The recommended package for appliances: What actors need and which policies advanced countries combine

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1. Abstract

What are the best policies and measures to stimulate energy efficiency in residential appliances, heating, ventilation cooling and lighting? The debate on this is at least as diverse as the markets and concepts for energy efficiency in these areas, and is often discussed quite controversially. However, no magic formula seems to have been found so far. It is, therefore, time to bridge the information gap and address the question in a new way - by combining both theoretical evidence on what policy support markets need, and empirical evidence on the combinations or packages of policies which have worked.

In the context of its new four-year project bigEE – "Bridging the Information Gap on Energy Efficiency in Buildings" – the Wuppertal Institute is implementing this new approach. The bigEE project aims to develop an international internet-based knowledge platform for energy efficiency in appliances, buildings, and building-related technologies. Hence, it must provide evidence-based information.

On the theoretical side, the analysis starts with value chains in the appliance sector and the barriers but also market-inherent incentives of the different types of market participants. Empirical evidence will feed the collection of these barriers and incentives. This enables to identify, which policies and measures need to be combined to jointly overcome the barriers and strengthen the incentives.

On the empirical side, model examples of good practices are collected and compared. The search for these policy packages or single instruments is guided by the results of the theoretical analysis. A network of international experts and existing databases and platforms is also giving information for the search. In order to identify what is "good practice" among the examples collected, the project uses a newly developed multi-criteria assessment scheme, which is presented in this paper. The assessment scheme is tested by a successful policy to demonstrate the procedure of the assessment scheme.

Finally, the impacts achieved with the model examples, lessons learned from their implementation, and their transferability shall be used to validate the different factors which are necessary to implement a successful policy and which were identified in the theoretical analysis.

2. Introduction

Energy efficiency has major potentials for innovation and market opportunities and should therefore be supported by adequate policies and measures. Decision makers already recognised energy efficiency as a key element for progress towards a more sustainable energy future, with high potentials and advantages for their own country. Consequently, the topic has been on the policy and business agenda for years, with significant achievements already made in several countries worldwide.

A main topic for energy efficiency in the residential sector is the electricity consumption of residential appliances like refrigerators, TVs or washing machines. To implement a policy that strives towards energy efficient products and to minimize the use of electricity, decision makers must have good knowledge of the respective sectors concerned, in order to be able to adequately implement a successful policy.

The question remains: What are preconditions for a successful policy and which criteria are crucial to consider? What must a criteria scheme look like to decide about the success of a policy and measure? The new project bigEE – "Bridging the Information Gap on Energy Efficiency in Buildings" – tries to answer these questions and summarises several concepts to fill this information gap and thus attempts to create a new and comprehensive approach. The aim is to detect all relevant factors, which are needed to develop a successful policy and further to make these factors visible to policy makers worldwide. They have the chance to use this knowledge as basic information and thus implement a policy with a well-grounded theoretical and empirical background.

With the presentation of knowledge based on already established experiences and research efforts, the bigEE project aims to increase the energy efficiency level of appliances worldwide and to promote policy options for decision makers to achieve this goal. This paper concentrates on the policy side. A focus is put on the connection between theoretical and empirical evidence and the question how established theoretical options fit together with experiences gained from already implemented policies and measures. This paper focuses on the identification of policy options for increasing the energy efficiency of residential appliances.

In the following chapters, the bigEE project will be briefly described to illustrate the project background and scope. Afterwards the 'ideal' policy package in the appliance field, which is known in principle with its various policy instruments and the interactions between single policy instruments will be presented. It is now widely accepted that a policy package can achieve the greatest success, given that a large variety of barriers and market failures exist, which hinder a rapid market change towards higher energy efficiency in appliances.

The bigEE project tries to validate this 'ideal' policy package and address the question of how energy efficiency can be supported most effectively – by combining a theoretical, actor-centred analysis with empirical evidence on model examples of good practice policies. By closely analysing the actors in the value chains and their incentive structures and then deducing implementation strategies and ideal policy packages, this paper aims to provide a solid methodological basis for the often-quoted necessity to implement comprehensive policy packages. The methodological approach, which will be presented in the following chapters, is based on and seeking to extend and refine the theory-based policy evaluation approach, which goes back to US experiences with energy efficiency policy evaluation (e.g. Blumstein et al. 2000) and was applied and developed further more recently within the EU project AID- EE (Ecofys & Wuppertal Institute 2007). In the second part, the paper compares the outcome of this actor-centred analysis with empirical evidence on policy instruments that have actually worked and delivered significant energy savings. In this context, a newly developed multi-criteria assessment scheme will be presented to identify good practice policies. One briefly outlined model example illustrates the empirical evidence for a successful policy option that could be part of an 'ideal' policy package.

3. Bridging the information gap on energy efficiency in buildings

t is widely accepted that energy efficiency is the biggest, fastest, and most cost-effective option for saving energy and mitigating climate change, with at least 40% of the energy efficiency potential in appliances and buildings (IPCC 2007). Yet, both investors and policy-makers are still far from fully tapping this potential, even if abundant information on good practice technologies and policies is in principle available. However, the information is scattered, too little tailored for specific target groups, and not easy to find for decision-makers. Thus, the information and implementation gap is still large, both in the market and with policy-makers.

This is why bigEE – "Bridging the Gap on Energy Efficiency in Buildings" – the new project by the Wuppertal Institute, with financial support from the German government, aims to develop an international internet-based knowledge platform for energy efficiency in appliances, building-related technologies and buildings overall. The platform will address the needs of decision-makers in businesses and policy; a structured presentation will make it easy to find the information wanted. Primary target groups of the initiative are policy-makers, public and private investors, and actors and consultants in policy and energy service implementation.

