bigEE

Your guide to energy efficiency in buildings.

Energy efficiency policies for buildings

bigEE's recommended policy package, good practice examples and tips for policy design

Wuppertal Institute
for Climate, Environment
and Energy

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Introduction

Significant potential still exists for saving energy in buildings around the world. Energy use in Ultra-Low-Energy Buildings (ULEB) could be between 60 and 90% less compared to the prevailing conventional designs in many markets around the world. Despite enormous energy saving potential, market forces alone are not likely to achieve such saving potential.

Energy use in Ultra-Low-Energy Buildings can be 60 to 90% less.

This is because the value chain of the building sector is complex and includes a wide range of actors such as investors, building developers, equipment manufacturers, designers, property traders and builders, as well as endusers.

They all face numerous barriers despite the incentives in taking action towards higher energy efficiency. However, these barriers prevail all too often, resulting in much too little action and therefore, only a smaller part of the latent potential will be realised by markets alone. There is a need for a collaborative multi-stakeholder approach to energy efficiency in which policy-makers have an important role to drive change.

bigEE – Your guide to energy efficiency in buildings – is an international initiative that aims at assisting investors and policy-makers all over the world to make informed decisions on enhancing energy efficiency in buildings. bigEE's web-based knowledge platform provides a comprehensive source of information for policy-makers and investors from the private and public sectors when it comes to Best Available Technologies (BAT), energy saving potentials, net economic benefits, and good practice policies.

This bigEE brochure is designed to address the needs of policy-makers and their implementing agencies, as well as civil society stakeholders with respect to available cost-effective policy solutions for energy efficiency in buildings. It provides an overview of the economic, social, environmental and health benefits of energy efficiency in buildings, and explains the current barriers to energy efficiency in the building market together with the associated incentives for investors and policy-makers. At the core of this text are the policy packages that bigEE recommends for promoting energy efficiency in new buildings and the renovation of existing buildings, with examples from countries that have implemented similar packages in practice, together with some explanations on and examples for the individual policy instruments constituting the package. The two pages following this introduction will offer a glance at the recommended policy package. In the last chapter, the brochure provides a guide to designing and implementing an effective policy package.

Recommended policies at a glance

Figure 1 shows the components of the bigEE recommended policy package: as a framework, clear vision and targets for energy efficiency need to be established at the highest government level. This should be accompanied by allocating finance and resources for implementation of sectoral policies and addressing market imperfections simultaneously. At the sector-specific level, policy instruments such as regulations, incentives and financing and capacity building are important components of a comprehensive policy package for energy efficiency in buildings.

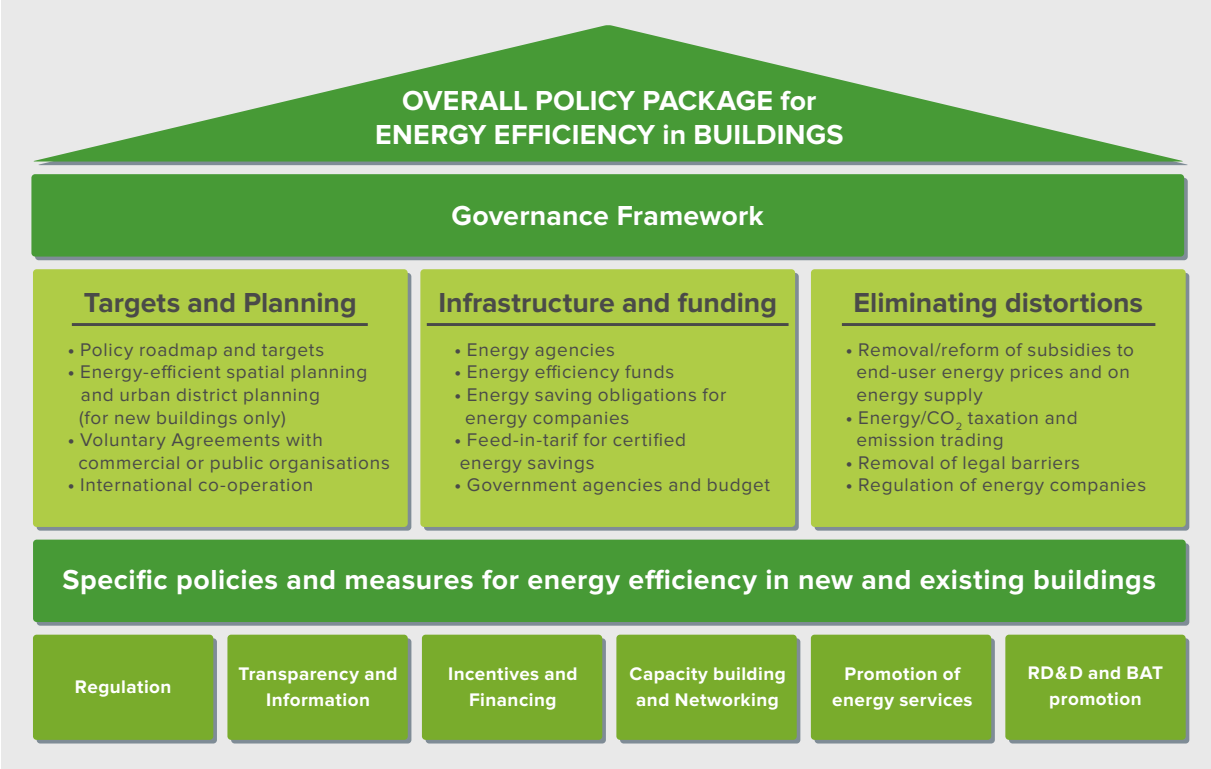

Figure 1: Components of the recommended policy package for energy efficiency in new buildings

Figure 2 and 3 show how the sector-specific policy instruments interact and reinforce each other to transform the markets for new and existing buildings respectively.

For new buildings, the task for policy-makers is to gradually move the market towards highest levels of energy performance, until finally Ultra-Low-Energy Buildings become the mainstream standard and Minimum energy performance standards (MEPS) can require this standard (Figure 2). For renovation and operation of existing buildings, the goal is two-fold: pave the way (1) for high energy savings in each retrofit and in operation (vertical axis in Figure 2), and (2) for increased rates of energy-efficient retrofit (horizontal axis in Figure 3). On this road, the different specific policies and measures in the package serve four main functions (bold headings to groups of policy instruments).

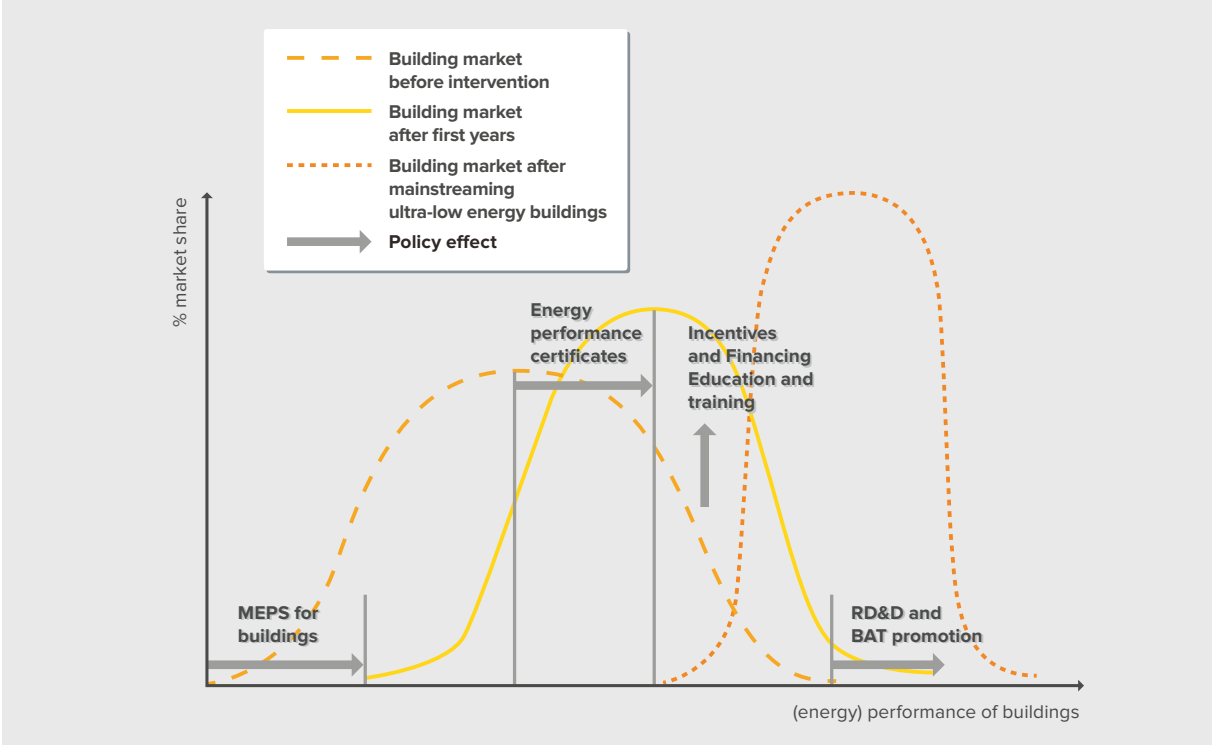

Figure 2: The interactions of policy instruments for energy efficiency in new buildings

Source: Wuppertal Institute (2012), adapted from Klinckenberg Consultants (2006)

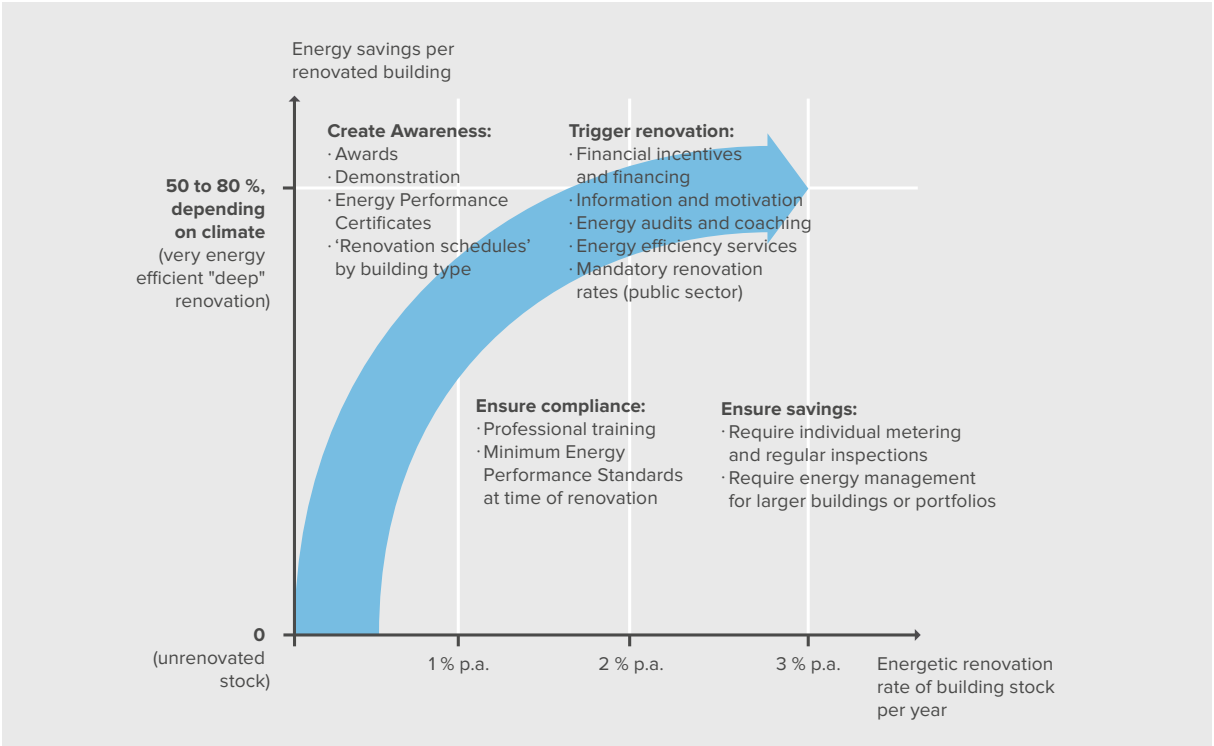

Figure 3: The interactions of policy instruments for energy efficiency in building renovation and operation

Source: Wuppertal Institute (2012)

For details on the bigEE initiative, energy efficiency solutions for new buildings and building retrofit as well as appliances, policy packages and instruments, and their respective good practice examples please visit the bigEE online platform **www.bigee.net**.

Table of contents

1 Energy efficiency in buildings

Energy efficiency in buildings is crucial for sustainable development, climate and resource protection and a low-risk worldwide energy system. Approximately 40% of global final energy demand and one third of the energy-related emissions are related to buildings (IEA 2008). Up to 90% of energy can be saved through energy efficiency in new buildings and in retrofits, and various co-benefits achieved at the same time. Yet, to make this happen, policy is needed to help the actors in the building value chain overcome their various barriers to harness energy efficiency and to strengthen their market-inherent incentives. The goal is to make energy efficiency as easy and attractive as possible, sometimes to make it feasible at all, and ultimately to make it the standard choice.

For improving the energy efficiency of buildings, we have to abandon the 'as-fast-and-cheap-as-possible' construction approach because it systematically ignores lifecycle costs and creates buildings that will be wasting enormous amounts of energy and money throughout their whole lifetime. Early and comprehensive use of energy efficiency design and technology can substantially reduce both energy use and emissions. In particular, in industrializing economies such as China and India, the soaring rates of new construction urgently call for a radical change in the way that buildings are designed and new properties are built.

The brochure is structured as follows:

- The first section outlines the available opportunities for energy efficiency in buildings, incentives for different actors to take steps for designing, buying, using and promoting energy-efficient buildings, and how policy-makers can mainstream Low-Energy Building technologies and solutions.
- The second section discusses the bigEE recommended policy package to achieve Low-Energy Buildings. It details the role of different policy measures in addressing different market actors with respect to barriers they face to improve energy efficiency in the building sector and finally provides examples of countries that have successfully combined policies in effective packages.
- Section three describes guidelines to design energy efficiency policies, set-up monitoring and evaluation systems and compliance regimes to ensure implementation of such policies.

