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Phase-in options for energy efficiency standards

Case Study Prepared for the GIZ

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1. Introduction

Energy efficiency offers many low-cost investment options for mitigating climate change. In developing countries, energy efficiency often presents a neglected part of national energy systems as political priorities and vested interests of public and private actors have favoured access to electricity and modern energy services for many years. The effective linking and sequencing of public and private energy efficiency standards may not only be co-beneficial to climate mitigation and energy security, but can also support market transformation towards a greener economy. Since climate change has risen on the global agenda again in the past decade, more and more developing countries opt for the introduction of energy efficiency standards for industry, building and appliances.

Energy efficiency standards have different features. They can aim at processes or products, be voluntary or mandatory, regulatory standards or standards set by industry. They can aim at minimum performance of a product, often coupled with labels, or at incentivising industry to innovate by setting the standard at the level of the most efficient product available on the market ("top runner"). Energy efficiency standards also include broader performance-based instruments such as building codes or certification schemes such as ISO norms. As a first step, three broad types of energy efficiency standards can be differentiated: process standards, product standards and hybrid, performance-based standards. Further criteria for defining an energy efficiency standard are its form (e.g. voluntary or mandatory), geographical reach, functional coverage (e.g. generic or sector specific) and the actors and drivers involved in setting and implementing it (Nadvi/Wältring 2002).

Energy efficiency standards can be part of a policy package with tax rebates or loan subsidies, supporting investments in energy efficiency to comply with standards set. Energy efficiency standards are thus a policy instrument which can be adapted to the existing regulatory environment, economic structure and actor interests. It can be readjusted over time. If designed well, energy efficiency standards are an important tool for market transformation, as best practice examples in Germany have shown in the past. Many of the standards applied in Germany belong to the highest in the world, inspiring other countries to follow suit. However, if designed badly without mechanisms to meet control and compliance challenges that often exist particularly in developing countries, energy efficiency standards may also turn into a weak instrument – a toothless tiger rather than a transformative tool.

To date, it is not entirely clear which combination of public and private standard setting currently works best in developing countries and how phasing-in can be organized so that market development is supported and control and compliance challenges minimized. The following research question results:

Which combination of public and private energy efficiency standards works best? How can potentially conflicting interests of the main stakeholders be managed?

This study contributes to answering these questions, focusing on the phasing-in rather than the dealing with control and compliance challenges. Two main arguments will be made: First,

standards need to be phased in gradually due to lack of consumer awareness, veto players with vested interests and a lack of verification mechanisms. Second, approaches need be contextualized to country conditions and allow for policy learning. The timing and degree of state intervention required differs between areas targeted and depends on the local political system. The study will discuss particularly insightful examples of political economy dynamics and policy processes in Germany, India, China and Uganda.

Section 2 gives an overview of different types of standards and outlines general options for phase-in. Sections 3 and 4 the go into a more detailed analysis of energy efficiency standards in two very different sectors: industry and buildings. Both sections review best practices in Germany first, before moving on to existing experiences and examples in emerging economies and developing countries. The final section summarizes differences and similarities of the political economy of phasing-in energy efficiency standards in industrialized and developing countries and draws lessons learned for future programmes on energy efficiency standards.

2. Types of standards and phase-in options

In the field of energy efficiency, different options for the introduction of standards exist that can also be combined to a policy package over time. The choice for a type of standard and a mechanism to support phase-in depends on the sector and target group. The sectors accounting for the highest GHG emissions and energy consumption are industry, transport and buildings (sometimes also listed as residential sector). Exact numbers and the distribution of consumption and savings potential across sectors are highly context-dependent, varying for example according to the need for space heating. The energy production sector is sometimes listed separately from industry. Target groups of energy efficiency standards are the producers of equipment, machinery, materials or appliances and/or the end-users in industry, landlords or tenants or consumers buying or using equipment and appliances. This vast field already makes clear that various forms of standards exist that require different support mechanisms are necessary for phasing-in.

In all sectors, voluntary or mandatory standards can be introduced that have a regulatory or information function. Standards are voluntary when they are non-binding for the target group, either because the regulatory agencies seek to prepare the market for standards over time or because the initiative was started by industry itself. The voluntary minimum energy performance standard for lighting in Bangladesh or the voluntary labelling programs for air conditioners and refrigerators in Indonesia provide examples. Standards are mandatory when they are legally binding; often this is accompanied by a set of test and control measure and/or a ban of inefficient products. Standards set by governmental agencies usually aim for a mandatory implementation over time. Energy efficiency standards can have a regulatory or information function. While those standards with an information function are limited to energy audit schemes, labelling programmes for appliances, lighting and buildings as well as benchmarking initiatives by industry, standards with regulatory functions such as minimum

energy performance standards, fuel economy standards or building codes can be quite diverse. Table 1 summarizes the main types of energy efficiency standards, further clarifying this.

Table 1: Types and functions of energy efficiency standards

Type	Target	Sectors	Function	Mandatory/ Voluntary
Minimum energy performance standard	Product	Appliances Lighting Electrical equipment Buildings	Regulatory: sets the minimum efficiency (but not usually the highest possible standard)	Mandatory; can be phased-in by moving from voluntary to mandatory
Top performance-oriented standards („Top-runner“)	Product	Appliances Electrical equipment and machinery	Regulatory: sets the standard at the most efficient product on the market based on fleet average; dynamic standard	Mandatory (revised/tightened at regular intervals with industry stakeholder input)
Prescriptive building codes	Products	Building materials and components	Regulatory: Sets standards for materials and building components (e.g. windows; heating system); does not take user behaviour into account	Mandatory; often phased-in by targeting public buildings first, then moving to commercial and private buildings
Outcome-based building codes	Products and processes	Buildings (whole)	Regulatory; set overall target of energy use for the building but give flexibility how to achieve it; user behaviour of building is integrated	Voluntary or mandatory
Benchmarking	Process and/or product	Industry	Information for the company and incremental improvement of industry sectors over time	Voluntary; can be made mandatory if private-public agreement
Energy management systems	Process and/or product	Industry	Information, can be regulatory; do not forcibly lead to more energy efficiency/energy saving but are usually regarded as important step towards more energy efficient production and awareness	Voluntary or mandatory
Labels	Product	Appliances Lighting Buildings Cars	Information for consumers; marketing for producers	Voluntary or mandatory

Source: Author’s own compilation.

Setting **minimum energy performance standards (MEPS)** is a commonly used option for regulating specific products or components of production such as electric motors in industry. MEPS set a minimum level of energy efficiency of a product, usually measured by its energy consumption. In a first preparatory step, MEPS can be introduced as voluntary mechanisms by either governments or be implicitly prepared by voluntary benchmarking activities in industry. Benchmarking initiatives are usually private and voluntary: companies compare their own energy consumption or energy efficiency to other peer companies in the field or compare different entities of their own company such as manufacturing plants to each other. The best performing company or plant then sets the benchmark of best performance. This can

support a later introduction of MEPS by governmental agencies. Alternatively, governmental agencies set mandatory requirements directly. The development of these standards usually takes a lot of time and capacities; many developing countries opt for international donor support in the process.

