Transferred Just on Paper?
Why Doesn't the Reality of Transferring/Adapting Energy Efficiency Codes and Standards Come Close to the Potential?

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ABSTRACT

Is it simply bad design, implementation problems, and corruption? Evaluation of programs transferring/adapting energy efficiency building codes (EEBCs) and standards from the North to developing countries often fails to realize the substantial potential benefits due to institutional problems both within the host countries and within the international donor organizations. Successful adoption/diffusion of energy-efficient practices can depend on complex interactions among manufacturers, retailers, contractors, consumers, policy makers and code-enforcement officials. Dissemination of even proven and effective practices have often failed when faced with such combined barriers as (1) lack of government support for implementation, (2) absence of effective building code enforcement infrastructure, (3) under-emphasis by international donor programs on implementation and enforcement, (4) insufficient attention and follow-up by donor programs on a long-term basis, (5) traditions in some locations of corrupt enforcement practices. Local goals and realities of the countries often differ from established international goal setting practice. What prevents us from designing programs that align goal setting with local realities of the countries while addressing the barriers?

This paper assesses current EEBC practices and their strengths and weaknesses. The paper starts with an account of the status of the development of international energy code for buildings. It then summarizes transfer processes to developing countries for energy code development/implementation. The paper concludes by identifying key barriers to successful use of EEBCs to save energy in developing countries, and by discussing how such barriers might be overcome.

Introduction – Benefits of Energy Efficiency Building Codes (EEBCs)

Energy Efficiency Building Codes (EEBCs) and standards for commercial, institutional, and government buildings are widely considered to be cost-effective as government-based regulatory programs that can potentially help to capture substantial energy savings.[1] Four generations of energy codes and standards in the US have produced estimated energy efficiency improvements of about 60% over a 30-year time frame.[2]

In developing countries, estimates of potential energy savings for first-generation building energy coded have typically ranged from 20% to 35%, and these savings can be

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[1] In this paper we focus on energy codes for commercial, institutional, and government buildings, since many building energy codes for developing countries have focused on these building categories.

[2] "Introduction to Compliance With ASHRAE Standard 90.1 – 1999/2001", slide #21, developed by J. Deringer, introductory 48-slide PowerPoint presentation to *An ASHRAE Professional Development Series (PDS) Presentation*, a 2-day workshop on ASHRAE Standard 90.1.

significant since in some developing countries, commercial, institutional and government buildings can often account for 25% - 33% of the country's electricity use. [3]

A potential side benefit of EEBCs for developing countries is that EEBCs can also be very effective as information vehicles that can inform a broad group of decision-makers within the building industry about energy efficiency objectives. Also, once developed, such EEBCs often act as base case conditions for additional DSM and market transformation programs (e.g., incentive programs, design assistance programs, and demonstration building programs).

Short History of Worldwide Diffusion of EEBCs

EEBCs virtually did not exist prior to 1973. They were created by governments as one of many policy instruments in response to a worldwide "oil shock" in 1973 from an OPEC oil embargo. Thus, many industrialized countries quite quickly developed and implemented EEBCs as part of a broad range of government and DSM energy programs in efforts to reduce their dependence on foreign sources of energy, especially oil.

EEBCs in Industrialized Countries

EEBC status. Today, over 3 decades after 1973, jurisdictions in at least 30 industrialized countries have established EEBCs, and many have noteworthy track records of implementing, enforcing and refining the EEBCs.[4] For example, a number of jurisdictions in the US and Canada have effectively implemented EEBCs[5] and are now refining the implementation of their third and fourth generation EEBCs, which are imbedded in their locally enforced building codes.[6] These are widely viewed as minimum acceptable levels of energy efficiency in buildings.

In some locations there are additional, related utility DSM programs that use the EEBCs as benchmarks to encourage more advanced energy savings via design assistance or rebate programs such as "Savings by Design" in California, and "Energy Edge" in Minnesota. In addition, green building programs are becoming increasingly popular voluntary programs for overall sustainable design that also use EEBCs to benchmark additional energy savings.