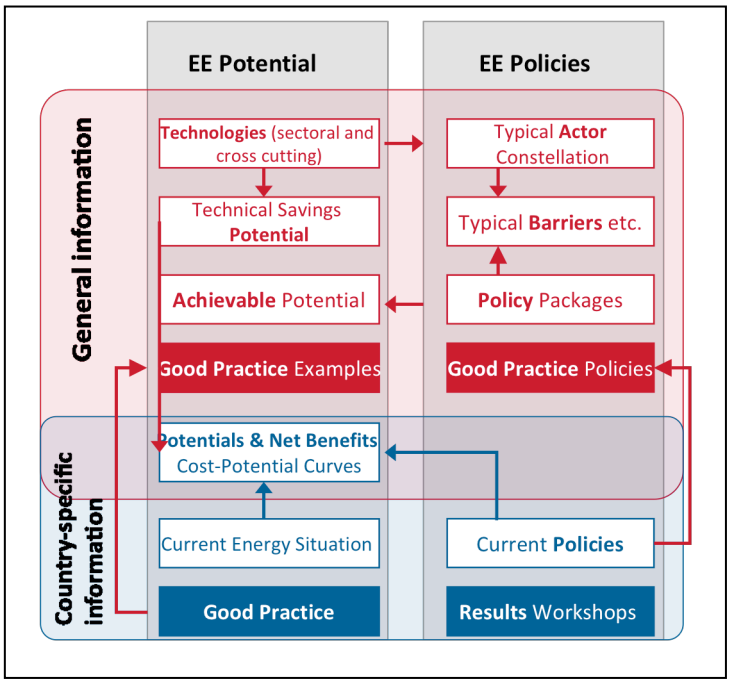
Apart from information universally applicable, up to five partner countries will be addressed, starting with China and India. A central task for bigEE is collecting, making comparable and updating information on "best available technologies", energy saving potential, net economic benefits, and good practice policies. To achieve the required quality of information, the bigEE team collaborates with scientific institutes – international and in partner countries, with existing initiatives – international and in partner countries, with existing initiatives and platforms, and the Sustainable Buildings Network (SBN) under IPEEC. Furthermore, bigEE engages in the active dissemination of information relevant for investors and policy makers in the partner countries, by setting up and cooperating with a network of local partners.

The summarised objectives of the bigEE project are:

- Raise greater awareness and attention for the variety of benefits of increased energy efficiency in new and existing buildings and residential appliances.
- Close the gaps of scattered information and material on energy efficiency by providing latest know-how in a target group oriented, consistent, easily accessible, and transparent way.
- Manage and communicate available knowledge especially for emerging economies.

Figure 1 gives an overview about the bigEE topics. The project aims at two parallel knowledge fields: The technological potentials and the policy options to increase energy efficiency. The column with the title "EE Policies" on the right side of the figure sets the framework for the contents of this paper.

Figure 1: The bigEE project - overview



Source: Wuppertal Institute 2011

4. The 'ideal' policy package for appliances

The bigEE project pursues a web-based presentation of energy saving potentials and good practice policies and policy combinations for buildings and appliances worldwide. The objective of this paper is to present how the project attempts to find these ideal packages and good practice policies.

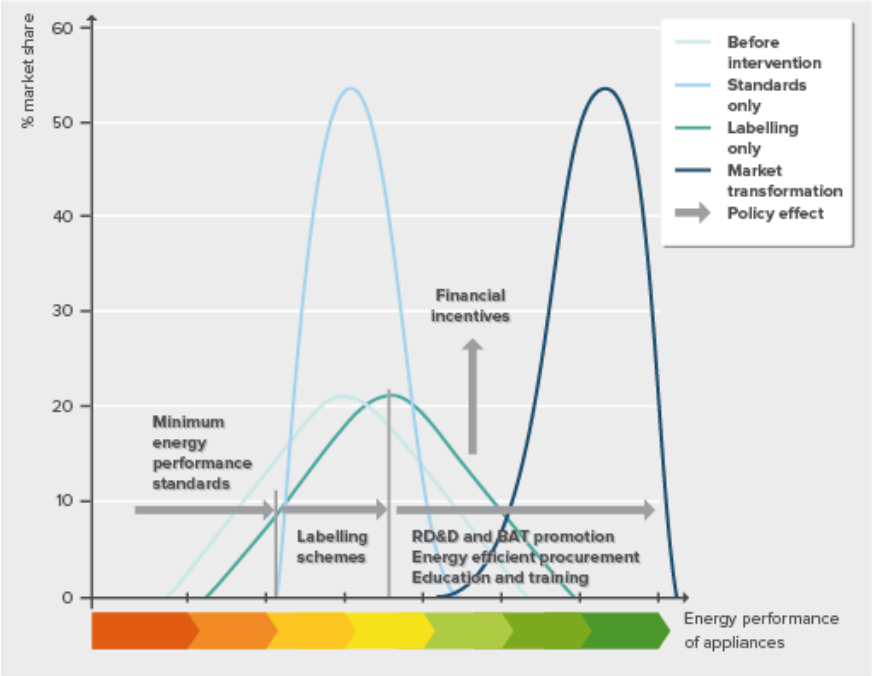
According to international research and experience, a package of several types of consistent and technology-specific and actor-specific policy instruments is useful to be most successful. Instead of a single instrument, a package offers the opportunity to achieve synergies between single instruments, and to reach all market actors (Thomas 2006).

Every policy measure has its own advantages, ideal target groups and specific operational mechanisms. Each is tailored to overcome one or a few certain market barriers, but none can address all barriers. Most instruments achieve higher savings, if they operate in combination with other measures, and often these impacts are synergistic, i.e. the impact of the two is larger than the sum of the individual expected impact (IEA 2005). Therefore, the ideal policy consists of consumer-oriented instruments and instruments for manufacturers (to build a "push and pull strategy" to push consumers and manufacturers away from energy intensive practices and to pull them towards energy efficient ones). Several instruments exist worldwide with the aim to increase the energy efficiency of appliances. For energy efficiency in appliances, these instruments can be packaged as follows:

Legal provisions on minimum energy performance standards (MEPS) reduce search and transaction costs and partly overcome the investor-user dilemma. They are a cost-effective way to at least elimi-

nate the worst energy-performing products from the market. However, they do not harness additional savings potentials due the most energy-efficient products in such cases. Therefore, appliance standards are often combined with labelling and rebates in order to give incentives for investments beyond the level required by the minimum energy efficiency standard. On the other hand, labelling programmes cannot completely transform the market and, for this reason are completed by MEPS in the great majority of countries (WEC & ADEME 2004). To pull the market even more into an energy efficient direction, information programmes, trainings for sales staff and manufacturers, and especially procurement programmes can influence the market to promote energy efficient appliances. Figure 2 illustrates an ideal policy package for appliances and describes the interactions between minimum energy performance standards, energy labels, rebate schemes, market and technology procurement, and information and training programmes.