The introduction of MEPS is often combined with labelling programmes for the targeted products. Again, these can be either voluntary or mandatory. By 2014, 81 countries had MEPS and labelling programmes; MEPS cover 55 products, with refrigerators, air conditioners, lighting and television the most commonly regulated (Ren21 2014: 119). While MEPS remove the most inefficient products from the market by setting a minimum threshold, comparative labelling schemes support consumers in gradually choosing more efficient products. Most of the products covered by MEPS belong to the appliances and lighting sectors, thus addressing all end-users and the manufacturers of these specific products. Electric motors only target industry. For the phase-in process, the products covered and the level of energy efficiency need to be specified in cooperation with regulating agencies and manufacturers of the products. If international MEPS are adopted, the choice for a type of standard or label implies a particular market power for those international or national companies already applying this standard.

The minimum level of the standard can be revised and gradually increased and/or the MEPS can additionally progress from voluntary to mandatory in different product categories. This requires ex-ante data collection and analysis of electricity consumption and savings potential of products on the market. Testing and control facilities need to be set-up and collaboration between governmental standard setting bodies and major industry stakeholders is advisable before the first introduction of MEPS, regardless of whether they are voluntary or mandatory. Additionally, the phasing-out of inefficient and counterfeit goods needs consideration as compliance with standards in the absence of comprehensive controls may be low and interests of the vendors and consumers (seeking a lower priced good) work against top-down standard setting. If a certain good is exclusively imported and no local production exists, setting a higher mandatory MEPS in combination with an import ban and import controls may be more useful. In countries with nascent local content production , setting too high mandatory MEPS too early may negatively affect economic development. Here, the timing may be relevant and each product category requires separate revision.

Performance-oriented standards based on the "top runner", i.e. the most efficient product on the market, present another phase-in option. First, national standardisation bodies identify the most efficient product available on the market. Then, these bodies and governmental regulatory agencies define this as a mandatory standard for all products in this category (e.g. refrigerators). Each manufacturer and importer has to ensure that the average efficiency of all units shipped within that category meets the standard by the target year (usually three to twelve years into the future). This approach has been first introduced by Japan in 1999 and enjoys considerable success there. The European Union adopted the top-runner approach for certain product categories in 2011 so that MEPS and top-runner model now complement each other. The top-runner model more directly stimulates efficiency improvements and innovation than MEPS because the complete industry sector is forced to innovate more quickly to

comply with the highest standard available instead of having to comply with a minimum standard (which can but does not necessarily reflect the most efficient product available). However, continuous revisions and a rigorous compliance and control system are necessary for the top-runner approach to work effectively. The standards introduced through this approach are usually binding from the start. Capacity to innovate and improve to the top-level available on the market should realistically exist. This phase-in model may therefore be difficult to implement in less and least developing countries. Top-runner programmes require a high level of trust and cooperation between government and a relatively limited number of domestic manufacturers. Japan has combined this approach with a mandatory labelling programme which shows consumers whether a product meets the top-runner standard already or not. While a MEPS-approach is sometimes used in the design of building codes as well, the top-runner model this far has only been applied to appliances and machinery.

There is a difference between **prescriptive building codes** that give specific minimum or maximum values for components or features of a building and **performance-based or outcome-based codes** that focus on the actual resulting energy use. The latter specify the level of energy performance a building or its components have to achieve, while giving flexibility in the methods and solutions to reach this level. Governments may choose to introduce one or both kinds of codes on either a voluntary or mandatory basis. Germany, for instance, employs a combination of both. The choice for a type of standards and the sequence from voluntary to mandatory codes depends on the awareness and capacities of local construction industries and the availability of materials – making a standard mandatory if more efficient materials are not available or builders do not know how to construct in the required ways will forcibly lead to non-compliance. The political economy shaping the introduction and implementation of building standards is quite different to the industry and appliance sectors (see below).

Process or management standards based on voluntary engagements or accords between industry and government that eventually lead to mandatory regulation present another sub-field of energy efficiency standards. They are more encompassing and require companies to follow rather complex procedures which require specially trained energy auditors and certification consultants. The phase-in process therefore usually starts with voluntary mechanisms and may be driven more strongly by industry integrated in global value chains. The setting of these standards is much more strongly impacted by international dynamics, the influence of standardisation bodies on the international level and the global diffusion of best practice standards. The costs and procedural requirement for obtaining an ISO energy management certificate is likely to be a barrier to the voluntary engagement of smaller local companies. Here, the combination of policy and donor support in setting up supporting agencies as well as concrete information campaigns about costs and benefits may be particularly relevant (see below). Allowing for sufficient time for companies to change and adapt is important as well.

Generally, the following framework conditions are considered conducive to the phase-in of energy efficiency standards (Thomas 2015), irrespective of the type and path chosen:

- Existence of political commitment and a policy roadmap for energy efficiency

- Analysis of existing barriers and incentives for actors along the complete value chain (e.g. from component manufacturer to recyclers) prior to policy and programme development; revision of programmes over time
- Existence of functioning energy agencies and standardisation bodies
- Integration of major stakeholders in the standard-setting process
- Energy efficiency funds available
- Reform of subsidies for energy pricing if necessary and possible
- Identification of training needs and support of new business groups, e.g. energy auditors

In industrialized countries, both regulatory and information-oriented standards are often coupled with economic instruments such as tax rebates, subsidies or tradable allowances on the market. Phasing-out of obstructing subsidies in parallel to the phasing-in of standards in a targeted policy package is useful. In the following, these general insights will be followed-up in an in-depth analysis of standards in industry and buildings. These two sectors function differently in terms of actor groups and their interests, market dynamics and targeted policy processes. Roughly two thirds of global energy is consumed in the two sectors.[1] Phase-in of standards in these fields may therefore have a particularly high impact on global emissions.

3. Energy management standards in industry

3.1 Germany: Combing stick and carrot

This section reviews the most important dynamics, advantages and disadvantages of the German policy mix. It will focus on energy management standards such as audits and ISO 50001, the new international norm for energy management systems. This norm may influence up to 60% of the world's energy use (ISO Secretariat 2011). In spite of their linkages with efficient products used, these standards are primarily process standards aimed at cleaner production.

Industries within Germany work with a range of mandatory and voluntary standards, targets, audits and certification systems. While economic, market-based instruments have long been the primary choice of German policy-makers to promote energy efficiency, the current policies combine market instruments such as the European Emissions Trading Scheme, taxes and subsidies with voluntary agreements and commitments between government and industry (e.g. 2012 Agreement on combined heat and power). Furthermore, it is now mandatory that all large conduct an energy audit every four years (as of 2015). For small and medium enterprises (SMEs), a stand-alone programme offering financial support for energy audits exists since 2008, but audits are not required by law.