Of the 30+ industrialized countries with EEBCs, at least 17 European countries have developed EEBCs[4] and some of them have decades of experience in implementing the EEBCs. [7] In the South Pacific area, in the past decade or so both Australia and New Zealand have been developing and implementing EEBCs largely modeled upon the institutional foundation derived from Great Britain, but with careful examination of technical experience from North America. Other developed countries (e.g., Japan, Korea, Singapore, Taiwan, etc.) have had EEBCs in place for some time.

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[3] Estimated projected savings based on DOE-2 analyses for Malaysia (about 20% for office buildings in 1986), for Indonesia and the Philippines (about 20% for offices in 1989), for Jamaica (using ASEAM, about 30%-35% for offices in 1994), for Vietnam (about 30%-35% for offices and hotels in 2003), for Egypt (about 30%-35% for offices and hotels in 2004).

[4] Tabulation from www.icbec.org/Status/Status.htm

[5] For example, in California, Minnesota, New York, Florida, and Washington State.

[6] In the US, many codes are based on ASHRAE Standard 90. The major "generations" of this standard are (1) 90-1975, 90A-1980, 90.1-1989, and 90.1-1999/2001.

[7] For example, in England, Wales, Denmark, and Germany.

Information about energy code status. This data is reasonably available for developed countries. For example, the US Department of Energy maintains a website that includes the current status of energy codes within the US.[8] Likewise the International Energy Agency (IEA) maintains summary descriptions of energy policy activities for about 26 European countries. These IEA descriptions usually include a brief description of current energy code activities; but the format and content of energy code information is not nearly so consistent as that provided in the US.

EEBCs in Developing Countries

EEBC status. At least 21 developing countries[9] have developed at least first generation EEBCs, and 3 more countries are now reported to be developing their first generation codes. In some countries the EEBCs were developed as early as the late 1980's or early to mid 1990's, thus providing opportunities for at least informal assessments of use and effectiveness.

Failed to produce significant energy savings. EEBCs do exist on paper in many developing countries. The EEBC documents have been written; and some have been promulgated as voluntary national standards or national energy codes. However, they have not been widely used, and they have failed to produce significant energy savings. The authors are not aware of a single developing country which can identify a significant set of buildings, either government or private sector, that have been designed and constructed to meet the building energy codes that have been developed.

Indeed, a reasonable conclusion is that there has been a major failure to effectively use EEBCs to save energy within the building stock of developing countries. Thus, EEBCs have failed to produce even a fraction of the energy saving potentials that have been estimated.[10]

Later in this paper we will identify a number of key barriers to the effective use of EEBCs in developing countries, and we will recommend some actions and programs that may overcome such barriers.

Information about energy code status. Data about EEBC status in developing countries is difficult to obtain and few summary or comparative information sources exist. Often data is not available except by locating and interviewing experts in each country. When data is available, it tends to be not detailed, and available only on a country-by-country basis. Two websites do provide some worldwide EEBC information that includes some developing countries: (1) the International Collaboration for Building Energy Codes (ICBEC) maintains a summary listing for locations outside the US,[11] and several of the tabulations in this paper are derived from data presented on the ICBEC site, and (2) the architecture department at the University of Hong Kong

[8] This information may be located at: http://www.energycodes.gov/implement/state_codes/index.stm.

[9] In this tabulation of developing countries, we include several Newly Industrialized Countries (NIC), such as India, China, Mexico, South Africa.

[10] Energy analyses have been done in a number of countries: Malaysia, 20% savings for offices (DOE-2) Kannan, etal, 1987; Indonesia, 20% savings for offices (DOE-2) Soegianto etal, 1989; Philippines, 20% savings for offices (DOE-2) Soriano etal, 1989; Thailand 30% offices and hotels (DOE-2) Busch, 1992, (Jamaica, 30%-35% for offices (ASEAM) Cumper & Marston, 1994; Vietnam, 30% for offices and hotels (DOE-2), Deringer etal, 2003; Egypt, 20%-30% for multifamily residential, office, and hotel (DOE-2) Hanna, Mostafa, etal., 2004.