Figure 2: Effects of an integrated policy package for domestic appliances



Source: Wuppertal Institute 2011

In order to prove this hypothesis of an ideal policy package that includes push and pull strategies, reaches all relevant market actors, and moves the market towards the most energy efficient appliances, the bigEE project uses a combination of theoretical and empirical evidence. The aim of this paper is to only present the scientific approach with few examples. The approach, and the paper as well, is divided into two parts: The first step is a theoretical, actor-centred analysis which is in a second step combined with an empirical evidence on model examples, i.e. already implemented good practice policies.

5. Theory-based, actor-centred analysis

Different steps are needed to derive an 'ideal' policy package, which increases the energy efficiency of appliances. The refined actor-centred approach can be subdivided into several steps. It starts with the identification of all relevant market actors along the value chain of the national market for the type of appliance concerned. In order to be able to adequately design and implement energy efficiency policies and measures, political decision makers must have good knowledge of the concerned market actors and thoroughly analyse the specific incentives and barriers faced by each of them. As a next step, implementation strategies to overcome the identified barriers and to strengthen the incentives need to be developed. Then, policy instruments to materialise these implementation strategies must be

discussed; usually already a package of individual policies and measures needs to work together to implement one strategy. The final step is the combination of these strategies and their respective policies to create market-adapted overall policy packages with the adequate combination of policy instruments.
In a further step, this theoretical approach will be combined with an empirical proof. In the second part of this paper one single instrument will be described and analysed as an example for a part of an effective policy package. This example - a financial incentive programme – was not only successful as a single option but especially as a part of a package consisting of MEPS, labels and soft measures like training and educational programmes.

5.1 Market actors and specific barriers and incentives

Before creating a policy to increase the energy efficiency of residential appliances, it is essential to have a closer look at all relevant market players along the value chain and their actor-specific market-inherent barriers and incentives to manufacture, sell, or buy an energy-efficient product. The list below illustrates key actors on the supply side, on the demand side, and further actors (Thomas 2006). They may be more or less relevant on a national market, but for our analysis to be valid in general, we have included all of them.

On the supply side

- Component manufacturers: Manufacturers and importers of components which are sold to unit manufacturers
- Original equipment manufacturers (OEMs): manufacturers and importers of appliances which are sold to downstream manufacturers
- Manufacturers and importers of appliances which are sold to end-users
- Wholesale companies
- Retail companies
- Sales staff in retail companies
- Recyclers

On the demand side

- Investors in energy efficiency who are users of the energy-efficient technology at the same time
- Users who are not, at the same time, investors in energy efficiency (e.g., household members, employees, hotel guests)
- Investors who do not use the technology themselves (e.g., employers)

Actors specialised in end-use energy efficiency improvement actions

- ESCOs (Energy Service Companies) or EESCs (Energy Efficiency Service Companies) both meaning energy efficiency service providers
- Energy consultants on appliance efficiency
- Energy agencies

Actors involved in finance of equipment, and end-use efficiency improvement actions, policies, and measures

- Insurances
- Public, private-public and private banks

Actors involved in governance of buildings, equipment, and end-use energy efficiency improvement actions, policies, and measures

- Supranational, national, regional, and local governments
- Supranational, national, regional, and local parliaments
- Supranational, national, regional, and local administrations in charge of policy implementation
- Energy agencies (here in a different role than above)

Non-governmental actors involved in consultations about / formulation of end-use energy efficiency improvement actions, policies, and measures

- (Environmental) NGOs
- Consumer organizations
- Trade associations
- Research institutes and universities

After identifying the relevant actors in the appliances market, it is necessary to put the focus on the actor-specific barriers and incentives. Each actor group has its own characteristics and therefore every policy has to pay attention to these. By knowing the barriers and incentives of every actor the policy package can be adapted to guarantee desired results and achieve the greatest possible success. bigEE has developed extensive tables subdivided according to the target group looking at all relevant actors. These tables are presented hereafter.

Actor	Incentives	Barriers
(Component) manufacturers	• Increased direct earnings or profits for actors on the supply side: The energy-efficient option usually requires higher upfront investment. From a supply perspective, this means higher prices / revenues and possibly higher profits (if customers are willing to pay more due to the expected ener-	Technical barriers • Component/product unavailability • Performance Uncertainties Knowledge/information barriers • Unavailability of information • Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How can the developer make the prod-

	gy cost savings). • Unique selling proposition for suppliers. This can lead to competitive advantage or even market leadership • Contribution to protecting the environment • Improved reputation: Receive social recognition in return for environmentally-sound behaviour • Offering higher value to the customers • Both end-users and the environment benefit from energy-efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits)	uct even more energy efficient? • Asymmetric information and opportunism: another aspect of the difficulties consumers face in evaluating the veracity, reliability, and applicability of claims made by sales personnel for a particular energy- efficient product or service. This barrier reflects the fact that sellers of energy- efficient products or services typically have more and better information about their offerings than do consumers. It also reflects the incentive that sellers have to provide misleading information. • Information and search costs: Which is the most and energy efficient solution for the appliances? Which component manufacturer offers the best value for money? <u>Economic/financial barriers</u> • Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period • Risk of production and marketing: will there be sufficient demand with the result that the production change-over pays off, a minimum quantity of units is reached, and the price can be kept at a competitive level? • Risk exposure, irreversibility, discount rate required • Extra production costs and the resulting higher price of BAT: risk of loosing customers to the competition (assuming that customers look at first cost only) • Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting in energy savings lower as they

		should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective) • Hidden costs: unexpected costs associated with reliance on or operation of energy-efficient products or services. These costs could include additional operating and maintenance costs associated with energy-efficient equipment or additional staff costs associated with monitoring or servicing transactions • Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. • High profitability requirements: These are often caused by lack of capital and insecurity about continuity • Uncertainty about availability of sufficient quantities of reasonably priced components: Will we be able to produce the quantities the markets demand, and to earn a profit? <u>Organisational barriers</u> • Organisational practices or customs, e.g., end-users often use first costs or payback times as investment criteria. <u>Lack of interest/motivation for energy- efficiency improvement</u> • Prevailing price competition or predominance of other product features over energy efficiency • Other functional priorities of customers: priority criteria are the functionality or the appearance instead of energy aspects • Consumer satisfaction and security of appliance: Has the new