1.1 The potential for energy savings is high

New Ultra-Low-Energy Buildings needing 60 to 90% less final energy for heating and cooling than conventional new buildings can be constructed cost-effectively in most parts of the world. Retrofitting existing buildings can bring similar improvements. Extensive energy-efficient renovation measures ("deep renovation") can achieve final energy savings of 50 to 90%. These can be profitable investments, too, if done as part of typical refurbishment cycles and if the energy costs savings during the life cycle are considered (GEA 2012).

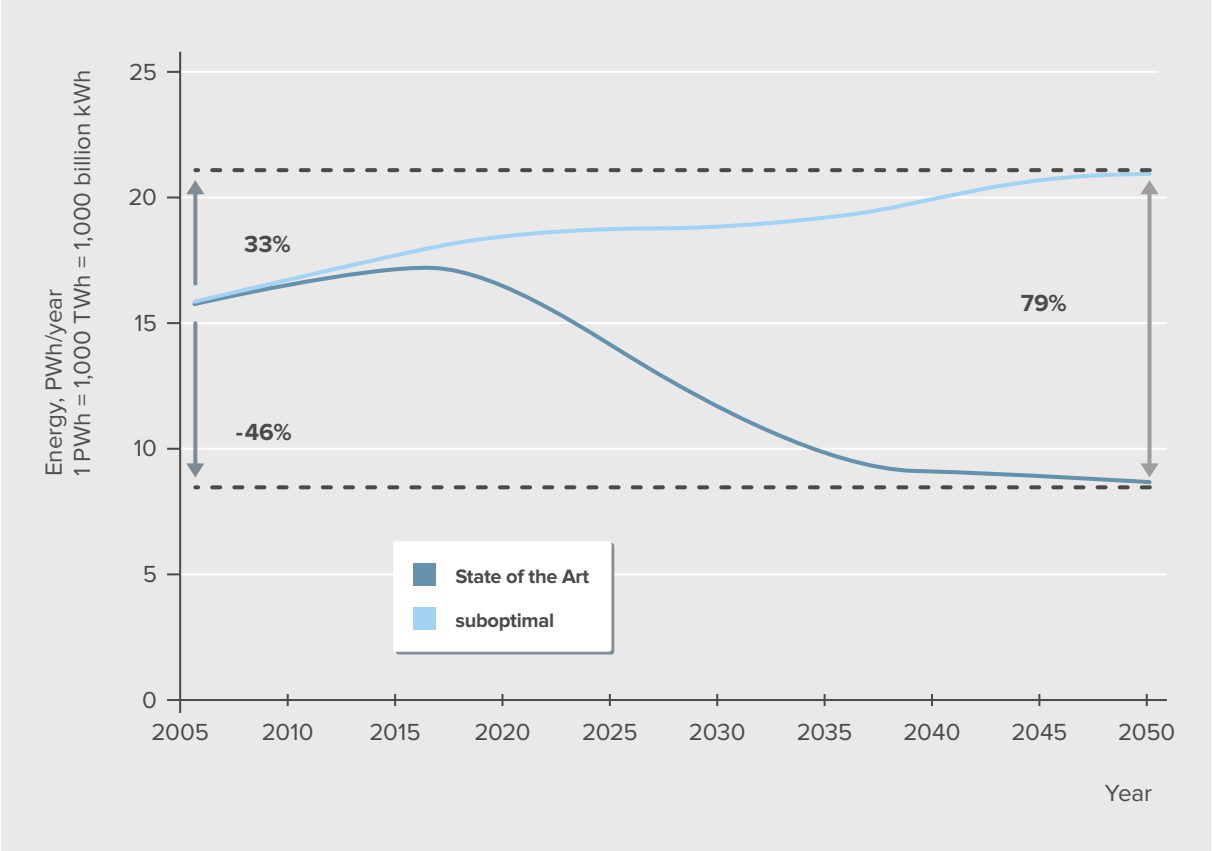

Figure 4: World space heating and cooling final energy use, 2005-2050, suboptimal and state-of-the-art energy efficiency scenario
Source: GEA (2012)

Most recent scenarios (GEA 2012, see Figure 4) show that state-of-the-art energy-efficient renovation and new build could result in worldwide overall energy savings of 46% in 2050 compared to 2005 or 60% of the energy consumption expected in 2050 for the suboptimal scenario, expressed in final energy demand for heating and cooling. Despite growth in the building stock, this translates into an absolute decrease in energy consumption from 15.7 PWh (15,700 TWh) in 2005 down to 8.5 PWh (8,500 TWh) in 2050. GEA (2012) estimated that the approximately US$57 trillion of cumulative energy cost savings until 2050 in avoided heating and cooling energy costs alone substantially exceed the estimated US$15 trillion investments that are needed to realize this pathway. Such a transition will only be achieved with early, comprehensive and systematic implementation of state-of-the art energy efficiency measures in design, construction and technology in both new and existing buildings.

These measures are urgently needed because policy that only encourages suboptimal improvements, e.g. energy savings of only 35%, will lead to considerable “lock-in” effects. Once renovated or built, it will not be cost-effective to further upgrade the energy efficiency of these buildings for several decades. In other words, inadequate action now means losing cost-effective opportunities for long-term investments, energy and carbon emission reductions. This scenario could lead to energy consumption for heating and cooling of 20.8 PWh in 2050 (i.e., an increase of 33%). Some “Business-as-usual” scenarios cited below even predict a doubling of worldwide greenhouse gas emissions from buildings by 2050.

Both paths are visualized in Figure 4, the state-of-the art scenario in dark blue (with “deep renovation” in existing buildings and Ultra-Low new nergy buildings) vs. the suboptimal development path in light blue. The overall difference in 2050 adds up to an implementation gap of 79% of the 2005 energy use or more than 12 PWh/year (12,000 TWh/year).

1.1.1 Regional differences

Looking at new build versus renovation, the priorities in terms of energy efficiency differ among the world regions. In Western Europe, North America and Pacific OECD, the focus should be on renovating the large existing building stock. New buildings are clearly the main challenge in Centrally Planned Asia, South Asia, Latin America, Middle East, Africa and Non-OECD Pacific Asia. These regions are characterised by high new construction rates and increasing energy demand for cooling. Only in Eastern Europe and the former Soviet Union is there similar potential for new and existing buildings (GEA 2012).

1.1.2 Building energy efficiency and climate change mitigation

Expressed in carbon emissions, the building sector, including electricity use, caused emissions of 8.6 gigatons (Gt) of in 2004 (IPCC 2007). Different projections calculate between 11.1 Gt and 14.3 Gt of carbon emissions in 2030. A survey of studies (IPCC 2007) shows that on a global scale, approximately 29% of the projected baseline carbon emissions can be reduced cost-effectively by 2020. In the long run, the IEA “Blue Map” Scenario in Figure 5 shows that out of the needed overall carbon emission reductions of 48 gigatons per year in 2050 for all sectors, 38% are attributed to the building sector (IEA 2008).

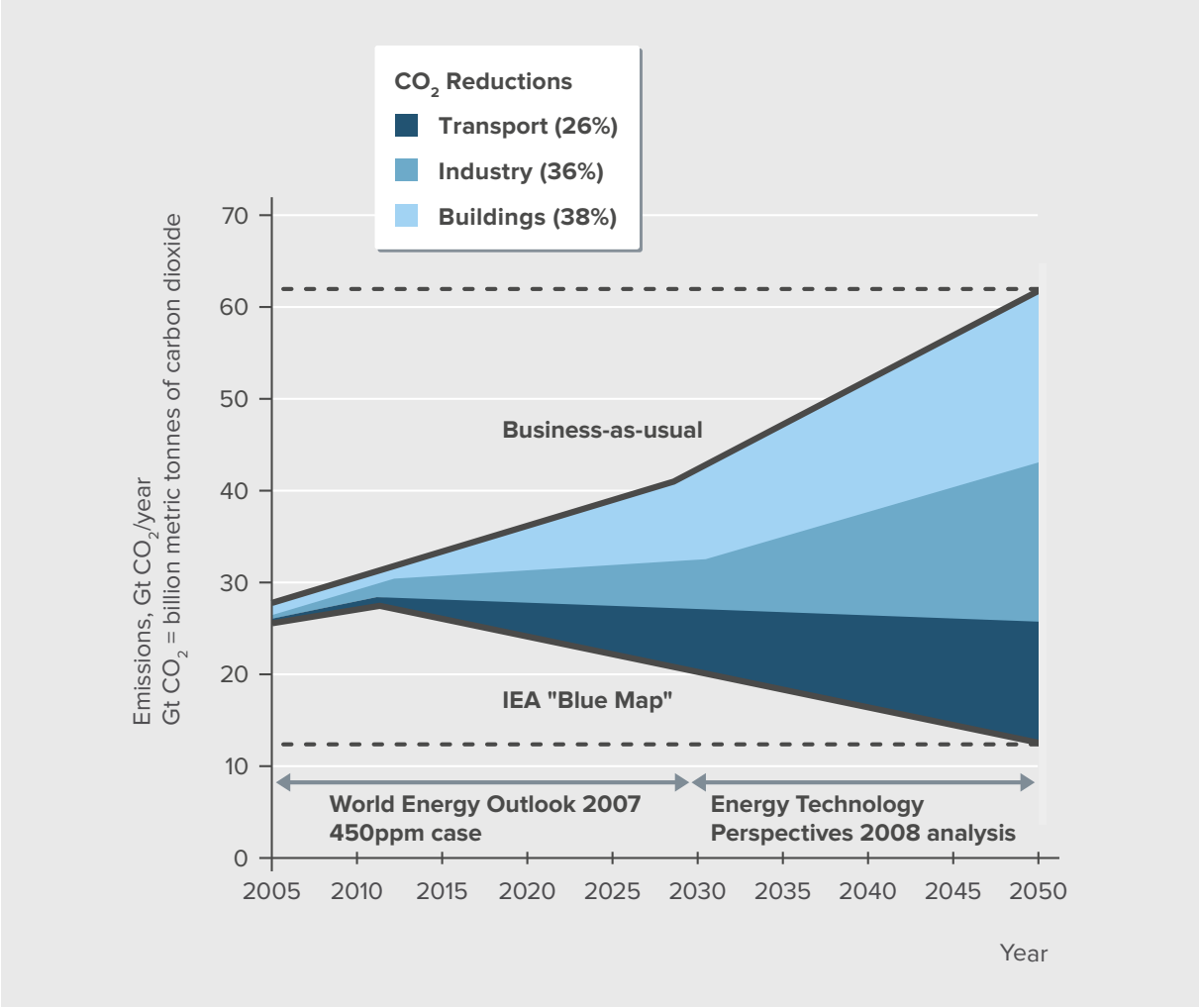

Figure 5: Carbon Emissions in the IEA Blue Map Scenario

Source: IEA (2008) as cited in WBCSD (2009)

1.2 Co-benefits of energy efficiency

Policy can not only tap into the cost-effective energy saving potential in the building sector but also achieve additional "co-benefits" by improving buildings' energy performance or by making appliances more energy-efficient. Such co-benefits may provide economic benefits in the same range as the direct energy cost savings (Jakob & Nutter 2003). The most interesting of these co-benefits are improvements in health, higher workers' productivity through better indoor climate and lighting, and higher living standards by making energy bills affordable. Co-benefits increase social and/or individual welfare and come as a free add-on to the direct benefits of energy efficiency for investors and policy, which are reduced energy costs and climate change mitigation. They also contribute e.g. to further primary goals of energy efficiency policy – improved competitiveness and security of energy supply – and to other policy goals such as employment. Consequently, the co-benefits provide strong additional incentives for governments and investors alike to strive for energy-efficiency. Making people aware of the nature and extent of the non-energy benefits is therefore an important task for energy efficiency policy.

Along these lines, it will be helpful to define, quantify and monetise as many of these benefits as possible so that governments and investors can factor them in when assessing costs and benefits of energy efficiency improvements. This would make the case for even more investments in energy efficiency improvements than are already now proven cost-effective.

Co-benefits of energy efficiency in buildings

Investors	• Higher price premium for energy-efficient buildings • Enhanced competitiveness of suppliers of energy efficiency solutions • Improved public image for companies that make their buildings state-of-the art in terms of energy efficiency • Improved productivity in commercial buildings and reduced sick leave times due to health and comfort benefits
National economy	• Increased energy security by reducing dependence on imports of depleting supplies of fossil fuels • Economic development in emerging economies like India and China by reducing energy demand
Society	• Poverty alleviation by using surplus energy to connect more areas to energy grid • Reduced dependence of low-income households on social benefits or subsidies on energy price • More jobs for skilled workers in new construction and building renovation and indirect jobs to meet demand of products and services created due to extra-money at users' disposal
Environment	• Contribution to mitigating climate change • Increased resource efficiency and reduced demolition waste of energy-efficiently designed buildings • Ecosystem protection, reduced pollution of outdoor air and related damage to soil, water and crops
Health	• Healthier, more comfortable indoor environment • Reduced noise and increased daylighting • Increased thermal control • As a result: Improved productivity and reduced sick leave times in commercial buildings

Table 1: Summary of co-benefits of energy efficiency in buildings

Read more in the bigEE file "Why policy needs to assist building and appliance markets to become energy-efficient": www.bigee.net/s/pri6uc

1.3 In need for a collaborative approach

To realise energy efficiency in the building sector, it is essential that all members of the complex value chain act in favour of energy-efficient designs and choices, or else the energy efficiency chain will break. Our advice to policy-makers is to analyse the situation in their country to devise which support market actors need. This is important before designing and implementing policies for energy-efficient buildings.

The actor constellation in the building sector: New construction of a building is an extremely complex process. In each of the three main phases of development, construction, and operation, there are several interlinked steps in the value chain that have to be co-ordinated. This process involves a large number of different market actors, the most relevant of which are architects, developers, financiers, builders, contractors, component suppliers, and last but not least investors, building owners, tenants, and individual users. In addition, there are also some actors that are not part of the value chain itself, but nevertheless play important roles in influencing market decisions, such as public authorities, energy agencies, and energy service companies (ESCOs) – to name just a few. Processes for energy-efficient building refurbishment are quite similar to new build and involve many of the same actors, although they normally exclude the tasks and actors of property development and sale or letting. Such renovation processes and actor constellations are thus almost as complex as those for new build.

Table 2 shows which actors are involved in the different steps of the value chain or have an influence on the value chain. These items should all be considered for a thorough analysis to prepare the creation of an appropriate policy package for energy efficiency in buildings.