[11] The code status data is located at: http://www.icbec.org/Status/Status.htm

maintains a large listing of energy efficiency websites that includes some information on worldwide EEBC activities.[12]

Over a decade ago Janda and Busch conducted the only existing comprehensive survey of worldwide energy codes; it was a broad-brush effort, as befits a first survey.[13] Then in 1998 Busch and Deringer published the results of another survey with a focus on the implementation of EEBCs. Another recent EEBC survey document is from Australia - *International Survey of Building Energy Codes* – which is a broad title for a document with a more narrow scope, for it examines, in significant detail, several energy codes from a relatively few industrialized countries – The UK, Canada, New Zealand, USA, Singapore and Australia.[14]

How Building Energy Codes Have Been Used

Traditionally, EEBCs have set minimum design requirements for key energy use aspects of new buildings and retrofits or additions to existing buildings. Building systems covered typically include (1) the building envelope, construction materials and techniques, (2) lighting equipment, controls, and installed lighting power, (3) electric power and distribution, and (4) air-conditioning and service water heating equipment. More recently, EEBCs have begun to incorporate either requirements or trade-off credits for more "passive energy" features such as the use of natural ventilation, daylighting, and cool roofs (e.g., codes recently developed in Vietnam and Egypt). Energy codes also entail costs to develop, implement, and enforce.[15]

Energy codes have been used (1) within mandatory enforcement programs, (2) as voluntary standards, and/or (3) as the basis for various market transformation programs. We now summarize each of these uses:

1. **Mandatory enforcement.** This is a common enforcement path in the industrialized countries. The energy code is formally adopted (promulgated) as a section or volume of the overall building code or in a government regulation. There are generally three mandatory enforcement paths: (1) *for non-government buildings,* enforcement as part of local building codes, *(2) for government buildings,* enforcement as part of agency regulatory requirements *(*E.g., US DOE, US GSA, state and city regulations, etc.), and (3) *Enforcement by utility companies at hookup time,* an approach that is not common but permits enforcement of compliance to be concentrated in just a few locations. For this reason utility hookup enforcement has been proposed for consideration in developing countries especially where (1) the code compliance infrastructure is not well formed, and/or (2) it is likely that traditional enforcement would result in widespread abuse by code officials.

[12] The energy links portion of the UHK site is located at http://www.arch.hku.hk/research/BEER/links.htm.

[13] Janda, KB and Busch, J. Worldwide Status of Energy Standards for Buildings. Energy—The International Journal 19 (1) 27-44. 1992

[14] International Survey of Building Energy Codes, ISBN 1 876536 32 2, Commonwealth of Australia 2000, produced for the Australian Greenhouse Office by the Office of the Australian Buildings Codes Board.

[15] In discussing potential savings from setting energy codes and standards it is important to note that standards are of social as well as technological significance. Importantly, such standards traditionally make broad assumptions about the nature of demand as well as about how it might be met. What representations of "modern" and "productive" life are unwittingly codified through the promotion, and enforcement of specific standards?

Several prerequisites are needed for a building energy code to work properly in a mandatory enforcement setting. First, overall building code compliance regulations must be in place. Second, a building code compliance administration and infrastructure must be in place and properly functioning. Third, the underlying enforcement of the overall building code should be reasonably effective. Fourth, the code officials responsible for administering EEBCs need to be knowledgeable about the basic strategies for saving energy that are imbedded in the EEBC. While these prerequisites exist to some extent in many industrialized countries, in many developing countries such knowledgeable individuals are not yet available.

2. **Voluntary Standards.** EEBCs have been used as voluntary standards in both developed and developing countries, either on a temporary or permanent basis. For example, in Indonesia an EEBC was developed in the late 1980s and became a national voluntary standard in the mid-1990s. In Jamaica the EEBC document was finished in 1994 and was quickly issued as a voluntary standard in anticipation of future promulgation as a mandatory regulation; however, as of 2003, the Jamaican EEBC is still voluntary. In China, EEBCs were first developed for residential buildings in the north in the 1990's and implemented on a voluntary basis with less than satisfactory results. In 2001 - 2003, EEBCs were developed for residential buildings in central and southern China, and the compilation of a national EEBC for public (commercial) buildings was started in 2002. There has been movement both at the national and local levels to gradually make these EEBCs mandatory. For example, the residential EEBC has been mandatory in Beijing since the late 1990s, while in Shanghai it is being phased in, and will be mandatory for all buildings starting in 2006.
3. **Market Transformation Programs.** There are several very effective uses of EEBCs in which the EEBC energy requirements are used as the basis for programs that encourage additional levels of energy efficiency beyond the "minimum" code levels. This type of voluntary (or even mandatory) use may be in the form of (1) demonstration building programs, (2) utility demand-side management programs such as design assistance programs or rebate programs, and (3) green building rating systems and programs. Such market transformation programs have been widely used in the United States in association with EEBCs, but they are hard to implement in developing countries or in newly industrialized countries (NICs) in the absence of an effective baseline energy code.

