bigEE

Your guide to energy efficiency in buildings.

Energy efficiency policies for appliances

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

Wuppertal Institute
for Climate, Environment
and Energy

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Author
Dr. Stefan Thomas

with contributions from
Lena Tholen
Jana Rasch
Ahmad Hafiz

Design: designbuero-koeln.de

Introduction

Thanks to new design solutions and energy improvement options, energy consumption for appliances can be reduced cost-effectively with the support of appropriate policies in countries around the world. Upgrading appliances used in buildings with more energy-efficient models can save between 60 and 85% of energy compared with inefficient models being used in many countries while providing same or even better services. Energy-efficient refrigerators and freezers can have energy savings of about 60%, televisions up to 65% and computer monitors even more than 80% (Topten International Group 2014). Despite enormous energy saving potential, market forces alone are not likely to achieve this potential.

In the case of residential appliances, their development takes various stages including manufacturing, sales and operation, recycling and a multitude of actors take decisions that can influence the energy performance of an appliance. Actors in the appliance value chain range from parts developers, manufacturers, retailers, end-users and recyclers. Before devising policies for the energy efficiency of appliances, policy-makers should carefully examine all the actors in the appliance value chains to better address their inherent incentives and barriers to manufacture, sell, or buy an energy-efficient product. In doing so policy-makers become able to address several interlinked steps in the value chains that have to be co-ordinated within different actors from development to recycling to other important actors who can influence decisions by market actors; such as public authorities, energy agencies, research institutes and interest groups.

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 and appliances. bigEE's web-based knowledge platform – **www.bigee.net** – provides a comprehensive source of information for policy-makers and investors from the private and public sector(s) on best available technologies (BAT), energy saving potentials, net economic benefits, and good practice policies.

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

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

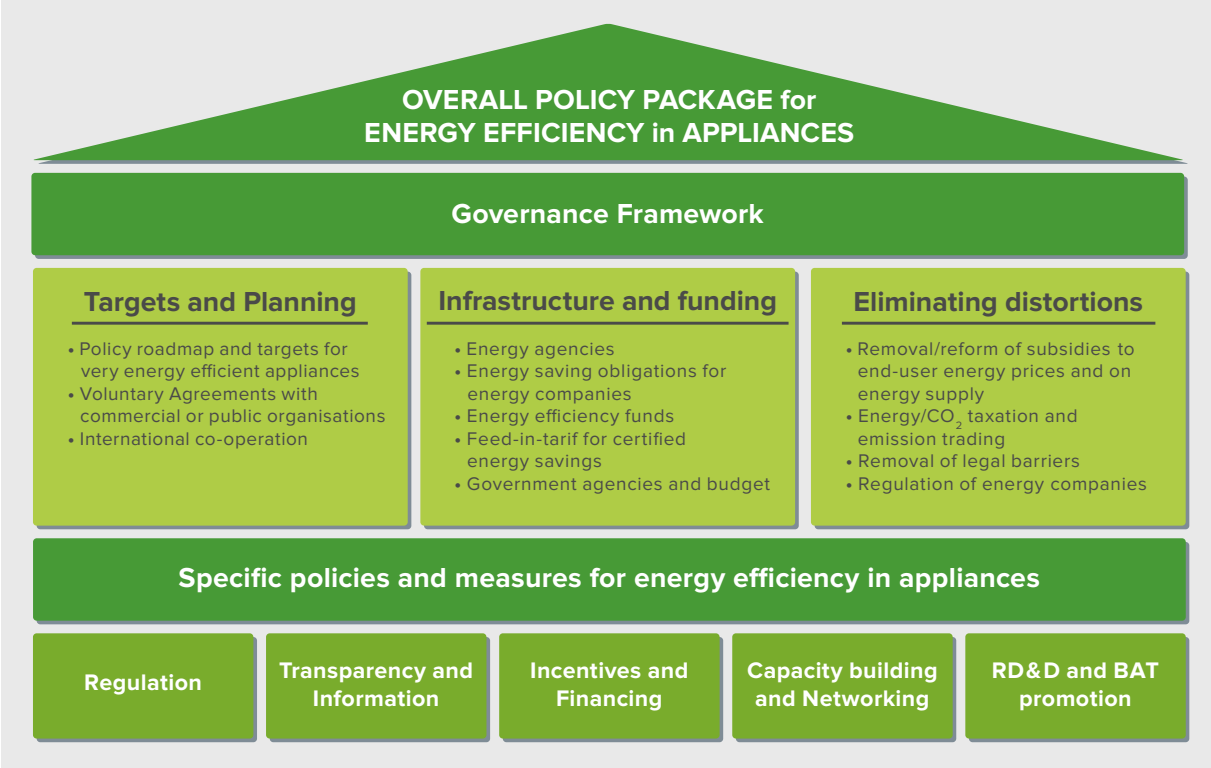


Figure 1: The bigEE recommended policy package

Figure 2 shows how the sector-specific policy instruments interact and reinforce each other to transform the market for appliances. Value chains for appliances are complex and many different actors have to work together to achieve an optimal outcome. Therefore, policies and measures need to be combined to a well-designed package. Policymakers need to consider demand- and supply-side actors, national circumstances and the most important market barriers in their country and select their priorities. Each instrument has a certain aim, such as to disallow energy-wasting technologies, promote the most energy-efficient ones, or stimulate innovation. The impact of well-combined policies is therefore often larger than the sum of the individual impacts.

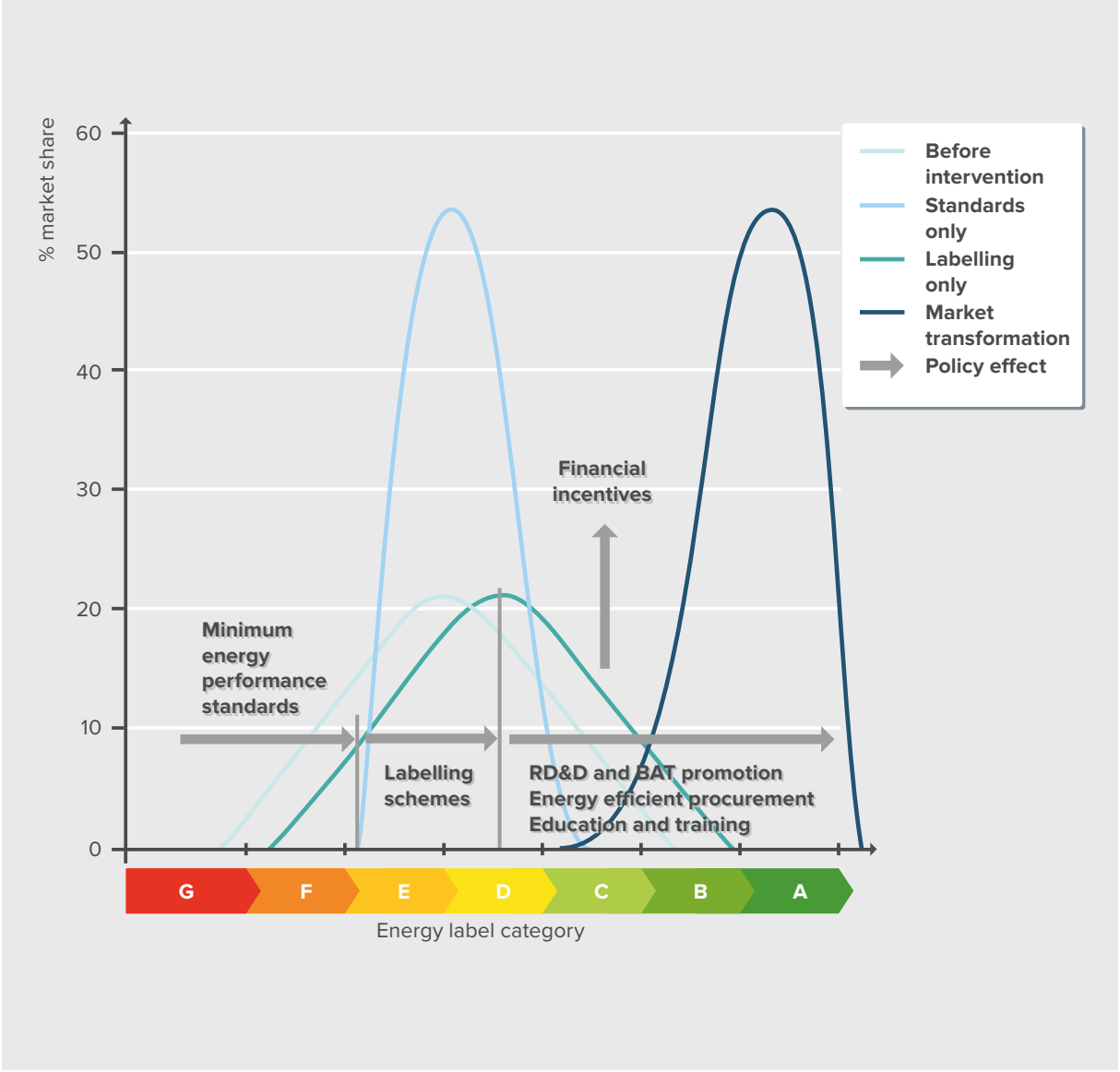


Figure 2: The interactions of policy instruments for energy efficiency in in appliances

Source: Wuppertal Institute (2012)

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

Table of contents

Introduction 3

Recommended policies at a glance 4

Table of contents 6

1 Energy efficiency in appliances 7
- 1.1 The potential for energy savings is high 8
- 1.2 Co-benefits of energy efficiency 9
- 1.3 The need for a collaborative approach 10
- 1.4 Barriers and incentives 12
- 1.5 The role of policy 13

2 Recommended policy package for energy efficiency in appliances 14
- 2.1 Interaction between appliance-specific elements of policy package 15
  - 2.1.1 Good practice examples of policy packages 17
    - 2.1.1.1 Policy package for energy efficiency in refrigerators in California (USA) 18
    - 2.1.1.2 Policy package for energy efficiency in refrigerators in Brazil 19
    - 2.1.1.3 Policy package for energy-efficient refrigerators in Japan 20
- 2.2 The components of the recommended policy package 22
  - 2.2.1 Overall governance framework for energy efficiency 22
  - 2.2.2 Specific policies and measures 26
  - 2.2.3 Good practice examples of specific policies and measures 30
    - 2.2.3.1 EnergiePremieRegeling (energy rebate scheme), The Netherlands 30
    - 2.2.3.2 Utilities' Refrigerator replacement programme, Brazil 31
    - 2.2.3.3 Topten (European Union, China, USA) 32
    - 2.2.3.4 Kurveknækkeraftale, Curve Breaker Agreement, Denmark 32
    - 2.2.3.5 Energy-Efficient Product Procurement (EEPP), United States 34

3 Guidelines for designing energy efficiency policies for appliances 36
- 3.1 Some guiding principles 38
- 3.2 Need to monitor and evaluate policies 38
- 3.3 Need to establish compliance and control and enforcement regimes 39

4 Outlook 40

5 References 41

6 Links 44

1 Energy efficiency in appliances

Energy efficiency in appliances is crucial for sustainable development, climate and resource protection and a low-risk worldwide energy system. The most energy-efficient appliances already available today can save between 60 and 85% of energy compared to inefficient models that are still on sale in many countries, while providing the same or better service. Efficient refrigerators and freezers may save about 60% of energy, television sets up to 65% and computer monitors more than 80%. Various co-benefits could be achieved at the same time. Yet, to make this happen, policy is needed to help the actors in the appliance value chain to 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.