		product the same functionality and security as the known product? (Risk aversion towards innovative technology) • Inseparability of product features: the difficulties consumers sometimes face in acquiring desirable energy-efficiency features in products without also acquiring (and paying for) additional undesirable features that increase the total cost of a product beyond what the consumer would be willing to pay for just the added energy-efficiency features alone. • Perceived lack of motivation by customers to buy energy-efficient products due to the demand-side barriers that the customers face – leading to the risk of production and marketing mentioned above.
Wholesalers and retailers	• Direct increased earnings or profits for actors on the supply side: The energy-efficient option usually requires higher upfront investment: 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 • Unique selling proposition for suppliers. This can lead to competitive advantage or even market leadership • Contribution to protect the environment • Improved reputation: Receive social recognition in return for environmentally-sound behaviour • Offering higher value to the customers • Both end-users and the environment benefit from energy-efficient solutions: Offering such	<u>Technical barriers</u> • Energy-efficient product or service may be unavailable from the manufacturers <u>Knowledge/information barriers</u> • Unavailability of information of energy efficiency of products (no labelling) • Lack of knowledge about efficient products: Is it worth to educate employees about the advantages of energy and cost efficient products? • Asymmetric information and opportunism: another aspect of the difficulties consumers face in evaluating the veracity, reliability, and applicability of claims made by sales personnel for a particular energy- efficient product or service. This barrier reflects the fact that sellers of energy- efficient products or services typically have more and better in-

	solutions thus underpins a company's CSR goals (reputational benefits)	formation about their offerings than do consumers. It also reflects the incentive that sellers have to provide misleading information. • Information and search costs: Which is the most and energy efficient solution for the appliances? Are the new products as good as the well-known old products (habits, good experiences)? Is it worth to inform consumers? • Consumer satisfaction and security of appliance: Has the new product the same functionality and security as the known product? (Risk aversion towards innovative technology) Economic/financial barriers • Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period • Profit is linked to sales: The more expensive products retailers sell the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy- efficient appliance • Risk of stocking and marketing: will there be sufficient demand with the result that the production change-over pays off, a minimum unit of quantity is reached, and the price can be kept at a competitive level? • Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting

		in energy savings lower as they should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective) • Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, .. years? Prices may be low or volatile. • High profitability requirements: These are often caused by lack of capital and insecurity about continuity Organisational barriers • Organisational practices or customs e.g. end-users often use first costs or payback times as investment criteria Lack of interest/motivation for energy-efficiency improvement • Transaction costs or hassle/ inconvenience (in combination with) time constraints • Perceived other functional priorities of customers: priority criteria are the functionality or the appearance instead of energy aspects • Prevailing price competition or predominance of other product features over energy efficiency • Inseparability of product features: the difficulties consumers sometimes face in acquiring desirable energy-efficiency features in products without also acquiring (and paying for) additional undesirable features that increase the total cost of a product beyond what the consumer would be willing to pay for just the added energy-efficiency features alone. • Perceived lack of motivation by customers to buy energy-efficient products due to the demand-side

		barriers that the customers face – leading to the risk of production and marketing mentioned above.
Sales staff	• Offering higher value to the customers • Contribution to protecting the environment • Both end-users and the environment benefit from energy-efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits) • Increased (re-sale) value of the property	Technical barriers • Component/product unavailability • Performance Uncertainties Knowledge/information barriers • Unavailability of information • Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How can the developer make the product even more energy efficient? • Asymmetric information and opportunism: another aspect of the difficulties consumers face in evaluating the veracity, reliability, and applicability of claims made by sales personnel for a particular energy-efficient product or service. This barrier reflects the fact that sellers of energy- efficient products or services typically have more and better information about their offerings than do consumers. It also reflects the incentive that sellers have to provide misleading information. • Information and search costs: Which is the most and energy efficient solution for the appliances? Which component manufacturer offers the best value for money? Economic/financial barriers • Risk of production and marketing: will there be sufficient demand with the result that the production change-over pays off, a minimum quantity of units is reached, and the price can be kept at a competitive level? • Extra production costs and the resulting higher price of BAT: risk of loosing customers to the competi-

		tion (assuming that customers look at first cost only) • Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting in energy savings lower as they should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective) • High profitability requirements: These are often caused by lack of capital and insecurity about continuity • Uncertainty about availability of sufficient quantities of reasonably priced components: Will we be able to produce the quantities the markets demand, and to earn a profit? Organisational barriers • Organisational practices or customs, e.g., end-users often use first costs or payback times as investment criteria. Lack of interest/motivation for energy-efficiency improvement • Prevailing price competition or predominance of other product features over energy efficiency • Other functional priorities of customers: priority criteria are the functionality or the appearance instead of energy aspects • Consumer satisfaction and security of appliance: Has the new product the same functionality and security as the known product? (Risk aversion towards innovative technology) • Inseparability of product features: the difficulties consumers sometimes face in acquiring desirable

		energy-efficiency features in products without also acquiring (and paying for) additional undesirable features that increase the total cost of a product beyond what the consumer would be willing to pay for just the added energy-efficiency features alone. • Perceived lack of motivation by customers to buy energy-efficient products due to the demand-side barriers that the customers face – leading to the risk of production and marketing mentioned above.
Investor in energy efficiency who are users of the energy-efficient technology at the same time	• Saved energy costs: The energy efficient product is often the cost-efficient solution • Contribution to protecting the environment • Increased (re-sale) value of the property • Improved reputation: Receive social recognition in return for environmentally-sound behaviour	<u>Technical barriers</u> • Product or service unavailability • Performance Uncertainties <u>Knowledge/information barriers</u> • Unavailability of information about energy efficiency of appliances (no labelling) • Lack of knowledge about energy-efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? • Asymmetric information and opportunism: another aspect of the difficulties consumers face in evaluating the veracity, reliability, and applicability of claims made by sales personnel for a particular energy-efficient product or service. This barrier reflects the fact that sellers of energy- efficient products or services typically have more and better information about their offerings than do consumers. It also reflects the incentive that sellers have to provide misleading information. • Information and search costs: Which is the most and energy efficient solution for the appliances? Which manufacturer offers the best

