no energy standards of any kind, while a third mentioned a voluntary standard for offices, government facilities, and hotels. All three respondents were certain, however, that energy efficiency was not a high priority, given current excess electric capacity and indigenous energy supplies.



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*Figure 2: Status of Energy Standards in 81 countries, 2009*

survey host site. The survey was compiled and distributed through the professional version of SurveyMonkey. As with the previous survey, we did not attempt to verify the information given or "correct" survey discrepancies between respondents from the same country. This capability may be possible in the next phase of the research, which is discussed at the end of the paper.

## COUNTRIES WITH STANDARDS

### From Proposed to Adopted

Many of the countries with proposed standards in 1994 actually took the steps to adopt these standards into law, sometimes changing the standards along the way. In 1994, Hong Kong's proposed standard was to have applied to office buildings and hotels. The standard Hong Kong actually passed in 1995 was different in scope than the proposed standard, applying somewhat more broadly to commercial buildings except for hotels and schools (Hong Kong Government 1995). Other countries such as Australia, for example, moved from a set of proposed standards to mandatory standards for all buildings, plus a coordinated set of voluntary initiatives designed to encourage best practices in building design, construction and operation (Australian Government 2008).

### From Nothing to Something

Of the thirteen countries without standards in 1994, four countries have taken actions to develop and adopt standards. Two (Brazil and Paraguay) have proposed standards. In 2007, India passed the Energy Conservation Building Code (ECBC) for

non-residential buildings. The ECBC is intended to become mandatory, but at present is voluntary (Chakarvarti 2008). Mexico has adopted mandatory standards for non-residential buildings (Huang et al. 1998).

#### COUNTRIES WITHOUT STANDARDS

Even though many countries do not have energy standards for buildings, there is evidence of other kinds of programs that promote energy efficiency or energy conservation in buildings. Many countries without energy standards at the building level are participating in standards and labeling activities for appliances. The Collaborative Labeling and Appliance Standards Program (CLASP) has activities in over 27 countries, including: Argentina, Australia, Bahrain, Belize, Brazil, Chile, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Honduras, India, Mexico, Nepal, Nicaragua, Panama, Poland, South Africa, Sri Lanka, Thailand, Tunisia, Uruguay (UNDESA 2008). For countries without energy standards for their buildings, appliance and labeling standards offer some protection from end-use extravagance. Other countries without standards, like Iran, have developed energy efficiency offices and a range of programs designed to improve energy efficiency (IEEO-SABA 2008).

#### INTERNATIONAL STANDARDS

In addition to energy standards activity at the national level, similar activities are also taking place in international arenas. There has long been interest within the European Community to develop a European building energy standard. Although the International Standards Organization (ISO) did not have a technical committee on the topic of building energy standards in 1994, by 2009 this institutional change had been implemented. TOC 205 on "Building Environment Design" is currently developing eight different projects, four of which are directly related to energy performance or energy efficiency (ISO 2008). Most importantly in the international arena, the European Parliament and Council approved in December 2002 a comprehensive directive on the energy performance of buildings (EPBD), which has been implemented in stages and comes into full force in January 2009. Although a recent report by European Energy Network suggests that the EPBD is not delivering completely on its promise (EnR 2008), EPBD has certainly made a bold statement about not just energy standards themselves but the broader policy and market context in which they occur. The next section will develop these ideas in greater detail.

## Beyond Standards: Review of Ongoing Policy Initiatives & Market Transformation

Recent work assessing policy effectiveness for energy efficiency in buildings has emphasized that although energy standards for buildings are frequently used, their effectiveness varies greatly from country to country (Koeppel and Ürge-Vorsatz 2007). Koeppel & Urge-Vorsatz note that effectiveness of energy standards may be particularly low in developing countries, given difficulties with enforcement and even corruption. Even in developed countries, the estimated savings from energy codes range from 15-16% in the US to 60% in some countries in the EU. These authors and other proponents of market transformation stress that a combination of policy instruments (regulatory instruments, information instruments, financial/fiscal incentives, and voluntary agreements) is the key to achieving real reductions in the building sector. The idea behind market transformation is to use a coordinated suite of tools to transform the market in which building design, construction, and operation occurs. In practice, it is difficult to discern exactly how to coordinate these policy tools, but the idea of a multi-pronged approach does seem to fit with the diverse interests and elements in the building industry.