The bigEE project aims at addressing this problem by summarising knowledge and presenting comprehensive, independent and high-quality information on energy efficiency in buildings, supporting decision-making and its implementation. This bigEE brochure presents policy-makers, implementers and those interested in energy efficiency policies for appliances with an overview of the energy saving potential, economic, social and environmental benefits of appliances, barriers and incentives for actors in the value chain and the policy package to address them.

The brochure is structured as follows:

- The first section outlines the available opportunities for energy efficiency in appliances, incentives for different actors to take steps for designing, buying, using and promoting energy-efficient appliances and how policy-makers can mainstream low-energy appliances.
- The second section discusses the bigEE recommended policy package to achieve energy efficiency in appliances. It details the role of different policy measures in addressing different market actors with respect to specific barriers they face to improve energy efficiency in appliances 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

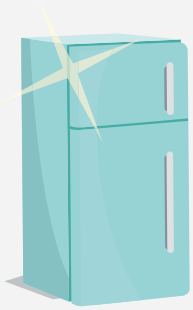
Transformation in residential appliance markets towards best available technologies could cut global electricity demand by 4.6% and CO_2 emissions by 6.5% by 2030 compared to the business-as-usual scenario (CLASP 2011). The potential for refrigerators and freezers is about 60%, for television sets up to 65% and for computer monitors more than 80% (Topten International Group 2014). Further energy efficiency improvements are also likely in the future. If this potential were harnessed by markets and supported by policy, more than 1500 TWh of annual world-wide electricity demand and 1,000 Mt of annual CO_2 emissions could be saved by 2030. Even in economies that already have policies enacted requiring or promoting high energy efficiency levels, significant savings are possible. Where requirements are limited, the savings from accelerated adoption of leading policies would stimulate much larger savings.

Therefore it is highly advisable for policy-makers all over the world to pay attention to the large potentials and to energy efficiency improvements. It is important to abandon the approach of 'as-fast-and-as-cheap-as-possible' because it ignores lifecycle costs and leaves us with appliances that will be wasting vast amounts of energy and money throughout their lifetime.

Different type of appliances and energy saving potential

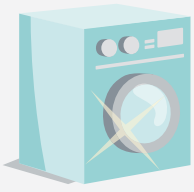
The following paragraphs present energy saving potential in major types of appliances.

Refrigerators/Freezers



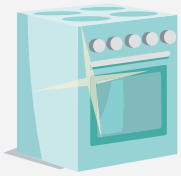
The electricity consumption in refrigerators and freezers accounts for about 14% of global electricity consumption in private households. Currently, about 1.4 billion cold appliances are in use around the world consuming about 650 TWh of electricity and causing GHG emissions of 450 million tons of CO_2 eq a year. The appliance related GHG emissions are still on the increase. However, replacing inefficient refrigerators and freezers with energy-efficient models can reverse this trend despite their growing use. Compared with the situation in 2008, about 360 TWh/yr of electricity savings and GHG reductions of 220 million tonnes per year can be achieved by 2030 due to energy-efficient cold appliances.

Washing Machines



Doing the laundry is an important household need around the world. In the past this has been a time-intensive mechanical work for households. But due to the invention of electric washing machines, this task can now be performed quickly with minimal human intervention. These machines account for about 2% of global residential electricity consumption in private households. Available energy-efficient technologies can cut electricity consumption by as much as 55% and water use by about 73% with corresponding reductions in greenhouse gas emissions.

Cooking stoves



Energy is needed for cooking by end-users on a universal basis. It accounts for about 5% of greenhouse gas emissions worldwide, which is about 2 billion tonnes of CO_2 equivalent emissions per year. Around three quarters of this is due to inefficient biomass- or coal-based cooking in developing countries. Around 50% of energy for this solid-fuel cooking could be saved with very low costs and high net benefits. Switching to energy-efficient and low-carbon modern cooking appliances may allow even higher savings but at higher costs. Globally biomass (wood, dung, crop residues or charcoal) makes up about 88% of cooking fuel. This is due to the large number of biomass users, the low energy content of biomasses and inefficient stove designs. The daily fuel wood consumption alone accounts for about 7 million m^3 in absolute terms. Thus the efficiency of fuel consumption is mostly dependent of the type of cooking stove – there is a very big difference between open fire cooking in many poor countries and modern stove technology. While an induction cooktop is about 90% efficient relative to its electricity input (but maybe only 35% relative to primary energy in an electricity system with predominantly fossil-fuelled or nuclear power plants), a three-stone fire might have an efficiency of about 10-15%. In terms of primary energy, gas stoves are generally the most efficient cooking stoves. Concerning GHG emissions, gas stoves also are advantageous at least when electricity generation is assumed to be mostly based on fossil fuels.

Appliance energy efficiency and climate change mitigation

The previous paragraph show that a high potential for energy saving and climate change mitigation exists in domestic appliances. An increased worldwide adoption of energy efficiency regulations can contribute about 40% of these savings. The other 60% lies in achieving ‘best-practice’ technology level in appliances.

1.2 Co-benefits of energy efficiency

Policy can not only tap into the cost-effective energy saving potential in the appliance sector but also achieve additional ‘co-benefits’ by improving the appliances’ energy performance or by making them more energy-efficient. These co-benefits can have economic benefits of the same magnitude as direct energy savings. The most interesting thing about these co-benefits is the more affordable energy bills, increased individual/social welfare and the direct increasing of earnings for actors on the supply side. 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 investment in energy efficiency improvements than is already now proven to be cost-effective.

The next table summarizes the co-benefits of energy efficiency in appliances.

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

Co-benefits of energy efficiency in appliances

Investors	• Higher price premium for energy-efficient appliances • Enhanced competitive advantage for suppliers of energy efficiency solutions • Improved public image for companies that introduce state-of-the art appliances • Increased cost savings due to investment in energy-efficient appliances
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 prices • More jobs for skilled workers in manufacturing, sales and maintenance of energy-efficient appliances
Environment	• Contribution to mitigating climate change • Increased resource efficiency • Ecosystem protection, reduced pollution of outdoor air and related damage to soil, water and crops
Health	• Reduced indoor pollution • Reduced noise • Healthy and improved lifestyles with energy-efficient appliances

Table 1: Summary of co-benefits for energy efficiency in appliances

1.3 The need for a collaborative approach

Throughout the different phases of development, manufacturing, sale and operation, a multitude of actors take decisions that can influence the energy performance of an appliance. Therefore 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 appliances.

Policy-makers should take a closer look at all relevant market players and their actor-specific market-inherent barriers and incentives to manufacture, sell, or buy an energy-efficient product. In each of the main life-cycle phases from development through to recycling, there are several interlinked steps in the value chain that have to be co-ordinated. Consequently, this process involves a large number of different market actors like manufacturers, retailers, wholesale companies, investors, and users.

There are also some actors that are not part of the value chain for appliances themselves, but nevertheless have an important role to play in influencing the decisions of the market actors – for instance: public authorities, energy agencies, research institutes, and different interest groups (e.g. consumer groups, industry representatives etc.).

The following flow chart illustrates how the relevant actors in the appliances value chain interact in the different life cycle phases of appliances. The arrows demonstrate the supplier relations. The right side of the chart lists influencing actors, who have opportunities to influence the design, manufacturing, sale, or use of the product. Different actors can influence the energy consumption of appliances via the governance framework, research and development activities or energy efficiency advice and other measures.

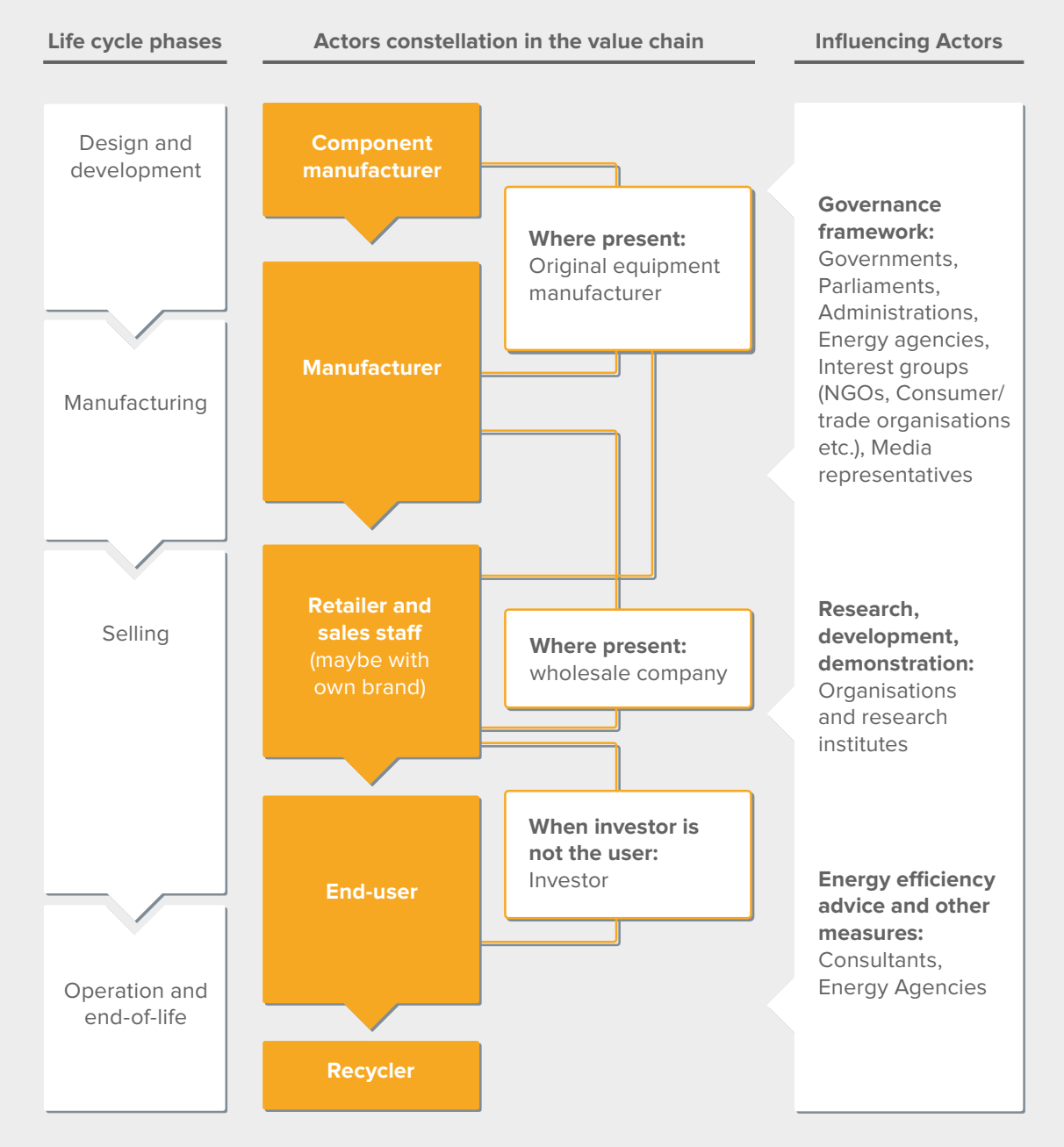


Figure 3: Actors constellation in the supply chain of appliances

Source: Wuppertal Institute (2012a)

1.4 Barriers and incentives

All members of the appliance value chain have their specific barriers but also inherent incentives for harnessing energy efficiency. Too often, however, barriers are stronger than incentives. This is why policy-makers should analyse the situation in their own 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 persistent in the appliance sector due to the multitude of actors involved in it. Many different actors have to work together to achieve 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. The following table lists common barriers and incentives for the actors in the appliance value chain.