The case of ISO 50001 is particularly interesting because energy-intensive firms in Germany have to pay less renewable energy surcharge (EEG-Umlage) and less electricity tax if they are

[1] Most statistics on global energy consumption do not differentiate between appliances and buildings, but only sub-divide buildings in residential and commercial use, sometimes separately accounting for lighting. The energy and emissions savings potential for appliances in developing countries is likely to be substantial as well, but is hard to quantify. Appliances will therefore not be treated in an in-depth way in this study.

certified under ISO 50001 or the Eco-Management and Audit Scheme/ISO 14001. [2] Additionally, the high electricity price drives firms towards energy savings – ISO 50001 is a helpful tool to achieve these. The voluntary certification scheme is thus supported by both a strong financial incentive ("carrot") and the new mandatory energy audit ("stick") for large companies. Currently, Germany is the global leader in the adoption of ISO 5001 with 2477 certified firms in 2013, while India tops the list of emerging economies and developing countries with 172 certified firms. In terms of sectors, the agriculture & fisheries, pulp & paper and food & beverages sectors make the top three in 2013.

The introduction of energy management systems in industry offers cost reductions[3] for firms and mitigates carbon emissions. Additionally, many firms use the recognition of certification systems by consumers and customers as a marketing tool. In spite of these benefits, the costs and complexity of introducing these systems lets many firms hesitate, depending on firm-size, sector, incentives and actual profit margin. The complementarities of domestic and international standards are an important source of market power for industry, giving those firms that already apply standards close to the new international norm a first mover advantage (Mattli/Buthe 2003). Even though ISO norms are voluntary standards, their global recognition and their popularity as a reference point in policy regulations makes its definition a highly contested procedure. The key stakeholders in Germany are:

- The national standardisation body DENA
- The international ISO council
- Energy-intensive industries (often acting as veto player)
- SMEs (their interest to avoid mandatory energy management system certification is seconded by larger incustries, giving them a stronger voice)
- Certification and auditing businesses
- Environmental and climate change NGOs
- Different legislative bodies involved in rule- and policy-setting

In Germany, the implementation of the energy audit recommendations and the measures necessary to keep the ISO certification over time are left to the companies. This serves industry's interests in flexible handling of the rule, while weakening regulatory force to maximize climate mitigation as quickly as possible. The core interests of industry are to keep electricity prices low, while keeping a competitive advantage. The latter includes the support of energy efficiency as a means to reduce costs and boost competitiveness, albeit within the limits of the time, costs and means for high-end innovations necessary now to even further increase energy efficient production.

In many industrialized countries, the policy process leading to the introduction of energy management systems in industry starts with voluntary moves by business associations themselves or by national standardisation bodies. In Germany, a voluntary agreement between

[2] ISO 14001 and EMAS both aim to provide good environmental management. EMAS is more far-reaching, but firms that have already adopted ISO 14001 can quite easily progress to EMAS without duplicating efforts (Kahlenborn et al. 2010).

[3] In most industries, energy management systems lead to a reduction of 10-20% in energy intensity in the first two years, and 2-3% reduction annually afterwards (Matteini 2012).

government and industry to reduce carbon emissions and energy use by 20% in the years until 2005 was signed in 1995. While not a standard itself, this was an important milestone in preparing the different energy efficiency and climate change regulations to come. The first specific energy management norm entered into force in 2009 (DIN EN 16001).

Three factors are likely to be responsible for the overall high level of energy efficiency in German industry and the quick spread of ISO 50001 among large companies. First, the **sequence** of measures from voluntary agreements between stakeholders and guidelines on auditing to the introduction of voluntary European and ISO standards, to energy auditing mandatory for large industry prepared both target companies and the auditing/certification industry adequately over time. Second, the combination of energy management standards with a strong financial incentive for large companies (tax exemption or reduction) and a smaller one for SMEs (KfW gives SMEs a subsidized loan for investments in energy efficiency and energy management systems) as well as co-benefits from energy management for emission trading certificates make investments attractive for the private sector. The **policy package** of market-based incentives, loans and strict regulatory instruments smartly combines "stick" and "carrot". Third, the participation of industry representatives at an early stage of standard development, for example in ISO norm setting, and the revision and renewal of agreements and incentive schemes enabled **feedback-loops and learning** across actor groups. Additionally, learning energy efficiency networks (e.g. the "LEEN" initiative[4]) exist for both large companies and for SMEs to foster peer learning and best practice exchanges.

Overall, the push for energy audits and ISO-type energy management systems depends on reliable, transparent standardisation bodies, functioning accreditation bodies for auditors and a differentiated support structure for companies. This requires substantial technical, financial and skill resources and capacities in both public and private sectors. Even though these resources are generally available in Germany, the diffusion of ISO 50001 and of energy audits by themselves are not complete yet (Fleiter et al 2012). The linking of public and private, voluntary agreements and mandatory audits form a convincing incentive package for German stakeholders to invest in energy management. State actors have cooperated with industry groups from the start, while national standardisation bodies and supranational entities are central to the overall regulatory development. Strong commitment to advance energy efficiency in industry exists. However, there are no mandatory energy saving obligations for industry yet and the tax exemptions would need to be lifted for a maximal climate mitigation effect. In Germany, the introduction of energy management system standards incentivises private investments in the field, but primarily by large companies. They have also started to change some market segments, but a full market transformation including SMEs has still not been achieved.

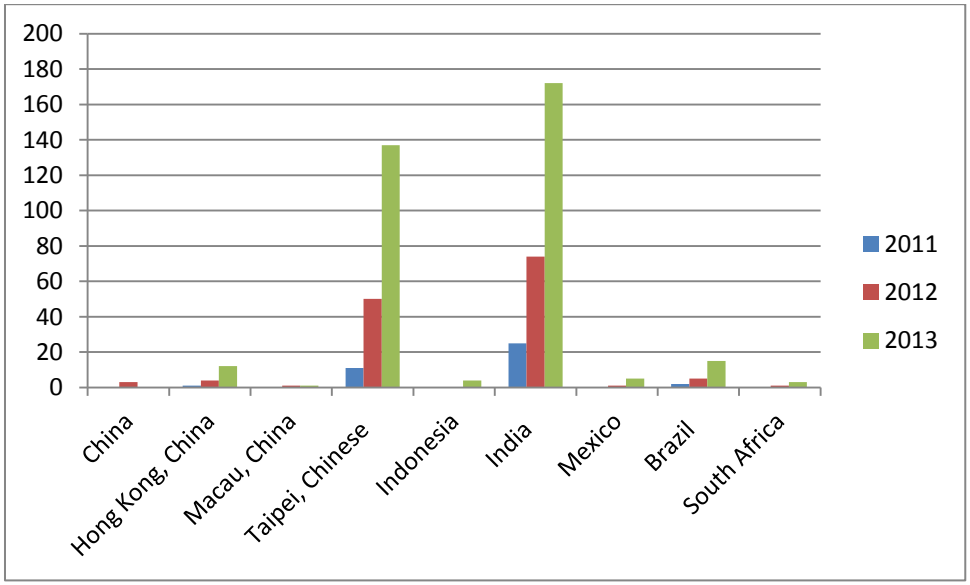
[4] In a LEEN initiative, 10-15 companies form a network to exchange best practices on energy efficiency to learn from each other. The project coordinator (usually a utility, community or a business association) contacts potential companies for potential membership and manages the time and financial planning, appoints a moderator of the group and an energy consultant accompanying the process. The LEEN association (GmbH) organizes the training of moderators and energy consultants and gives general process support. In germany, around 30 of these networks currently exist (http://leen.de, last accessed 09/09/15)