In addition to policy initiatives undertaken by governments, a host of non-state actors have started to engage in promoting energy efficiency in buildings. The extent to which cities, regions, and businesses have started to play a role in climate change mitigation has been the subject of several books and numerous articles on the changing nature of governance in a global world (Newell and Levy 2005; Newell 2000). Within this context, non-governmental organizations such as the US Green Building Council are experiencing immense growth, both in the US and around the world (USGBC; WGB 2008). Similarly, the Clinton Climate Initiative (CCI) has chosen to partner with the 40 largest cities in the world rather than the governments of the nations in which those cities reside. Finally, the World Business Council for Sustainable Development is also focusing its attention on energy efficiency in buildings (WBCSD 2007). Although they are not the usual originators of energy efficiency policies, cities, businesses, and non-governmental organizations are increasingly playing a voluntary role in transforming the market towards a lower-carbon future.

While some might argue that the voluntary initiatives are the way of the future, we assert that setting a stringent standard for building performance will always be of assistance by setting a floor for the market. It also serves as an enduring reminder to architects, engineers, owners, operators, and others in the building industry that certain basic elements of building performance should be included in every new design and retrofit.

## Recommendations for Further Research

Although the complexities associated with both building research and energy standards obstruct meaningful comparative analysis and information transfer, they do not preclude it. Greater access to the methodology, tools, and information used to support existing standards would give countries without standards a basis to choose between revising research and re-inventing it. The current information gap is already spanned by calculation methodologies and predictive computer models. Other useful connections might be forged through an international comparison of non-residential buildings or by the development of a comprehensive reference for technical and administrative requirements of energy standards.

Although further study of methods or special topics would help to fill in the information gap, the key to bridging it may lie in making basic information about existing building energy standards more readily accessible. In 1994, we proposed a directory with information compiled from different countries to enable exchanges between countries with effective existing standards and countries seeking to update their standards or develop new ones. As a model for this kind of work, we pointed

to an annual report done in the United States by the National Conference of States on Building Codes and Standards (NCSBCS 1991). Internationally the same need for detailed information exists but no equivalent descriptive source for energy standards information meets this need. Today, creating an online database of energy codes and regulations would be the obvious next step towards this goal. In the coming year, we plan to contribute our survey data to the Alliance to Save Energy's Building Codes Assistance Project (BCAP). Although most of BCAP's work to date has focused on assisting code development in the US, BCAP is expanding internationally. With its partners, BCAP is currently working on a comparison of building energy codes in Asia-Pacific Economic Cooperation countries. Together with the Alliance, we plan to develop an online interactive database, building on the information gathered through our survey.

## Conclusions

All signs point to the conclusion that energy standards, particularly for non-residential buildings, will play an increasingly significant role in the future of national and possibly international energy-efficiency policies. The information presented here is another step toward fostering cooperation among countries with standards and those contemplating standards or other policies for increasing energy-efficiency in buildings. While it is difficult to generalize, our work to date and proposed database provides a basis for further inquiry into the development, structure, and implementation of energy standards throughout the world. This information may be particularly useful to countries at similar stages of development, countries with common cultural roots, and/or those in comparable climates. While energy standards for buildings have been developed and adopted in at least one-third of the world's countries, the other two-thirds have few ways of learning about the existence of information on this topic, and all countries currently face barriers to accessing it. Our original project constructed a framework for an international reference for building energy standards. Fifteen years later, we believe that this framework still holds value in the field of energy standards research and can help support increased communication within it.

## References


Australian Government. *Energy standards for housing and commercial buildings*, [Accessed: 2008. Available from http://www.greenhouse.gov.au/buildings/index.html.