Barriers

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

Knowledge/information barriers
- Lack of awareness of the energy efficiency improvement options for appliances on the part of investors and users

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

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-efficient appliances, unless there are split incentives

Co-benefits
- Health and comfort increases due to improved indoor climate, increased ecological and social benefits due to reduced electricity consumption are some of the many positive side effects split incentives

Directly increased earnings or profits for actors on the supply side
- 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

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

Organisational barriers
- Organisational practices or customs, e.g. end-users often use first costs or payback times as investment criteria

The investor-user barrier
- Misplaced or split incentives between investor and final user. The user has almost no opportunity to influence the investment in energy-efficient technologies, as the user mostly depends on the agreement of the investor

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

Increased (re-sale) value of the property
- From a supply perspective, this means higher revenues and possibly higher profits (if customers are willing to pay more due to the expected energy cost savings). Justification for higher prices.

Table 2: Barriers and incentives for the building sector value chain members

1.5 The role of policy

As with buildings, we must identify and analyse carefully all incentives and disincentives for each relevant actor involved in the value chain. Such an analysis will enable political decision-makers to understand why market forces often do not bring about energy efficiency alone, but needs support through custom-tailored policy packages. Policy is needed to help the various actors overcome their respective barriers in harnessing energy efficiency and to strengthen their market-inherent incentives. The goal is to make energy efficiency as easy and attractive as possible, sometimes making it feasible at all, but 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 inherent incentives? The following chapters present our findings on the potential answers.

Read more in the bigEE file
"Why policy needs to assist building and appliance markets to become energy-efficient":
www.bigee.net/s/4twbqv.

2 Recommended policy package for energy efficiency in appliances

Looking at the potential energy savings in appliances and the many benefits they bring (cf. section 1), the goal for policy-makers should be to make energy-efficient appliances the standard. To achieve these goals, all actors in the value chain with their specific barriers and incentives need to be reached through policy. This requires a well-combined set of policies and measures addressing the demand- and supply-side actors and reflecting the national circumstances. Case studies from experienced countries confirm the bigEE recommended policy package.

As we have seen, value chains in the appliance sector are complex. Actors ranging from manufacturers, retailers, wholesale companies, investors and users have inherent incentives to improve energy efficiency in appliances. But they often face strong barriers to take steps for efficient appliances themselves. It is important for governments in each country to analyse the appliance value chains and specific barriers and incentives inherent to each actor before designing and implementing policies for energy-efficient appliances. Appropriate policies are needed to correct market distortions and reducing 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 shows that several instruments will need to interact and reinforce each other in a comprehensive policy package. Each 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).

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 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 appliances 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 appliances and the common Governance Framework policies needed to guide and enable the former, as shown in Figure 4.

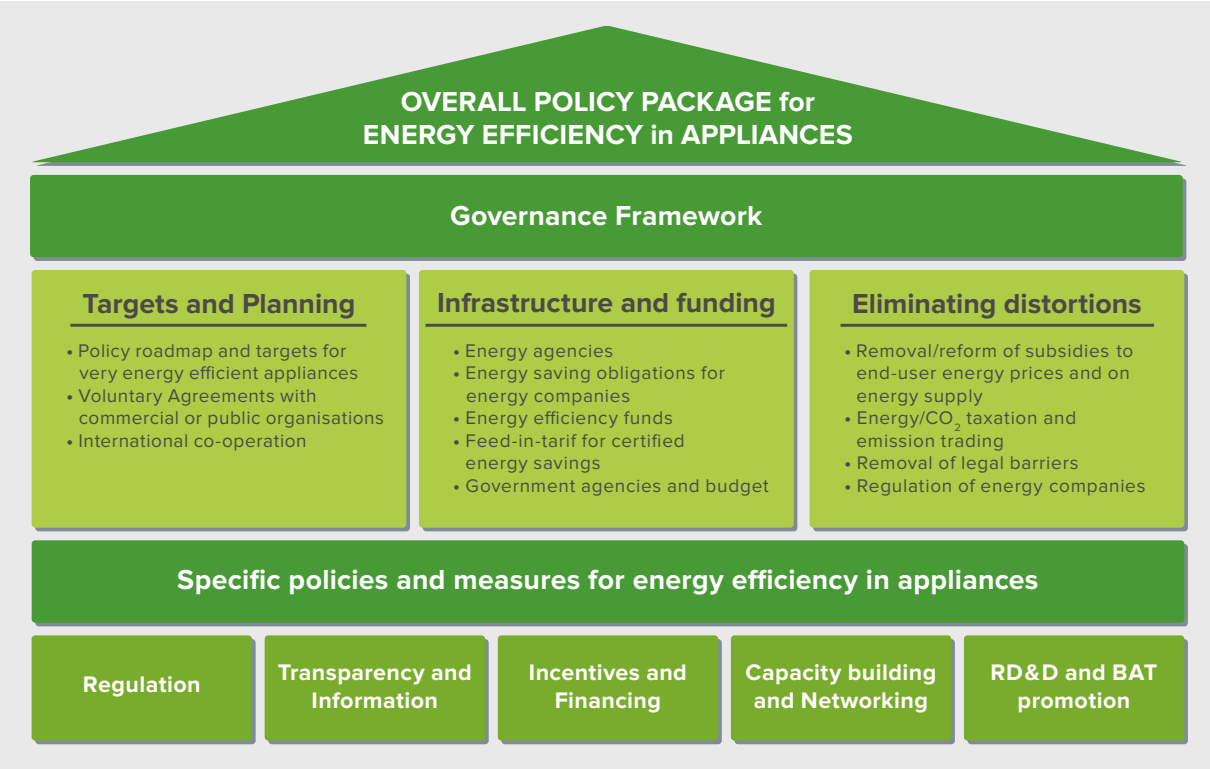


Figure 4: The bigEE recommended policy package

2.1 Interaction between appliance-specific elements of policy package

Appliances are standardised units that the investor purchases 'off the shelf' and just connects to the energy source and in certain cases to the water network. The manufacturer optimizes energy efficiency, but all market participants influence the choice between very energy-efficient and inefficient models. The main goal for policy is, therefore, **to move markets to highest energy efficiency levels and ultimately to make very energy-efficient models the standard.**

A secondary goal is the promotion of energy-intelligent use of appliances. Figure 5 shows the relationship between the performance of appliances (the A-G energy efficiency categories are used to demonstrate the energy efficiency level, A is the highest energy efficiency level, G is the lowest level) and the policies applied to increase the energy performance of appliances.

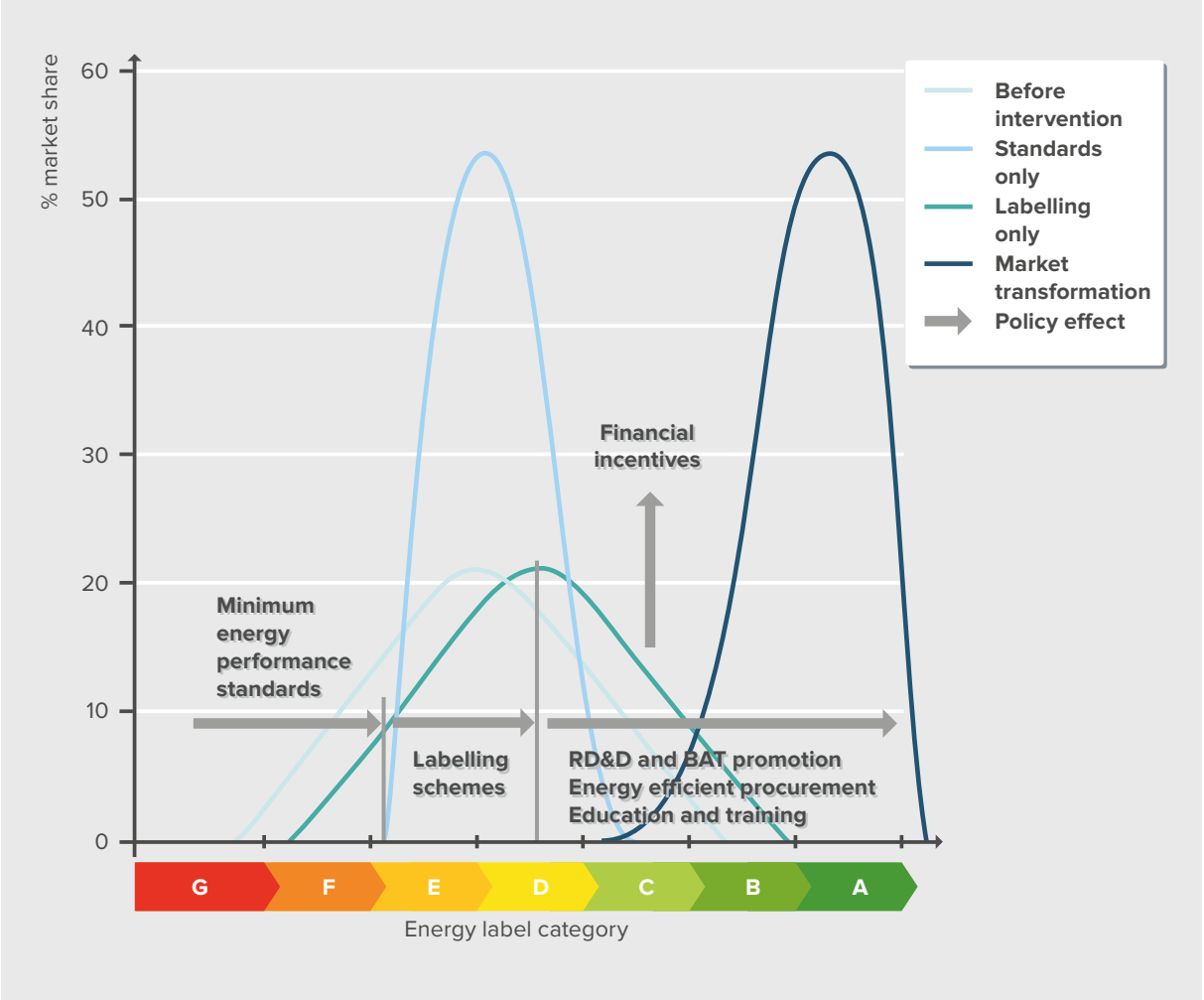


Figure 5: The interactions of policy instruments for energy efficiency in in appliances

Source: Wuppertal Institute (2012)

The following text briefly describes the relevant policy instruments to increase the energy efficiency of appliances and illustrate the combinations and interaction of these policies.

- **Mandatory minimum energy performance standards (MEPS)** are the most important policy for energy efficiency in appliances. 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 very energy-efficient appliances. MEPS reduce transaction costs as well as the landlord-tenant and buyer-user dilemma by removing the least energy-efficient models from the market. They should, however, always be at least as stringent as the energy performance level leading to least life-cycle costs. In a transition period before a law can make MEPS mandatory, a voluntary standard may help. Preferably, **other statutory requirements**, such as individual metering, would complement the legal framework.

- **Energy Labelling** works together perfectly with energy performance standards. MEPS usually eliminate the worst products from the market but do not harness additional energy-saving potentials. Energy labels present the best products on the market and are primarily made for buyers and end-users. They are, thus, one element of the package to 'reach the energy efficiency top', like the others that follow here.

- Mandatory energy labelling schemes mostly compare the products on a classification scale to show the best but also the worst products on the market. Such classification labels are, however, useful only if there is a large enough spread of energy efficiency levels between the models of a type of appliance offered in a market. Where that is not the case, an endorsement label for the most energy-efficient models may just be an alternative and nothing else. Furthermore, an information campaign is needed in order to promote the label and to raise the consumer's awareness towards energy efficiency.