3.2 Emerging economies and developing countries

The introduction of energy management standards in industry in emerging economies and developing countries is happening on a much smaller scale than in industrialized countries. Apart from the awareness and interest by stakeholders, there needs to be a minimum commitment to the topic, the means to cover initial costs, the technical skills and capacity support within firms and outside of them to set up required auditing and certification facilities. UNIDO runs a support programme for ISO 50001 in ten developing countries that offers energy audits and within-company training at a reduced charge, among else. These can be understood as first supportive steps towards the introduction of energy management systems. Several donors including GIZ are also supporting the set-up of energy auditing associations and promote energy efficiency investments in large industry and among SMEs.

Most developing countries start with voluntary standards as a first step to prepare stakeholders and the market for possible future regulations. This implies that the whole system of energy auditing and energy management needs to be demand-driven to some extent or at least recognized and supported by a critical mass of companies, before a broader incentive package is likely to be successful. The adoption of the new ISO 50001 norm has been taken up by an increasing number of large companies in India and China (see Figure 1), while other major emerging economies with a strong influence on climate mitigation are lagging behind. The difference between mainland China and Taipei may be due to a different interest of local regulators and companies in pushing for energy management systems before the official intrudtcion of ISO 50001, making the adoption of the new international standard easier for companies in these areas.

Figure 1: Adoption of ISO 50001 in major emerging economies



Source: ISO council (most current data available).

As will become clear in this section, the political interest in energy efficiency, the previous experience of firms and their integration into global markets and value chains influence the

likeliness of investing in energy management systems and/or conducting an energy audit for developing country firms. Additionally, overcoming the often cited barriers for industrial energy efficiency investments in developing countries is central. These include a lack of information and skills, risk and transaction costs, access to capital, split incentives and behavioural barriers such as a bias for the status quo or the aversion to overly complex, ambiguous mechanisms or decisions (Sorrell 2011; Pegels et al. 2015). With few exceptions, almost all developing countries struggle with these challenges, limiting the amount of energy auditing as well as the adoption of ISO 50001 in spite of cost reductions and benefits to energy security (see Table 2).The political economy of energy management in industry is as much shaped by the interests of national actors groups as by the resources, capacities (made) available and the economic structure of the country.

Table 2: Adoption of ISO 50001 in emerging economies and developing countries

	2011 (no of companies)	2012 (no of companies)	2013 (no of companies)
Malaysia		2	12
Philippines		1	1
Thailand	10	41	132
Vietnam		5	7
Argentina		2	6
Chile		3	10
Egypt		6	7
Jordan			1
Ethopia		1	3
Malawi		1	5
Mozambique		1	5
Swaziland			36
Tanzania		1	5
Uganda		1	2
Zambia		1	2
Colombia			1
Dominican Republic			1
Guatemala			1
Afghanistan			2
Sri Lanka	1	1	2

Source: ISO council.

Export-driven economies and those companies integrated into global value chains are under stronger pressure to reduce production costs and are more exposed to international best practices. Furthermore, **transnational corporations** may function as lead examples. Those companies that already adopted other norms and standards are also more likely to endorse ISO 50001 or voluntary national energy management standards as well, while other large

companies and SMEs tend to refrain from these investments (McKane et al. 2009). The positive marketing effects from certification usually do not exist yet as consumers are not aware of the norms. Some companies simply prefer technological modernization and expansion to incremental process improvements - engaging top management levels in large companies is often the key to change this attitude throughout the firm (IEA 2012).

The **auditing and certification lobby** is politically weak in most developing countries. Even though industry associations start advocating for energy management among its members, energy auditors and consultants struggle to survive, particularly in less developed countries (see Box 1 on Uganda).

Box 1: Industrial energy efficiency in Uganda

Uganda does not have a national energy management standard yet, but efforts to establish the energy audit sector and minimum energy performance standards are ongoing. The Ministry of Energy and Minerals Development initiated a discussion about making energy audits every three years mandatory for large industry, but the development process of the law is stalled. The missing regulatory framework and specific incentive structure to invest in energy efficiency still reflects long-standing governmental priority to expand energy access and secure energy supply by building large hydropower dams. Demand-side management is only slowly coming more into focus, driven by the requirement to develop Nationally Appropriate Mitigation Actions (NAMAs) and by specific donor support in energy efficiency.

Immediate financial benefits are available to industry through power factor reduction - reducing the rate of real power flowing to the load, to the apparent power in the circuit. The utility provider Umeme charges penalty fees for a low power factor and gives financial rewards for optimized power factors. Since initial investments in power factor correction can be substantial, this is restricted to large companies. In 2009, Umeme ran an information campaign on energy auditing and power factor correction aimed at industry. Despite some interest in the private sector, implementation is currently lagging behind.

A number of large companies have completed energy audits and trainings with the National Cleaner Production Centre/UNIDO, GIZ or the Private Sector Foundation. GIZ is additionally supporting an energy auditor business association to further establish this business sector, but several energy auditors reported having to give up their services due to a lack of interest in industry. Industry interest in energy management seems to depend on

- The size of the company and it desire to compete globally (the larger and more export-oriented, the higher the interest)
- The commitment and understanding of top-level management of the topic
- The organizational structure of the company and the ability to embed the concept across management levels
- The amortization rate and complexity of the required investments (financial and process)
- In terms of policy process, introducing easier low-cost options first before moving to more complex certification requirement may work better

In spite of the barriers to engage in energy management existing within in industry and still existing technology, finance and skill challenges, a stronger move by the state towards regulatory frameworks and voluntary standards seems useful.

Sources: Expert interviews in Uganda conducted as part of another project in April 2014.

Many countries still **lack regulatory frameworks** that support the introduction of energy management in industry and do not set specific incentives aimed at this goal. Overall, the number of emerging economies and developing countries that have developed national energy

management standards is also small. ISO 140001 and ISO 90001 often have an energy component, so that those developing country firms that already implemented other ISO norms are more likely to engage in the ISO 50001 certification process, but a stronger driving role of the state is required – regardless of the type and scope of standard introduced.