Value chain links and corresponding actors

Property development	• Property development companies • (Social) Housing companies • Investor-occupier
Financing	• Banks • Equity funders • Public-private partnership (PPP) • Insurances • Property valuers
Design	• Architects • Engineering consultants
Component supply	• Component manufacturers • Wholesale and retail
Construction	• General management companies • Construction companies and contractors • Manufacturers of pre-fabricated houses
Installation of systems	• System suppliers • Installation contractors

Value chain links and corresponding actors	
Sale/Letting	• Property development companies (as sellers or landlords) • Manufacturers of pre-fabricated houses • Housing corporations • Real estate agents • Landlords/landladies • Buyers, tenants
Commissioning	• Commissioning providers • Engineering consultants • Facility managers
Operation/Use	• Investor-occupiers (as developers or as buyers of completed buildings) • Landlords/landladies • Tenants • Employees, customers, visitors, guests etc. • Facility managers
Influencing factors and corresponding actors	
Governance framework **Regulation Incentives**	• National/local authorities • Building Permission Authorities • Energy agencies
Advice and research	• Consumer organisations • Science • NGOs
Supply of Energy Efficiency Services	• ESCOs • Energy agencies • Energy consultants/assessors

Table 2: Actor constellations in the building sector

1.4 Barriers and incentives

All members of the building value chain have their specific barriers but also immanent incentives for harnessing energy efficiency. Too often, however, barriers are stronger than incentives. This is why policy-makers should analyse the situation in their country to devise which support market actors need to overcome barriers and strengthen incentives.

Many studies have shown that even in spite of their cost-effectiveness, most possible energy savings are not realised by market forces alone, because of a variety of barriers and market failures. These obstacles are especially powerful and persistent in the building sector because of its complexity and the multitude of actors involved in it. Many different actors have to work together for an optimal outcome.

By knowing the barriers and incentives of each type of actor, the policy package can be adapted to guarantee desired results and achieve the greatest possible energy savings. Table 3 lists common barriers and incentives for the actors in the building value chain.

Barriers

Economic/financial barriers
- Capital constraints and risk-averseness of value chain actors in the building sector

Knowledge/information barriers
- Lack of awareness of the energy saving options on the part of both building users and financiers

Lack of interest and motivation for energy efficiency improvement
- Low and unrealistic energy prices decrease motivation of majority of actors to reduce energy costs
- High transaction cost of accessing information about energy efficiency solutions decreases actors' motivation to invest in energy efficiency

The landlord-tenant, developer-buyer or investor-user dilemma
- Investor-use dilemma where investor in building energy efficiency may be actual beneficiary of the savings that will occur. For example a building owner normally is the one who has to pay for the thermal insulation while it is his or her tenant whose energy bills are reduced.

Technical barriers
- Solutions to energy efficiency may not be available yet or there may be uncertainties whether the new technologies will perform reliably

Market distortions and regulatory barriers
- Subsidised energy prices and lack of inclusion of externalities will distort energy prices and disguise the true value of energy efficiency

Incentives

Saved energy costs
- This will be an important incentive for investing in energy efficiency improvements, unless there are split incentives

Co-benefits
- Health and comfort increases due to improved indoor climate, productivity gains in commercial properties due to better lighting and noise reduction are just some of the many positive side effects

Directly increased earnings or profits for suppliers
- The price premium and additional investment in energy efficiency increase turnover and profits for the suppliers

Unique selling proposition for suppliers
- This is a strategic benefit. It can lead to competitive advantages or even market leadership with increased profits

Improved reputation
- End-users as well as the environment benefit from energy-efficient solutions: They serve to underpin a company's Corporate Social Responsibility (CSR) goals, which also yields competitive advantages

Contribution to protecting the environment
- This may be an intrinsic motivation for any actor

Higher occupancy rates and market value of the property
- If the total rent (basic rent plus energy costs) is lower for energy-efficient buildings, it may be easier to find tenants

Table 3: Barriers and Incentives for the Building Sector Value Chain Members

1.5 The role of policy

Energy-efficient buildings already exist in many countries. The technologies and the design know-how to cost-effectively build them are also available – what is still lacking is their wider dissemination. Given the high energy-saving potential and co-benefits presented above, the challenge is for policy and market actors together to transform the building sectors in a way that efficient buildings will no longer be an exception but become the standard choice of market actors.

As we have seen, policy is needed to help the various actors overcome their respective barriers to harness energy efficiency and to strengthen their market-inherent incentives. The goal is to make energy efficiency as easy and attractive as possible, sometimes to make it feasible at all, and ultimately to make it the standard choice.

Having identified all relevant actors and their specific barriers the question is: How can policy assist market actors to overcome these barriers and how can policy strengthen their immanent incentives? The following chapter presents our findings on possible answers.

Read more in the bigEE file "Why policy needs to assist building and appliance markets to become energy-efficient":
www.bigee.net/s/pri6uc

2 Recommended policy package for energy efficiency in new buildings and renovation

Looking at the potential energy savings in new build and the many benefits they bring (cf. chapter 1), the goal for policy-makers should be to **make Ultra-Low-Energy Buildings (ULEB) the mainstream standard.** For renovation and operation of existing buildings, the goal is two-fold: **pave the way for high energy savings in each retrofit and in operation, and for increased rates of energy-efficient retrofit.** To achieve these goals, all actors in the complex building value chain with their specific barriers and incentives need to be reached through policy. This requires a well-combined set of policies and measures reflecting the national circumstances. Case studies from experienced countries confirm the bigEE recommended policy package.

As we have seen, value chains in the building sector are long and complex. Actors as diverse as property developers, financiers, contractors, building designers and architects, component suppliers, investors, owners and users/tenants all have inherent incentives to improve the energy efficiency of buildings. But they also face strong barriers to take steps for efficient buildings themselves. It is important for governments in each country to analyse the building sector value chains and specific barriers and incentives inherent to each actor before designing and implementing policies for energy-efficient buildings. As described above, these policies are needed to correct market distortions and reduce transaction costs for actors to access the information about available technologies and solutions for energy efficiency. A governance framework is required to provide an overarching structure to co-ordinate and implement energy efficiency policies and measures and manage their inter-relationships. Experience from advanced countries and an analysis of market barriers show that several instruments will need to interact and reinforce each other in a comprehensive policy package. Every policy or measure has its own function in the package, its advantages, target groups and specific operational mechanisms. Each is tailored to overcome one or a few certain market barriers and to strengthen the actor-specific incentives, but none can address all of these barriers and incentives. Therefore, the impact of well-combined policies is often larger than the sum of the individual expected impact (IEA 2005).

Make Ultra-Low-Energy Buildings (ULEB) the mainstream standard.

Different policies addressing the demand- and supply-side actors of markets should be properly combined according to national circumstances. This does not mean that governments seeking to improve the energy efficiency have to implement all possible policies in order to be successful, but they should combine a selection of instruments tackling the most important market barriers. As successful countries have demonstrated, a comprehensive and coherent policy package for energy efficiency in buildings will usually provide a sound balance between clear mandatory measures, incentives, information and capacity building or in other words, ‘the sticks, the carrots, and the tambourines’.

In our recommended package, bigEE distinguishes between the set of specific policies and measures for energy efficiency in buildings and the common Governance Framework policies needed to guide and enable the former, shown in Figure 6.

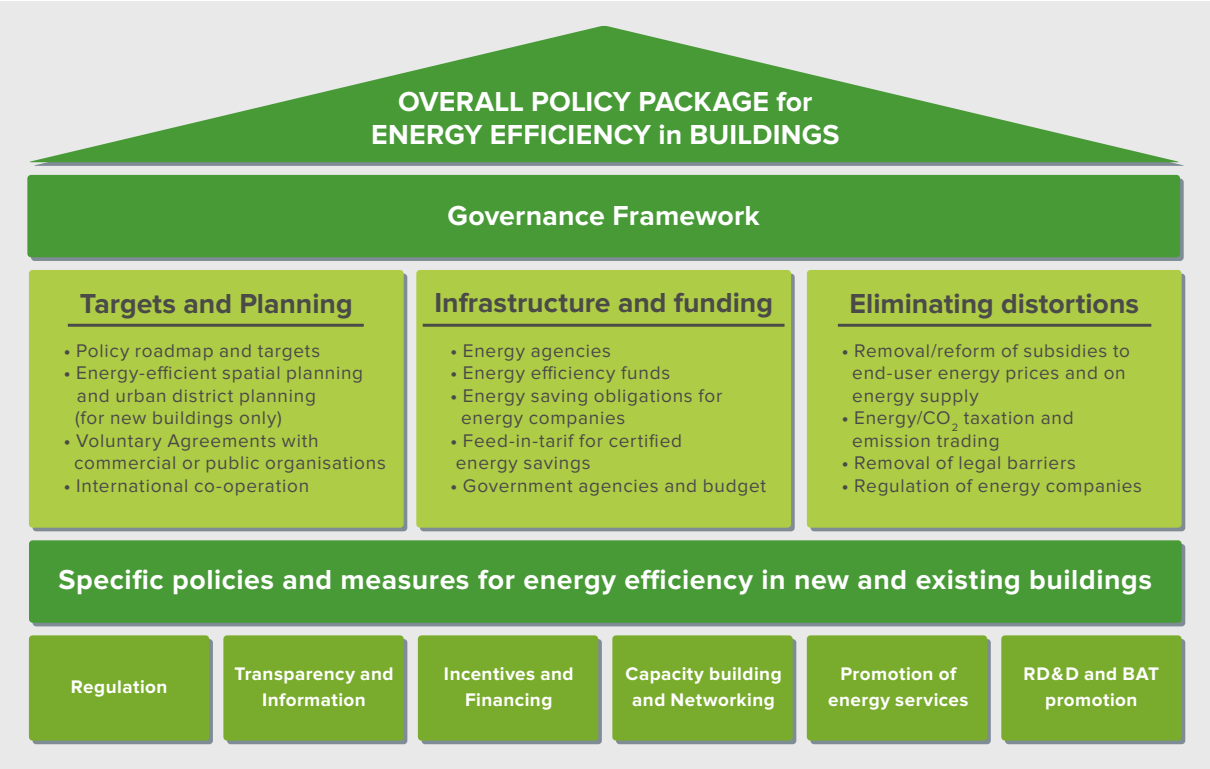

Figure 6: The bigEE recommended policy package

2.1 Interaction between building-specific elements of policy package

To achieve the goal of making Ultra-Low-Energy Buildings (ULEB) the mainstream standard in new buildings we need to combine a variety of policy instruments and implement them as a package.

Figure 7 and the following text present the policy instruments we recommend to combine in a package for achieving this aim.

- Mandatory **minimum energy performance standards (MEPS)** for all new buildings (and building components where useful) are the most important policy for energy efficiency in new buildings. They should be created by law and then strengthened step by step every three to five years, to finally require energy efficiency levels equivalent to ULEB. MEPS reduce transaction costs as well as the landlord-tenant and developer-buyer dilemma by removing the least energy-efficient building practices and concepts from the market.

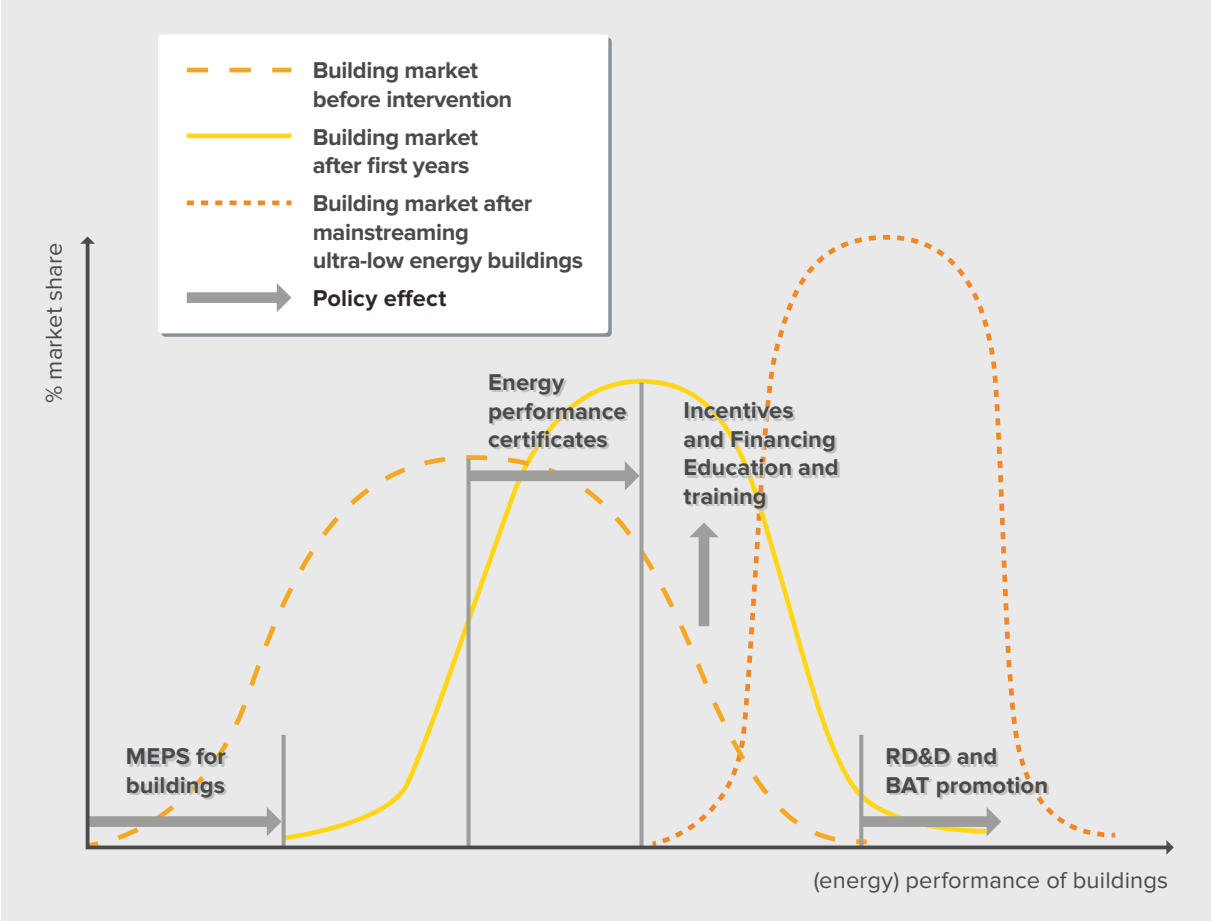

Figure 7: : The interactions of policy instruments for energy efficiency in new buildings

Source: Wuppertal Institute (2012), adapted from Klinckenberg Consultants (2006)

They should, however, always be at least as stringent as the energy performance level leading to least life-cycle costs. In order to be effective, compliance with MEPS must be controlled at the local level in both the design stage and after construction. In a transition period before a law can make MEPS mandatory, a voluntary standard may help. Especially in developing countries, it may be useful to combine such voluntary or even the introduction of mandatory MEPS with financial incentives or financing for meeting the MEPS requirements, at least for poorer households (Iwaro and Mwasha 2010). Preferably, **other statutory requirements** such as individual metering, energy management for larger buildings and building portfolios, or regular inspections of heating, ventilation, and air conditioning systems would complement the legal framework.