- The market should, in addition, be prepared for the next step(s) of MEPS regulation towards very efficient appliances through policies tackling the substantial information deficits and financing barriers. This includes the already mentioned energy labels, but also **advice**, easy-to-use product choice and life-cycle cost calculation **tools and financial incentives** – such as rebates, grants and tax incentives – for broad market introduction of energy-efficient appliances. The latter are more costly than other instruments, so they will be particularly useful if there is a very large spread of energy efficiencies in the market and, hence, large energy cost savings are possible. In addition, they can often be limited to a certain time period (e.g., two or three years) until the market offer and demand has switched to the energy-efficient models. For low-income households, **financing support** may be needed to purchase very energy-efficient appliances that have a higher upfront cost but pay back over their lifetime through lower energy bills. It is mainly for such information and financial programmes that energy efficiency funds or energy companies must contribute.

- **Education and training** of professionals (manufacturers, sales staff, and other relevant market actors) should prepare introduction and further strengthening of MEPS regulation. Certification of successful participation in the training can make it more attractive for both the qualified market actors and their customers.

- Once a certain market share of (highly) efficient appliances is reached, the professionals are trained and used to selling the energy-efficient models and the cost-effectiveness of the next step is proven, this level can then be mandated by the regulation to become the new MEPS level.

- Future steps of MEPS regulation towards very energy-efficient appliances should be prepared by innovation support through **R&D funding**, award **competitions**, and maybe also by financial incentives for broad market introduction. The **public sector** should **lead by example** through energy-efficient public procurement, thereby paving the way for the other sectors to follow. To push the market further towards energy-efficient appliances and create first markets for them, **co-operative procurement** programmes can make an important contribution towards very efficient products due to the high purchasing power. Voluntary agreements with large buyers to purchase more energy efficiently than required by MEPS may also support market introduction.

2.1.1 Good practice examples of policy packages

This section consists of cases studies from California (United States), Brazil and Japan. The case studies demonstrate the experience of these countries in designing and implementing the policy package for energy efficiency in appliances. Policy-makers from other countries can learn from the experiences of these countries and adapt policy packages according to their own national circumstances.

2.1.1.1 Policy package for energy efficiency in refrigerators in California (USA)

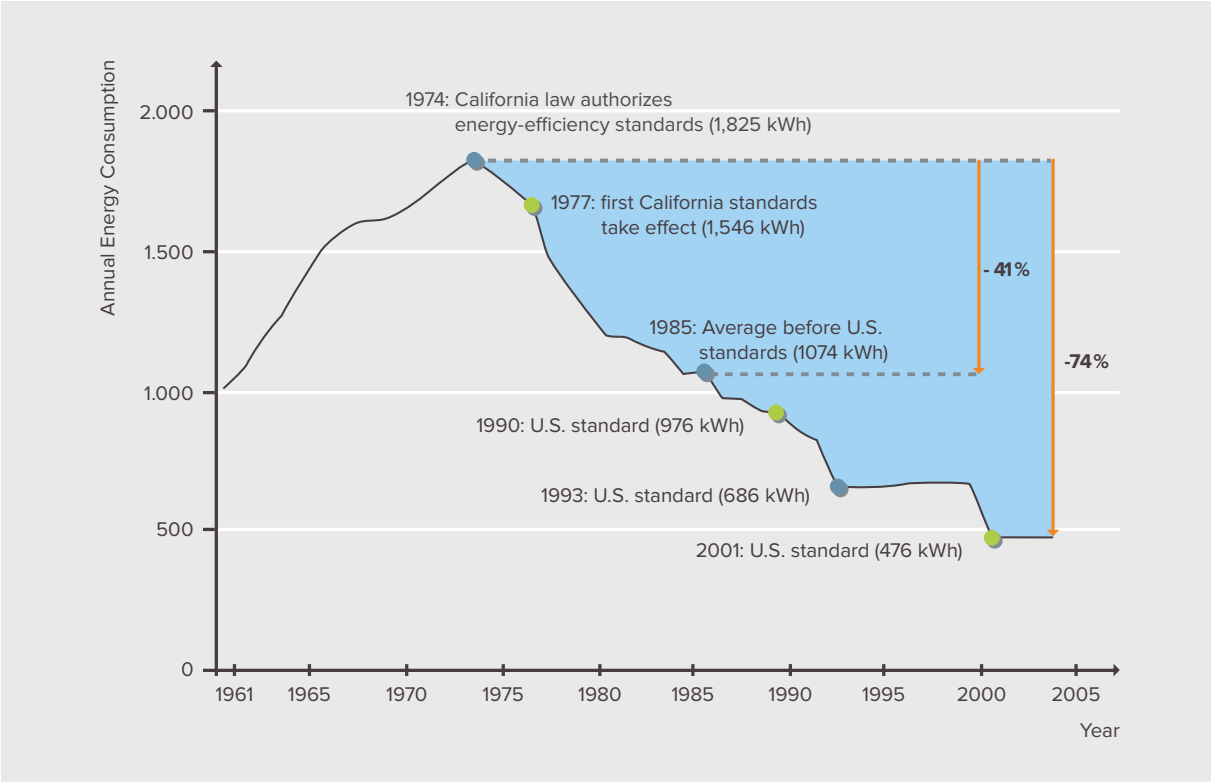


Figure 6: Minimum energy performance standards and electricity consumption for refrigerators in California since 1960.
Source: CLASP 2005

California's comprehensive policy package for energy efficiency in general and especially for refrigerators consists of several interacting federal and state measures in order to reduce electricity consumption. In 2006, "Assembly Bill 32" regulated mid-term and long-term GHG reduction levels. While a roadmap (Scoping Plan) specifies the overall strategy, the Strategic Plan emphasises measures on energy efficiency in particular. For example, the Plan stipulates that appliance standards are strengthened and expanded frequently. In comparison to standards established countrywide by the U.S. Department of Energy, California already has a broader set of equipment standards. Phasing out least efficient appliances due to MEPS is as important as financially incentivising the purchase of highly efficient products. Utility companies that are required by state law to provide energy efficiency services and, thus, must develop energy reports that need approval by the California Public Utilities Commission give rebates for energy-efficient appliances to consumers. The rebate programmes and other energy efficiency programmes are funded by the "Public Goods Charge" on electricity mandated by law.

The fact that California introduced a cap-and-trade programme on greenhouse gas emissions in 2012 (with enforcement measures effective only in 2013), in which utility companies must participate, makes customer rebate programmes even more attractive because by reducing the energy consumption of their customers, utility companies reduce the need to buy allowances. In order to promote the rebate scheme and increase the number of very efficient product sales, the California Energy Commission – the key department for all strategic policy planning in the state – developed a product database in which customers can find products eligible for funding. Apart from that, the U.S. federal level with the Environmental Protection Agency in the driver seat introduced two labels (the Energy Star and the EnergyGuide) making it easy for customers to identify energy-efficient products, although these labels are not necessarily criteria for California's appliance rebates.

Summarising: Energy efficiency policy in the USA is a complex topic especially because "policies reflect the interplay of federal, state, and local jurisdictional levels" (Doris et al. 2009, p. 1). The state of California is often referred to as the frontrunner in the field of energy efficiency and clean energy policies and established a comprehensive governance framework to support energy-efficient appliances. The following table presents the annual savings by end-use (2011) and underpins the success of the energy efficiency policies in California.

	GWh	% of total savings	MW	% of total savings
Residential	403	28.41%	61	23.25%
Consumer Electronics	17	1.23%	2	0.67%
HVAC	2	0.13%	2	0.79%
Lighting	315	22.19%	41	15.87%
Pool pumps	2	0.16%	0	0.07%
Refrigeration	59	4.17%	11	4.25%
Water heating	1	0.05%	0	0.05%
Other	7	0.48%	4	1.53%

Table 3: Annual savings by end-use in California's residential sector 2011
(Results from activity installed in 2011 only)
Source: South California Edison Company 2012, p. 154

Read more on California's policy package for energy efficiency in refrigerators in the bigEE Policy Guide:
www.bigee.net/s/rcxhh2

2.1.1.2 Policy package for energy efficiency in refrigerators in Brazil

Brazil's energy system emits comparatively low levels of CO_2, not least because 70% of its energy is produced via hydro plants (ACEEE 2010). However, the inadequate security of supply puts growth of the Brazilian economy at risk. The big challenge is to increase energy security without incurring massive costs and without increasing emissions (GIZ 2009). Therefore, the Brazilian government had already established a political framework with energy efficiency targets in the mid 1980s.

One important sector to reach these targets is energy-efficient household appliances. In this context refrigerators and freezers are an area with a long energy efficiency history. Since the mid 1980s, Brazil has tried to improve the energy efficiency of these appliances with a number of initiatives including the adoption of a standard test procedure (mid 1980), voluntary energy efficiency targets (1994), recognition and award for very efficient models (1995-1999), pilot rebate programmes for top-rated appliances (1996-1998), and voluntary agreements for efficiency improvements (1998) (Geller 2000).

In the more recent past, the government introduced MEPS for refrigerators (2007) to exclude the most energy-consuming models from the market. Two energy labels accompany the MEPS: one is mandatory and displays the energy consumption of an appliance to make the market transparent; the other one is an endorsement label that highlights the most energy-efficient appliances.

The labelling schemes work perfectly with the MEPS. Standards usually eliminate the least energy-efficient products from the market but do not harness additional saving potentials. Labels present the best products and are primarily made to inform investors and end-users. Furthermore, refrigerator replacement programmes are implemented as well under an obligation scheme for energy companies.

With this combination of instruments, Brazil has almost halved energy consumption of new refrigerators and transformed the market. To further reduce greenhouse gas emissions, the replacement programmes are supported by refrigerator recycling programmes, in which the refrigerants and foaming agents are disposed of in an environmentally friendly manner and in order that recyclable materials can be used again by the local industries. New jobs are created thereby.

Read more on Brazil's policy package for energy efficiency in refrigerators and freezers in the bigEE Policy Guide: www.bigee.net/s/gryeew

2.1.1.3 Policy package for energy-efficient refrigerators in Japan

Japan combines several measures to a consistent policy package promoting the dissemination of energy-efficient appliances. Probably the most important instrument is the "Top Runner Program", which was designed to stimulate continuous technological improvements by the manufacturers towards an increased energy efficiency of selected product groups. The underlying logic is to identify the most efficient technologies in the market and then turn it into the top runner standard which similar products have to meet before a defined target year is reached. This target year is usually three to 12 years into the future.

Besides targeting the actions of suppliers, an additional mechanism in the framework of the Top Runner Program is concerned with the purchasing decision of end-users. A mandatory comparative energy labelling scheme for five important types of appliances and a voluntary but more comprehensive energy labelling scheme enable end-users to conclude informed purchasing decisions by showing how far a certain product has achieved the energy consumption efficiency standard of the Top Runner Program. Furthermore, the labelling schemes inform readers about the energy consumption and the monetary savings of the product and aim to guide a consumer's purchasing decision. The mandatory classification label uses a five-star rating that provides consumers with comparative purchasing information.

This ranking system is also an important precondition for the "eco-point scheme". For four or five star labelled products, the consumer can get so called "eco-points". These eco-points can be exchanged with, for example, energy-efficient or environmentally friendly products or prepaid cards.

In addition to the Top Runner Program, the labelling initiatives and the eco-point scheme, a retailer commendation programme was introduced to contribute to further energy-efficient product sales. The programme selects stores, which are active in selling and promoting energy-efficient products (ECCJ 2010). Retailers who have pushed energy-efficient products outstandingly receive this award and can label their store as a "Top Energy Efficient Product Retailing Promotion Store".

To take account of the old inefficient household appliances, Japan has established a recycling programme. Collection centres were established as well as recycling plants. In 2004, 25% of all recycled electric appliances were refrigerators (2,800,000 units).