China introduced the national energy management standard in 2009. It is influenced by the US model, stressing the tasks and responsibility of management. National norms and provincial implementation types first existed in parallel to ISO 50001, but the national standard has been revised in 2012 and is now in line with ISO 50001 (see Box 2). In 2009, South Africa adopted the Danish national energy management standard in to meet energy supply shortages more quickly and to bridge the time until ISO 50001 was published in 2011. Denmark served as a role model because of its particular good experience with the norm (Kahlenborn et al. 2010). The South African norm is a voluntary standard and easily compatible with ISO 50001. The government and industry already signed the Energy Efficiency Accord, a voluntary agreement, in 2005. Public financial support is provided for specific energy efficiency projects, but demand has actually been low because the processing of the subsidy application can take up to two years (Kahlenborn et al. 2010).

All national as well as ISO norms follow the widely applied "Plan-Do-Check-Act" management approach. The IEA identifies ten critical steps for successful planning, implementation, monitoring and evaluation of energy management systems in industry (IEA 2012).

Starting with voluntary, easy to implement measures that offer short payback periods is useful in those countries where awareness is low and resistance to investments and change is high. The gradual phase-in of more complex certification mechanisms and investments with longer amortisation rates is likely to be easier if small commitments have been taken and the technical skills and resources have been developed simultaneously. In several emerging economies, **voluntary agreements between industry and government** and/or **commitment incentives** such as energy saving awards have proven to be a useful first step. The industry agrees to targets and timelines for action, while government provides certainty on future regulation (IEA 2012).

Regardless of the policy process chosen, the access to the skills of experienced energy management consultants can be understood as a necessary, but not sufficient condition for more effective implementation of energy management systems and higher energy savings. Additionally, **linking energy management measures with other policies geared towards industry** while also addressing barriers particular to the local industry is likely to increase companies' acceptance. Here, an iterative exchange between public bodies and industry stakeholders that leads to joint learning over time is important. The **state has a stronger role in supporting expertise and skills development** from the start and giving financial incentives or support especially to mid-sized industry and SMEs than in industrialized countries. The **private sector drives energy benchmarking**. Companies and industry sectors in emerging economies have started comparing the energy performance of a product, facility or process to a similar one, for example in India's cement industry. Here, the integration into global value chains and the presence of transnational corporations is a relevant factor again.

Siemens India, for instance, set a new benchmark for industrial energy efficient motors in 2012. Voluntary benchmarking of energy consumption and energy auditing are incentivised in India by a financial support scheme as well as by the introduction of the mandatory "Performance, Achieve and Trade (PAT)"- Scheme. The PAT-Scheme is market-based mechanism that is linked to specific energy consumption reduction criteria for every type of industry plant (Chaudhary et al. 2012).

Box 2: Energy management system standards in China

Since the 1980s, China has been monitoring energy use in industry, but concrete interest in energy management systems in industry only started to rise in the early 2000s. In 1995, the government published a guideline for energy management in industry, which already indicated to industry that future regulation was to come. Following the introduction of the Energy Conservation Law in 2001, the government developed a comprehensive package of mandatory and voluntary policies and measures aimed at advancing energy efficiency and energy saving. The "Top 1000" energy savings agreement between key industry (Top 100 program) and government was voluntary when first introduced in 2006 and gradually extended to provincial and local levels. In 2012, it was made mandatory and expanded to the "Top 10 000". It requires companies to annually send their energy use stats to government and to meet national and international standards.

Additionally, a number of R&D support strategies for different business sectors and financial compensation for technical retrofitting and the phasing-out of small and inefficient industrial plants exists. The proper adoption of energy management systems can actually makes it easier for companies to comply with the different regulations and monitoring schemes. A differentiated energy pricing policy for industry has entered into force in 2012, offering lower electricity prices for more energy efficient enterprises. This presents a strong incentive for private sector investments in energy efficiency and compliance with energy management standards.

In the development phase of the national energy management standard, the national standardisation body played a strong role. The Ministry of Science and Technology, the National Development and Reform commission as well as several international experts, e.g. from the United States and the Asian Development bank, were involved. The integration of non-public stakeholders was limited.

The Top-10000 program and its combination with energy management systems helped to raise some awareness among provincial authorities and top-level management. But the implementation of is still challenged by a lack of understanding in non-Top 1000 companies, a lack of funding and adoptable technical means. Energy auditing capabilities also vary greatly throughout the country. The current regulatory challenge consists of extending incentives and requirements beyond the large, energy-intensive companies.

Overall, the policy package and path for phase-in chosen in China up to now is characterized consisted of a short phase of voluntary agreements and incentives, followed by comprehensive mandatory requirements for large industry. This shift from voluntary to mandatory is based on an assessment of the actual capabilities of leading industry to reduce energy intensity. Compared to other countries, China's policy process is clearly state-driven and puts more emphasis on mandatory regulation than voluntary and market incentives. Fiscal incentives are part or the broader energy efficiency policy package, but are not specifically tied to energy management system introduction.

Sources: Li et al. 2014; Zhou et al. 2012; Goldberg et al. 2011

4 Energy efficiency standards in buildings

4.1 Introduction

About one-third of global energy is consumed in residential, public, and commercial buildings where it is used for a variety of ends such as space heating, cooling, ventilation and cooking. Energy efficiency standards or building codes are globally recognized as an important instrument to achieve energy consumption reduction and to incentivise private investments and market development of energy efficient refurbishment and construction. In most industrialized countries, energy efficient building codes are mandatory for the construction of new buildings now. Often, phase-in is accompanied by a number of incentives and complementary measures to foster private investments and meet compliance challenges. In spite of existing regulation in many countries, energy efficiency in buildings, especially in older buildings that would need to be refurbished. The following market barriers for energy efficient buildings exist in industrialized and developing countries alike (Liu et al. 2010):

- issues with visibility and relevance of energy cost-benefit signals
- split incentives among key stakeholders (e.g. building owner – tenant)
- coordination among building sector's many stakeholders
- lack of information and knowledge (e.g. on buildings' energy performance)
- complexity of delivering more efficient buildings (more complex in enforcement than appliance standards, for example)

The amount of buildings in urban areas is expected to more than double by 2030. Given high pressures on energy security and mitigation of GHG emissions in developing countries, it is important that new buildings are constructed in a way that locking into unduly high life-cycle energy costs (World Bank 2008). Policymakers in developing countries face the additional challenge of having to enhance housing programmes for the poor, while also reducing illegal construction under budget constraints. Since tax compliance is often low in developing countries, gradually introducing energy efficiency standards for new buildings is the preferred policy option. This allows sufficient time for skills and technical capacities to develop, for example in the construction sector. Indeed, many emerging economies and developing countries have official energy efficiency standards for new buildings. However, many countries opt for voluntary standards or standards for non-residential buildings, while especially hot countries are lagging behind on introducing any kind of green building code or energy efficient building standard. In almost all emerging economies and developing countries, there is a significant gap between the initial development of standards and the actual implementation and compliance.