Related Appliance & Equipment Efficiency Standards and Labeling Programs

Several related energy programs are often used in parallel with building energy codes. These related programs include (1) appliance and equipment efficiency standards, (2) labeling programs, and (3) rating programs. These programs focus on just specific items of equipment (e.g., lighting equipment, electric motors, air-conditioning units, etc.).[16] Since there is a potential for overlap or inconsistency, it is important that coordination occur between the government entities responsible for developing and enforcing these policy instruments. Labeling and rating programs are broader than appliance or equipment efficiency standards, for they provide information about higher efficiency equipment in addition to minimum standards of

[16] For example, the US DOE website http://www.eere.energy.gov/buildings/appliance_standards/ lists published or pending energy efficiency standards for such commercial products as: distribution transformers; unitary air-conditioners and heat-pumps; small electric motors; electric motors; and, high intensity discharge lamps

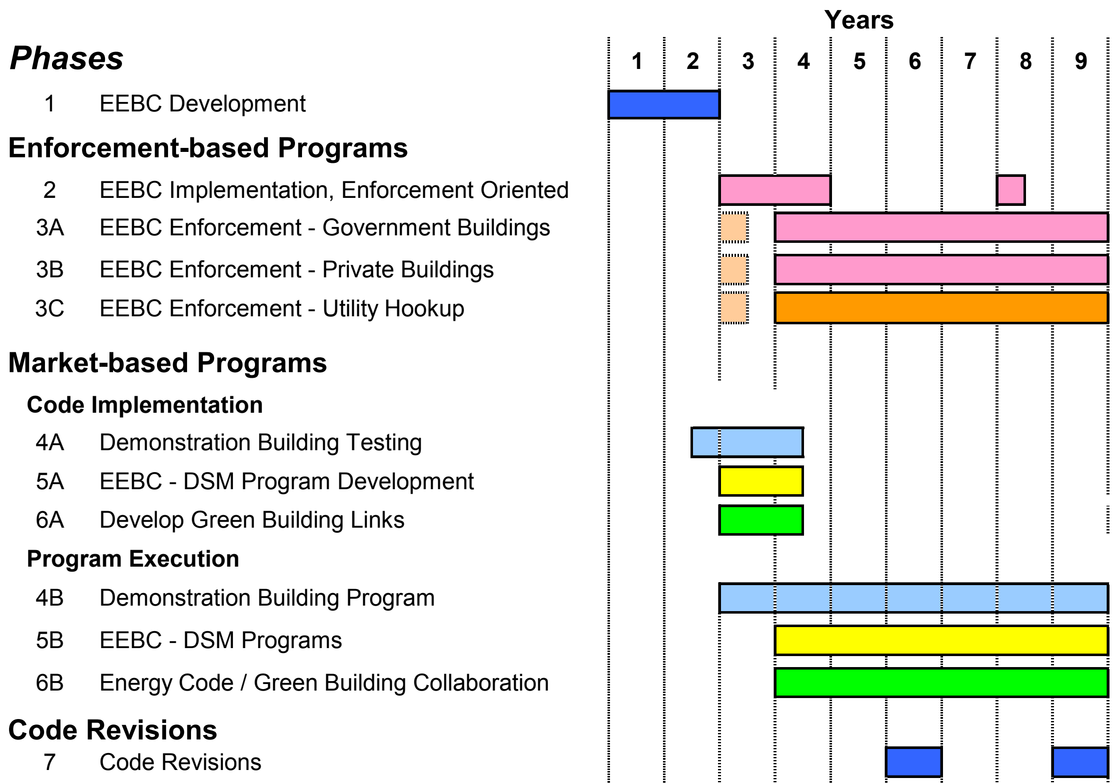
performance.[17] There is currently much interest worldwide in establishing closer links between EEBCs and environmental rating systems.[18] This in turn may lead to a change in the structure of EEBCs. For example, EEBCs may shift to contain multiple stringency levels (tiers), or point systems, to permit better integration with environmental rating systems (e.g., LEED).[19]