Information campaigns, for example, several school programmes, product databases, catalogues and campaigns for consumers were implemented to address the demand side. Another programme is named "Smart Life" and represents new lifestyles. It informs consumers about the labelling scheme and energy efficiency in general (EECJ 2012).

To address the public sector Japan introduced the Green Purchasing Law (The law concerning the promotion of eco-friendly goods and services by the state and other entities) in 2001. The law makes it obligatory for ministries, agencies and other governmental institutions to procure eco-friendly products. Green procurement has been considered to be one of the most successful environmental initiatives in Japan (ICLEI Europe 2001).

With these policies the energy efficiency of home electronics equipment has largely improved. Figure 7 illustrates the annual power consumption trends of electric refrigerators (EECJ 2010). In 1998, household refrigerators and freezers accounted for 17% of electricity use in the residential sector in Japan. The numbers in Figure 7 indicate guidelines as an estimate for the annual power consumption by refrigerators with the rated capacity of 401-450 litres for each fiscal year.

With the great earthquake in 2011 and the consequences of this disaster, energy efficiency and conservation have increased their relevance as a solution to energy supply-demand problems and to achieve a reduction of nuclear dependency.

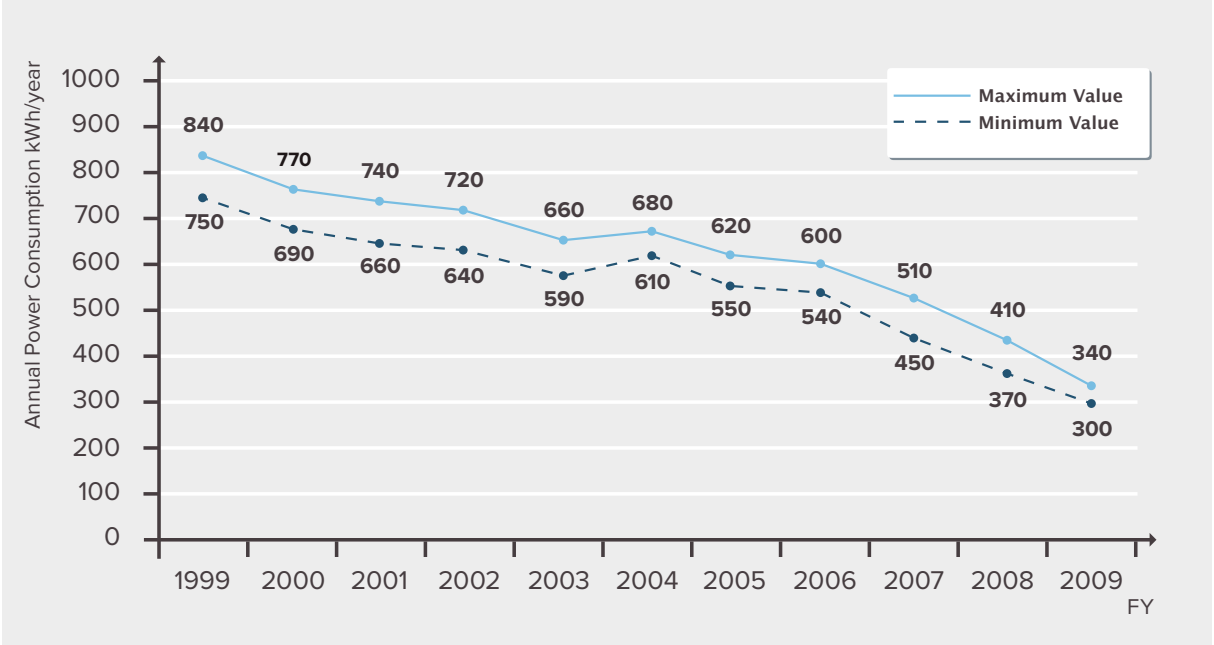


Figure 7: Estimate of annual power consumption trends for large electric refrigerators (401 to 450 liters)

Source: Japan Electric Manufacturers' Association (2011)

Read more on Japan's policy package for energy efficiency in refrigerators in the bigEE Policy Guide:
www.bigee.net/s/zk24q6

2.2 The components of the recommended policy package

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. A single policy cannot address all market barriers; it will rather 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 comprehensive policy package approach will provide a balance between clear mandatory measures, incentives, information and capacity building. A governance framework is also needed to enable implementation of these policies.

2.2.1 Overall governance framework for energy efficiency

In the bigEE recommended policy packages (Figure 8), 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 have been highlighted 📌.

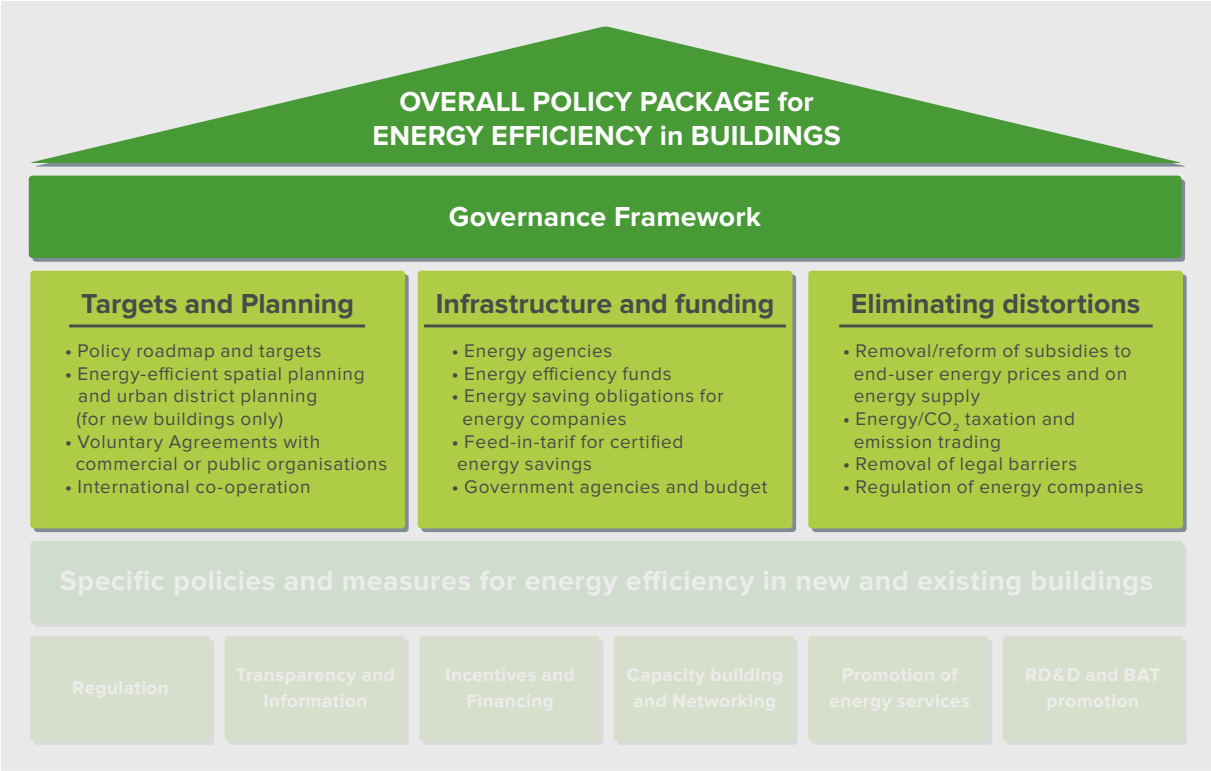


Figure 8: The bigEE recommended policy package: Governance Framework.

Short description of policy or measure

Targets and planning

Policy roadmap and targets for very efficient appliances

Countries can co-operate in many ways to learn from each others' experience in policy-making and policy success. The international co-operations are diverse. For example countries can jointly develop energy performance standards for appliances and buildings 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 uniform labels. Countries can also co-operate in professional training and in the development and application of evaluation methods for energy savings, costs, and benefits.

Voluntary Agreements with commercial or public organisations

Voluntary Agreements (VAs) on energy efficiency targets and procurement of energy-efficient appliances can be concluded by the government with commercial or public organisations (e.g. banks, insurance companies, supermarkets, local authorities). The organisations commit to reach energy efficiency targets and/or to implement energy efficiency actions. In addition to energy efficiency in buildings, such VAs should also include purchasing only (very) energy-efficient appliances. VAs can thus be a complement to regulations, e.g. for by promoting much more energy-efficient appliances than mandated by law. Support for implementing VA schemes, such as tools for public purchasers, benchmarking, monitoring, information dissemination and financial incentives, plays an important role. In order to make such agreements effective, they must include rules for independent monitoring and impose effective penalties in case of non-compliance. For the public sector, however, mandatory rules for public procurement to buy only energy-efficient appliances are even better than voluntary agreements.

International co-operation

Countries can co-operate in many ways to learn from each others' experience in policy-making and policy success. The opportunities for international co-operation are diverse. For example, countries can jointly develop energy performance standards for appliances 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.

Infrastructure and Funding

Energy agencies

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

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 energy in energy end-uses (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 research and development and demonstration (RD&D)/best available technologies (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.

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 (also known as energy efficiency 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 or energy companies, 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.

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 or of large energy efficiency projects a fixed remuneration for every certified unit of energy saved. This could be an alternative to energy saving obligations for energy companies that creates more competition in the energy efficiency market. No countries have implemented such FITs for certified energy savings 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.

Eliminating distortions

Remove/reform of subsidies to end-users 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 emission 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

Sometimes law prohibits energy-efficient solutions. Examples could be the prescription of minimum washing temperatures (e.g. 40 °C), minimum brightness levels of computer screens, the prohibition to hang out clothes to dry in the sun, or other standards that favour inefficient technologies. 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 natural monopolies (mainly grid companies) or 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 policy package needs to be designed and implemented within the conditions of 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. energy labelling and rating schemes), monetary incentives or financing (e.g. tax benefits), capacity building (education and training programs for relevant market actors), research and development and demonstration (RD&D) and Best Available Technology promotion (e.g. R&D funding and award competitions). These specific policies and measures are explained in Table 5. Priority elements have been highlighted 📌.

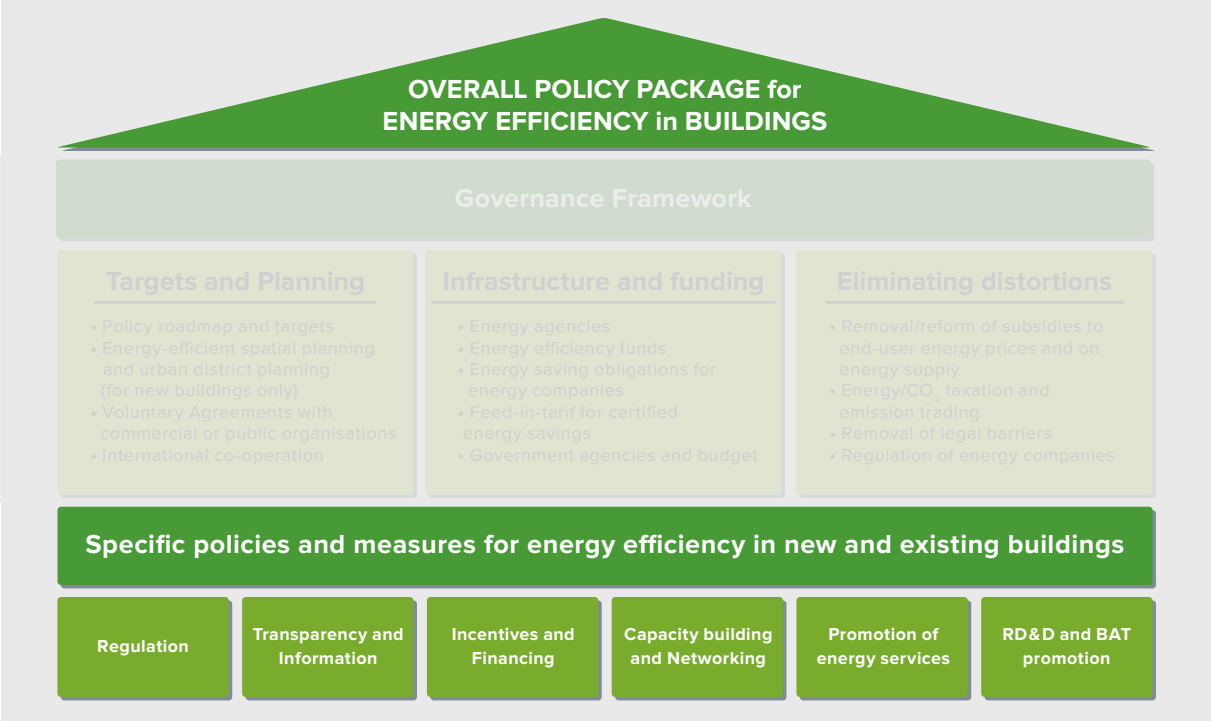


Figure 9: The bigEE recommended policy package: Specific policies and measures for energy efficiency in new and existing buildings.