In developing countries, the political interest in energy efficient buildings may differ considerably depending on heating and cooling needs in the country and the place of energy efficiency within the political agenda (energy access vs. energy efficiency). Overall incentives to invest in energy efficiency may be low. The high cost of gathering reliable information on a building's energy performance; a lack of technical capacity with which to design, construct and maintain energy efficient buildings and limited access to financing are likely to be additional barriers in many developing countries.

The main stakeholder groups with possibly contradictory interests seeking to influence energy efficiency standards in buildings are the following:

- Owners/Landlords of buildings or apartments
- Tenants
- Property developers
- Construction sector
- Energy advisory services sector
- Energy agencies
- Political parties and administration on national, regional and local levels
- Supporting banks and donors

Investors or landlords do not benefit themselves from energy efficiency investments in their buildings, while tenants have no incentive to invest in the improvement of the building substance by themselves. These split incentives prevent basing investment decisions on life-cycle costs and, consequently, the realization of the benefits of energy efficiency investments.

The interests of the current construction sectors in many developing countries are unlikely to favour energy efficient buildings that require more complicated building-processes, more expensive materials and a range of technical skills and calculation capacities that many small and medium enterprises or craftsmen do not have yet. The construction and energy advisory sectors would need to be build-up over time with capacity building programmes, financial incentives to engage in the field and targeted job creation programmes.

The following section gives an overview of the main stakeholder groups and their interests, comparing and contrasting differences between Germany and developing countries.

4.2 Germany

In Germany, buildings account for around 40% of final energy consumption (heating, ventilation and warm water provision). Over 75% of the 18 million residential buildings in Germany are older than 30 years. The building sector is therefore an important part of German climate policy and key to achieving the country's energy efficiency reduction goal of 20% by 2020 and 50% by 2050. Only 40% of buildings are owner occupied (15 million units), while 14 million units are privately rented from small landlords and another 10 million units from commercial landlords and real estate companies. The vast majority of homes (75%) have been constructed before 1979, so before any energy efficiency regulation (Schröder et al. 2011). The legal maximum for rent increases is 11% in Germany, also after refurbishment. This may limit landlords' investments and tenants' contributions to them. Real estate companies owning a large number of buildings have a strong interest in regulatory certainty and potential benefits, e.g. through the market's reaction to energy labelling, before they start investing.

Germany's approach to tackling the general barriers to advancing energy efficiency in buildings has three tiers. The energy saving ordinance (Energieeinsparverordnung, EnEV), comprising the German building code, and the act on the promotion of renewables in the heat sector provide the regulatory framework. Subsidy programmes for the refurbishment and construction of new buildings by KfW and for heating with renewable (Marktanreizprogramm zur Nutzung erneuerbarer Energien im Wärmemarkt, MAP) provide financial incentives for the compliance with regulations and voluntary mechanisms. The third tier consists of market- and information based programmes such as the energy performance certificate (energy label). Germany has opted for a "whole house" approach to energy saving rather than targeting parts of buildings with different measures.

In 2011, the energy efficient refurbishment of existing buildings had regional value chain effects of 14 billion Euros and generated about 287 000 full time jobs (Weiß et al. 2014). Since 2006, 3.7 million dwellings could be refurbished or newly built in an energy efficient manner with an overall investment volume of 182 billion Euro. On average, every public Euro invested in KfW[5] subsidy programmes between 2006 and 2011 generated 10-12 Euros of private investment (KfW 2014, Weiß et al. 2014). Recent evidence suggests that the German regulatory approach impacts technology adoption in low quality housing, which induces improvements in the high quality segment where innovators the respond to market signals (El-Shagi et al. 2014). However, the rate of refurbishment has actually slowed down to less than 1% in 2013/4, giving rise to calls for a review of the incentive scheme.

The KfW subsidized loan programmes are strongly linked to the regulatory framework and the promotion of energy advisory services for building. The measures in the three pillars are designed to complement and mutually strengthen each other, while giving a clear, consistent message and assuring a high quality of standards introduced (Schimschar 203; Schröder et al, 2011). This was achieved by a high degree of collaboration between actors in the policy process, the integration of experimental pilot projects and accompanying research that fostered feedback and learning cycles, and the gradual tightening of requirements in all fields, drawing on lessons learned until then.

The first mandatory thermal insulation requirements were introduced in Germany in 1995 [6]and almost immediately accompanied by a KfW preferential loan programme in 1996.This first CO_2 Reduction Programme offered long-term low-interest loans with fixed interest rates to public and private investors in energy efficient retrofitting or insulation of buildings, for instance private owners as well as municipalities. KfW raised the funds for this programme on the financial market and passed the money on via commercial banks (Schröder et al. 2011).

The regulatory framework was expanded, while the national standardisation body DENA and KfW promoted model and experimental projects and commissioned research to accompany and evaluate running programmes. For example, DENA developed and tested the standards

[5] KfW is a major financial institution active on both national and international markets and currently functions both as an implementing agency for the German government and as an advocate for advancing energy efficiency in buildings at different governance levels.

[6] The first thermal insulation regulation was developed in 1977 already, but momentum towards mandatory standard-setting only developed in the 1990s.

for Low-Energy Houses (Niedrigenergiehaus) on 400 individual projects. KfW subsequently adopted these standards to support an additional 5,000 prototype buildings (Schröder et al. 2011: 35). The German energy saving ordinance was introduced in 2002, in line with the European directive on energy performance of buildings (also 2002). The German ordinance EnEV was revised and tightened in 2007, 2009 and 2013/14. The EnEV 2013 is the first that outlines a stepwise tightening of construction law to a carbon neutral standard by 2021 (El-Shagi 2014: 10). The European directive upgraded national standards in 2010 and now requires all new buildings to be as near as zero energy as possible, thus also paving the way for carbon neutral standards.

According to KfW buildings experts, strong lobbying at the European level was necessary before the regulatory space was created to introduce the kind of scheme Germany had envisioned. Since building is a site-specific issue, the mandate to regulate and/or control may differ between governance levels (supranational, national, regional), especially in federal systems like Germany. Actors with different interests may push or block at each level, delaying or completely stalling the process as is currently the case with the introduction of a tax incentive for building refurbishment (see below).

The German CO_2 Reduction Programme was superseded by the $C0_2$ refurbishments programme in 2004, which includes two subsidized loan schemes: the KfW programme for energy efficient refurbishment and the KfW programme for energy efficient new buildings.

Under the refurbishment programme, private home owners can opt for a grant of up to 25% of investments costs or a low-interest loan. It does not matter whether the building will be refurbished completely („KfW Effizienzhaus“) or step by step with different measures as long as the steps lead towards the “whole house standards”. The more energy efficient the building is after refurbishment, the higher the grant KfW gives to supporting repayment. There are currently five categories of efficient buildings (Effizienzhaus 55, 70, 85, 100, 115). These can be counted as a voluntary standard based on a calculation of energy consumption. They are staggered according to their energy consumption compared to a comparable new building, in line with the EnEV building code. For example, the refurbishment of a dwelling in line with "KfW-Effizienzhaus 55" means a 22,5% grant supporting repayment and a loan with 0.75% interest p.a. is available. KfW offers an additional grant if a certified energy expert accompanies the building process. Due to KfW’s programme, a separate DIN norm (DIN 18599) has been developed and introduced as standard calculation of building’s energy performance.