- **Education and training** of building professionals (architects, planners, developers, builders, building and installation contractors, financiers and other relevant market actors) is essential to prepare introduction and further strengthening of MEPS regulation up to ULEB. Easy-to-use tools for energy-efficient building design and for life-cycle cost calculation are important for the training. **Certification** of successful participation to the training can make it more attractive for both the qualified market actors and their customers.

- The markets should, furthermore, be prepared for the next step(s) of MEPS regulation towards ULEB through policies tackling the substantial information deficits and financing barriers. These include building **energy performance certificates** (and energy labels for components where useful), **showcasing** of demonstrated good practice buildings, **advice** and **financing support** for investors, and **financial incentives** – such as grants and tax incentives – for broad market introduction of ULEB. It is mainly for such information and financial programmes that energy efficiency funds or energy companies must contribute.

Promotion of energy services for energy savings and voluntary agreements with large developers to build more energy-efficiently than required by MEPS may also support market breakthrough.

- Once a certain market share of (Ultra-) Low-Energy Buildings of a specific energy performance level is reached, the professionals are trained and used to the required practices, and the cost-effectiveness of this energy performance level step is proven, this level can then be mandated by the regulation to become the new MEPS level. This would be one step of MEPS regulation towards ULEB in new build.

- Future steps of MEPS regulation towards ULEB should be prepared by innovation support through **R&D funding, demonstration** (including in public buildings), award competitions, and maybe also already by financial incentives for broad market introduction. The **public sector** should **lead by example** through energy-efficient public procurement and ambitious targets for its own buildings, thereby paving the way for the other sectors to follow.

The **existing building stock** provides larger potential for cost-effective energy savings than new construction. It is also the bigger challenge to retrofit the walls, roofs, windows, and heating and cooling systems of existing buildings to highest energy performance levels in an integrated way. The operational goal for energy efficiency in existing buildings thus has two dimensions:

- **Achieving very energy-efficient and comprehensive, "deep" retrofits whenever a building is renovated**, and **increasing the rate at which buildings undergo such "deep" energetic renovations**.

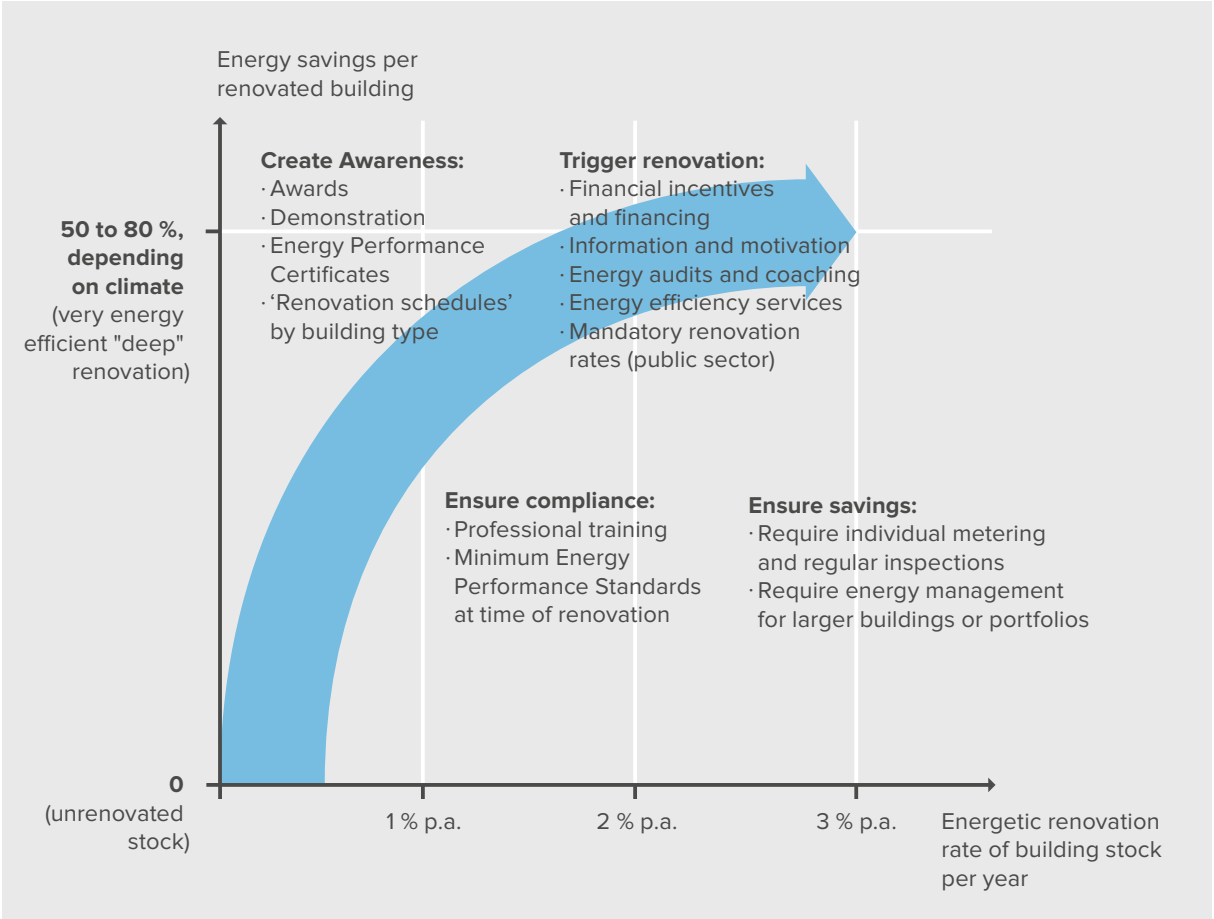

Figure 8: The interactions of policy instruments for energy efficiency in building renovation and operation

Source: Wuppertal Institute (2012)

Figure 8 and the following text present the recommended combination of policy instruments for achieving this two-dimensional goal.

- Every year, many existing buildings undergo renovation for maintenance or beautification anyway. These opportunities should be harnessed to improve energy efficiency by adding thermal insulation or shading and using more energy-efficient windows, heating, and cooling systems, instead of just replacing paint, tyles, or windows as they were before. The reason for this recommendation is that it is very often cost-effective to add the incremental energy efficiency investment at the time of renovation but not cost-effective to repay the full renovation cost from energy savings. Renovation without improving energy efficiency therefore means a lost opportunity and will likely lock in high energy consumption until the next renovation.

- Mandatory **minimum energy performance standards (MEPS)** for existing buildings undergoing major renovation (e.g. more than 10 or 20% of the building shell or of the walls, windows, or roofs) as well as for building components and heating and cooling systems are therefore an important policy for energy efficiency in existing buildings, too. They should be created by law and then strengthened step by step every three to five years, to finally require energy efficiency levels equivalent or close to ULEB also for existing buildings when the technology is mature and cost-effective enough. MEPS reduce transaction costs as well as the landlord-tenant and seller-buyer dilemmata by removing the least energy-efficient building practices and components from the market. They should, however, always be at least as stringent as the energy performance level leading to least life-cycle costs. In order to be effective, compliance with MEPS must be controlled at the local level in cases of major renovation. In a transition period before a law can make MEPS mandatory, a voluntary standard may help. However, for existing buildings it is much more important to accompany MEPS with individual advice as well as financial incentives or financing for meeting the MEPS requirements, since otherwise building owners may wait with major renovation. A possibility may be to mandate the rate at which the portfolio of large building owners has to undergo energy-efficient renovation each year, as the European Union has recently decided for national government buildings in its Member States.

- Preferably, **other statutory requirements** such as individual metering, energy management for larger buildings and building portfolios, or regular inspections of heating, ventilation, and air conditioning systems would complement the legal framework to ensure energy-efficient operation of buildings.

- The most important policies and measures for energy efficiency in existing buildings are those tackling the substantial information deficits and financing barriers, in order to first move markets towards very energy-efficient retrofit levels („deep renovation“) and then to trigger energy-efficient renovation at all, to increase retrofit rates.

- These instruments include building **energy performance certificates** (and energy labels for components where useful) with mandatory display upon advertisement, rental or sale, **showcasing** of demonstrated good practice building renovations, and **award competitions** for very energy-efficient renovations, combined with **information and motivation programmes** to disseminate the results, to raise awareness for energy efficiency opportunities in renovation and to develop more energy-efficient and cost-effective technologies and concepts for building renovation. In addition to these instruments, **individual advice**, such as **energy audits** need to show building owners what they (or their tenants) can save and what is cost-effective, and **coaching** can be essential to assist investors in implementing the retrofits. Still, due to long pay-back times and/or lack of finance, **financing support** for investors, and **financial incentives** – such as grants and tax incentives – for broad market breakthrough of very energy-efficient retrofits. It is mainly for such information and financial programmes that energy efficiency funds or energy companies must contribute. Promotion of **energy efficiency services** for guaranteed energy savings and voluntary agreements with large developers to renovate energy-efficiently at an increased rate may also support market breakthrough.

- Only all of these instruments together are likely to achieve the double goal of very energy-efficient retrofits at increased rates.

- In addition, there must also be a sufficient number of skilled providers willing and able to perform the energy-efficient renovation tasks. **Education and training** of building professionals (architects, planners, portfolio managers, builders, building and installation contractors, financiers and other relevant market actors) is essential to increase renovation rates and ensure high quality and very energy-efficient retrofit. Easy-to-use **tools** for energy-efficient building design and for life-cycle cost calculation are important for the training. **Certification** of successful participation to the training can make it more attractive for both the qualified market actors and their customers.

- Once a certain market share of retrofits to a specific energy performance level is reached, the professionals are trained and used to the required practices, and the cost-effectiveness of this energy performance level step is proven, this level can then be mandated by the regulation to become the new MEPS level for major renovations. This would be one step of MEPS regulation towards energy efficiency levels equivalent or close to ULEB in existing buildings.

- Future steps of MEPS regulation towards energy efficiency levels equivalent or close to ULEB should be prepared by innovation support through **R&D funding, demonstration** (including in public buildings), **award competitions**, and maybe also already by financial incentives for broad market introduction. The **public sector** should **lead by example** through very energy-efficient renovations and ambitious energy savings targets for its own buildings, thereby paving the way for the other sectors to follow.

2.1.1 Good practice examples of policy packages

This section consists of case studies from California (United States), Tunisia and Denmark. The case studies demonstrate the experience of these countries in designing and implementing the policy package for energy efficiency in buildings. Many instruments these countries combine target new build, retrofit, and operation alike, so the packages are presented in an integrated way here. Policy-makers from other countries can learn from the experiences of these countries and adapt policy packages according to their national circumstances.

2.1.1.1 California's (United States) policy package for energy efficiency in buildings

California uses a co-ordinated package of measures in order to improve energy efficiency in new and existing buildings. Under the umbrella of a Long Term Energy Efficiency Strategic Plan, Minimum Energy Performance Standards (MEPS), financial incentive programmes and information and motivation campaigns are interacting. As a consequence, per capita electricity consumption has remained stable in California since the 1970s, while it increased from 8,000 to 12,000 kWh/yr on average all over the USA.

The energy and cost savings recorded between 1975 and 2003 cumulate to 40,000 GWh/yr in electricity, which is about 15% of California's current electricity use, 12,000 MW in peak demand and US$ 56 billion in monetary savings achieved. About half of this is due to energy efficiency programmes targeting all sectors but mainly energy efficiency in buildings, the other half being divided almost equally between MEPS standards for buildings and appliances (Figure 9).

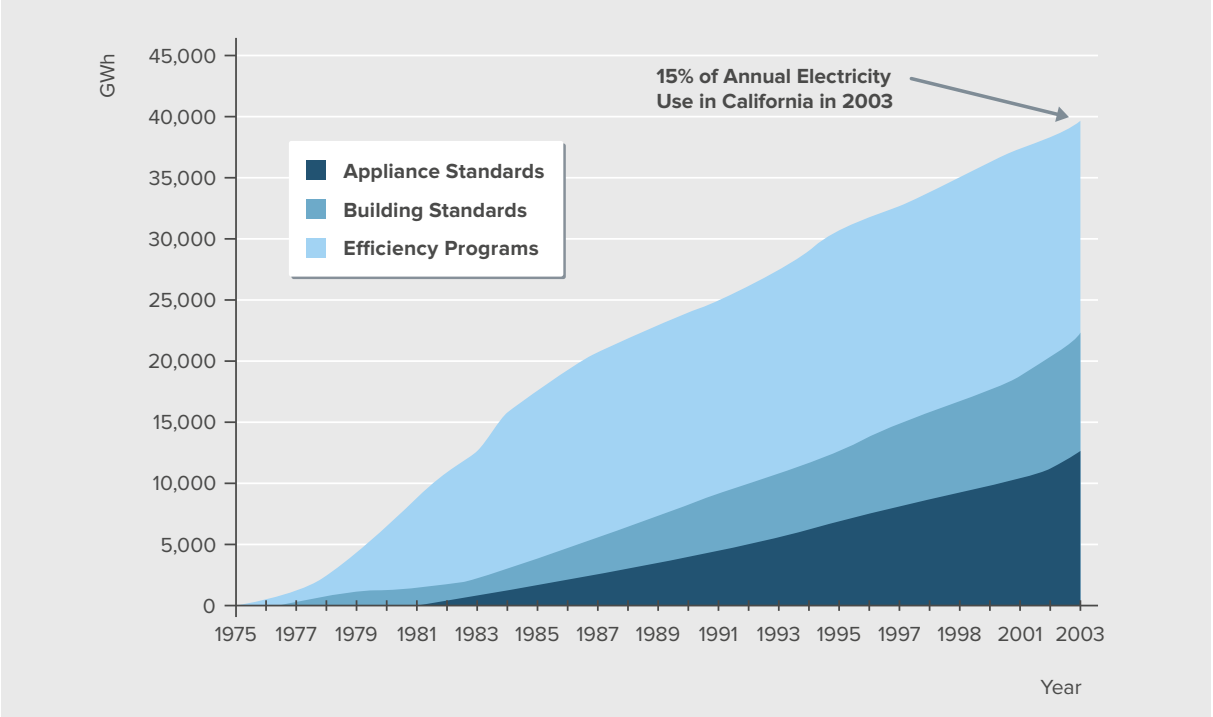

Figure 9: Cumulative Energy Savings of California Standards and Energy Efficiency Programmes in GWh/yr
Source: Wuppertal Institute (2012b), adapted from Desmond et al. (2005), p. 7.