		value for money? • Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experiences) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? • Insufficient energy management: especially firms/authorities: companies have insufficient knowledge about (the drivers of) their own energy consumption, lack of knowledge about efficient technology, missing competences high search and transaction costs • Unfamiliarity of financiers with EE investment (leading to lack of capital due to difficulties to obtain loans) Economic/financial barriers • Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period • Risk aversion: not investing due to risk exposure and or irreversibility of the investment, leading to high discount rate required • High profitability requirements: These are also often caused by lack of capital and insecurity about continuity • Hidden Costs: unexpected costs associated with reliance on or operation of energy-efficient products or services. These costs could include additional operating and maintenance costs associated with energy-efficient equipment or additional staff costs associated with monitoring or servicing transac-

		tions • Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting in energy savings lower than they should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective) • Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Energy prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback time? Organisational barriers • Organisational practices or customs, e.g., using first cost or payback times as investment criteria. Lack of interest/motivation for energy- efficiency improvement • Transaction costs or hassle/ inconvenience (in combination with) time constraints • Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? • Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?) • Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects • Inseparability of product features: the difficulties consumers sometimes face in acquiring desirable energy-efficiency features in prod-

		ucts without also acquiring (and paying for) additional undesirable features that increase the total cost of a product beyond what the consumer would be willing to pay for just the added energy-efficiency features alone. • Companies focus on core activities
Users who are not, at the same time, investors in energy efficiency and who pay the energy costs (user pre-installed kitchen, shared washing machine)	• Contribution to protect the environment • Saved energy costs: The energy efficient product is often the cost-efficient solution • Improved reputation: Receive social recognition in return for environmentally-sound behaviour	For users who are not, at the same time, investors, the same barriers are valid as for users who are themselves buyers of energy efficient products. A main barrier is the insecurity about the duration of usage (continuity), because in comparison to the investor the user has no profit through a higher resale value. In addition to the already mentioned aspects, the following must be added: The investor-user barrier: Misplaced or split incentives between investor and final user - Almost no possibility for users to influence the investments in energy efficient technologies, as the user mostly depends on the agreement of the investor
Users who are not, at the same time, investors in energy efficiency and who do not pay the energy costs (employees, hotel guests, household members)	• Contribution to protect the environment • Improved reputation: Receive social recognition in return for environmentally-sound behaviour	For users who are not, at the same time, investors, the same barriers are valid as for users who are themselves buyers of energy efficient products. A main barrier is the insecurity about the duration of usage (continuity), because in comparison to the investor the user has no profit through a higher resale value. In addition to the already mentioned aspects, the following must be added: The investor-user barrier: Misplaced or split incentives between investor and final user • Almost no possibility for users to influence the investments in energy efficient technologies, as the user mostly depends on the agreement of the investor • If the user is an employee of the

		investor, the user has no direct economic advantage from energy-saving behaviour (e.g., switching off PCs and lights when leaving the office): only the employer will benefit from an energy-efficient user behaviour of the employee.
Investors who do not use the technology themselves but pay the energy costs (employers, hotel owner, household economic heads)	• Save energy costs - Contribution to protect the environment • Increase 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. • Improved reputation: Receive social recognition in return for environmentally-sound behaviour	For investors who are not, at the same time, users, the same barriers are valid as for users who are buyers of energy efficient products. In addition to the already mentioned aspects, the following must be added: The investor-user barrier: Misplaced or split incentives between investor and final user • Lack of knowledge of the market situation: Is energy efficiency a main aspect for end-users? • If the user is an employee of the investor, the investor has no direct influence on energy-saving user behaviour: the investor is dependent on the cooperation of the user.
Investors who do not use the technology themselves and do not pay the energy costs (landlords installing preinstalled washing machine)	• Contribution to protect the environment • Increase 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. • Improved reputation: Receive social recognition in return for environmentally-sound behaviour	For investors who are not, at the same time, users, the same barriers are valid as for users who are buyers of energy efficient products. In addition to the already mentioned aspects, the following must be added: The investor-user barrier: Misplaced or split incentives between investor and final user • No direct economic advantage for cost-effectiveness: Only the end-users profits from energy savings • Lack of knowledge of the market situation: Is energy efficiency a main aspect for end-users?

Table 1: Actor specific barriers and incentives

The identified barriers and incentives create one question: How can these barriers that market actors face be overcome and how can the immanent incentives be strengthened? The described barriers are the major reason why there is a gap between potential and realised energy savings. That is why policy makers have to identify these barriers to overcome them and to strengthen the market inherent incentives for energy efficiency. A number of ways to achieve this are available. The following chapter summarises some of these strategies and describes them briefly. The aim is to make energy efficiency feasible, easy, attractive, and eventually even the default.

5.2 Implementation strategies and policy packages

A number of direct ways to reach the relevant actors, tackle their barriers and strengthen their incentives, and thus to maximize the energy savings exist. These ways can be named implementation strategies. An implementation strategy may act on several incentives and barriers. An example for an implementation strategy is: "*Bring down the first costs of energy-efficient appliances via market transformation/economics of scale*". This example picks up economic aspects and tries to overcome economic and financial barriers and strengthen financial opportunities. The economic barrier is only one example for several other barriers and corresponding implementation strategies. These strategies are described in the following table with their actor-specific barriers it tackles and incentives it strengthened.

Implementation Strategy	Incentives strengthened	Barriers tackled
Bring down the first costs of energy- efficient appliances via market transformation/ economies of scale	(User) Saved energy costs: The energy efficient product is often the cost-efficient solution (Investors, manufacturers, wholesalers, retailers) Improved reputation: Receive social recognition in return for environmentally-sound behaviour (Investors, manufacturers, wholesalers, retailers) Contribution to protect the environment (Investors) Increase value of the property: From a supply perspective, this means higher revenues and possibly higher profits (if customers are willing to pay	(Manufacturers) Extra construction costs: risk of loosing customers to the competition (assuming that customers look at first cost only). (Manufacturers, wholesalers, retailers) Risk of production and marketing: will there be sufficient demand with the result that the production/portfolio change-over pays off, a minimum quantity of units is reached, and the price can be kept at a competitive level? (Manufacturers, retailers, wholesalers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity

	more due to the expected energy cost savings). Justification for higher prices. (Manufacturer, wholesalers, retailers) Increased direct earnings or profits for actors on the supply side: The energy-efficient option usually requires higher upfront investment: 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 (Manufacturers) Offering higher value to the customers	(Manufacturers, wholesalers, retailers) Prevailing price competition of other product features over energy efficiency (Wholesalers, retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (Investors, users, manufacturer, wholesalers, retailers) Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period (Investors, users) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback to occur? (Investors, users, manufacturers, wholesalers) Organisational practices or customs, e.g., using first cost or payback times as investment criteria. (Investors, users) Transaction costs or hassle/inconvenience (in combination with) time constraints (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (User ≠Investor) Almost no possibility for users to influence the investments in energy efficient technologies, as the user

