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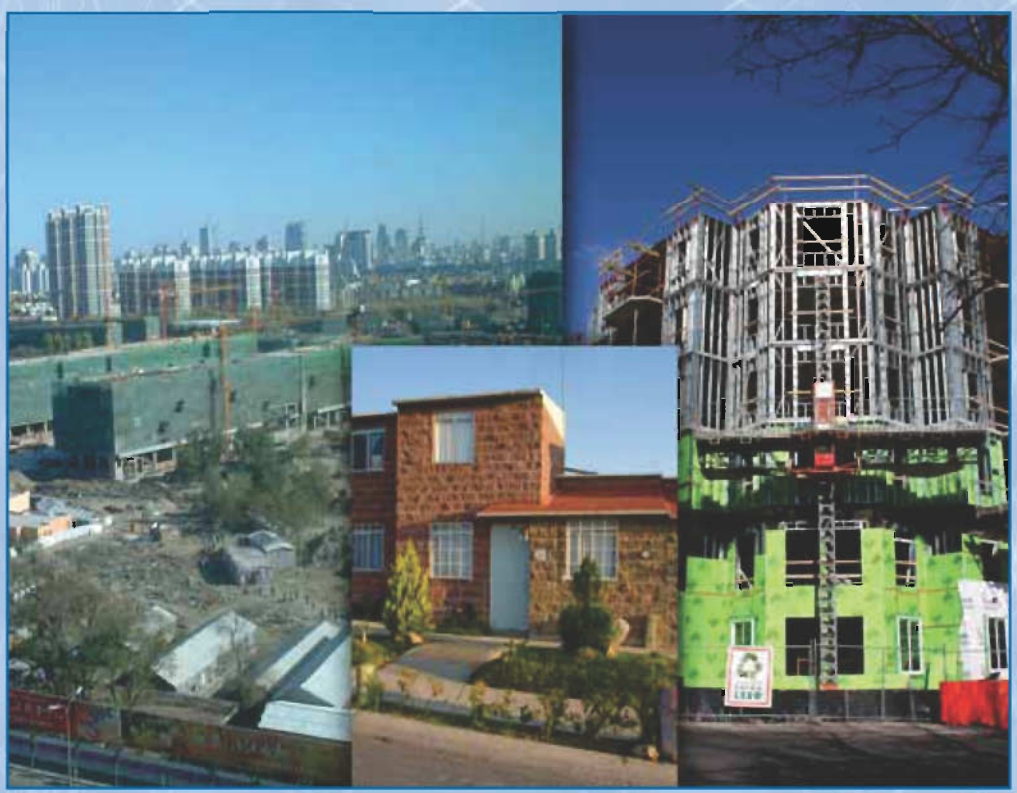
Mainstreaming Building Energy Efficiency Codes in Developing Countries

Global Experiences and Lessons from Early Adopters

Feng Liu
Anke S. Meyer
John F. Hogan



THE WORLD BANK

The International Bank for Reconstruction and Development/The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

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Foreword

Urbanization and growing wealth in developing countries portend a large increase in demand for modern energy services in residential, commercial, and public-service buildings in the next two decades. Pursuing energy efficiency in buildings is vital to energy security in developing countries and is identified by the Intergovernmental Panel on Climate Change (IPCC) as having the greatest potential for cost-effective reduction of CO_2 emissions by 2030 among all energy-consuming sectors.

Building energy efficiency codes (BEECs), together with energy efficiency standards for major appliances and equipment, are broadly recognized as necessary government interventions to overcome persistent market barriers to capturing the economic potential of energy efficiency gains in the residential, commercial, and public-service sectors. Implementation of BEECs helps prevent costly energy wastes over the lifecycles of buildings and energy systems in space heating, air conditioning, lighting, and other energy service requirements. But achieving the full potential of energy savings afforded by more energy-efficient buildings also requires holding people who live or work in buildings accountable for the cost of energy services.