Governance framework and measures for both new and existing buildings
Regarding new buildings, California wants to have net zero energy homes by 2020 and net zero energy commercial buildings by 2030.

One of the most important measures are Minimum Energy Performance Standards (MEPS) for new and existing buildings (Title 24, CBSC 2010), which were introduced in 1978 and have been revised regularly. Between 2003 and 2013, California expects a further US$ 23 billion to be saved through the improvement of the building codes.

In order to promote buildings that exceed the minimum requirements, Californian investor-owned and also municipal energy companies offer incentive programmes for energy-efficient refurbishment of existing buildings, but also for new construction. For new buildings, they make use of the well-established nationwide Energy Star® label for new homes, while they offer free design assistance for new non-residential buildings in order to achieve maximum energy savings from the very beginning. Due to the larger potential of refurbishment (as there is not much new construction), most of the money is invested in the existing buildings market. Financial incentives for energy efficiency measures are funded via the Public Goods Charge levied on the electricity and gas prices. It is collected and used by the utility companies to fulfil their obligations to help their customers save energy, while achieving net economic benefits for society and the customers. Since 1976, more than US$ 5.6 billion has been invested in electricity and natural gas savings in buildings. The California Public Utilities Commission regulates the activities of the investor-owned utility companies. Municipal utilities also implement strong energy efficiency programmes.

These measures are complemented through information activities such as, for instance, “Flex Your Power“, which is a „state-wide energy efficiency marketing and outreach campaign”. The campaign website provides comprehensive information about energy efficiency measures in California and customers can find incentive programmes suited to their needs.

Read more on California’s policy package for energy efficiency in buildings in the bigEE Policy Guide:
www.bigee.net/s/kk2kgk

2.1.1.2 Tunisia's policy package for energy efficiency in buildings

Tunisia puts a lot of effort in its energy efficiency programmes for buildings – not least because economic growth and increasing prosperity, placing the country with an HDI score of 0.683 "at the lower end of the highly developed countries (HDI>0.677)" (BTI 2012, p. 26), have resulted in overloading Tunisia's electricity grid in recent years (GTZ 2009, p. 296). Due to insufficient natural resources, energy imports are increasing since 2000. In Tunisia, the (residential and tertiary) buildings sector is growing to be the biggest energy consumer having been the third largest in 2010 (26%; transportation sector: 31%; industrial sector: 36% (FFEM et al. 2010, p. 7) and in industry 60% of energy is used for building materials. Since 1975, Tunisia's housing stock has increased by 3%/yr from 1 million in 1975 to 2.5 million dwellings in 2010. The main element of the Tunisian policy package is a MEPS and labelling programme for new buildings and extensions to existing buildings. According to the Quadrennial plan, which runs from 2008-2011, 400,000 toe/yr can be saved in the buildings sector. With an energy use of 9,200 ktoe in 2009 (World Bank 2012) this is about 4.5% of the current energy consumption in Tunisia's buildings. Further measures include obligations for large energy consumers to undertake energy audits; information campaigns; financial incentives; capacity building for, and cooperation with architects, engineers, and consultants in order to support builders throughout the construction process; and demonstration buildings, which are supposed to show the possibilities and benefits of energy-efficient construction.

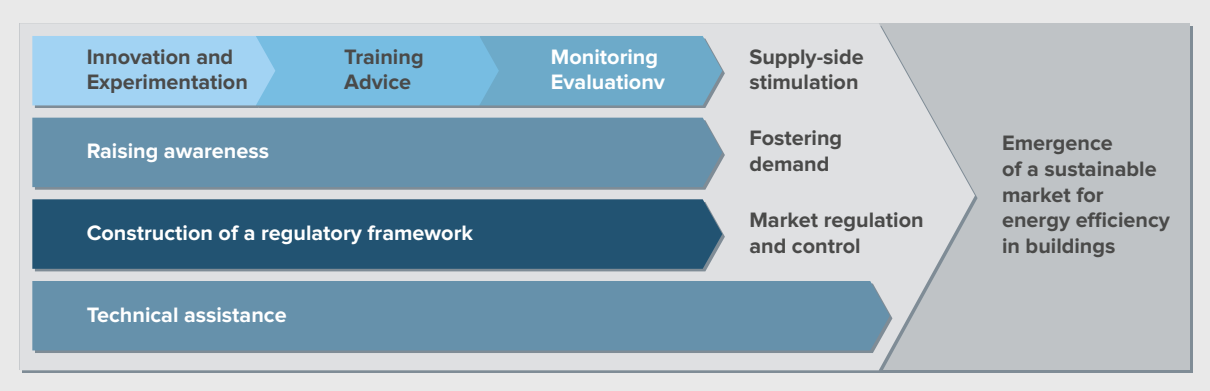

Figure 10: Tunisian building energy policy package

Source: FEEM et al. (2010); Saheb (2012), p. 6.

There is a National Energy Fund (FNME), which provides financial incentives for energy efficiency and renewable energy. Further investors like banks and GEF (Global Environment Facility) accompany the financial measures. Capacity building is a further measure, which includes training activities for construction techniques, an e-learning programme, and tools to assist building professionals to design more efficient buildings.

Read more on Tunisia's policy package for energy efficiency in buildings in the bigEE Policy Guide:
www.bigee.net/s/nvazgv

2.1.1.3 Denmark's policy package for energy efficiency in buildings

Denmark pursues high targets with regard to the future use of energy. According to the "Energy Strategy 2050", which was adopted in 2011, this policy of energy efficiency improvements, also and particularly for existing buildings, will be further pursued. This will contribute to the overall aim of the strategy to be independent from fossil fuels by 2050. And energy efficiency in buildings is crucial: Although e.g. the energy efficiency of households was improved between 1990 and 2008 by almost 16% (Odyssee & MURE 2011), the buildings sector is still one of the greatest energy consumers in the country. In 2009 the final energy consumption in households was 192,145 TJ which is 30.4% of total Danish energy consumption; 83% of it was related to heating purposes (Gram-Hanssen 2011, p.2).

Since the 1960s different policies have been implemented in Denmark that now all contribute to this aim. Measures of energy efficiency governance like the founding of the Danish Energy Agency in 1976, the Danish Energy Savings Trust (following on from the Danish Electricity Savings Trust from 1996), the energy saving obligations for electricity, gas and district heating network companies or the energy tax all contribute to higher energy efficiency.

Since 2006 all Danish energy distribution network companies (electricity, gas, district heating) are obliged to promote a more efficient use of energy (McCormick and Neij 2009, p. 17; Togeby et al. 2009, p. 301). Each year the obligations are increased and will be tightened further by 50% from 2013 and by 75% in 2015-2020. Figure 11 presents how the targets developed over the years since the inception of the obligation scheme.

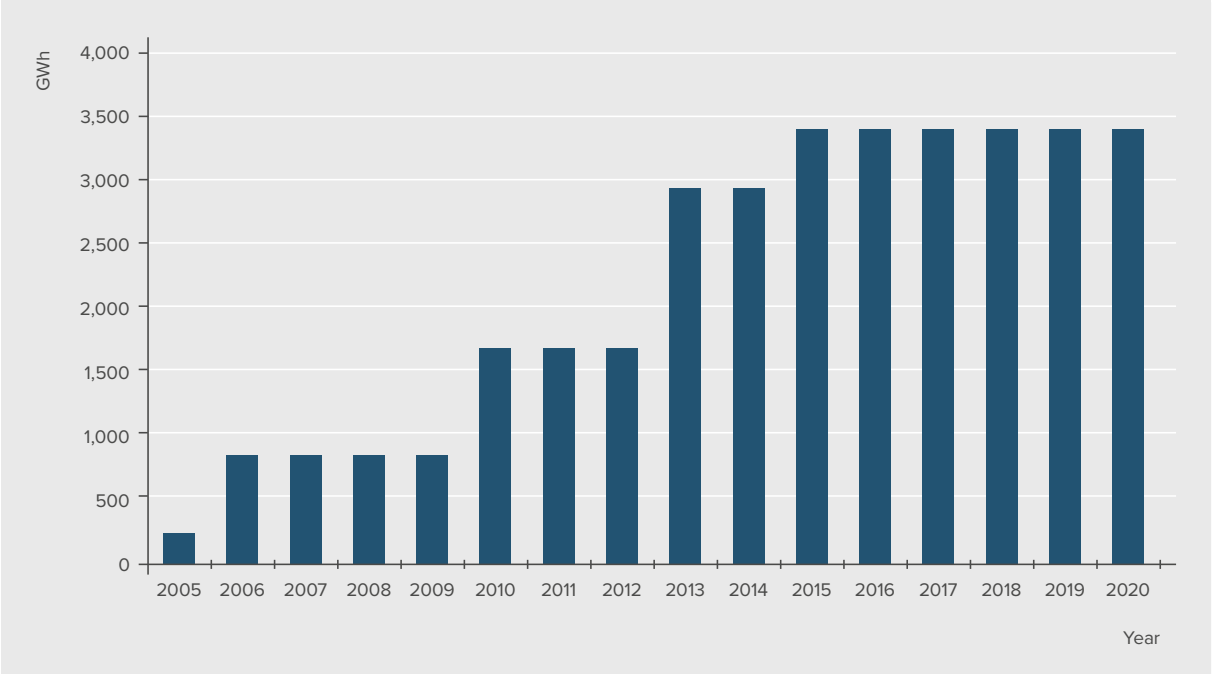

Figure 9: Development of energy-saving targets of energy network or distribution companies from 2005 (electricity only) to 2020 (electricity, gas, district heat and heating oil) in Denmark

Source: EA Energianalyse et al. (2012)

But also with specific policies and measures for energy efficiency in buildings Denmark has a long tradition, with buildings energy efficiency standards as the main element: In 1960 Denmark was among the first countries worldwide to introduce nationwide energy efficiency standards for energy use of buildings; today it has one of the most ambitious and strictest MEPS for new buildings among comparable countries (Danish Energy Agency 2010, p. 17). The energy requirements have been gradually tightened several times. Since 2006, provisions on the renovation of existing buildings are included as well (Gram-Hanssen 2011, p. 5). This seems to be crucial: Approximately 75% of the buildings in Denmark were built before 1979, when the requirements were tightened for the first time (Thomsen et al. 2009, p. 3). These legal requirements for buildings are accompanied by requirements for appliances. Moreover, Denmark has implemented an energy performance certification scheme, energy audits, advice from energy companies and from the regional energy advice offices of Energy Service Denmark, as well as a Knowledge Centre for Energy Savings in Buildings targeting the construction supply-side actors. Demonstration projects provide a basis for convincing information and training to investors, architects, construction companies and other contractors. For providing financial incentives to energy efficiency action, some grants and subsidy programmes were implemented as well, both by the government and the energy companies.

Read more on Denmark's policy package for energy efficiency in buildings in the bigEE Policy Guide:
www.bigee.net/s/1izq2n

2.2 The components of the recommended policy package

A single policy cannot address all market barriers; rather it will address only those barriers for which it is created. A combination of policies in a policy package is therefore recommended to target different market actors and the respective barriers. A compre hensive policy package approach will provide a balance between clear mandatory measures, incentives, information and capacity building – “the sticks, the carrots, and the tambourines”.

2.2.1 Overall governance framework for energy efficiency

As described in the previous chapter, the different policies addressing supply and demand side actors of the market need to be combined in a policy package in order to tackle the most important market barriers. Figure 12 outlines the basic components of bigEE recommended policy package: As a framework, clear vision and targets for energy efficiency need to be established at the highest government level. This should be accompanied by allocating finance and resources for implementation of sectoral policies and addressing market imperfections simultaneously. At the sector-specific level, policy instruments such as regulations, incentives and financing and capacity building are important components of a comprehensive policy package for energy efficiency in buildings.

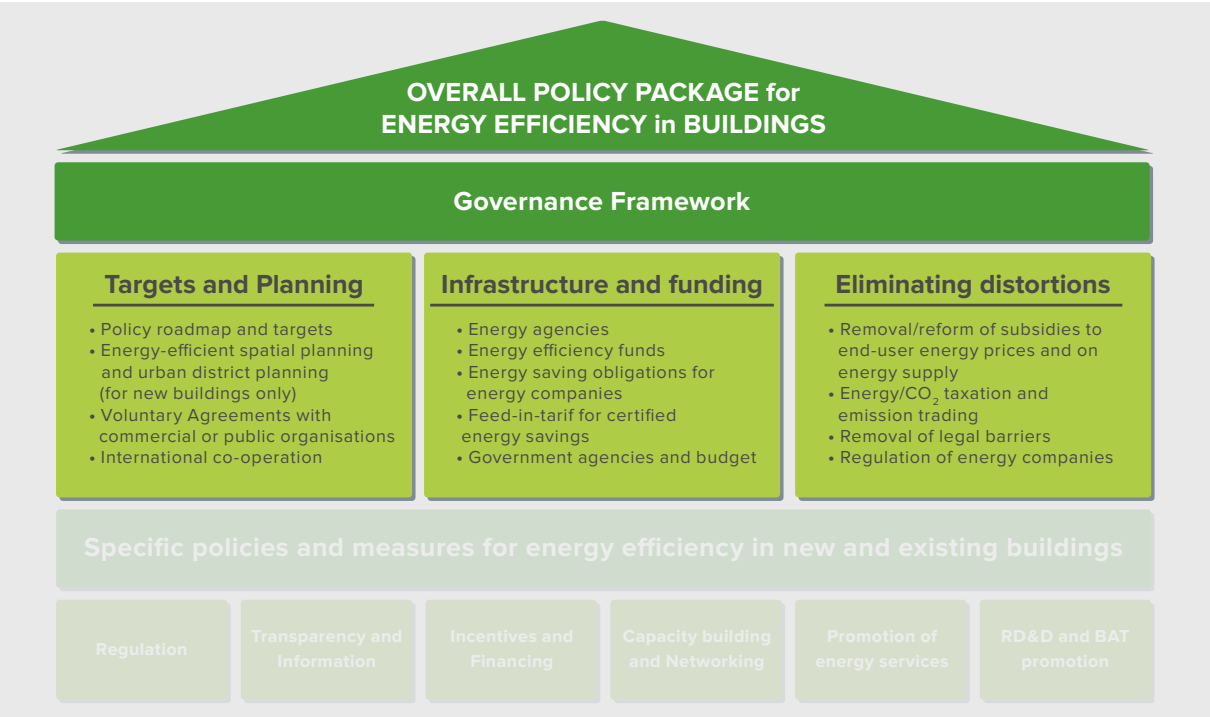

Figure 12: The bigEE recommended policy package: Governance Framework.