Short description of policy or measure

Regulation

Minimum energy performance standards (MEPS)

Minimum energy performance standards are a key regulatory tool for improving the energy efficiency of appliances. They set the minimum level of energy efficiency a product must meet to be sold in the marketplace. The aim is to remove the least energy-efficient products from the market to reduce energy consumption. MEPS are one of the most effective ways to encourage energy efficiency improvements in products.

Top Runner Approach

The Top Runner Approach is a standard setting tool which (at one point in time) identifies the most energy-efficient appliance of a given product category and, secondly, defines this efficiency value as the standard for the product group. Similar products have to meet this standard before a defined target year is reached and every manufacturer must comply with this standard. This approach is a potential alternative to MEPS. It is designed to more directly stimulate continuous technological improvements by the manufacturers of products. The Top Runner Approach can also be characterised by a continuous revision system. An effective control and enforcement regime is essential to ensure compliance with the standards.

Other legal requirements

Other legal requirements like individual metering – particularly smart metering – informative billing, and energy management for larger service sector buildings or building owners, aim at changing the energy consumption behaviour of end-users by providing frequent feedback, e.g. on energy bills. Such measures can easily be combined with information programmes and other policies to enhance the effectiveness. Savings of up to 30% can be achieved through individual metering. In order to ensure and sustain these savings, individual metering should be supported through comparative billing for example, so that end-users can benchmark their performance.

Transparency and Information

Mandatory comparative labelling schemes

Mandatory comparative energy labelling is crucial to make the market offer of standard appliances or systems transparent regarding energy consumption and energy costs. Such labels are the basis for other information and for financial incentive policies and programmes. Comparison labels allow consumers to judge the energy efficiency and relative ranking of all products that carry a label. In order to provide complete market transparency, it must be mandatory by law for manufacturers and retailers.

Voluntary endorsement labelling schemes

Voluntary energy efficiency endorsement or eco-labels highlight the ‘best in class’ products. Energy efficiency endorsement labels can be useful for types of appliances, for which a mandatory comparative energy label is not appropriate or not yet implemented. Eco-labels can highlight other environmental features in addition to energy efficiency but should not contradict a comparative energy label.

Provision of targeted information

Energy consumption is normally invisible, as are the manifold opportunities to save energy through energy-efficient appliances. Policy must use intelligent instruments to convey focused information on these opportunities and their benefits to energy end-users but also other actors including sales staff in appliance retail. To induce concrete action, the information must also clearly say what one can do to reap those benefits.

Feedback and other measures targeting user behaviour

Feedback measures will increase end-users' awareness and transparency about their own levels of energy consumption. Combined with practical tips for energy-efficient user behaviour and its potential energy and cost savings in appliances, feedback and other 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, benchmarking, normative messages, practical information 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 prompts, motivation campaigns for behaviour change, energy saving competitions and training of users on energy-intelligent use of appliances. Experience 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.

Incentives and Financing

Financial incentives

Financial incentives reduce the incremental costs of the most energy-efficient appliances and are typically used with a view to accelerating their market penetration. They can thus make an important contribution to increasing the share of best available technologies (BAT) in the market and to replace existing old low-efficiency appliances. However, they are mainly appropriate for appliances with a high spread of energy efficiency levels between the least and most energy-efficient models on offer and with high absolute energy savings. Good candidates are usually refrigerators and freezers, heat pump clothes driers, commercial food preparation, refrigeration, and washing appliances, and maybe TV sets. There are different options for providing financial incentives, and the choice will depend on national circumstances.

Financing

Financing instruments target the barrier of insufficient availability of, or access to, capital for financing the incremental costs of energy-efficient appliances. This barrier is particularly an issue for low-income households that often cannot afford the additional cost to purchase and benefit from such equipment. Thus, in addition to enabling the realisation of untapped energy saving potentials, financing instruments also contribute to (energy) poverty alleviation and work towards the transformation of appliance markets. The most relevant instruments to tackle the financial barrier for very energy-efficient appliances are preferential loans or on-the-bill financing (OBF) schemes.

Capacity building and networking

Voluntary agreements with manufacturers

Voluntary agreements (VAs) are negotiated between the government and individual manufacturers and importers on improving the average or minimum energy efficiency of the appliances sold in a market. These energy efficiency targets should be coupled with commitments and time schedules on the part of all participating parties. Such agreements typically have a long-term outlook, covering a period of five to ten years, so that strategic energy-efficiency investments can be planned and implemented. Governments should identify win-win situations, in which the benefits of public and private sectors overlap (IEA 2010). The ecological effectiveness of such VAs depends on the agreement on and the realisation of concrete and ambitious reduction targets, accurate and independent evaluation procedures and effective penalties in case of non-compliance with the targets. Under these conditions, voluntary agreements with manufacturers may be an alternative to MEPS or precede and prepare these.

Education and training for supply chain actors

Education and training programmes for sales staff in retail companies and possibly for manufacturers (particularly in developing countries) aim at transforming the appliance market by

1) establishing knowledge on the status-quo of designing, selling and operating very energy-efficient appliances

2) correctly and convincingly informing investors and users about the cost-effectiveness and other benefits of efficient appliances, so as to change consumers' purchasing decision, making them opt for a highly energy-efficient appliance.

Such programmes are beneficial to manufacturers, retail companies and consumers. While retail companies participating in training and certification programmes can distinguish themselves from other retailers, consumers can obtain tailor-made information through a personal energy advice. Supplementary measures such as a (visible) logo attracting consumers to the participating shops or an award scheme drawing media attention, may make it even more interesting for supply chain actors to participate.

RD&D and BAT promotion

Energy efficiency public procurement

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).

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 products already available on the market (BAT) or new, even more energy-efficient appliances ('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 and eventually becoming the default technology in new construction.

Research and development funding

Through promotion of research and development (R&D) activities as well as demonstration projects, innovations in terms of technologies and design concepts are fostered. R&D is critical to drive the development of innovative technologies to contribute to mid-term and longer-term policy goals and to ensure that efficient technologies are ready for commercialisation in time. R&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 R&D policy governments can further support capacity building of comprehensive national scientific and technological research institutions on energy efficiency (GTZ et al. 2006).

	Competitions and awards Competitions for energy efficiency awards promote the development and commercialisation of new appliances that are more energy-efficient than the best available technologies (BAT). Simultaneously, through awareness raising channels, the award scheme will draw the public's attention towards energy-efficient appliances. Manufacturers and investors in energy-efficient appliances can benefit both financially and in terms of improved reputation and prestige. Many countries have already organised competitions and awards to promote the best practices in energy-efficient appliances. At times, improvements in energy efficiency over pre-existing BAT of 25 to 50% have been achieved.

Table 5: Short description of policies and measures

2.2.3 Good practice examples of specific policies and measures

The following section presents good practice examples of specific policies and measures for energy efficiency in appliances as implemented in different countries of the world.

2.2.3.1 EnergiePremieRegeling (energy rebate scheme), The Netherlands

The Dutch programme "EnergiePremieRegeling" (EPR) was implemented in The Netherlands between 2000-2003, aiming, inter alia, at the promotion of energy-efficient appliances by creating favourable conditions for users and investors to buy the most efficient appliances. The programme, which was implemented in co-operation with energy companies, offered cash rebates for the purchase of higher energy-efficient household appliances, like washing machines, TVs, or refrigerators (e.g. in 2002, customers received €50 for each refrigerator with energy label A and 100€ for super efficient A+ and A++ appliances; the programme was based on dynamic requirements, i.e. one year later in 2003, only the super-efficient appliances were eligible for rebates), and other promotional activities.

The programme aimed at achieving a permanent transformation of the market and at inducing investors to buy energy-efficient products. Grants for the purchase of the energy-efficient appliance were offered, lowering the cost of the product to the consumer and making consumers aware that it was cost-effective for them to select energy-efficient appliances when they bought one.

These financial incentives were funded by an energy tax (Regulating Energy Tax; Regulerende Energie Belasting REB), of which 15% was channelled back to the consumer through EPR rebates paid out by the energy companies. This so called "ecotax" on electricity and gas was in principle paid by the consumer to the state, but the energy companies collected it. The energy companies subtracted the energy rebate payments under the EPR scheme plus an addition of 10 to 20% for their efforts in communicating and administering the programme from their ecotax debt to the state budget.

This programme achieved, as an example, that 94.4% of the market of washing machines were class A and higher i.e. the highest penetration in Europe at that time. The same was true for the super-efficient refrigerators and freezers, even a year after the programme ended in 2003.

Savings of at least 300 GWh/year and 0.3 million tons of CO_2 were realized with the EPR programme (including the measures for insulation of buildings). The programme gave net economic benefits to the consumers who participated, but had slightly negative economic results for society.

This overall result, however, includes costly measures such as solar energy and may also be due to free-rider effects: these were intentionally high, since the government wanted to ensure giving back a share of the increased energy tax to consumers.

Read more on The Netherlands' good practice example on Rebate scheme for energy-efficient appliances and other actions in the bigEE Policy Guide: www.bigee.net/s/dpsjvz

2.2.3.2 Utilities' Refrigerator replacement programme, Brazil

Brazil has introduced several programmes to increase the energy efficiency of appliances. One of these programmes is a refrigerator replacement programme. Electricity distribution companies are required to invest part of their revenues in energy efficiency programmes. Since 1998 these funds were often used by the distribution companies to invest in energy efficiency programmes to support low-income households. Around 30% of the Brazilian refrigerators are more than 10 years old. Most of these old refrigerators belong to low-income households. Figure 10 illustrates the age of the refrigerators in Brazil (in 2007).