Mandatory energy-efficient design requirements for buildings were first introduced in Europe and North America in the late 1970s and have proven to be an effective policy instrument. Several developing countries began similar efforts in the 1990s, and many more joined the pursuit in the last decade. Compliance enforcement has been the biggest challenge to implementing BEECs. Even in industrialized countries, enforcement remains uneven and inconsistent because of variations in local government political and resource support, robustness of the enforcement infrastructure, and conditions of the local construction market. With few exceptions, compliance enforcement of building energy efficiency codes in developing countries is either seriously lacking or nonexistent.

To help expand the World Bank Group's support to the adoption and implementation of BEECs in developing countries, the Energy Sector Management Assistance Program (ESMAP) and the Carbon Finance Unit of the World Bank launched a collaborative effort in 2008 with the objectives of (1) evaluating global experiences and extracting good practices in implementing BEECs, and (2) developing a carbon finance methodology for supporting programs and projects that invest in more energy-efficient buildings. A new carbon finance methodology has been submitted to the Small Scale Working Group under the Executive Board of the Clean Development Mechanism.

This report summarizes the findings of an extensive literature survey of the experiences of implementing BEECs in developed countries. It also includes case studies of four developing countries—China, Egypt, India, and Mexico—and the state of California in the United States of America. It aims to inform both the World Bank Group and its client countries about global best practices and emerging lessons from developing countries in the design and implementation of BEECs. The report also

serves as a primer on the basic features of BEECs and the commonly adopted compliance and enforcement approaches.

The key challenges to improving compliance enforcement in developing countries include the level of government commitment to energy efficiency, the effectiveness of government oversight of the construction sector, the compliance capacity of domestic/local building supply chain, and the financing constraints. These challenges are surmountable in countries where economic growth is sustained and energy efficiency is pursued as a key element of national energy strategy.

The process of transforming a country's building supply chain toward delivering increasingly more energy-efficient buildings takes time and requires persistent government intervention through uniformly enforced and regularly updated BEECs. The report notes, in particular, that recent development in *green buildings* through voluntary rating systems, such as the Leadership in Energy and Environmental Design (LEED) certification, are effective market-based initiatives inducing the building construction sector to move toward greater energy and environmental sustainability. Nonetheless, mandatory BEECs cannot be negated in any economy due to deep-seated market barriers.

Increased international support is called for to strengthen the enforcement infrastructure for BEECs in middle-income developing countries. For low- and lower-middle-income countries, there is an urgent need to assist in improving the effectiveness of government oversight for building construction, laying the foundation for the system to also cover BEECs.

It is our hope that this report will be a useful reference for the energy and urban operation staff of the World Bank Group and will help them engage client countries in policy dialogues and project designs in the development and implementation of BEECs.

Jamal Saghir
Director
Energy, Transport and Water
The World Bank

Executive Summary

Key Messages

Mandatory building energy efficiency codes (BEECs), when practically formulated, continuously updated, and actually enforced, are both effective and economic in overcoming persistent market barriers and delivering more energy-efficient buildings.

Price incentives and market information, such as charging users for energy services based on consumption and at cost-recovery prices and providing cost–benefit analysis of energy efficiency improvements, are essential to achieving energy savings afforded by BEEC-compliant buildings.

Adoption of enforceable BEECs is essential at the beginning of the process of transforming a country's construction sector toward delivering increasingly energy-efficient buildings. It is important for developing countries to start with realistic goals and to be conscious about the compliance cost implications. A practical and mandatory BEEC will initiate a positive feeding loop of enforcement, supply of technologies and materials, development of compliance capacity, and expanded enforcement that is reinforced over time.

Successful implementation of BEECs is a multifaceted and resource-intensive process that can take many years to achieve. Government interventions and persistency are critical to making energy efficiency a pillar of building construction. Enforcement failures may be directly attributed to the lack of indigenous technical, institutional, and market capacities. But the fundamental issue often is the lack of necessary government support and commitment to enable the development of those capacities. Such political and organizational mobilization has to be country-driven and supported by champions at local, regional, and national levels.

The main challenge for middle-income developing countries is the political commitment to adopting and enforcing broad-based BEEC compliance. The incremental cost financing for compliance with their BEECs can and should be largely borne by the building/home owners. International assistance should be primarily targeted at strengthening the enforcement and compliance infrastructure.