In the bigEE recommended policy packages, the general governance framework serves to guide and enable implementation of the sector-specific policies, as well as to remove price distortions in energy markets that would make energy efficiency improvements appear less cost-effective than they are. Table 4 explains the instruments in the governance framework in detail. Priority elements are highlighted 📌.

Short description of policy or measure

Policy roadmap and targets for Ultra-Low-Energy Buildings

A clear political commitment to energy efficiency is the necessary basis for long-term investment decisions in the construction industry and building market. It will provide a reliable planning framework for market actors and will reduce investment risk for investors and suppliers of energy-efficient buildings and technologies. To make such a commitment credible, it is crucial to set ambitious, yet achievable energy saving targets and to develop comprehensive medium- to long-term strategies towards eventually making Ultra-Low-Energy Buildings (ULEB), the standard both in new build and retrofit (e.g. a long-term policy roadmap and shortterm plans for developing advanced buildings and the related technologies, the market skills, and the MEPS, towards very low energy levels). Ideally, the roadmap and targets should be made statutory through an energy efficiency law, including provisions for a stable funding for energy efficiency policy.

Energy-efficient spatial planning and urban district planning

Including energy efficiency considerations in spatial planning and urban district planning is an important means to harness the easy energy savings possible and reduce primary energy consumption through early design decisions such as for siting and microclimate, building form and orientation, integration of energy-efficient cogeneration of heat and power and/or renewable energy supply, etc. Apart from the energy used in buildings, these planning processes are highly relevant for reducing transport needs and optimising ways of transport, with their associated energy demand.

Voluntary Agreements with commercial or public organisations

Voluntary Agreements (VAs) on energy efficiency targets and actions can be concluded by the government with commercial or public organisations (e.g. developers, housing companies, local authorities). The organisations commit to reaching energy efficiency targets and or to implementing energy efficiency actions, e.g. retrofitting their building stocks or investing only in (very) energy-efficient new buildings. VAs can thus be a complement to regulations, e.g. for promoting higher energy efficiency levels than mandated by law. In order to make such agreements effective, they must include rules for independent monitoring and impose stringent penalties in case of non-compliance.

International co-operation

Countries can co-operate in many ways to learn from each others' experience in policymaking and policy success. The opportunities for international co-operation are diverse. For example, countries can jointly develop energy performance standards for buildings and equipment so as to create regional markets with higher volumes and economies of scale. Furthermore they can jointly develop test procedures for the energy consumption and create harmonised energy labels. Countries can also co-operate in professional training and in the development and application of evaluation methods for energy savings, costs, and benefits.

Energy agencies

For greater effectiveness of their energy efficiency policy, governments are likely to need an energy agency. Tasks of energy agencies typically include the co-ordination of policies and implementing parts of the policy package, such as provision of information and initial advice, initial energy audits, promotional activities, education, training, dissemination, co-ordination of energy efficiency projects and programmes, demonstration activities, network-building between market actors, awareness raising, and organising campaigns.

Energy efficiency infrastructure and funding

Energy efficiency funds

Energy efficiency funds are special entities founded and funded by the state for organisation and funding of energy efficiency programmes. These programmes typically combine information, motivation, financial incentives and or financing, capacity building, and RD&D/BAT promotion. Energy efficiency funds (or trusts) can implement such programmes as an alternative to, but also jointly with energy companies or the government itself.

Energy efficiency funds or trusts may be given greater flexibility in implementing energy efficiency programmes than government agencies, and may receive a stable funding by creating dedicated levies or taxes on energy to feed the fund or trust.

Several successful examples around the world show that energy efficiency funds can achieve gross energy savings equivalent to 2% per year and more of the target groups' energy consumption, of which up to 1.5% per year are additional to baseline trends of energy efficiency. Usually, these energy savings are cost-effective for consumers and society.

Energy saving obligations for energy companies

Energy supply and or distribution system operator companies can be mandated by law to save a certain amount of end-use energy (i.e. on the demand side, with their customers) and prove achievement of that target.

The energy companies thus receive both the responsibility and the right of cost recovery for the organisation and funding of energy efficiency programmes. These programmes typically combine information, motivation, financial incentives and or financing, capacity building, and RD&D/BAT promotion. Energy companies can implement such programmes as an alternative to, but also jointly with an energy efficiency fund or trust, or the government itself.

A potential but weaker alternative to a legal obligation could be voluntary agreements with energy supply, transmission or distribution companies to achieve a certain amount of energy savings.

The most successful countries achieve gross energy savings equivalent to around 2% per year and more of the target groups' energy consumption through energy saving obligations. Up to 1.5% per year of these savings are additional to the baseline trends of energy efficiency. Usually, these energy savings are cost-effective for consumers and society.

Feed-in-tariff for certified energy savings

Feed-in-tariffs (FiTs) have already been implemented in the field of electricity generated from renewable energies in many countries. In a similar way, a country could also offer providers of standard energy efficiency programmes a fixed remuneration for every certified unit of energy saved. It could be an alternative to energy saving obligations for energy companies that creates more competition in the energy efficiency market.

No countries have implemented energy efficiency FiTs yet. However, similar approaches, such as competitive bidding or standard offer schemes for capacity (not energy) saved through load management or energy efficiency, have been realised in a number of countries.

Government agencies and budget

The traditional way is that integrated energy efficiency programmes with financial incentives, information and individual advice are managed by existing government agencies and funded from the public budget.

The advantage over other mechanisms is the direct implementation and budget control by government and parliament. Experience shows, however, that (1) appropriations for programmes in the government's budget are more subject to cuts and fluctuations or even "stop and go" effects than energy efficiency funds created via special levies or than targets under energy efficiency obligations and that (2) government agencies are often less flexible than energy efficiency funds and trusts or energy companies in the measures they can take to support consumers and market actors.

bigEE model example of good practice:

Efficiency Vermont (United States of America)
Efficiency Vermont (EV) was set up in 1999 and is an energy efficiency fund that delivers energy efficiency services to home-owners as well as businesses throughout the state of Vermont. Officially, it was named an Energy Efficiency Utility Program ("EEU Program"). Efficiency Vermont provides financial and technical assistance with regards to energy-efficient appliances and buildings. It is the first of its kind in the USA.

EV is funded by electric customers' bills through a special levy of around 0.5 US-ct/kWh or 4% of energy company revenues, known as the Energy Efficiency Charge, which is set annually by the regulatory agency Public Service Board (PSB). Its programs cover different types of measures or are combined with other measures, including financing, providing information, energy advice, regulation, competitions & awards, etc.

Read more on Vermont's good practice example on the energy efficiency utility program in the bigEE Policy Guide: www.bigee.net/s/jgtbi8

Eliminating distortions

Removal/reduction of subsidies on end-user energy prices and on energy supply
Energy prices should 'tell the economic and ecological truth' through full-cost pricing or the internalisation of external effects in order to discourage wasteful consumption of environmental resources. Therefore, existing inefficient subsidies for non-renewable energy production or on energy prices should gradually be removed – legislators and governments should rather use the budget saved to fund energy efficiency schemes for low-income households and small businesses, so as to keep their energy bills affordable instead of maintaining energy prices at artificially low rates.

Energy/CO_2 taxation and emissions trading
Energy prices should 'tell the economic and ecological truth'. Consequently, energy or CO_2 taxes, or an emissions trading system, should be introduced to internalise the external costs of environmental damage and threats to health into the final energy prices. By means of sending out the "right" price signal to market actors, both instruments – taxation and emission trading – improve financial gains from more energy-efficient behaviour and/or encourage energy efficiency investments. Revenue generated can be used to further increase the attractiveness of energy-efficient solutions by means of providing information and/or easily accessible funding opportunities, grants, or tax credits.

Removal of legal barriers (if they exist)
Sometimes, law prohibits energy-efficient solutions. Examples could be the prescription of low maximum air temperatures, e.g. 20 °C, during hot days in offices or schools, or of minimum ventilation rates even if nobody or few people are in the room, or the prohibition of solar water heaters on the roofs of historic buildings.

Such legal barriers to solutions that can save a lot of energy should be re-examined and if possible removed. However, no further general recommendations can be given, since such legislation is highly country-specific.

Regulation of energy companies
Regulation authorities should determine the allowed revenues of energy companies that are either natural monopolies (mainly grid companies) or are granted a monopoly of supply, such that they earn more by improving their customers' end-use energy efficiency and not by increased energy consumption. To this end, one important element is cost recovery for energy efficiency programmes that reduce customers' energy bills. Just as important an element is that annual revenues allowed by the regulator to the companies should not, or only to a very small extent, be based on the volume of energy or power sold or transported. By contrast, regulators should mandate that energy bills to final consumers should depend on the volume of energy or power delivered as much as possible. This will provide an adequate incentive to save energy or power.

Table 4: How to Establish a Governance Framework?

2.2.2 Specific policies and measures

A comprehensive sector-specific policy package needs to be designed and implemented within the conditions of the overall governance framework. A combination of specific policy instruments is needed: They range from regulations (e.g. Minimum energy performance standards), information instruments (e.g. building energy labels), monetary incentives or financing (e.g. tax benefits), capacity building (education and training programmes for relevant market actors), promoting energy services (e.g. private advice and support services for energy savings), research and development and demonstration (RD&D) and Best Available Technology (BAT) promotion (e.g. R&D funding and award competitions). These specific policies and measures are explained in Table 5. Priority elements are highlighted 📌.

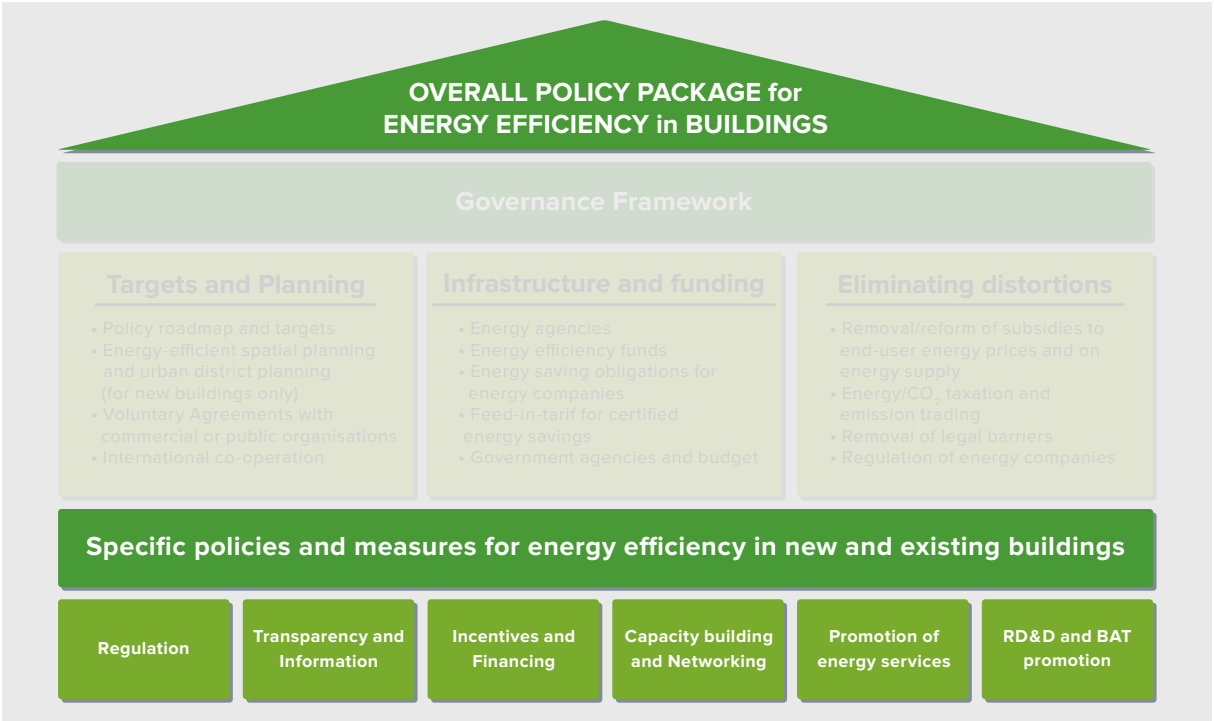

Figure 13: The bigEE recommended policy package:
Specific policies and measures for energy efficiency in new and existing buildings

Short description of policy or measure

Regulation

Minimum energy performance standards (MEPS) for buildings and equipment

By setting an upper limit for the allowed energy consumption of a building, Minimum energy performance standards (MEPS; also known as energy building codes or regulations) are used to exclude at least the most inefficient building concepts and technologies from the market. They are most important for new build but should also apply to major retrofits of existing buildings. While MEPS, at cost-effective levels, should be made compulsory by law, higher standards up to Zero Energy Buildings can first be established on a voluntary basis. MEPS should then be tightened step by step every three to five years, until after 10 to 15 years very low energy levels have been reached. Advanced countries have already achieved energy savings of 50 to 75% in today's new buildings as compared to conventional building practices of the past. An effective control and enforcement regime is essential to ensure compliance with the standards.

bigEE model example of good practice:

Regulations for energy efficiency of buildings, People's Republic of China

Starting from 1995, China has introduced Minimum energy performance standards (MEPS) for both new and refurbished residential buildings in all cities of its four most important national climate zones (rural areas are not targeted by the current MEPS). Highly notable is the compliance with MEPS, in which China has recently managed to reach almost 100%. The standards were designed to improve thermal comfort and the energy efficiency of heating and air conditioning systems in residential buildings. They also stipulate that the target building must apply energy efficiency measures for heating, ventilation, and air conditioning (HVAC) systems. Furthermore, they require a minimum energy saving level of 50% (Hot Summer and Cold Winter Zone and Hot Summer and Warm Winter Zone) and 65% (in the Severe Cold and Cold Zones) that the new residential building must achieve, in comparison with the local representative residential reference building without any energy efficiency measures (as built in the 1980ies) under the same indoor thermal environment requirement.