Typical Process of Creating EEBCs in Developing Countries

Typical Steps

In developing countries, it would be difficult if not impossible to effectively use or enforce an EEBC within a government regulatory program without having an institutional infrastructure in place to support the energy code. This infrastructure includes administrative structures and procedures, compliance forms and procedures, plus supporting tools, training, and information. Effective use on a voluntary basis requires many of the same supporting infrastructure elements as a mandatory effort. Thus, the 'development' of an EEBC is typically just the first of several steps needed in order to have an EEBC in place that can succeed in saving energy. These steps are shown in Figure 1.

Figure 1. Phases of a First-Generation EEBC



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[17] In the US, the Energy Star program is a comprehensive labeling program. See http://www.energystar.gov/

[18] For example, this approach is currently being examined as an option for the EEBC being developed in India.

[19] For a number of reasons, we recommend caution in attempting to transfer environmental rating systems from developed countries to developing ones without considering major changes in assumptions, etc. We think it would be interesting to see an environmental rating system developed from within a developing country or by a consortium of developing countries.

These steps are needed so that the supporting institutional framework for the EEBC can be put into place. Figure 1 shows a proposed "comprehensive" EEBC development, implementation, and revision program that emphasizes market transformation programs as well as more "traditional" code enforcement approaches. The traditional approach to implementing an EEBC involves only steps 1, 2, 3 and 7. In this "traditional" case, as shown in Figure 1, the first phase involves writing the EEBC document. The second "implementation" phase is code-enforcement oriented and prepares the infrastructure, administrative structure, procedures and tools needed to permit compliance with the EEBC in a code setting, plus prepares the code to be placed into law and to be enforced. The third phase involves using the EEBC either in a voluntary and/or mandatory enforcement program. The enforcement component has separate paths for private sector buildings, government buildings, and a possible utility hookup enforcement option. The market transformation component has separate paths for demonstration buildings, EEBC-DSM programs, and green building programs. A seventh phase revises the EEBC after say 3 to 5 years in order to take advantage of technology advances and improved energy efficiency knowledge by the local building industry.

We now summarize the typical steps involved in each of the first two main phases (1) development and (2) implementation.

EEBC Development Phase

Typically, six activities are involved in "developing" a building energy code:

1. ***Survey and comparison of international building energy codes.*** This is done in order to identify the best materials from other locations - code structures, formats, requirements, stringency levels, etc. - that might be appropriate for local conditions.
2. ***Survey of local buildings.*** *Information about the building stock and its energy use is needed in order to properly* plan, implement or evaluate an energy code or other energy efficiency programs. For proper EEBC planning (or energy planning in general) one needs, at a minimum, estimates of (a) Current floor space and future additions to floor space, preferably disaggregated by type of economic activity or building function, e.g., office use, hotel, retail, cultural, health, etc., (b) electricity consumption, preferably disaggregated by the same categories**,** (c) energy use by key end-uses, air-conditioning, lighting, ventilation, etc., (d) the percentage of commercial building stock that is air-conditioned, and, (e) penetration rates of key energy-using equipment, including data on shipments of such items as chillers, packaged air-conditioning systems, motors, lighting equipment, glazing, etc. Unfortunately, most of the above information is not available in many developing countries. Gathering such data for the first time is resource and time intensive; and., it requires a level of in-country technical capacity that may also not exist and need to be built. Thus, building surveys for energy codes usually gather very basic data that is supplemented by professional judgment in order to produce estimates of the features and energy use levels of a few typical "base case" buildings that are uses as benchmarks for developing and evaluating code requirements.
3. ***Energy code document.*** The energy code document may be written by local in-country experts or by international "experts" from outside the country. In either case the writing of the code document usually involves multiple drafts, each reviewed by a local technical advisory committee of in-country building industry experts.