Development and implementation of BEECs in low- and lower-middle-income countries should be selective and initially targeted at the market segment where economic benefits are great and enforcement is most likely to succeed. In many of these countries, government oversight of urban building construction is often hampered by an inefficient or inadequate construction permit system and a large informal construction sector. International assistance will need to first focus on enabling the government to effectively manage the construction sector.

Greater attention should be given to development and implementation of appropriate BEECs in warm-climate developing countries. There is a large gap in the adoption of BEECs between cold-climate and warm-climate developing countries.

New approaches must be adopted to make carbon financing and other international clean technology financing mechanisms useful for mainstreaming BEECs in developing countries.

BEECs are legal requirements regulating the energy performance of building designs and their compliance during construction. Global experiences in the past 30 years or so indicate that enforcement of mandatory BEECs in new constructions and for the altered portions of existing buildings is an effective and necessary government policy intervention to reduce energy wastes during the life cycle of new buildings, mainly through reduced demand for active energy use in space heating, space cooling, ventilation, lighting, and service water heating. Most industrialized countries introduced BEECs in the late 1970s and have achieved broad-based enforcement. Many developing countries began to introduce BEECs in the 1990s. With a few exceptions the enforcement practices are still lacking, hindered by major institutional and economic barriers and limited by underdeveloped technical capacity.

This report summarizes the findings of an extensive literature survey of the implementation experiences of BEECs in developed countries (including a case study of California), as well as from case studies of four developing countries—China, Egypt, India, and Mexico. The report is written with the objective of informing the World Bank Group's energy and urban operations staff and its clients about the good practices from developed countries and emerging lessons from developing countries in the development and implementation of BEECs, focusing primarily on compliance enforcement in new building constructions. In developing countries, preventing the lock-in effect in new buildings are of greater and more urgent concern than energy efficiency retrofits in existing buildings in terms of impacts on future energy consumption.

Main Findings and Conclusions

There is an urgent need to assist fast-growing developing economies where active space heating and/or space cooling are normal practices and where the formal building construction sector plays a large role in urban development. The plug-in energy loads of buildings and related energy use and efficiency, such as those of appliances and office equipment, can be addressed over time and with flexibility and well-targeted policies and programs. But the built-in energy loads—such as those for space heating, space cooling, and lighting—are intrinsically related to building design and construction and are best (or must be) addressed during the design and construction process.

The urban building stock in developing countries is expected to more than double by 2030. Demand for energy services in buildings in developing countries will rise substantially in the next two decades, driven by population growth, urbanization, and increased and expanded wealth. Per capita energy use in buildings, indicative of the level of energy services, is much higher in developed countries than in developing countries. For example, per capita fuel and electricity uses in residential, commercial, and public-service buildings in Japan, one of the most efficient economies in the world, are about 2 and 15 times higher, respectively, than in China. Many of the large developing economies, such as China and India, are expected to grow significantly in wealth, driving up energy demand in buildings. The International Energy Agency projected that global final energy consumption in buildings would grow by 30 percent from 2007 to 2030 if prevailing practices and trends continued. Most of that increase is expected to come from fast-growing developing countries.

Increase of energy services in buildings in developing countries should and can be supported with dual attentions to shoring up energy supply and scaling up energy efficiency. The 2007 assessments of the Intergovernmental Panel on Climate Change (IPCC) find that (1) among all greenhouse gas–emitting sectors, buildings have the largest global mitigation potential in the period leading up to 2030, primarily through cost-effective energy efficiency measures; (2) substantial reductions in energy use in buildings can be achieved using mature technologies for energy efficiency that already exist widely and that have been successfully used; and (3) a significant portion of these savings can be achieved with reduced life-cycle costs. The last point is significant because many investments in energy efficiency in buildings are beneficial just for the sake of reducing energy costs. Climate change mitigation is a co-benefit.

Energy-efficient building design implemented together with efficient heating and cooling systems/equipment represents the largest technical potential for energy savings in residential, commercial, and public-service buildings. For developing countries, a key point of interest is to avoid locking in unduly high life-cycle energy cost when investing in new buildings and associated energy systems. In China's cold and severe cold regions, the heating load of apartment buildings can be reduced by at least 50 percent with cost-effective and readily available thermal insulation measures and high-performance windows, compared with traditional buildings. In India, new large commercial buildings can achieve nearly 40 percent energy savings cost-effectively, compared with existing national benchmark buildings.