Read more on China's good practice example on regulations for energy efficiency of building design and operation in new and refurbished buildings (MEPS China) in the bigEE Policy Guide: www.bigee.net/s/f152h5

Other legal requirements

In addition to MEPS, a number of further legal requirements have a positive impact on the overall energy consumption of a building, either on their own or in enhancing other policy instruments in their impact to reduce energy use. For example, individual metering is an important feedback measure for occupiers of multi-unit buildings that may induce more energy-efficient user behaviour. Likewise, the requirement of appointing energy managers, regular inspections or building energy efficiency commissioning will help to detect incorrect installations or operational settings of energy systems and to frequently check energy-intensive building equipment (e.g. boilers, ventilation or air-conditioning systems).

Revision of landlord and tenant laws
Legislation that allows landlords to fully or partially recoup the costs for energy efficiency improvements of existing buildings or of energy-efficient vs. conventional new buildings from the tenants can help overcome the landlord-tenant dilemma. Rent increases must not exceed the energy cost savings the tenants can achieve, though. We further recommend mandating that rent plus energy costs must be disclosed to potential tenants, but that rent and energy costs must be charged separately.

Transparency and Information

Mandatory Energy Performance Certificates (EPCs) and equipment labels
Energy performance certification – sometimes also referred to as building energy labelling – aims to inform prospective buyers or tenants about the level of energy efficiency of a particular building compared to other buildings of the same kind. Energy performance certificates (EPCs) display the results of a professional assessment of a building's energy performance (also known as building energy rating), thus making energy use visible and raising awareness about energy saving potentials. The availability of EPCs to prospective buyers or tenants should be mandatory to enhance market transparency. Consequently, EPCs are an important means for establishing energy performance as a relevant purchasing, rental or investment criterion and can thus increase the demand for, and supply of, low-energy buildings.

bigEE model example of good practice:

Building energy rating, Republic of Ireland
Like all Member States of the European Union (EU), Ireland has introduced Building Energy Performance Certificates, called Building Energy Rating (BER) in Ireland. However, other than most Member States, Ireland has required building owners to present the BER to potential buyers or tenants, and is publishing the ratings in a public online database. This is likely to maximise market transparency and, hence, to improve the effectiveness of the rating scheme. In February 2012, in total almost 290,000 Building Energy Ratings had been published, out of a total building stock of 1.46 million permanently occupied dwellings.

Read more on Ireland's good practice example on Buildings Energy Rating (BER) in the bigEE Policy Guide: www.bigee.net/s/9fs2xk

Energy advice and assistance during design and construction
Energy advisers and consultants are essential to inform home-builders and investors about energy efficiency and its benefits in general but also to help them identify concrete energy saving opportunities, assess the related costs and benefits, and ultimately take adequate action. Policy should ensure free basic advice and consider providing grants for consultancy to stimulate demand for it. Policy should also support advice to investors to find qualified architects, engineers, contractors, and certified surveyors for quality control including compliance with energy efficiency standards and requirements of financial incentive and financing programmes.

bigEE model example of good practice:

Energy Guides, Hannover (Germany)
The "Energielotsen" (Energy Guides) in the Hannover region (around 672,000 inhabitants in proKlima municipalities) in Germany are architects or engineers who are consulting clients on energy efficiency measures for buildings during the whole construction or refurbishment process. Regarding new build, the programme has provided financial support for around 300 very energy-efficient new homes from 2005 to 2010. In the proKlima area, 3,255 new homes have been constructed between 2005 and 2010 and proKlima has provided financial and technical support for 11.1% of them.

Read more on Hannovers's good practice example on Energy Guides in the bigEE Policy Guide: www.bigee.net/s/5xhzza

Energy audits and advice and assistance during retrofit
For existing buildings, individual advice is essential to help building owners identify concrete energy saving opportunities and to assess the related costs and benefits. Building owners need to understand these to be convinced to take action for improving energy efficiency at all, and for maximising benefits and avoiding mistakes when they invest. Policy should hence ensure there is free basic advice and consider providing grants for comprehensive energy audits and consultancy to stimulate demand for them. Policy should also support advice to investors to find qualified architects, engineers, contractors, and certified surveyors for ensuring quality control, including compliance with energy efficiency standards and requirements of financial incentive and financing programmes.

Provision of information
Informing investors and end-users about energy saving opportunities, both in new build and in retrofit, and the achievable cost savings and other benefits, as well as about assistance available through other policies and services, will enable decision-makers to make more informed choices and improve uptake of energy efficiency options.
Important instruments for providing information are, for instance, information centres, demonstration buildings, information campaigns, websites, and calculation tools.

Feedback and measures on behaviour
Feedback measures will increase end users' awareness and transparency about their own levels of energy consumption. Combined with emphasis on the impact of user behaviour on the energy performance of a building, feedback measures can motivate users to change their behaviour, but also to invest in energy saving technologies. Feedback was shown to be more effective when social marketing techniques, normative messages and similar measures targeting behaviour change were applied.

Important instruments for providing feedback on energy consumption levels are, for instance, individual metering, smart metering, and informative/comparative billing.
Other measures targeting user behaviour include, e.g. prompts, motivation campaigns for behaviour change, energy saving competitions, and training of building users on energy-intelligent use of lighting, ventilation, heating, cooling, windows, and appliances.
Experiences in many countries, including recent reviews on feedback programmes in the USA and Canada, show electricity and fuel savings in the range of 5% to 15%. Feedback and other measures often need to be continued or repeated to secure such savings.

Financial incentives for ULEB and deep retrofits

Investors will evaluate costs and benefits of an investment in Low-Energy Buildings (LEBs), in Ultra-Low-Energy Buildings (ULEBs) or in very energy-efficient ('deep') retrofits to (U)LEB. Other investors may not even be aware of the possibility of improving energy efficiency. In order both to increase awareness of the benefits of energy efficiency and to improve the benefit-to-cost ratio and thus foster decisions in favour of constructing ULEBs or deep energy-efficient retrofits, financial incentives may be powerful instruments. They can make an important contribution to accelerating the market penetration of (U)LEBs and energy-efficient retrofitting as well as certain energy efficiency technologies or services with a better energy efficiency than required by Minimum Energy Performance Standards (MEPS). As a result, they help prepare markets for the next steps in strengthening MEPS towards higher energy efficiency levels for both new buildings and for retrofitting existing buildings.

Examples of financial incentives include: direct grants, tax incentives, or indirect incentives (e.g. granting larger floor area, higher density, or expedited building permits). The choice will depend on national circumstances.

Experience with many successful financial incentive programmes for improved energy efficiency in the building sector exists, but only a few examples have targeted ULEBs and deep retrofitting so far. Some Austrian provinces have already achieved more than 50% of ULEBs in new build through policy packages including financial incentives as an essential component. In Germany, the KfW programmes have been successful in promoting renovation of existing buildings to LEBs.

bigEE model example of good practice:

Green mortgage and this is your home, United Mexican States

In Mexico, especially low and middle income groups benefit from two funding initiatives facilitating energy-efficient investments in mainly new residential buildings. While Esta es tu casa (This Is Your Home, TIYH) offers grants for building, buying or renovating low-income homes, which must meet specific energy efficiency criteria, the Hipoteca Verde (Green Mortgage, GM) offers loans incentivising the purchase of energy efficiency technology to a wider target group. For the latter, an evaluation has estimated that homeowners can achieve net savings of close to €1,000 within 10 years. In 2009, both programmes together saved on average 48% of electricity and gas compared to houses without such measures. Demand is very high – close to 400,000 GM loans were formalised during 2011, which is almost all new homes receiving mortgages from the agency INFONAVIT. In addition, the TIYH programme released almost 100,000 grants in 2010. The fact that both, TIYH and GM, can be combined is a particular advantage to both measures. They also are assumed to have positive effects on the construction industry and the technology supply industry, as well as on the government's budget due to avoided energy price subsidies. Further projects, some supported by the international community, enhance the Mexican policy package making low-energy homes appear feasible in Mexico in the not so distant future.

Read more on Mexico's good practice example on Green Mortgages and This is your house (GM and TIYH) in the bigEE Policy Guide: www.bigee.net/s/ry1bk3

Financing

Financing instruments target the barrier of insufficient availability of, or access to, capital for financing the incremental up-front costs of energy-efficient buildings or retrofits. Scaling up investment in energy efficiency is crucial to achieve a sustainable energy future. Among the vast variety of different financing schemes, preferential loans, revolving energy efficiency funds or government-facilitated third party financing schemes (e.g. on-the-bill or property tax financing) are exemplary and suitable public policy responses to address the existing financing gap and to foster private investment.

Capicity building and networking

Education and training

Capacity building measures for workforce in the construction sector (architects, planners, developers, building contractors, installation contractors, facility managers, real estate agents and other intermediaries) aim to provide actors with the relevant knowledge and skills so they:

a) have knowledge on the status-quo of designing, building, retrofitting, operating, monitoring, and assessing Low-Energy Buildings, as well as the corresponding policy framework and market;
b) can correctly and convincingly inform investors, building owners and tenants about the cost-effectiveness and other benefits of such buildings or of energy-efficient retrofits.

Capacity building measures for public administrations responsible for urban development and construction on Low-Energy Buildings enhance their analytic capabilities required to develop effective policies on low energy building and to assess project feasibility.

There is also a need to educate the general public on energy efficiency and its benefits, and thus increase demand for energy-efficient solutions. For more information on this take a look at the element 'Provision of information': **www.bigee.net/s/um5rej**

Certification of qualified actors

Certification of the qualification level of supply chain actors such as architects, energy or engineering consultants, energy service companies, and installation contractors, regarding energyefficient design, building analysis, construction, or installation both increases their incentives to undergo training (because they will benefit from improved credibility among potential customers) and helps investors in their search for properly skilled and trustworthy service providers.

Energy efficiency clusters/networks

Networks such as local networks on Low-Energy Buildings and energy-efficient refurbishment or energy efficiency clusters of small and medium companies (SMEs) can link relevant actors and promote exchange of experiences and good practices. They are also instrumental for co-ordinating marketing, information and motivation, and professional training activities at the local or regional level.

Promotion of energy services

Promotion of energy services for energy savings

Building owners or investors often lack the required capital and expertise and are afraid of technical and financial risks involved in improving energy efficiency. In such cases they can outsource the financing and implementation of energy efficiency investments to third parties, such as energy service companies (ESCOs) and private or public energy companies. This is more common for energy-efficient retrofits but could also be explored for new construction projects.

Such an innovative service, however, faces its own barriers to market adoption. We therefore recommend that governments promote and support energy services such as energy performance contracting or third-party financing schemes and adopt for instance the following general measures for this purpose: providing targeted information and coaching to potential energy services customers, capacity building, standardised models and contracts, regulations such as the establishment of quality standards and certification schemes for energy service providers, facilitating energy service provider's access to financing and creating risk-mitigating measures, creating a favourable framework condition for energy service providers' involvement in public procurement, encouraging the establishment of an association of energy service providers and SuperESCOs.

RD&D and BAT promotion

Funding for research, development and demonstration (RD&D) projects

Through promotion of research and development activities as well as demonstration projects (RD&D), innovations in terms of technologies and design concepts are fostered. RD&D is critical to drive the development of innovative building concepts, such as Low-Energy Buildings, Ultra-Low-Energy Buildings, and nearly Zero Energy or Plus-Energy Buildings, both in new build and retrofit, as well as the related technologies. This will contribute to mid-term and longer-term policy goals and help ensure that energy-efficient building concepts and technologies are ready for commercialisation in time. RD&D funding is a key driver for innovative ideas, assists the accelerated market introduction, and reduces the incremental costs of energy-efficient solutions. However, market breakthrough is often hindered by a plethora of market barriers and is thus likely to need further policy support. Through a coherent RD&D policy, governments can further capacity building of comprehensive national scientific and technological research institutions on energy efficiency (GTZ et al. 2006).

bigEE model example of good practice:

MED-ENEC demonstration programme on energy effi ciency in the construction sector in the Middle East and North Africa region

Demonstration projects for energy effi ciency in new buildings and refurbishment in several countries in the Middle East and North Africa region have shown energy savings between 20% and more than 95% compared to conventional practice. Only about half of the pilot projects are economically viable at current (often subsidised) energy prices, but through learning eff ects and the adoption of only the most energy-effi cient measures, cost-eff ectiveness can be improved for most future projects. Generally cost-eff ectiveness is more diffi cult to attain in countries with subsidised energy prices. The way the buildings have been constructed, the payback time range is from two to 60 years and average payback time is around 23 years, but can be reduced signifi cantly as stated above.

Read more on Middle East's and North Africa's region MED-NEC good practice example on MED-ENEC demonstration projects for energy efficiency in Buildings (MED-ENEC) in the bigEE Policy Guide: www.bigee.net/s/gcby53

RD&D and BAT promotion

Public sector programmes

The public sector should lead by example. It can, thereby, also create first markets for energy-efficient building concepts and technologies.

a) 'Lead by example' programmes in the public sector to 'deeply' retrofit existing buildings to very low energy consumption levels and to only build (ultra) low-energy buildings (as public buildings, in social housing, etc.):

In addition to saving energy and reducing public expenditure, such programmes also raise awareness and investor confidence about the benefits of Low-Energy Buildings and retrofits and demonstrate cost-effectiveness. They also directly provide a market to suppliers of energy-efficient buildings and retrofits.

b) Public procurement requiring very energy-efficient building technologies:
The resulting demand volumes can increase market penetration and reduce market prices for these technologies. This, in turn, will lead to these technologies being used more often and eventually becoming the default technology in new construction and retrofit.