In the programme for energy efficient new buildings, only three categories of energy efficient buildings are supported: KfW Effizienzhaus 40 (receiving an additional 10% grant supporting loan repayment), Effizienzhaus 55 (receiving an additional 5% grant supporting repayment) and Effizienzhaus 70 (no grant; this indicates the tightening of standards). Low-interest loans for energy efficient refurbishment or buildings are also available for public buildings and some commercial buildings.

The KfW categories for refurbishment and new buildings cover the whole span of technically feasible options. Before introducing or adjusting the categories, KfW commissioned studies

and entered into dialogue with the building sector to assess what is technically feasible. The current categories for new buildings also reflect the substantial tightening of the building code by 30% in the 2009 revision of EnEV compared to the 2007 EnEV. Before potential beneficiaries can apply for a loan, the CO2 reduction of the planned measures must be certified by a qualified and registered energy adviser. The beneficiaries' local bank identifies the KfW programme and submits the loan application to KfW, which checks the technical requirements again before approval. The client enters into a contract with the local bank, not with KfW directly.

The German loan and subsidy programmes are not unconditional, but require either engagement with an energy advisor or, in case of loans for solar water heating, even an investments in energy efficiency already before loans and grants are paid out. In spite of the linking of regulation, information and financial support and a gradual tightening of standards based on feedback and learning processes, refurbishment rates have dropped in recent years.

Tax incentives are considered to be the most important incentive for energy efficiency investments in buildings among German households - especially younger people react more strongly to tax incentives than to preferential loans and subsidies (Brügelmann et al. 2011). KfW subsidies are therefore more geared towards the older population who have lived in their homes for decades already. The introduction of tax rebates for energy efficient building refurbishment and construction as an alternative path to loans and subsidies (without replacing these) is still being discussed.

4.3 Emerging economies

The major differences that exist between industrialized and developing countries are the differences in energy prices due to subsidies in many developing countries which exacerbate the split incentives between landlords and tenants, weaker governmental oversight of the building sector and generally lower levels of energy services and data available (e.g. no energy auditors or inspectors with sufficient training at local levels). Political interest and support of stakeholder groups may be lower due to a lack of awareness or a stronger interest to attain competing political goals.

A well established building supply chain including the development of indigenous supply of materials and components that keep costs down are required for greening the building supply chain (UNEP 2014). In many developing countries, the building supply chain is not fully understood yet. On the one end of the constructions sector, a vast variety of suppliers produces different parts of materials necessary for building (SMEs and larger companies, local and national or international). On the other end of the construction chain, a fragmented building market makes coordination extremely difficult. It consists of many small landlords, corporate property owners, project developers and different public housing authorities at local and regional level. Also, relying on private leadership to emerge and spread via benchmarking is unlikely to lead to sufficient momentum. Communication and diffusion of best practice

examples driven by private actors may need public support, e.g. by energy agencies or national award systems.

Moreover, experiences in countries such as India (see Box 3) show that not only initial political support for the topic, but persistence of regulating agencies over many years is essential. The development of positive market and stakeholder response and may be slower than expected, emphasizing the driving function of public actors and initiatives.

Before an efficient building standard is set, an extensive amount of data collection is required: a market analysis of technologies and materials available and their efficiency as well as data on the actual energy consumption of different types of buildings in potentially differing local climates is necessary. Stakeholder communication and involvement before a regulatory framework is set builds up trust between regulators and the building sector, makes the identification of barriers and capacity needs possible and in the end supports understanding and compliance with the standards. Accompanying the standard phase-in process with technical capacity programmes in the construction sector, particularly for SMEs, may be required. Here, a prior assessment of actual needs along the value chain according to the different type of standard chosen (prescriptive or performance-based) is useful. If a prescriptive standard is set, component manufacturers are more strongly targeted than architects and builders because the latter do not have a choice how to achieve the energy consumption target. For performance-based standards, architects and builders need to have a broad amount of knowledge about different construction possibilities, while manufacturers of components with a high savings potential (e.g. window and insulation materials) may be strongly called upon than others (e.g. cement, roofing). If performance-based standards are set, the user behaviour of the building also plays an important role. Here, public agencies and donors may need to additionally engage in awareness raising and knowledge transfer on the consequences of different behaviours for both energy bill and potential labelling of the home as an efficient building. According to the type of standard set, the energy auditing and advisory services need acquire the respective knowledge on the different options.

Overcoming general resistance to investments in energy efficiency of buildings due to split incentives and marginal returns on investment constitutes a significant barrier to successful phase-in processes. Financial support mechanisms such as preferential loan schemes, subsidies for the construction of efficient buildings and/or tax rebates are different options that need to be discussed among stakeholders in the respective local context. While tax incentives may work better for young people in Germany, loan schemes are more suitable for older homeowners – similar differences among stakeholder groups may exist in developing countries. Overcoming the split incentive problem in very fragmented buildings sectors with is likely to be a key challenge. In countries such as China, where property speculation in urban areas is strong, mandatory standard setting and strong control and compliance systems at an earlier stage of the phase-in process may be more useful than a more gradual shift that prepares the building sector over time. In most developing countries and emerging economies, standards in the end will need to be mandatory and a continuous effort to set-up control and compliance mechanisms will be necessary because fragmented, contradictory stakeholder interests are not easily overcome. An assessment of job creation potentials in local value

chains, including SMEs, may support the creation of political will at national, regional and local levels. Coupling the introduction of standards in public buildings with green procurement could also send a clear signal to the construction sector, creating strong job effects over time.

Gradual phase-in from awareness raising and voluntary standards is particularly useful in those countries where skill and technical capacities in the construction sectors are very low and/or the awareness levels of energy efficiency in buildings as a concept are low, for instance where expected investment returns on more efficient buildings are lower due to climatic conditions (e.g. pressure to insulate and reduce heating costs is higher in cold climates). Local authorities may decide to shift from voluntary to mandatory standards, as is the case in India, giving regulatory entities time and options to gear national codes to local contexts. A combination of different codes with flexible implementation is also possible. In China, separate codes for public and private buildings exist, adjusted to the different climatic zones. The codes are mandatory, but two options for compliance are given: a prescriptive path with specific regulations for individual components and a performance-based path that compares the overall en energy consumption of a new building to a reference building (Young 2014). For national standardisation bodies and other regulatory agencies involved in the policy process, it may be useful to communicate to stakeholders from the start that mandatory standards will follow at some point in the future. This indicates commitment to the topic and the necessity of stakeholders to engage with the topic.