Removing or lowering the market barriers to delivering of more energy-efficient buildings requires government intervention through mandatory BEECs. There have been no exceptions even in the most develop economies in the world. Mandatory BEECs compel the supply chain to begin to develop and produce more energy-efficient buildings and to integrate energy efficiency requirements into standard practices. The main market barriers, universal to all economies, include the following:

- *Issues with visibility and relevance of energy cost signals.* When building/home purchase decisions are made, the future costs of heating, cooling, and lighting services in buildings are relatively unimportant, since they generally are fairly small sums on a monthly basis. Moreover, subsidies in or unaccountability of energy costs existing in many countries can further blunt or even wipe out incentives to invest in energy efficiency. The complexity of buildings, mixed with occupant behavior, also makes it difficult to convey credible and clear-cut cost and benefit information.
- *Split incentives among key stakeholders.* In the building sector, investment decisions, including those regarding the energy features of a building, are usually made by developers and investors, not by those who will occupy the building later and be responsible for paying the energy bills. Consequently, energy efficiency features are not installed and occupants do not reap the benefits. Split incentives prevent basing investment decisions on life-cycle costs and, consequently, the realization of the benefits of energy efficiency investments.
- *Lack of information and knowledge.* Information about energy efficiency options is often incomplete, unavailable, expensive, and/or difficult to obtain or trust.

Even developers, design professionals, and contractors are not always aware of the energy efficiency technologies available. Even when they are aware of the technologies, they can be reluctant to take a chance on the technology and include it in building design. Many construction companies lack the knowledge to correctly apply new technologies.

- *Complexity of delivering more energy-efficient buildings.* The process of delivering a building project is among the most fragmented in delivering a commercial product. A project developer needs to deal with independently operated professional and trade units such as architects, engineers, and various construction and installation contractors, as well as suppliers of materials and components, and finally with code enforcement agencies to deliver a building that meets the needs of the clients/customers in safety, function, and energy efficiency. Since the interests of the market participants are often not aligned, the results are often suboptimal, at best.

Although not intentionally designed, the biggest shortcoming of BEECs is that they do little if anything to raise demand for more energy-efficient buildings or to encourage the supply chain to do more than what is necessary to comply with the requirements. Therefore, market incentives are also vital to encourage commercial deployment and market recognition of energy efficiency innovations that surpass the requirements of BEECs.

BEECs have become a widely adopted energy efficiency policy, much more so in cold-climate regions than in warm-climate regions. But there is a significant gap between the development of a BEEC and its actual implementation and enforcement, even in many developed countries. Most industrialized countries have mandatory BEECs. Among developing economies and economies in transition, BEECs are most prevalent in Eastern Europe and East Asia. Many of the countries in these regions are in cold climate zones and require heating. The most urbanized region in developing countries, Latin America and Caribbean, shows a lack of BEECs, and even where they exist, they are not implemented.

Systematic surveys on the compliance situation of BEECs are rare and results are hardly comparable. Given that the definition of compliance and the relative importance of different components vary significantly, the compliance figures revealed in partial data and anecdotes need to be taken with caution. But they do suggest that compliance and quality of enforcement is much less than perfect in most countries that enforce their BEECs. For example, compliance rates in the U.S. states range from low double digits to near 100 percent. Noncompliant items can be large or small. For example, a survey in Denmark in 2000 found that in 43 percent of the surveyed buildings insulation of internal pipes and water tanks had been missing. BEEC compliance is generally significantly poorer in developing countries where BEECs are either mandatory or voluntary. China is among a few developing countries where BEEC compliance has reached a significant level. National inspections conducted by the central government indicate that construction compliance in large Chinese cities has reached 80 percent in 2008.

Despite the somewhat disappointing compliance record, progress can be observed in terms of actual energy performance of buildings. New buildings today consume

much less energy than older buildings from before the 1970s energy crisis. Both in Western Europe and the United States, energy efficiency improvements through BEECs since the 1970s amount to about 60 percent. But, it remains a fact that there is a substantial compliance gap almost everywhere and that energy savings and emission reductions are much smaller than they could be if BEECs were universally complied with. The extent of the lost opportunities is not known, since there is very little measuring of actual energy performance of buildings after construction is completed.