		mostly depends on the agreement of the investor (Investor ≠ users) No direct economic advantage for cost effectiveness. Only the end-users profits from energy savings
Ensure manufacturers and retailers that there is a market for energy-efficient appliances.	(Manufacturers, retailer) Contribute to environmental protection. (Manufacturers, retailer) Improved reputation: Receive social recognition in return for environmentally sound behaviour. (Retailers, manufacturers) Increase (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 (Retailers, manufacturers) Unique selling proposition for manufacturers and suppliers. This can lead to competitive advantage or even market leadership (Retailers, manufacturers) Offering higher value to the customers (Retailers, manufacturers) Both end-users and the environment benefit from energy-efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits)	(Manufacturers, retailers) Risk of production and marketing: Will there be sufficient demand so that the production change-over pays off, a minimum unit quantity is reached, and the price can be kept on a competitive level? (Manufacturers, retailers,wholesalers) Extra construction costs: risk of loosing customers to the competition (assuming that customers look at first cost only) (Retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (Manufacturers, wholesalers, retailers) Perceived other functional priorities of customers: priority criteria are the functionality or the appearance instead of energy aspects (Manufacturers, wholesalers, retailers) Prevailing price competition or predominance of other product features over energy efficiency (Manufacturers, retailers)Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials?

		(User, manufacturer) Asymmetric information and opportunism (Investor, manufacturer, retailer) Information and search costs: Which is the most and energy efficient solution for the appliances? Are the new products as good as the well-known old products (habits, good experiences)? Is it worth to inform consumers? (Investors) Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experiences) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Investors, manufacturers) Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period (Investors, manufacturers) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback time? (Investor ≠ users, retailers, manufacturers) Lack of knowledge of the market situation: Is energy efficiency a main aspect for end- users? (Manufacturers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity (Manufacturers, retailers) Uncertainty about availability of sufficient quantities of reasonably priced components: Will we be able to produce the quantities the

		markets demand, and to earn a profit? (Investors, Manufacturers, users, retailers) Organisational practices or customs, e.g., end-users often use first costs or payback times as investment criteria. (Manufacturers) Transaction costs or hassle/inconvenience (in combination with) time constraints (Manufacturers, investors, retailers) Perceived lack of motivation by customers to buy energy-efficient products due to the demand-side barriers that the customers face – leading to the risk of production and marketing mentioned above
(1) Enable buyers to compare the energy consumption of appliances with the same functionality, (2) Inform investors about energy-efficient appliances, their benefits and net savings to be made, comparing the most energy-efficient models on the market (BAT) to less efficient ones	(Investors, user) Saved energy costs: The energy efficient product is often the cost-efficient solution (Investors, user) Contribution to protect the environment (Investors, user) Increased (re- sale) value of the property (Investors, user) Improved reputation: Receive recognition in return environmentally-sound behaviour (Investor ≠ users) Increase 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.	(Investors, users) Unavailability of information on energy efficiency of appliances (no labelling) (Investors, users) Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Investors, users) Information and search costs: Which is the most and energy efficient solution for the appliance? Which manufacturer offers the best value for money? (Investors, users) Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experience) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Investors, users) Organisational practices or customs, e.g. using first cost or payback times as investment criteria (Investors, users) Transaction costs or

		hassle/inconvenience (in combination with) time constraints (Investors, users) Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Investors, users) Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?)
Ensure independent testing of energy consumption and quality	(Investors, Users) Saved energy costs. The energy efficient product is often the cost effective solution. (Investors) Increase (re-sale) value of the property. (Investor ≠ users, manufacturers) Increase value of the property: From a supply perspective, this means higher revenues and possibly higher profits (if customer is willing to pay more due to the expected energy cost savings). Justification for higher prices.	(Investors, users, manufacturers) Reluctance/scepticism towards new products and technologies from new supplier/companies. Will other than the already known companies (habits, good experience) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Investors, user, manufacturers, retailers) Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Manufacturers, user, investor) Information and search costs: Which is the most and energy efficient solution for the appliances? Which product offers the best value for money?
Fund research	(Manufacturers, retailers) Unique selling	(Manufacturers, retailers)Lack of

and development on energy efficiency of appliances and train manufacturers' development staff, retail sales staff, and large buyers' procurement staff about energy-efficient technologies, solutions and net savings	proposition for suppliers. This can lead to competitive advantage or even market leadership (Manufactures, retailers, wholesalers) Both end-users and the environment benefit from energy-efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits) (Investor ≠ users, manufacturers) Increase value of the property: From a supply perspective, this means higher revenues and possibly higher profits (if customer is willing to pay more due to the expected energy cost savings). Justification for higher prices. (Manufactures, retailers, wholesalers) Contribution to protect the environment (Manufactures, retailers, wholesalers) Improved reputation: Receive social recognition in return for environmentally-sound behaviour (Manufactures, retailers, wholesalers) Offering higher value to the customers	knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Manufacturers, retailers,wholesalers) Unavailability of information (Investors) Reluctance/sceptism towards new products and technologies from new supplier/companies: Will other than the already known companies (habits, good experience) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about technical details? (Manufacturers) Information and search costs: Which is the most and energy efficient solution for the appliance? Which component manufacturer offers the best value for money? (Manufactures) Risk of production and marketing: will there be sufficient demand with the result that the production change- over pays off, a minimum unit of quantity is reached, and the price can be kept at a competitive level? (Manufacturers) Extra construction costs: risk of losing customers to the competition (assuming that customers look at first cost only) (Manufactures) Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting energy savings lower as they should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective) (Manufactures) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10,... years? Prices