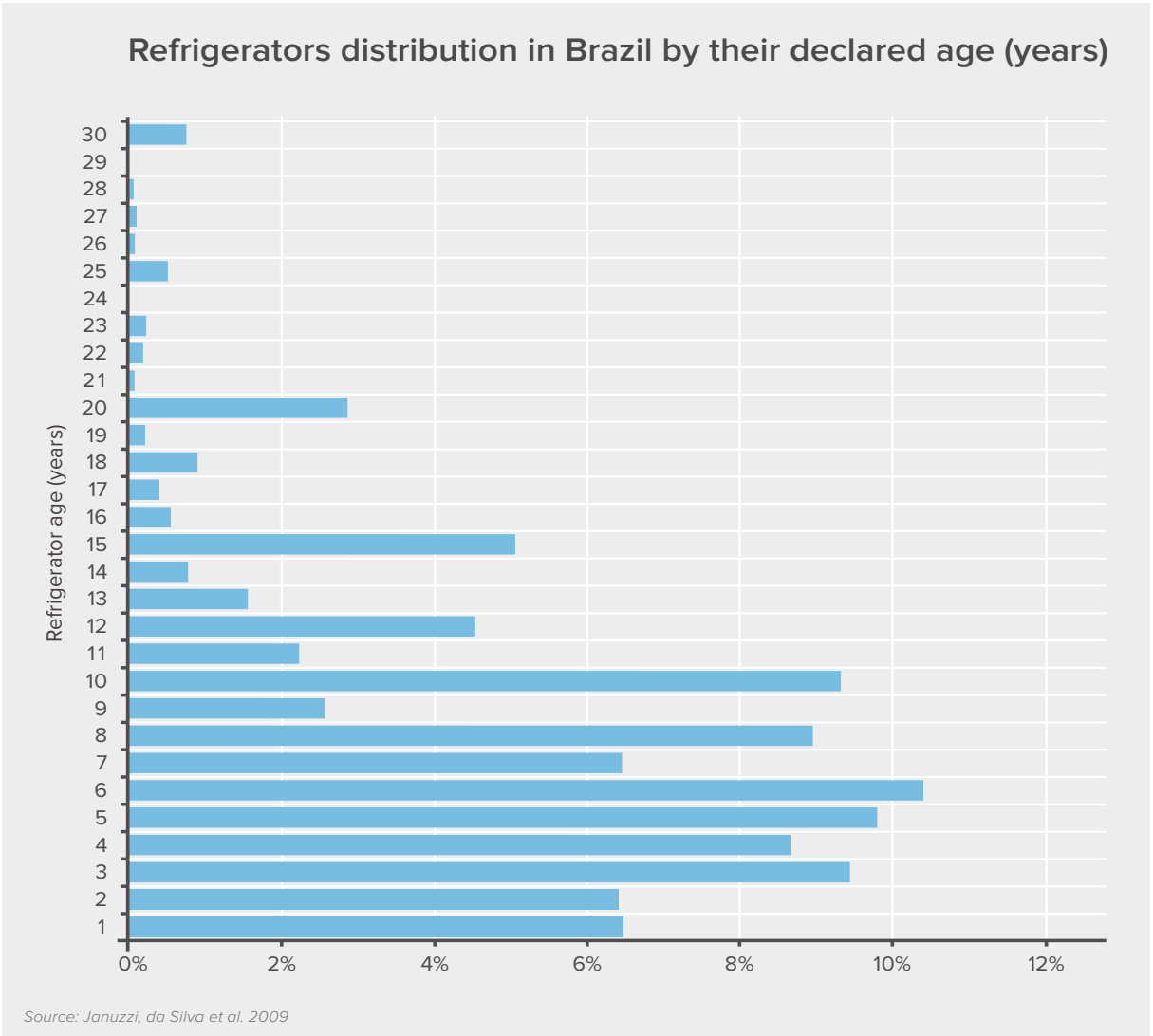


Figure 10: Refrigerators distribution in Brazil by their declared age (years)

Source: De Martino Jannuzzi et al. 2009

To change this situation and to replace these old refrigerators, the programme donates new energy-efficient refrigerators (class A) to low-income consumers. It is financed by a charge collected from all electricity consumers. The obligation to invest in demand side energy efficiency programmes began in 1998 and is regulated by ANEEL (Agência Nacional de Energia Elétrica), the national regulatory agency. Distribution companies decided which programmes to carry out. In 2011 this obligation became a national law (instead of a regulation by ANEEL).

The initial cost for the utilities (distribution and supply energy companies) is high as the refrigerators are free to the customers, but 26 out of 94 programmes achieved direct economic benefits higher than the costs. The others at least achieved social and environmental benefits. One aim is to reduce the utilities' commercial losses due to irregular connections. The programme also wants to aid the provision of energy in the long term for all households in Brazil by reducing the overall consumption.

Read more on Brazil's good practice example Utilities' Refrigerator replacement programme in the bigEE Policy Guide: www.bigee.net/s/h6g7ws

2.2.3.3 Topten (European Union, China, USA)

Topten is an international programme promoting energy-efficient electrical appliances and other products. It operates mainly through a website, on which consumers and other buyers can find the most efficient products of a type.

National sites cover 19 countries, including 17 European countries, China and the USA. Each country site presents the most energy-efficient products in that market, in categories including office equipment, lighting and household appliances. Each of the national Topten sites is accessible through the common portal www.topten.info.

The website provides information on energy consumption, cost and key attributes of around ten most energy-efficient products as well as a typical inefficient alternative. The tool is easy to use and simplifies the buying decision. Consumers can easily find the most energy-efficient and cost-effective appliance to meet their needs and see the savings they can make. Other separate Topten pages provide advice for professional buyers, including procurement guidelines and sample tender documents.

Product details are tailored to each category but the key criteria are energy efficiency, other impacts on the environment, human health and quality. Details are updated every six months to create a dynamic benchmark (Bush et al. 2009).

Additional information provides advice and encourages consumers to save energy by showing how it causes climate change and what consumers can do to reduce their impact. A Topten game has started in several countries to reward the entrant with the greatest energy savings.

Read more on China's good practice example Topten in the bigEE Policy Guide: www.bigee.net/s/kaqbj8

2.2.3.4 Kurveknækkeraftale, Curve Breaker Agreement, Denmark

In 1999 the Danish Energy Saving Trust (DEST) started promoting energy-efficient procurement and established a programme called the A-Club, aiming to reduce the rising electricity consumption of public institutions, which was growing by about 1% annually. The goal was to promote energy-efficient A-labelled products and to transform the market. The participants signed an agreement stipulating that they must purchase energy-efficient products when available.

The Curve Breaker Agreement (CBA), which was established in 2007, replaced the A-Club and was even more successful in saving electricity.

In order to continue the process to push the market towards energy-efficient appliances DEST made several tools available to the participants of this Curve Breaker Agreement. The programme was primary introduced to reduce the electricity consumption of the public sector, but also non-governmental actors can participate.

Before an agreement was signed, the institution interested in increasing its energy efficiency had to co-operate with a special contact person at the DEST. Together the institution and this coach identified energy saving potentials and they, moreover, came to terms on the amount of electric energy that is to be saved within a particular period of time (e.g. 15% of electricity saved between 2009 and 2011). Both, amount of energy saved and time, became contractual after DEST and the participant signed a CBA. Regular meetings between consultants and participants safeguarded tailor-made support and surveillance over constant energy reduction efforts. All members were required to make their energy consumption transparent through the website 'Se Elforbrug' in order a) to keep self-check their consumption and b) to make information available to the public. Transparency might increase public pressure on the participant in case of non-compliance. Secondly, participants had to publish how savings were achieved to demonstrate the success to other CBA members. The DEST, on the contrary, "offers coaching (i.e. via special training courses), behavioural campaign material and a special energy saving promotional suitcase" and "will work to ensure that efforts [...] are profiled in the media" (DEST 2008). As the DEST also regularly publishes energy-efficient purchasing guidelines, it has the knowledge capacities to consult CBA participants comprehensively in the field of public procurement. A chronological order of the CBA process is shown in Figure 11.

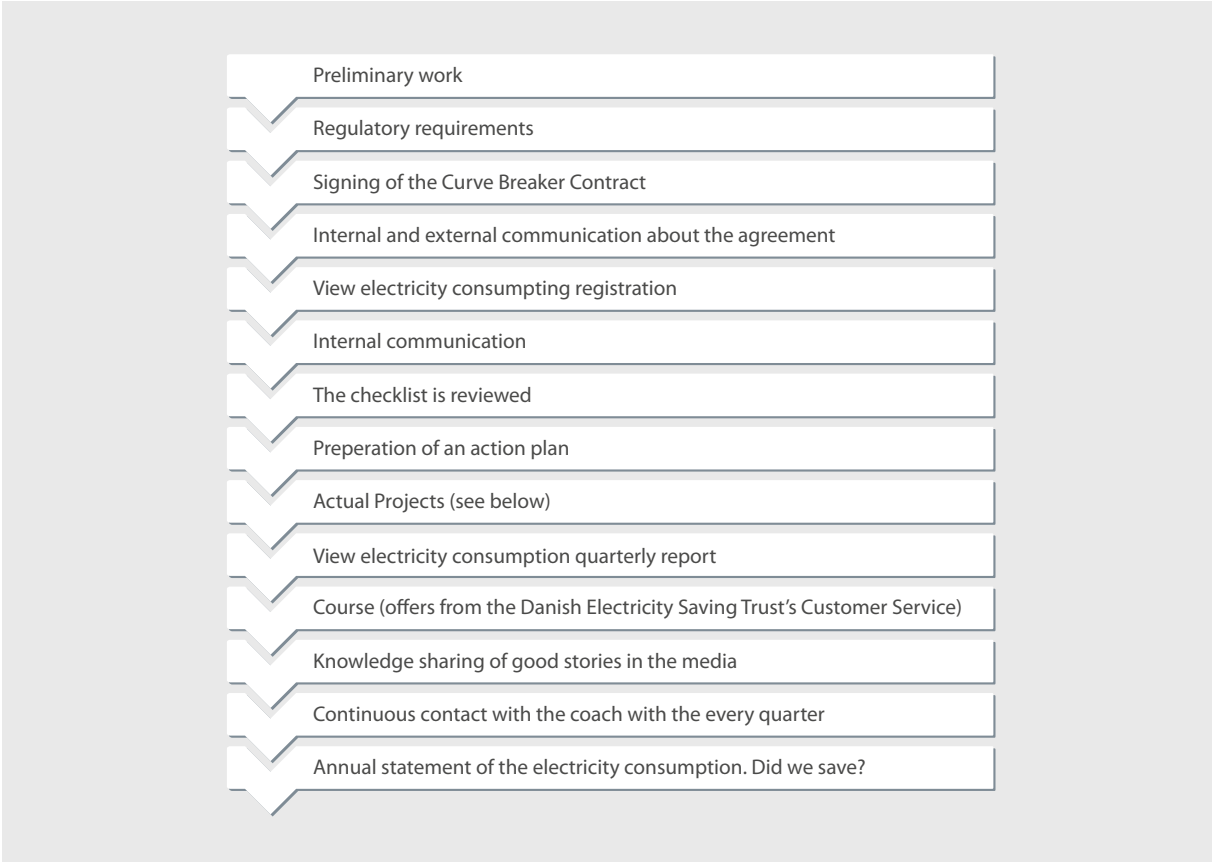


Figure 11: Curve Breakers: Progress and inspiration arrow

Source: Jarby et al. 2009, p. 15

The mandatory EU Energy Label and the voluntary Energy Star label were used to identify adequate office equipment. Even more conveniently were appliance and equipment lists, showing energy-efficient products. Public institutions in Denmark were eligible to benefit from temporary public subsidy schemes for energy-efficient appliances and systems. Such incentives had been made available by the DEST, which is financed through an extra charge of 0,06 Eurocents/kWh on electricity bills of private households and public institutions, as well as more recently by the Danish energy companies.

By 2010, 177 CBAs were concluded. Some committed to save up to 30% between 2008 and 2012. Some partner institutions had also been located outside of Danish borders such as the Danish Embassy in Athens, Greece or Cairo, Egypt. Some foreign embassies in Denmark also participated (for a complete list of signatories, see DEST 2010). The Curve Breaker Agreement has been dissolved in early 2013.