Most industrialized countries have managed to mainstream BEECs, meaning basic practice of energy efficient design and construction is a norm, not an exception. Although compliance still is suboptimal, there are good practices and important lessons among the pioneering countries in Europe and the United States:

- The countries and states that have done well in compliance are often those that have involved key stakeholders in the development of the BEEC, have devoted sufficient resources to support enforcement, made strong efforts to train and educate the key stakeholders in BEEC compliance, and adopted systematic approaches/procedures for enforcement. These countries and states also generally introduced complementary policies that provide incentives for supplying and acquiring energy-efficient buildings and information to all stakeholders about the benefits of such buildings.
- As BEECs become more complex and demanding, having a range of compliance options is important for most effectively addressing the varying needs of different building projects and preferences of different users. This movement from a fixed menu of options to flexible approaches that achieve the same overall energy savings is a natural evolution of BEEC enforcement in response to increasingly sophisticated buildings and diverse requirements of clients.
- Regularly updating the BEEC provides for incremental improvements and allows adjustments to improve implementation. The Energy Performance of Buildings Directive (EPBD) requires that BEECs in European Union (EU) member states are updated at least every five years. Many member states have shorter updating schedules. The national model BEECs and most state BEECs in the United States are updated every three years. Periodical updates provide a means to incrementally improve the stringency of the requirements and to incrementally expand the scope of the requirements, so that the changes are not so challenging to implement.
- A BEEC with more-uniform format and structure across various countries in an economically integrated region (EU) or within a large country (United States) facilitates performance evaluation and consistency in compliance. There will always be local differences in stringency based on climate, but having a more-uniform code format and structure allows designers and contractors, manufacturers, and suppliers to more easily identify the requirements for a particular locale regardless of which country or state it is in. It also has the benefit of spurring greater intraregional flow of technologies and innovations by leveling the playing field across previously segregated markets.

- Government must take the leadership role in implementing BEECs and promoting market transformation in building construction. Having the local government leadership will increase the likelihood that the BEEC is implemented in the city/county. Having the state and national government leaderships will increase the likelihood that the BEEC is implemented in the country. The EPBD of the EU is a good example of collective leadership.
- The public sector retains responsibility in most countries for enforcement of building codes in general and BEECs in particular. Faced with increasingly complex BEECs and insufficient resources for code enforcement at the local level, many countries have allowed contracting out some of the review and inspection duties that require substantial expertise to certified/accredited third parties. Since builders frequently hire third parties, mechanisms need to be put in place to ensure that third parties have incentives to carry out their work properly. These include spot checks by public-sector enforcement officials, loss of certification/licensing, penalties, and liability for mistakes.

The experiences from some of the early adopters of BEECs in developing countries are both sobering and encouraging. They reveal a broad spectrum of achievements and failures and underlying factors. China, India, Egypt, and Mexico are at different stages of implementing BEECs and have adopted varied approaches. Each represents an interesting case to inform the needs, challenges, and potential solutions to help mainstream BEECs in developing countries:

- ***China*** is on the verge of mainstreaming BEECs in new building construction in urban areas, thanks to national government leadership and persistent efforts over two decades. Even though compliance enforcement is still inconsistent and enforcement in medium and small cities is believed to be much more problematic than in large cities, implementation of BEECs is now commonly accepted practice in the construction sector, and incremental costs have been essentially internalized. The convergence of the following factors in the last five years or so has been important: (1) Improved and standardized system of BEEC compliance enforcement and procedures; (2) Broad-based capacity of the construction industry to meet the technical requirements of BEECs; (3) Widely available quality building materials and components for BEEC compliance; (4) Much increased ability to afford and willingness to pay for the incremental costs of BEEC compliance; and (5) Strengthened capacity and motivation of local governments to enforce BEECs.
- ***Egypt*** appears to face daunting challenges to implement two fairly sophisticated BEECs introduced in 2006 (residential buildings) and 2009 (commercial buildings) in an environment where basic building code requirements are not effectively enforced. Demand for and interest in energy efficiency is low because of widespread energy subsidies, especially for residential users. A new simplified general building law and the interest of the green building community, which is just now forming in Egypt, might provide a new motivation in constructing more-energy-efficient buildings. But strong national government leadership and support are needed for developing basic compliance and enforcement procedures required at the local level, in

training and capacity building of actors in the building supply chain, and in removing general energy subsidies.