4. ***Energy and Economic Analyses.*** This activity typically uses computer-based energy simulations (e.g., DOE-2, etc.) applied to typical "base case" buildings to estimate the energy savings and cost effectiveness of the key EEBC requirements, and how much energy might be saved by the proposed energy code. .
5. ***Implementation Plan.*** This activity develops a "plan" for implementing the building energy code document that is being developed. Unfortunately, most implementation plans are developed at the very end of the energy code development process, and funding levels projected for implementation activities are too small.
6. ***Training and Capacity-building***. Such activities are typically an important part of all energy code development and implementation projects.

EEBC Implementation Phase

Unfortunately, there have not been enough examples of implementation programs for 1st generation energy codes in developing countries to talk about "typical" examples,[20] but we will describe the main steps that we think are needed for effective EEBC implementation.

1. ***EEBC Promulgation.*** This task involves the completion of any remaining legal steps that may be required, after the completion of the public review of the EEBC development, to enable the EEBC to be placed into law either as a national energy standard or energy code for commercial and institutional buildings.
2. ***Develop the Energy Code Compliance Process.*** This includes developing compliance forms and procedures, users manuals or guidebooks, compliance tools and software. This can also involve establishing administrative procedures for checking compliance, and for documenting, recording, and publishing compliance results.
3. ***Develop the Energy Code Administration and Enforcement Structure.*** This involves establishing the enforcement authority, budget and staffing.
4. ***Develop and Conduct Training Programs.*** Such training may include (1) workshops for architects, engineers, and code officials, (2) EEBC and energy courses in architectural and engineering departments of universities, and (3) international study opportunities in EEBC Implementation activities.
5. ***Outreach and Public Information Programs.*** This includes programs intended for the building industry, for bankers and investors in buildings, and for the general public.
6. ***Evaluate EEBC Savings and Effectiveness.*** These activities would expand upon the computer-based energy and economic analyses conducted during EEBC development.
7. ***Develop Related Market Transformation Programs.*** These might include (1) Utility DSM Design Assistance Programs, (2) Technical Assistance Programs, either utility- or government-based, (3) Financial Assistance for Labeling Programs, and (4) Voluntary Green Building Labeling Programs.
8. ***Program of Multiple Demonstration Buildings***. Incremental funding is provided to permit the additional costs of (1) designing more energy efficient buildings, (2) installing more efficient equipment and materials, (3) installing monitoring equipment, (4) properly commissioning the buildings, and (5) monitoring and evaluating the buildings during

[20] Just a few EEBC programs for developing countries are known to have included extensive "implementation" efforts. These include Pakistan and Jamaica.

operation. Dozens of buildings might be included in the program, in order to transform the marketplace.

Typical Programmatic Funding

The funding for a first generation energy code in a developing country typically comes from an international donor agency or from a developed country interested in carbon credits or other objectives such as making international equipment markets more attractive for sales. Donor agencies that have contributed to energy code development include the Global Environmental Facility (GEF),[21] the World Bank (and ESCAP), and the United Nations. Funding from individual nations includes the US (via USAID), Germany (via GTZ), France (via ADEME), Canada (via CIDA) and the Scandinavian countries (such as Sweden's SIDA) typically via an international donor intermediary. In a few cases, donor foundations have contributed funds to energy code projects such as the Energy Foundation's contribution to energy code development in China.

Organizational Structure

The management of projects can vary considerably. Some projects are managed by the international donor agency. In other cases, the project is managed by an in-country agency with the international donor providing technical and/or management review. The in-country responsibilities for code development are often separated from those of code implementation. Energy code *development* responsibilities are typically assigned to a government agency selected for its energy policy or technical strength; for example, in Vietnam, the Ministry of Industry; in the Ivory Coast and India, the Bureaus of Energy Efficiency. However, such agencies usually do not have the authority or experience in the enforcement of building codes within the building industry. Therefore, in many cases, a different national-level government agency with such building industry strength is assigned the responsibility for implementing and administering the energy code. Examples include the Ministries of Construction in Vietnam and the Ivory Coast. This situation of splitting responsibility development and implementation/enforcement is similar to the process used in the US where the US DOE and several professional societies in the building industry develop energy standards and codes, while administration and enforcement is handled by a combination of building code organizations and local, state, and federal agencies that regulate building construction.