Chakarvarti, K. K. 2009. *Energy Conservation Act & ECBC- An Overview*, [Accessed: 2008 March 20 2009]. Available from www.energymanagertraining.com/PowerPlantComponent/Presentations-PPC/NPTI30Sep-1Oct2008/1_4ECAct&ECBC.ppt

CLASP. 2005. "Towards Energy Efficiency Thermal Building Codes and Appliance Standards & Labels in the Mediterranean Countries." Paper read at Regional Workshop, 23-25 November 2005, in Hotel the Medina Mediterranean, Yasmine Hammamet, Tunisia.

Deringer, J. *Status of Energy Codes Worldwide*, [Accessed: 2006. Available from http://www.deringergroup.com/consulting/EEBC/Status.htm.

EnR. 2008. Implementation of the EU Energy Performance of Building Directive - a snapshot report European Energy Network:

Hitchin, R. 2008. Can building codes deliver energy efficiency? Royal Institution of Chartered Surveyors: London. http://www.rics.org/

Hong Kong Government. 1995. Building (Energy Efficiency) Regulation. http://www.arch.hku.hk/research/BEER/besc.htm

Huang, J., J. L. Warner, et al. 1998. «A Commercial Building Energy Standard for Mexico.» Paper read at American Council for An Energy-Efficient Economy Summer Study, in Asilomar, CA.

IEA. 2006. *Energy Policies of IEA Countries*. Paris: International Energy Agency.

IEEO-SABA. *Iran Energy Efficiency Organization (IEEO-SABA): About Us*, [Accessed: 2008. Available from http://www.iraneeo.com/aboutus.html.

ISO. 2008. Online Search for Standards and/or Projects: International Standards Organization. http://www.iso.org/iso/search.htm?qt=building+environment+design&searchSubmit=Search&sort=rel&type=simple&published=on

Janda, K. B., & J. F. Busch. 1993. Worldwide Status of Energy Standards for Buildings. LBL-33587. Vols. I and II. Lawrence Berkeley National Laboratory: Berkeley, CA.

Janda, K. B., & J. F. Busch. 1994. "Worldwide Status of Energy Standards for Buildings." *Energy* 19 (1):27-44.

Koeppel, S., & D. Ürge-Vorsatz. 2007. Assessment of policy instruments for reducing greenhouse gas emissions from buildings. Report for the UNEP-Sustainable Buildings and Construction Initiative. Central European University: Budapest. http://web.ceu.hu/envsci/projects/UNEPP/index.html

Lausten, J. 2008. Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Buildings. IEA Information paper. OECD/IEA: Paris.

Moisan, F. 2005. "Energy efficiency: a worldwide review", In proceedings of *WEC COP 11*. 6 December 2005.

NCSBCS. 1991. The Energy Directory. National Conference of States on Building Codes and Standards: Herndon, VA.

Newell, P. 2000. *Climate for Change: Non-State Actors and the Global Politics of the Greenhouse*. Cambridge, UK: Cambridge University Press.

Newell, P., & D. Levy, eds. 2005. *The Business of Global Environmental Governance*. Cambridge, MA: MIT Press.

RICS. 2007. Towards an Energy Efficient European Building Stock. RICS Status Report on the Implementation of Directive 2002/91on the Energy Performance of Buildings (EPBD) in the EU Member States. Royal Institution of Chartered Surveyors: http://www.rics.org/Newsroom/Keyissues/Energy/EPBD_status_report_r_051207.html

Thomsen, K. E., K. B. Wittchen, et al. 2008. European national strategies to move towards very low energy buildings. IBSN 978-87-563-1329-2. SBi, Danish Building Research

Institute, Aalborg University: http://www.euroace.org/verylowenergybuildings/index.htm

UNDESA. *Collaborative Labeling and Appliance Standards Program (CLASP), Geographic Coverage*, [Accessed: 2008. Available from http://webapps01.un.org/dsd/partnerships/public/partnerships/179.html.

USGBC. 2009. *About USGBC*, [Accessed: March 20 2009]. Available from www.usgbc.org.

WBCSD. 2007. Energy Efficiency in Buildings: Business Realities and Opportunities. Summary Report. World Business Council for Sustainable Development: http://www.wbcsd.org/web/eeb

WGB. *World Green Building Council homepage*. Available from http://www.worldgbc.org/.

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