- ***India***, currently focusing on implementing its first and initially voluntary Energy Conservation Building Code (ECBC) for large commercial buildings (2007), is making a big effort to put in place the measures and procedures and to develop the compliance capacity necessary to successfully implement the BEEC locally. By focusing on large new commercial buildings first, the efforts are likely to yield relatively quick progress in compliance if local governments pursue enforcement seriously. A BEEC for residential buildings would face substantial barriers, since many residential buildings are informally built and almost all residential electricity consumers are heavily subsidized. Providing some incentives for the developers of high-end large residential building complexes to apply the requirements of the ECBC might establish precedents for eventual adoption of a BEEC for residential buildings. In general, pushing for the wide adoption of and compliance with increasingly strict energy efficiency standards for appliances and lighting would substantially and cost-effectively curb the enormous growth in residential electricity consumption.
- ***Mexico*** developed a mandatory commercial building code in 2001 but has largely failed to implement it due to a lack of interest of local governments to incorporate its requirements into their local building regulations. More recently, the National Housing Agency CONAVI developed a national model regulation for residential construction, which contains sustainability requirements. Developers wanting to participate in CONAVI's subsidized low-income housing development program will have to satisfy those requirements. This represents an attractive approach to leverage market uptake of more energy efficient buildings. By engaging concerned state and municipal agencies, this federally supported program could pave the way for them to incorporate energy efficiency requirements into their building regulations and enforce compliance.

Expanding the scope and scaling up the implementation of BEECs in developing countries will be a gradual process requiring removal of relevant political, institutional, technical, and financial constraints. Each country will have to deal with its weaknesses in these areas with approaches that suit its own situation. Global experiences indicate that implementation of BEECs is likely to have more success in countries and localities where the construction sector is well managed in terms of government oversight of building safety and quality, the building supply chain is well established in terms of technical and engineering capacity, the market for commercially produced buildings is well developed, and there is broad and firm political commitment to improving energy efficiency. Weaknesses in these areas are often the main challenges to developing countries:

- *Challenge 1: Maintaining firm political commitment to energy efficiency.* Expanding modern energy supply infrastructure and energy access remains an investment priority in developing countries. That often leaves energy efficiency with little political attention. This is a critical mistake for countries of many income levels. Convincing the people of the importance of energy

efficiency in national energy security provides a political mandate for the government to begin necessary steps to introduce and ramp up energy efficiency policies and programs as the specific needs are identified, such as the implementation of BEECs. The effect of such commitment has been well demonstrated in China and is emerging strongly in India.

- *Challenge 2: Establishing an effective government oversight system for building construction.* In many developing countries, government supervision of the construction sector for traditional safety requirements is ineffective due to the combination of overly complicated and costly permit application and review process and a lack of resources to handle the required due diligence. For these countries the implementation of BEECs is unlikely to succeed without improving the credibility and inclusiveness of the building permit and inspection system.
- *Challenge 3: Developing the compliance capacity of the building supply chain.* Compared with the prevailing commercial construction practices in many developing countries, implementing modern measures to reduce/minimize building heating, cooling, and lighting loads requires a host of new design skills and approaches, new or improved materials/components and construction techniques, as well as additional supervision, inspection, and testing/certification requirements.
- *Challenge 4: Financing incremental costs of more energy-efficient buildings.* Few decision makers and consumers in developing country would disagree that more energy-efficient and comfortable buildings are desirable. But with tight budget constraints for both governments and private citizens, tradeoffs often have to be made between more housing and more energy-efficient housing. Low-income countries often have priority in maximizing the floor area for a given amount of housing investment. Efforts to promote adoption of BEECs in developing countries should consider such constraints, together with the potential of tapping into international development financing mechanisms, including those addressing climate change mitigation and adaptation.