In most countries, an in-country Technical Advisory Committee (TAC) is formed and provides technical review and oversight for the project. Typically, the TAC consists of 10-20 members, and includes a broad range of stakeholders within the building industry, including government officials, building design professionals, manufacturing companies and trade associations (air-conditioning, lighting, windows, thermal insulation, electric motors, etc.), academicians from architecture and engineering schools. The TAC holds regular meetings and reviews and comments on all EEBC products.

Also, a team of international consultants (IC) typically provides technical expertise in the various aspects of energy code development and implementation. Sometimes the IC team is responsible for producing the analysis reports and the energy code document (e.g., in Vietnam).

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[21] Often, the application of GEF funds to projects are managed by the World Bank or the UN

In other cases an in-country team of experts is responsible for producing key products, while the IC team mainly provides technical assistance, training, and review oversight (e.g. in Egypt).

Key Barriers to EEBC Effectiveness

The authors think that a powerful set of barriers have impeded the effectiveness of building energy codes in the developing world. As a result such codes are seldom used and save little energy. The barriers occur both within the international donor community and the developing countries. Most of the barriers are widespread; and often multiple barriers are present simultaneously. We focus on 9 key barriers that are briefly described below. We conclude the paper with some recommendations including an approach to implementing EEBCs that might overcome some of the key barriers.

1. **Strong first cost bias.** Building owners throughout the world tend to under-invest in energy efficiency during building design and construction. This under-investment is often described in terms of market failure.
2. **Access to building financing.** This barrier is related to that of first cost bias. Buildings are expensive items. If funding is scarce or expensive, it will tend to be used visible items such as finishes that have an impact on immediate building equity rather than longer-term energy savings. The relatively high cost of money in many developing countries can exacerbate this barrier.
3. **Lack of Consistent International Funding.** International donor funding has been provided in a number of developing countries to support developing first-generation EEBCs. Such donor funding has rarely continued for the number of years needed to adequately support EEBC implementation and enforcement. Typically, the nascent in-country EEBC code implementation/ enforcement activities either never start or they wither as soon as international funding stops. This appears to have been the case, for example, of earlier efforts in Malaysia, the Philippines, and Indonesia. Several countries have recently developed EEBCs, but we have been unable to determine if implementation or enforcement efforts are planned or underway.[22]

   We know of only two developing countries – Jamaica and Pakistan - that have completed comprehensive EEBC implementation programs. These countries received international donor funding support to conduct implementation programs after completing their EEBC documents. Pakistan received funding from USAID, and Jamaica from CIDA with project management by the World Bank via the ESCAP program. However, even for Pakistan and Jamaica, there is not evidence of widespread application of the voluntary codes to new building construction.

   A possible remedy might be for international donors to develop much longer-term support strategies for building energy codes in developing countries. At a minimum, strong international funding support should continue through not just the code development phase, but through the implementation phase, and well into enforcement and evaluation phases. For energy codes for buildings, a ten-year strategic approach on the part of international donors would not be unreasonable. Another general recommendation would be to re-visit EEBC programs in countries that have already

[22] For example, implementation appears bogged down in both Mexico and Sri Lanka.

developed such programs to see what could be done to provide further donor support for more effective implementation, enforcement and market-transformation programs.

4. **Lack of Government Champion.** A strong indicator of success of an EEBC effort is the presence of one or more highly placed in-country individuals who act as champions for the EEBC. Ideally, one such individual would be in government and another would be in the private sector. However, from our experience in providing IC technical assistance to EEBC programs in a number of developing countries, it is highly unusual to find highly placed individuals within in-country government agencies who step up to act as champions of EEBCs and of the potential savings in energy that they may produce. A possible response to this barrier might be for international donor organizations to consider requiring a minimum level of EEBC enforcement performance as a requirement for receiving future loans or for preferential loan rates. This is similar to US federal pressure on states.

5. **Availability of energy efficient equipment / materials in the local marketplace.** Highly energy efficient equipment is often not routinely available in the local market or on the shelves of local stores. It is mostly imported for larger projects.

6. **Lack of equipment testing/certification.** The lack of testing and certification programs is a serious barrier to effectively enforcing energy efficiency codes and standards. Improved testing and certification are needed for a broad range of energy-related products – insulation, glazing products, electric motors, lamps and ballasts, air-conditioner, etc.