Bulk purchasing and co-operative procurement

Bulk purchasing and co-operative procurement works through gathering large buyers (private and public). It is useful for promoting very energy-efficient building technologies already available on the market (BAT) or new, even more energy-efficient equipment ('technology procurement'). The resulting demand volumes can induce manufacturers to develop, produce and market these technologies and equipment, increase market penetration, and reduce market prices for these technologies. This in turn will lead to these technologies being used even more often.

Competitions and awards

Competitions and awards for exemplary ultra-low energy new buildings or retrofits can be an important means of rewarding frontrunners in energy-efficient design and construction techniques. The publicity gained by developers and architects as well as owners of awardwinning buildings means value added in terms of profit and prestige – this increases their motivation to strive for a very low-energy building to win an award.
The demonstration and the publicity will raise awareness and confidence on the demand side about the feasibility and cost-effectiveness of such new or refurbished buildings.

Table 5: How do Specific Policies and Measures for Energy Efficiency work?

3 Guideline for designing energy efficiency policies for buildings

Successful policy requires careful planning and design, schemes to ensure compliance, and monitoring and evaluation to learn what works and what can be improved. bigEE provides some general tips for designing and implementing policies for energy efficiency in buildings and refers to what is good practice.

Based on existing research and empirical evidence bigEE recommends an evolutionary cycle approach to plan, design, implement and evaluate policies. As shown in Figure 14 there are two loops or cycles.

The external clock-wise cycle represents the initial policy-making process that involves:

- Setting up an aggregated energy saving target for the economy
- Establishing sector-specific targets based on sectoral potential (e.g. quantitative targets for achieving the vision of new Ultra-Low-Energy Buildings)
- Designing a governance framework and providing funding to enable implementation of a comprehensive policy package to address actor-specific barriers and incentives
- Evaluating policy costs and benefits prior to policy implementation
- Implementing policy and monitoring how successful the policy is in achieving the saving potential
- Revising the policy package and targets if needed.

The anti-clock-wise cycle represents two opportunities for reassessing the original policy design.

- The first feedback loop (on the right) facilitates revision of the targets if ex-ante evaluation (evaluation prior to the launch or implementation of policy or measure) projects over-achievement of the target. If under-achievement is projected it should trigger further analysis and measures to achieve the desired target.
- The second loop (on the left) indicates the stages where the policy package can be revised, if ex-post evaluation (i.e. evaluation conducted after the policy is implemented and has completed its intended time duration) reveals lower energy savings than required by the policy target.

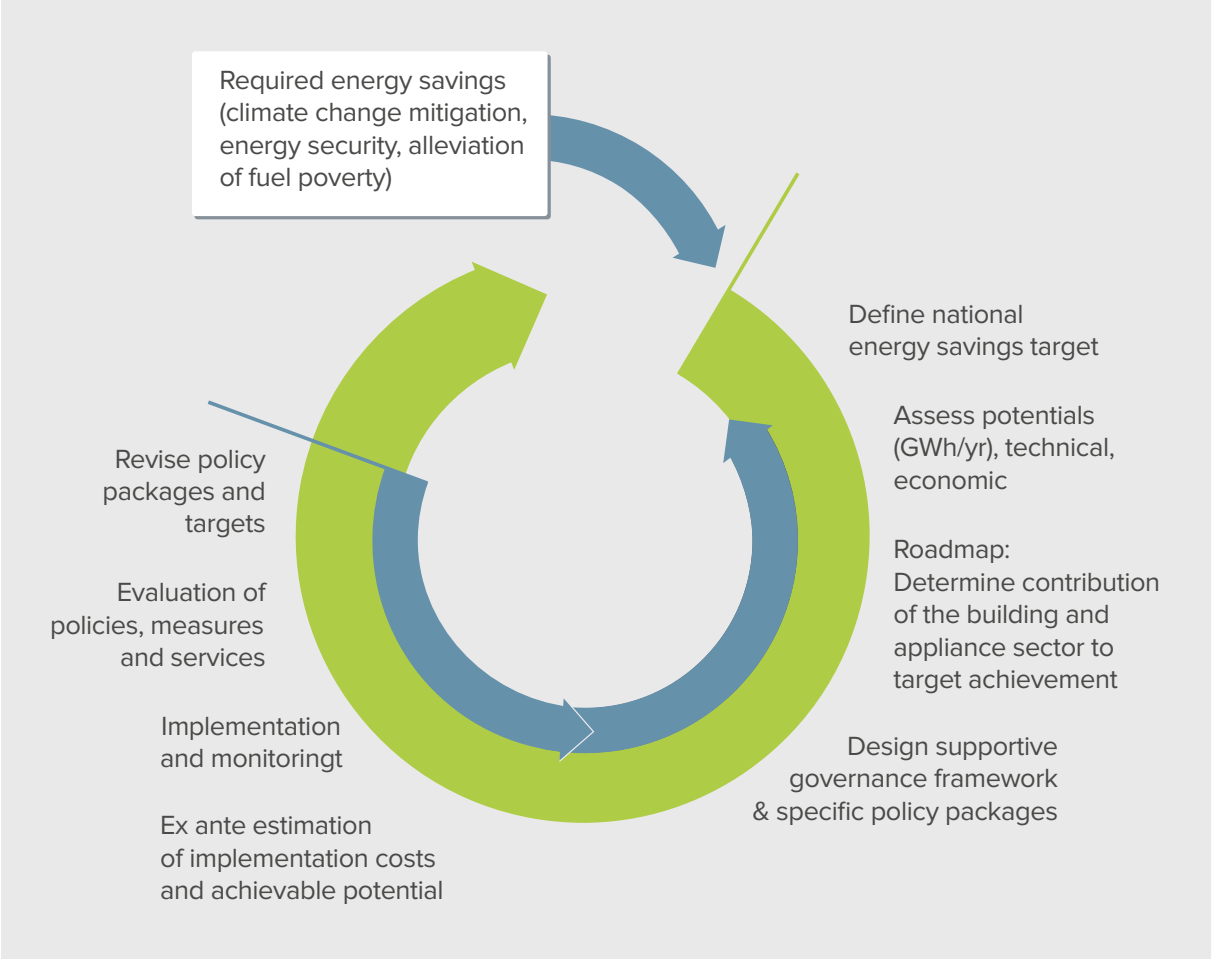

Figure 14: The policy planning, implementation, and learning cycle

Source: Wuppertal Institute (2012a), adapted from Wuppertal Institute & Ecofys (2009)

Read more in the bigEE file "How to design and implement energy efficiency policies": www.bigee.net/s/fyzzt7

3.1 Some guiding principles

Whatever the policy or measure to be designed or implemented, the following principles are useful to take into account. We recommend a thorough check of these guiding principles before designing and implementing a policy or measure:

- Build confidence in stable framework conditions
- Determine priorities based on status quo analysis
- Involve the market and assess the needs of market actors
- Make goals, instruments, and benefits transparent
- Increase uptake through highlighting co-benefits
- Design policies so as to create market dynamics towards highest levels of energy efficiency, while maximising benefits and minimising negative side effects
- Consider the social dimension
- Take national or local circumstances into account
- Monitor, evaluate and review policies

3.2 Need to monitor and evaluate policies

Policies and measures should be constantly monitored and thoroughly evaluated on a regular basis. The necessary mechanisms such as reporting requirements and well-defined methods for measuring and verifying results need to be established, and corresponding resources allocated already in the design phase, i.e. before a policy actually enters into force. Monitoring and evaluation (M&E) enables policy managers to demonstrate the programme's progress and its success or failure. M&E activities help to better understand the needs of target groups and to define intermediate objectives that are achievable and measurable.

The main differences between M&E are in the timing and frequency of observations or assessment and in the purpose and questions addressed. The following bullet points illustrate these differences between ex-ante impact evaluation, monitoring, process evaluation, and ex-post impact evaluation.

- **Ex-ante impact evaluation** starts with calculating the economic and technical potentials and assessing how much of the identified potential can be realised by what kind of policy or measure (or policy package). **Programme monitoring** will assist project managers in following and controlling the process, in quickly identifying problems and in solving them. The database generated in the monitoring process will be useful both for process and ex-post impact evaluations.
- **Process evaluations** serve to more systematically analyse programme performance at longer intervals than the more continuous monitoring. Unlike monitoring, process evaluations are more credible and often more useful, if done by external evaluators.
- **Ex-post impact evaluation** will show in detail whether a policy or measure has been effective in achieving its targets, e.g. as effective as anticipated in the ex-ante evaluation.

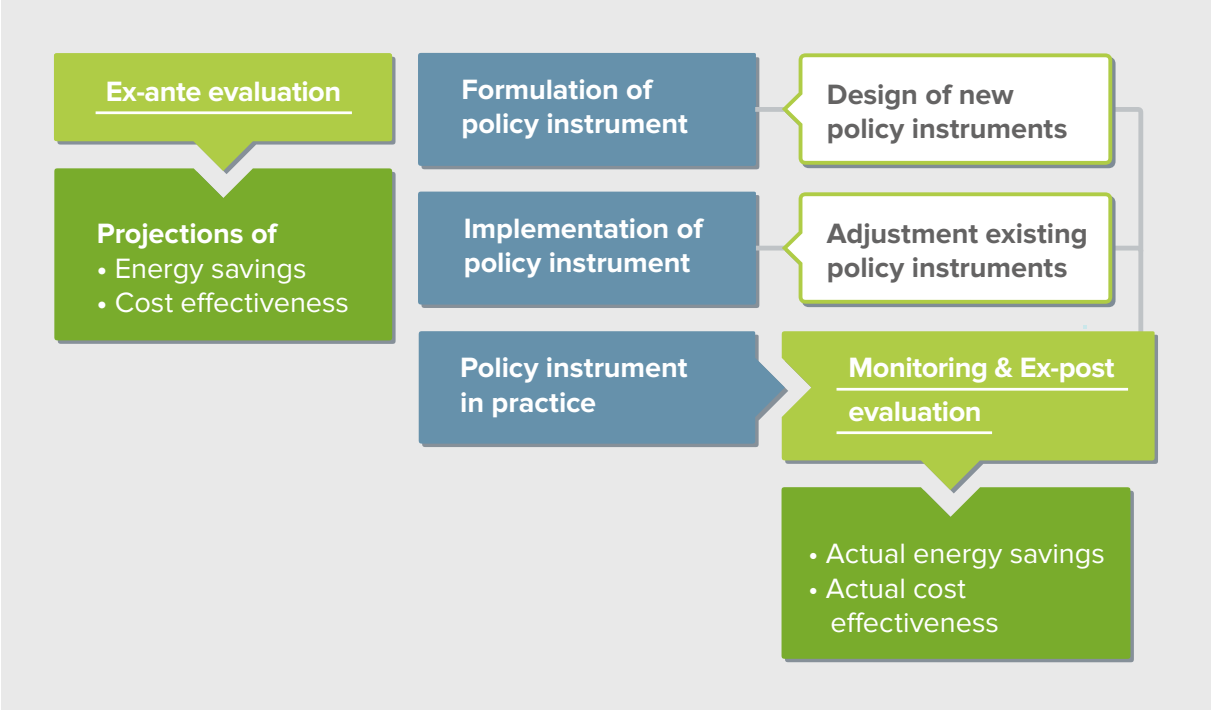

Figure 15: Why evaluation is important?

Source: Wuppertal Institute (2012a), adapted from Ecofys (2008)

3.3 Need to establish compliance and control and enforcement regimes

A missing or incomplete compliance system and sub-optimal monitoring procedures can have a major impact on the overall effectiveness of energy efficiency policies and measures. Badly planned and enforced compliance measures may lead to free-riding and related economic losses. Low rates of compliance will hinder market development and prevent the realisation of the full energy saving potential (IEA & OECD 2008).

For further details on the guiding principles of policy design and implementation, monitoring and evaluation, and how to establish a compliance system please consult our PDF "How to design and implement energy efficiency policies": www.bigee.net/s/fyzzt7

4 Outlook

This bigEE brochure was designed to give decision makers and policy implementers a first overview of all the important aspects related to energy efficiency policy for buildings: from the large untapped energy and cost saving potentials and the various associated co-benefits that make fostering energy efficiency worthwhile, to the complex markets and manifold barriers that call for policy intervention, and, finally, to our general recommendations on how such intervention should appear – i.e. the bigEE recommended policy package – and how it should be designed and implemented.

Nevertheless, it is still essential that each country analyses which actors, barriers, and incentives are relevant on their respective energy efficiency markets, which of the policies and measures are already in place and which need improvement and where the gaps are that need to be closed.

A first sample of good practice examples was also included in this document. More can be found in the policy guide on bigee.net where you can browse through more good practice examples of successful policies and policy packages from other countries to find suggestions for policies that are suitable to the respective national circumstances, as well as tips for their effective implementation.

In the corresponding guides on buildings and appliances you will also find detailed information on the potentials and technological solutions that policies can and should adress.

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6 Links

Policies – Buildings

Recommended Package: www.bigee.net/s/eqmmk9
Package Elements: www.bigee.net/s/t2kr6g
Package Examples: www.bigee.net/s/rnwurd
Policy Examples: www.bigee.net/s/9p4y9f

bigEE website link to the PDF document
"How to design and implement energy efficiency policies": www.bigee.net/s/fyzzt7

bigEE website link to the PDF document
"How policies need to interact in packages": www.bigee.net/s/k1gtjx

bigEE website link to the PDF document
"Why policy needs to assist buildings and appliances markets to become energy-efficient": www.bigee.net/s/pri6uc

bigEE website link to the pages
"Good practice examples of policy packages"
- California: www.bigee.net/s/kk2kgk
- Tunisia: www.bigee.net/s/nvazgv
- Denmark: www.bigee.net/s/1izq2n

bigEE website link to the pages
"Good practice examples of specific policies and measures"
- Vermont (United States): www.bigee.net/s/jgtbi8
- China: www.bigee.net/s/f152h5
- Ireland: www.bigee.net/s/9fs2xk
- Hannover: www.bigee.net/s/5xhzza
- Mexico: www.bigee.net/s/ry1bk3
- Middle East and North Africa region MED-ENEC: www.bigee.net/s/gcby53

Notes

bigEE

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Start now!

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bigEE is an international initiative of research institutes for technical and policy advice and public agencies in the field of energy and climate, co-ordinated by the Wuppertal Institute (Germany). It is developing the international web-based knowledge platform bigee.net for energy efficiency in buildings, building-related technologies, and appliances in the world's main climatic zones.

The bigee.net platform informs users about energy efficiency options and savings potentials, net benefits and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

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