		may be low or volatile (Manufacturers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity (Manufacturers, retailers,wholesalers) Transaction costs or hassle/inconvenience (in combination with) time constraints (Manufacturers, retailers,wholesalers) Perceived other functional priorities of customers: priority criteria are the functionality or the appearance instead of energy aspects (Manufacturers, retailers) Prevailing price competition of predominance of other product features over energy efficiency (Manufacturers, retailers, wholesalers) Perceived lack of motivation by customers to buy energy-efficient products due to the demand-side barriers that the customers face – leading to the risk of production and marketing mentioned above
Increasing motivation by making it as easy as possible to choose the energy efficient option – make appliance energy consumption and quality visible and comparable; use social marketing tools (e.g. norm appeals, vivid personalized communication, obtaining a commitment, etc.)	(Manufacturers, retailer) Contribute to environmental protection. (Manufacturers, retailer) Improved reputation: Receive social recognition in return for environmentally sound behaviour. (Retailers, manufacturers) Increase (resale) 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 (Retailers, manufacturers) Unique selling proposition for manufacturers and	(Investors, retailers) Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?) (Investors, manufacturers, retailers) Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Investors, users, retailers, sales staff) Unavailability of information on energy efficiency of appliances (no labelling) (Investors) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs

	suppliers. This can lead to competitive advantage or even market leadership (Retailers, manufacturers) Offering higher value to the customers (Retailers, manufacturers) Both end-users and the environment benefit from energy-efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits) (Investors) Save energy costs. The energy efficient product is often the cost effective solution.	and in comparison to other products? (Investor, manufacturer, retailer) Information and search costs: Which is the most energy efficient solution for the appliances? Are the new products as good as the well-known old products (habits, good experiences)? Is it worth to inform consumers? (Investors) Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experiences) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Investors, manufacturers) Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period (Investors, manufacturers) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback time? (Investor ≠ users, retailers, manufacturers) Lack of knowledge of the market situation: Is energy efficiency a main aspect for end- users? (Manufacturers, retailers) Risk of production and marketing: Will there be sufficient demand so that the production/portfolio change-over pays off, a minimum unit quantity is reached, and the price can be kept on a competitive level? (Manufacturers, retailers,wholesalers) Extra construction costs: risk of losing customers to the competition (assuming

		that customers look at first cost only) (Manufacturers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity (Investors, Manufacturers, users, retailers) Organisational practices or customs, e.g., end-users often use first costs or payback times as investment criteria. (Investors, Manufacturers) Transaction cost or hassle/inconvenience (in combination with) time constraints (Retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (User ≠investor) Almost no possibility for users to influence the investments in energy efficient technologies, as the user mostly depends on the agreement of the investor (User ≠ investor) The user is an employee of the investor, the user has no direct economic advantage from energy-saving behaviour (e.g., switching off PCs and lights when leaving the office): only the employer will benefit from an energy-efficient user behaviour of the employee
Highlight benefits (first of all achievable cost savings, but also non-energy benefits like improved	(Investors) Saved energy costs. The energy efficient product is often the cost effective solution. (Investors) Increase (re-sale) value of the property.	(Users, investors, manufacturers, retailers, wholesalers) Unavailability of information on energy efficiency of appliances (no labelling) (Users, investors, manufacturers, retailers, wholesalers) Lack of knowledge about

comfort, health, productivity), show how others are already benefitting from EE measures, frame recommendations in terms of money lost (or opportunity missed) through inaction rather than in terms of possible gains through action; disseminate information about real tangible good practice examples	(Investors, manufacturers, retailer) Contribute to environmental protection. (Investors, manufacturers, retailer) Improved reputation: Receive social recognition in return for environmentally-sound behaviour (Investor ≠ users, manufacturers) Increase 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.	efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Users, investors, manufacturers, retailers, wholesalers) Information and search costs: Which is the most and energy efficient solution for the appliances? Which manufacturer offers the best value for money? (Users, investors, manufacturers, retailers, wholesalers) Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?) (Investors) Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experiences) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Users, investors, manufacturers, retailers, wholesalers) Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period (Users, investors, manufacturers, retailers, wholesalers) Hidden Costs (Users, investors, manufacturers, retailers, wholesalers) Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects (Users, investors, manufacturers, retailers, wholesalers) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products?

		(User ≠ investor) Lack of knowledge of the market situation: Is energy efficiency a main aspect for end-users? (Manufacturers, retailers, wholesalers) Risk of production and marketing: will there be sufficient demand with the result that the production change-over pays off, a minimum unit of quantity is reached, and the price can be kept at a competitive level? (Manufacturers, retailers,wholesalers) Consumer satisfaction and security of appliance: Has the new product the same functionality and security as the known product (risk aversion towards innovative technology) (Investor ≠ users) No direct economic advantage for cost effectiveness.
Improve access to capital, e.g. subsidize purchase of energy-efficient appliances, establish innovative financing mechanisms	(Investors) Save energy costs. The energy efficient product is often the cost effective solution. (Manufacturer, wholesalers, retailers) Increased direct earnings or profits for actors on the supply side: The energy-efficient option usually requires higher upfront investment: 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 (Investors, manufacturers, retailer) Contribute to environmental protection. (Investors, manufacturers, retailer) Improved reputation: Receive social recognition in return for environmentally-sound behaviour	(Manufacturers) Extra construction costs: risk of loosing customers to the competition (assuming that customers look at first cost only). (Manufacturers, wholesalers, retailers) Risk of production and marketing: will there be sufficient demand with the result that the production change-over pays off, a minimum unit of quantity is reached, and the price can be kept at a competitive level? (Investors, users, manufacturer, wholesalers, retailers) Access of financing/Lack of capital: real or perceived costs, innovations only with short payback period (Wholesalers, retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less

		efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (Investors, users) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback time? (Investors, users, manufacturers, wholesalers) Organisational practices or customs, e.g., using first cost or payback times as investment criteria. (Investors, users) Transaction costs or hassle/inconvenience (in combination with) time constraints (Manufacturers, retailers, wholesalers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity (Manufacturers, wholesalers, retailers) Prevailing price competition or predominance of other product features over energy efficiency (Investors) Lack of motivation by consumers: demonstration projects and particularly trained supply chain actors are more likely to convince investors of the benefits of choosing the energy-efficient solution
Find ways to align opposing incentives in such a way that win-win situations occur	(Manufacturer, investor) Contribute to environmental protection (Investors, manufacturers, retailer) Improved reputation: Receive social recognition in return for environmentally-sound behaviour	(User ≠ investor) No direct economic advantage for cost-effectiveness: Only the end-users profits from energy savings (User ≠ investor) If the user is an employee of the investor, the investor has no direct influence on energy-saving user behaviour: the investor is dependent on the cooperation of the user
Make energy effi-	(Investors) Save energy costs. The ener-	(Investors, manufacturers, retailers) Lack