7. **Transition in energy expertise.** In many developing countries, we have observed that in-country architects have a strong tradition of designing smaller buildings to provide comfort conditions in response to local climate conditions while using little energy. Often, traditional buildings are being exquisitely designed and include natural ventilation and daylighting.[23] However, there is not a strong tradition or widespread expertise for designing or operating larger buildings with more complex air-conditioning or ventilation systems. As a result, many buildings are designed in the "international style" with large areas of unshaded glass and sleek facades. Because high-performance glass is not available and thus not used, these buildings use excessive and unnecessary amounts of energy. They will also be uncomfortable and have excess glare near the windows. Similar examples could be given for the changes in practices of lighting design. One technique that might be used to address this type of problem as it applies to EEBCs might be to establish some form of international technical advisory committee from developing countries to advise on EEBC programs for other developing countries**.**

8. **Lack of awareness and tools.** There is often a lack of awareness on the part of most stakeholders in the building industry of the opportunities for saving energy in buildings or the methods to use to achieve the savings. Outreach, information and training programs can be very effective for increasing awareness.

9. **Corruption and potential code official abuses.** The danger that officials might abuse regulatory programs for economic self-interest is unfortunately all too prevalent, especially in developing countries where government officials have very low pay scales. If such abuses were widespread, they would seriously undermine or destroy the substantial positive benefits of the EEBC program. Two possible actions to reduce such

[23] We have seen examples of this, for example, in India, Thailand, Vietnam, Indonesia, and Sri Lanka.

abuse are (1) to have all compliance documentation should be publicly available, and (2) to have regular randomly selected independent evaluations of a sample of EEBC compliance examples, and, the results of these evaluations should be published in a public report.

Achieving Successful EEBCs by Overcoming Key Barriers

Effective EEBC implementation programs need to be structured to overcome key barriers to effective use. Table 1 below relates implementation actions in terms of their ability to overcome the key barriers to successful use of an energy code.

An inspection of the matrix indicates that market transformation programs are in general able to address a far broader range of barriers than the traditional regulatory approach of mandatory enforcement. This does not mean that the traditional enforcement of EEBCs should be abandoned in developing countries. But, the implication is quite strong that more emphasis (and funding) should be placed on combining regulatory approaches with (1) market transformation approaches, and (2) more comprehensive EEBC implementation programs, such as that outlined above in Figure 1.

Table 1. Potential of Implementation Activities to Overcome Key Barriers

		Potential for Overcoming Barriers (H=High, M=Medium)								
		1	2	3	4	5	6	7	8	9
	EEBC Implementation Activities	Strong first cost bias	Access to building financing	Lack of long-term donor commitment	Lack of Government Champion	Availabilty of efficient products	Lack of equipment testing & certification	Limited local energy expertise	Lack of awareness and tools	Potential Abuses
1	Promulgation	H		H	H					H
2	Compliance Process			H					H	
3	EEBC Administration and Enforcement Structure	H		H		M	M		H	
4	Training and Capacity Building			H				H	H	
5	Outreach and Public Information Programs			H	H			M	H	H
6	Estimate energy savings and cost effectiveness			H	M	M		M	H	M
7	Market Transformation Programs	H	H	H		H	M	H	H	
8	Program of Multiple Demonstration Buildings	H	M	M	M	H	M	H	H	M

Concluding Remarks

We have tried to identify some of the causes for the failure of developing countries to effectively use EEBCs so that they actually obtain the substantial energy savings that have been so consistently predicted. In some cases we have also tried to identify possible actions that might help to overcome some of the substantial barriers.

In concluding we would also like to raise another point of caution that we have mentioned in passing above in this paper. Many assumptions are imbedded in the process of transferring EEBC knowledge from industrialized countries to developing ones; for example, “desirable” thermal and visual comfort conditions, assumed illumination criteria, building schedules, building form, etc. Some of these assumptions themselves may have strongly negative in-country effects, or at least unanticipated impacts or consequences. Closer examination of such factors may lead to very different approaches to the future structuring and implementation of EEBCs and green building rating systems in developing countries.

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