Recommendations and International Assistance Strategies

From the experience of developed countries and early adopters in developing countries, such as China, Mexico, and more recently Egypt and India, it is clear that government intervention and persistency are critical to making energy efficiency a pillar of building construction. Several conditions are particularly important to foster in the context of developing countries. International development institutions such as the World Bank could offer valuable assistance.

Expand and Strengthen the Political Support for Energy Efficiency

Engaging developing countries in substantive discussions of their energy efficiency strategies and actions requires convincing evidence and analysis of the costs and benefits of pursing those activities. Considering the importance given to energy efficiency by the international community, it is useful to conduct more in-depth and actionable sector-level energy efficiency assessments for developing countries. The multilateral development institutions (MDIs) or bilateral assistance agencies could help

expand and strengthen the political support for energy efficiency by increasing the in-country knowledge and awareness of the critical issues, practical solutions, and cost–benefit implications of promoting energy efficiency in general and BEECs in particular.

Improve the Effectiveness of Government Supervision of Building Construction Sector

BEECs are a new dimension of government oversight of the building construction sector. But the elements of successful implementation are similar to those for implementing the general building codes. It is difficult to imagine good compliance enforcement of BEECs if the building construction in general is poorly managed and governed. Improving the effectiveness of government supervision of the building construction sector can be addressed as follows:

- *Simplify the building law, streamline the permit process, and make it more predictable and user-friendly*. Many countries have simplified their building laws. For example, Egypt reduced the number of procedures to be complied with and the time it takes to clear each procedure. However, many countries still show wide divergence locally (for example, states in India).
- *Strengthen the compliance and enforcement infrastructure by* committing requisite government resources and through involvement of nongovernment entities for regulatory due diligence. China has developed a government construction oversight system that depends heavily on third-party services for compliance of building codes, including BEECs. Mexico's building code compliance involves the private sector, as well.

Develop Technical and Engineering Capacity of the Building Supply Chain

The local availability of materials and equipment that can reliably fulfill the requirements of the BEEC is frequently an issue that can slow down the progress of BEEC implementation. Strong and persistent push for BEEC compliance sends unambiguous signals to local manufacturers about the type of products in demand. The next steps would involve the development of standards for materials and equipment, the set-up of testing facilities and protocols and the development of a certification system. It is advisable that international assistance involved in the demonstration projects during the first years after BEEC adoption to pay special attention to the potential and viability for domestically producing the materials and components for BEEC compliance, as well as market development strategies to increase the supply and assure the quality of such products domestically or at regional level (involving multiple countries).

In parallel, different trades in the building supply chain need to be trained and updated about compliance requirements and good practices in every phase of building construction. National-level commitment and involvement are important in resource-constrained developing countries for establishing and sustaining systematic programs to educate new generation of architects and engineers, train professionals, inform the public, disseminate good practices, and standardize procedures. International assistance programmed into such nationally orchestrated efforts is likely to have greater systemic impact and value. China has taken this approach and achieved good results under the leadership of the Ministry of Housing and Urban-Rural Development. Although currently focusing on large commercial buildings, India is embarking on a similar

approach under the leadership of the Bureau of Energy Efficiency to help its building construction sector to adapt to the compliance requirements of the ECBC.

Capacity building for the building supply chain needs to extend to those tasked with enforcement of the building code, such as site plan and building design reviewers, and construction and equipment inspectors, whether they are government employees or third parties. Although China relies heavily on certified third parties for compliance enforcement, all city governments maintain a division in their construction department with responsibility of overseeing and supporting BEEC implementation. These similarly tasked government administrative units form a national network for the capacity building and market development assistance supporting the implementation of BEECs.

For developing countries that have made significant inroads in achieving compliance of their first BEECs, additional efforts should be made to support advanced energy efficiency programs. For BEECs to incrementally improve over time, it is desirable to have examples of greater energy efficiency. Utility incentive programs and green building programs can provide encouragement for progressive designers and developers to go beyond the minimum requirements in the current BEEC. Their experiences will then provide examples that can be pointed to as support for the next increment in the subsequent update to the BEEC.