Starting with implementation of energy efficient standards in buildings or more general green building codes in *new public buildings* could support awareness raising and decrease resistance if benefits of the new buildings are clearly visible and communicated to target groups. Some cities such as Seattle offer a fast-track option for building permits if the new building complies with the building code.

In sum, there is no clear guideline for the design of policy processes to foster energy efficiency in buildings in developing countries yet. Currently, regulators in different countries experiment with different types of standards and codes and processes for phase-in. The interests of different stakeholders as well as potential o-benefits of energy efficient buildings for job creation in local value chains, particularly SMEs, are important factors in the policy process. The choice of the type of standard, the sequencing and revision of standards over time, the development of a policy package with different support options targeted towards stakeholder groups as well as the concrete way of communication and integration of major interest groups all depend on the specific local context.

Box 3: Energy efficient buildings in India

The Indian Energy Conservation Building Conservation (ECBC) code was introduced in 2007 as a voluntary standard for commercial buildings. Extensive stakeholder consultations were held between the Bureau of Energy Efficiency (BEE) and other government departments, industry associations, architects and suppliers. As a result, it was decided to only target commercial and some public buildings such as hospitals for a start and leave the progression to mandatory standards and enforcement to the states to allow for some flexibility.

As of 2012, only two of 35 states in India have made the ECBC mandatory. Six others have initiated the amendment/notification process for mandating the Code. State and local governments, architects and developers still lack awareness, technical knowledge and resources to implement the ECBC. In many jurisdictions, the ECBC is not included in legal regulations yet, stalling implementation. Due to cost and complexity of implementation, state and local governments do not see energy efficient buildings as a priority.

The BEE aims to create a market pull-effect by developing the ECBC as a sort of brand that is recognized by the public. To do this, a star-rating programme has been introduced (1-5 stars; 5 is the most efficient) that label buildings in terms of the actual energy performance of the building. India has thus opted to introduce an outcome-based code.

This has been accompanied by a range of information and advertising initiatives as well as training programmes for technical staff, but implementation of the code on the ground still lags behind,.

Initially, the ECBC initiative was criticized for not providing any financial incentives to investors or home owners. Today, the combination of a regulation with a financial incentive in India mirrors German experiences, particularly in the type of loan offered. The National Housing Bank of India runs an "Energy-Efficient Homes" Programme for residential buildings, supported by a 50 million Euro credit from KfW. To be eligible for refinancing, apartments have to be at least 30% more energy efficient than a comparable benchmark building. A certificate is awarded upon achievement. The full amount of the line of credit had been disbursed by the end of 2013, contributing to 1900 individual home loan and 15 bigger construction projects.

India is currently considering the expansion of the ECBC to other building types and using specific performance metrics to enhance enforcement. International best practices are keenly surveyed and lessons learned adjusted to the Indian context. The comprehensive task of creating a market pull while also building the technical capacities and interest to implement and enforce building standards takes a lot of time and political persistence to achieve.

Sources: Alexeew et al. 2015; Yu et al. 2014; Evans et al. 2014; Chaudhary et al. 2012

5. Lessons learned and conclusions

This study discussed different types of energy efficiency standards and different phase-in processes, comparing and contrasting industrialized and developing countries. It has shown that the gradual implementation of energy efficiency standards in industry and buildings can create foster investments in climate mitigation along the value chain, create jobs and contribute to awareness raising on energy consumption and energy saving in different parts of society. The analysis has also shown that standards need to be phased in gradually due to lack of consumer awareness, veto players with vested interests, skills and technology gaps as well as a lack of strong compliance mechanisms in many developing countries. Since many emerging economies and developing countries are still experimenting with a combination of public and industry-driven standards, incentives and command and control approaches, it is

not possible to come to recommend one particular phase-in process that is suitable for every country or every sector. Approaches need be contextualized to country conditions and allow for policy learning. The degree of state intervention required depends on the awareness of stakeholders, the structure of the local market and the integration of companies into global value chains, for example. The interplay between national and regional or local political level can turn into a decisive intervening factor for the creation of the necessary political commitment and the dialogue between stakeholders in both standard-setting and implementation. National standardisation bodies and energy agencies fulfil a key role as bridging agencies that provide information, conduct the necessary ex ante analyses of the market and stakeholder analysis and potentially mediate the negotiation between industry and government. The following lessons learned can be drawn that are likely to apply to many developing countries:

- Continuous political commitment to the goal of energy efficiency is required irrespective of the type of standard or business sector targeted; perseverance to learn, redesign and enforce standards as well
- Functioning, strong standardisation bodies and energy agencies need to set up testing, control and compliance mechanisms adjusted to local market conditions
- The integration of industry and SME associations in the standard-setting process as well as review rounds over time supports targeted design, awareness and implementation while avoiding misunderstandings and requirements that cannot be fulfilled in the end
- Ex-ante analyses before standard is designed by the regulator are useful: on interests and needs of actors along the whole value chain; energy consumption of different technologies or building types; availability of technology on the market, skills and technological capacities required to innovate/change within a given time period; estimation of job creation and value chain effects (can help to create political and stakeholder support)
- Sequencing and revisions over time: Moving from voluntary to mandatory standards is often adequate to give industry time to adjust and innovate, but a mandatory standard with a functioning control and compliance system as a final goal should be envisioned and communicated in most cases to send clear signals. Regulatory certainty is important for all stakeholders. Revisions of the standards over time to allow for learning cycles and gradual tightening of regulations are necessary and should be planned for, regardless of the type of standard and phase-in model.
- Policy package: The phase-in of standards is likely to work best if it is embedded in a larger policy package that provides a) financial or fiscal incentives and/or support for investments e.g. through preferential loan schemes or tax rebates, b) regulatory certainty in control and compliance mechanisms and c) information and capacity building as required by different actor groups
- Buildings sector: Starting with mandatory standards for public buildings and voluntary ones for private new buildings and combining that with labeling scheme to inform buyers can be a useful start for phase-in. The choice for performance-based or prescriptive standards depends on the local technology available on the market and the

level of awareness/knowledge of builders, architects etc. Prescriptive codes may be simpler to implement because they usually target fewer, clearer stakeholder groups

- Industry sector: For standards and benchmarking initiatives started by the private sector, i.e. because of exposure to global standards and competitiveness, clear political support and the development of a policy and incentive package is required to support widespread diffusion. Certification schemes such as ISO norms may be combined with stronger mandatory targets over time and/or be required to continuous re-auditing or renewal after certain time periods

The enhancement of energy efficiency in both industrialized and developing countries often requires a combination of sticks (regulation, command and control instruments), carrots (fiscal incentive and financial support schemes) and a tambourine (review and gradual tightening of the policy package or certification schemes over time). This applies to energy efficiency standards as well, as this study has shown. Private investment in mitigation can be clearly fostered through the development and implementation of energy efficiency standards and the support of benchmarking and certification schemes in industry. If phase-in processes are gradual, context-sensitive, smartly combined with other policies and reviewed at regular intervals they are likely to contribute strongly to market transformation.

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