Read more on Denmark's good practice example Curve Breaker Agreement (CBA) in the bigEE Policy Guide:
www.bigee.net/s/w7s881

2.2.3.5 Energy-Efficient Product Procurement (EEPP), United States

Various acts and executive orders introduced by the Congress of the United States and the President of the USA require federal governmental agencies to procure only energy-efficient appliances. This shall contribute to the overall target for the Federal Energy Management Program (FEMP) of reducing the energy consumption in federal buildings by 30% in 2015 compared to 2003 (The United States Congress NA, Section 8253). The Energy Efficient Product Procurement Programme (EEPP) is one of several policies with the aim of realising this target.

Within the Federal Energy Management Program (FEMP), the EEPP provides guidance for public purchasers. Requirements were introduced for 14 product categories (e.g. office equipment, lighting, refrigerators). If federal agencies wish to procure products from these categories, it is mandatory to buy energy-efficient products instead of less energy-efficient ones. Procurement managers can be sure that appliances of the respective categories meet the necessary standards if

- these are labelled with an Energy Star
- meet the standards of the FEMP-Designated Product Category and/or
- are Low Standby Power Products (DOE & FEMP 2011, p.3).

The Energy Star, probably the most prominent of the three schemes, is attached to more than 60 product categories (explore our policy guide and find our detailed description). Predominantly it focuses on the consumer products rather than commercial ones. Thus, the FEMP needed to expand the EEPP programme to some more product categories in order to achieve better energy efficiency results. Consequently, the FEMP identified and regulated additional product categories that promised a large saving potential in the governmental sector, called "FEMP Designated Product Categories" (DOE & FEMP 2011).

Apart from setting energy efficiency requirements for products, the FEMP also disseminates information and tools to federal agencies and to their procurement managers, e.g. by giving training courses on energy-efficient procurement.

With the help of the EEPP programme and FEMP overall, federal agencies reduced the energy consumption in federal buildings significantly. Based on data submitted by 30 agencies, energy consumption decreased from 2003 to 2007 by 7.7% to 353.5 Btu used for 2.8 million m2 (DOE 2010, p.5). They even slightly exceeded the stated goal to achieve a 12% reduction from 2003 to 2009 (DOE & FEMP NAa, p.4). Due to the reduced energy use in federal buildings, the American government saves money and, at the same time, reduces the environmental impact (Harris & Johnson 2000).

Furthermore, the EEPP proactively promotes market transformation and performs leadership by example. The role model function does not only work internally in the US, meaning that subnational governmental and non-governmental actors follow this example. As the US government is "the largest volume buyer of energy-consuming products in the world", the United States and the EEPP can be regarded as a model for other countries (DOE & FEMP 2009, p.8).

The large volume of government purchases also pushes the USA's market for energy-efficient appliances in general, so that all other buyers of the products benefit from a larger and cheaper supply of energy-efficient products. The policy thereby helps to transform the market and achieves very large spill-over effects.

Read more on the United States' good practice example Energy-Efficient Product Procurement (EEPP) in the bigEE Policy Guide: www.bigee.net/s/pn6ttj

3 Guideline for designing energy efficiency policies for appliances

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

An evolutionary cycle approach is useful to plan, design, implement and evaluate policies.
As shown in Figure 12 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 in Figure 12 represents two opportunities for re-assessing 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) project 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.

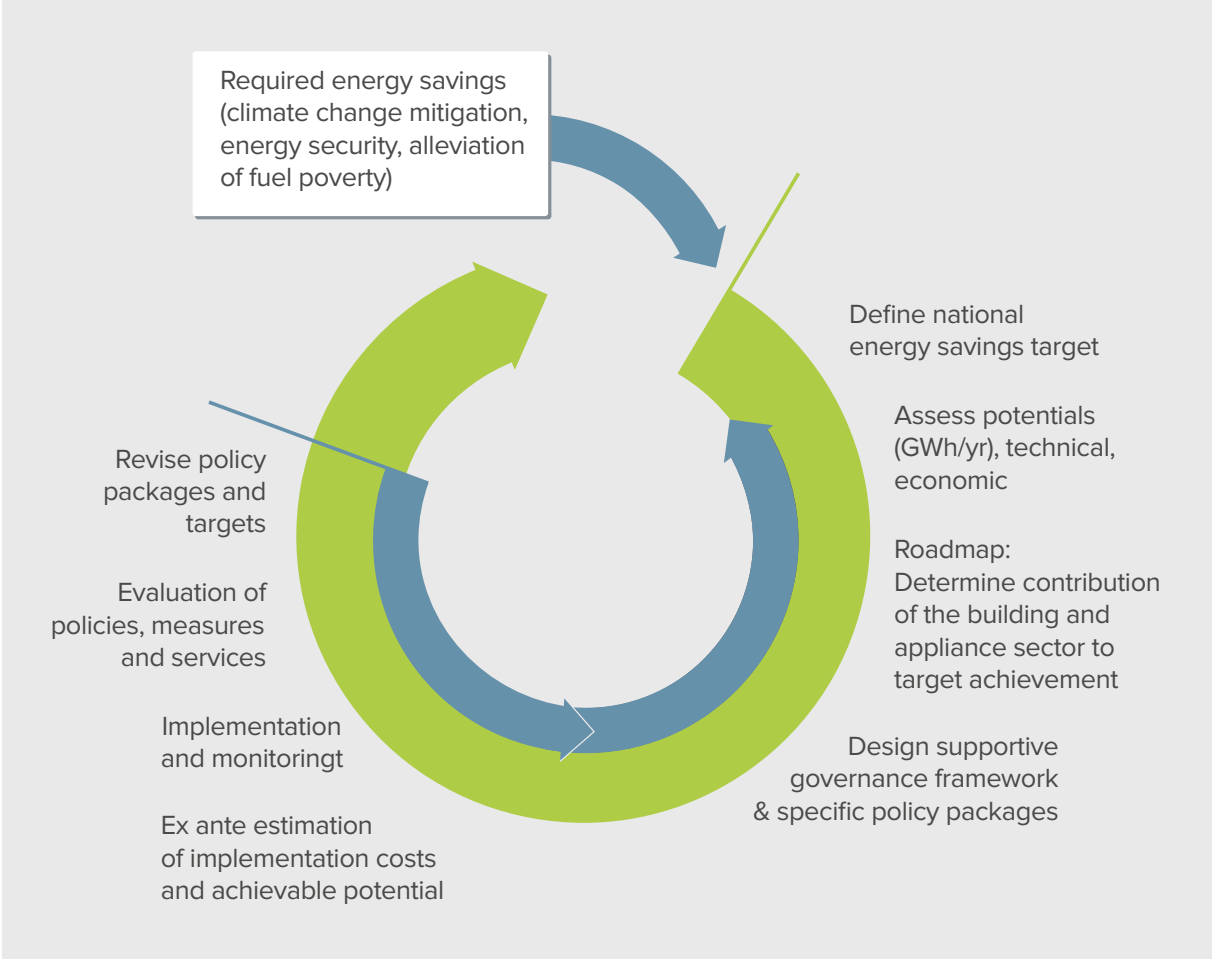


Figure 12: The policy planning, implementation, and learning cycle

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

Read more in the bigEE file "How to design and implement energy efficiency policies": www.bigee.net/s/bh7exr

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

For a detailed description of these principles please read our PDF "How to design and implement energy efficiency policies": www.bigee.net/s/bh7exr

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 in the design phase, i.e. before a policy actually enters into force. Monitoring and Evaluation (M&E) enables policy managers to demonstrate the programmes' 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 monitoring and evaluation are in the timing and frequency of observations or assessment and in the purpose, as well as 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, by quickly identifying problems and in solving them. The database generated in the monitoring process will be useful for both 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.

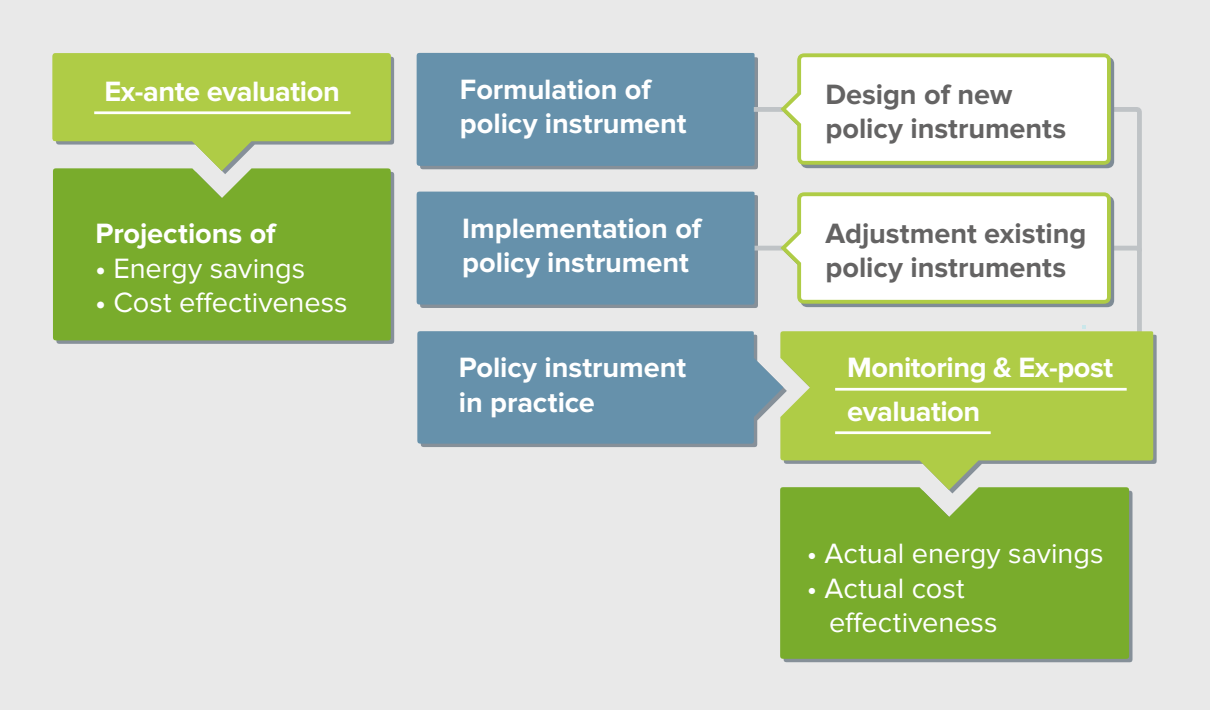


Figure 13: Why evaluation is important?

Source: Wupppertal Institute (2012b), 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. Insufficiently 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/bh7exr

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 appliances: 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 an 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 address.

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6 Links

Policies – Appliances

Recommended Package: www.bigee.net/s/82hc6c
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"Why policy needs to assist buildings and appliances markets to become energy-efficient": www.bigee.net/s/pri6uc

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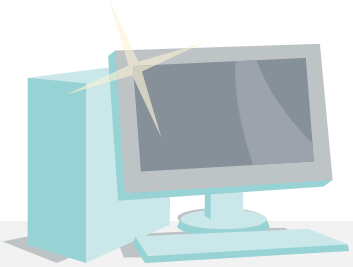

bigEE is an international initiative of research institutes for technical and policy advice and public agencies in the field of energy and climate, co-ordinated by the Wuppertal Institute (Germany). It is developing the international web-based knowledge platform bigee.net for energy efficiency in buildings, 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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Dr. Stefan Thomas • bigee@**wupperinst.org**

Wuppertal Institute for Climate, Environment and Energy • Doeppersberg 19 • 42103 Wuppertal • Germany • Phone: +49 (0)202 2492-129

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