Bridge the Gap in Incremental Cost Financing

Despite their life-cycle cost advantages, more energy-efficient buildings in general will cost more to build than their less-efficient counterparts. Mandatory BEECs essentially require home and building owners to pay for the incremental costs of more energy-efficient buildings. But this creates tension in developing countries where most of the population still is poor by developed country standards. In low-income countries, there are indeed hard tradeoffs between the current desire of having adequate housing and the long-term benefit of having energy-efficient housing. This constraint or dilemma can only be resolved with broad economic development and will take a long time for low-income countries.

There is a larger development issue in the pursuit of more energy-efficient buildings. In working toward the long-term goal of internalizing the incremental cost of more energy-efficient buildings, developing countries will need to rely on domestic policy reforms to set their economies on a sustained growth path. Directly relevant to energy efficiency promotion, it is essential that the policy reforms should lead to rationalization of energy pricing and billing, reserving subsidies for low-income households:

For mid-income developing countries, the incremental-cost financing for compliance with their BEECs can and should be largely borne by the building/home owners. China has essentially made that transition. The main issue for many middle-income developing countries is to finance the resource needs to enforcement broad-based BEEC compliance. User fees included in permit fees or payments of developers to third parties (as is the case in China) would be the usual sources. Utility DSM programs funded by energy efficiency surcharges could be useful in paying for capacity building, incentives, and monitoring and evaluation.

For low- and lower-middle income countries, the incremental costs of development and implementation of BEECs will be a major issue. It is thus important that these countries do what they can afford, targeting at the market segment where economic benefits are great and enforcement is most likely to succeed. India's initial effort on large commercial buildings is a good example. However, while smaller buildings may not be regulated until a later phase, it is important to begin addressing at least some of the energy consumption in all buildings in some manner. Initiatives may include supporting architecture designs (such as appropriate building orientation, shading, natural ventilation, and so on) that improve comfort without additional active energy service and energy efficiency measures that rely on locally available materials and benefit local manufacturing. A valuable companion program that could result in substantial benefits in the short to medium term would be the introduction and enforcement of energy efficiency standards for lighting and the most prevalent appliances.

The Global Environment Facility (GEF) has been a principal source of international financing for development and implementation of BEECs, focusing primarily on supporting national code development, pilots, and demonstrations. Carbon financing and other clean technology investment financing mechanisms could provide additional support for strengthening and broadening BEEC enforcement, and in particular encourage market-driven energy efficiency innovations from the private sector, such as the voluntary rating systems for green buildings.

Because of the complexity and high transaction cost of meeting the eligibility, monitoring and verification requirements of the Clean Development Mechanism (CDM), component based carbon-financing schemes focusing on the use of certified products, such as a special type of windows, insulation materials of certain defined physical properties, and/or more efficient air conditioners, could help spur the broader adoption of components of higher energy efficiency performance. Such an approach would be especially useful in new residential constructions where benefits of energy savings are highly disaggregated and building-level verification is much more difficult than large commercial buildings.

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Building energy efficiency codes (BEECs), which regulate the energy performance of building design and its compliance during construction, are broadly recognized as a necessary government intervention to overcome persistent market barriers to capturing the economic potential of energy efficiency gains in residential, commercial, and public service buildings. Compliance enforcement has been the biggest challenge to implementing BEECs. This paper summarizes the findings of an extensive literature survey of the experiences of implementing BEECs in developed countries, as well as in some early developing-country adopters, specified in case studies of China, Egypt, India, and Mexico. The paper also serves as a primer on basic features and contents of BEECs and commonly adopted compliance and enforcement approaches. It recommends increased international support in strengthening the enforcement infrastructure for BEECs in middle-income developing countries. For low- and lower-middle-income countries, there is an urgent need to help improve governmental oversight of building construction, which will lay a foundation for effective implementation of BEECs.

The Energy Sector Management Assistance Program (ESMAP) is a global technical assistance program administered by the World Bank that assists low- and middle-income countries to acquire know-how and to increase institutional capability to secure clean, reliable, and affordable energy services for sustainable economic development. ESMAP was established in 1983 under the joint sponsorship of the World Bank and the United Nations Development Programme as a partnership in response to global energy crises. Since its creation, ESMAP has operated in over 100 different countries through more than 500 activities covering a broad range of energy issues.

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