ciency the standard or at least reduce complexity by excluding the least efficient practices from the market	gy efficient product is often the cost effective solution. (Manufacturer, wholesalers, retailers) Increased direct earnings or profits for actors on the supply side: The energy-efficient option usually requires higher upfront investment: 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	of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Investor, manufacturer, retailer) Information and search costs: Which is the most energy efficient solution for the appliances? Are the new products as good as the well-known old products (habits, good experiences)? Is it worth to inform consumers? (Investors, Manufacturers, users, retailers) Organisational practices or customs, e.g., end-users often use first costs or payback times as investment criteria. (Investors, Manufacturers, users, retailers) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Investors, users) Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?) (User ≠ investor) Almost no possibility for users to influence the investments in energy efficient technologies, as the user mostly depends on the agreement of the investor (User ≠ investor) No direct economic advantage for cost-effectiveness: Only the investor profits from energy savings (User ≠ investor) The user is an employee of the investor, the user has no direct economic advantage from energy-saving behaviour (e.g., switching off PCs and lights when leaving the office): only the employer will benefit from an energy-

		efficient user behaviour of the employee (Investors, Manufacturers, users, retailers) Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects (Manufacturers, retailers) Risk of production and marketing: Will there be sufficient demand so that the production change-over pays off, a minimum unit quantity is reached, and the price can be kept on a competitive level? (Manufacturers, retailers,wholesalers) Extra construction costs: risk of losing customers to the competition (assuming that customers look at first cost only) (Manufacturers, retailers) Prevailing price competition of other product features over energy efficiency (Retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (Investors) Insufficient energy management: especially firms/authorities: companies have insufficient knowledge about (the drivers of) their own energy consumption, lack of knowledge about efficient technology, missing competences, high search and transaction costs (Investors, users, manufacturers) Price distortions due to rate design, subsidised energy prices and lack of inclusion of externalities: misleading price signals resulting energy savings lower as they

		should be (cost effectiveness of measures may be lower from an investor's perspective than from the societal perspective)
Change incentive structures so that chief executives also seek for long-term profit maximisation	(Manufacturers, retailers) Increased direct earnings or profits for actors on the supply side: The energy- efficient option usually requires higher upfront investment: 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 (Investors) Save energy costs. The energy efficient product is often the cost effective solution. (Investors, manufacturers, retailers) Contribute to environmental protection. (Investors, manufacturers, retailers) Improved reputation: Receive social recognition in return for environmentally-sound behaviour (Manufacturers, retailers) Offering higher value to the customers (Investors, users, manufactures) Both end-users and the environment benefit from energy- efficient solutions: Offering such solutions thus underpins a company's CSR goals (reputational benefits)	(Manufacturers) Risk of production and marketing: will there be sufficient demand with the result that the production change- over pays off, a minimum unit of quantity is reached, and the price can be kept at a competitive level? (Manufacturers, retailers) Extra construction costs: risk of loosing customers to the competition (assuming that customers look at first cost only) (Manufacturers) Insufficient energy management: especially firms/authorities: companies have insufficient knowledge about (the drivers of) their own energy consumption, lack of knowledge about efficient technology, missing competences, high search and transaction costs (Investors) Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects (Investors, wholesalers, retailers) Prevailing price competition or predominance of other product features over energy efficiency (Investors) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Manufactures, retailers) Shareholders vs. chief executives (industry and commerce) à long-term vs. short-term profit maximisation
Qualification of supply chain actors so that they	(Investors, users) Saved energy costs: The energy efficient product is often the cost-efficient solution	(Retail sales staff, Investors, users) Unavailability of information on energy efficiency (no labelling)

have the required knowledge to help customers choose the most energy-efficient and cost-effective option	(Investors, users) Contribution to protect the environment (Investors, users) Increased (re- sale) value of the property (Investors, users) Improved reputation: recognition environmentally-sound behaviour	(Investors, user) Lack of knowledge about efficient technology: Where to start? What are the different possibilities? How big are the saving potentials? (Investors, users) Information and search costs: Which is the most and energy efficient solution for the appliance? Which manufacturer offers the best value for money? (Investors, users) Reluctance/scepticism towards new products and technologies from new suppliers/companies: Will other than the already known companies (habits, good experience) offer the same quality, functionality and safety (risk aversion)? Is it worth to inform myself about the technical details? (Investors, users) Organisational practices or customs, e.g. using first cost or payback times as investment criteria (Investors, users) Other functional priorities: priority criteria are the functionality or the appearance instead of energy aspects (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Investors, users) Lack of motivation: In some cases savings are too small, uncertainty about level of benefits and costs (is it worth to inform myself?) (User ≠ investor) No direct economic advantage for cost-effectiveness: Only the end-users profits from energy savings
Reorientation of political frame-	(User) Saved energy costs: The energy efficient product is often the cost-efficient	(Manufacturers, wholesalers, retailers) Risk of production and marketing: will

work to increase energy efficiency by law	solution (Investors, manufacturers, wholesalers, retailers) Contribution to protect the environment (Investors) Increase value of the property (Manufacturers) Offering higher value to the customers	there be sufficient demand with the result that the production/portfolio change-over pays off, a minimum quantity of units is reached, and the price can be kept at a competitive level? (Manufacturers, retailers, wholesalers) High profitability requirements: These are often caused by lack of capital and insecurity about continuity (Wholesalers, retailers) Profit is linked to sales: The more retailers sell expensive products the higher is the profit. But: Is it worth to convince the customers to buy the efficient technology and to pay more for the product? It may take much more time to sell an energy-efficient than a less efficient but cheaper appliance, so that the margin earned per hour may be lower with the energy-efficient appliance (Investors, users) Uncertainties (e.g. about future energy prices, market development): What will be in 5,10, ..years? Prices may be low or volatile. Uncertainty how much savings can be reached? Is it worth to wait for the payback to occur? (Investors, users, manufacturers, wholesalers) Organisational practices or customs, e.g., using first cost or payback times as investment criteria. (User ≠ Investor) Almost no possibility for users to influence the investments in energy efficient technologies, as the user mostly depends on the agreement of the investor (Investor ≠ users) No direct economic advantage for cost effectiveness. Only the end-users profits from energy savings (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth

		to deal with energy savings, especially in comparison to investment costs and in comparison to other products? (Investors, users) Small size, low priority, low energy costs/low savings: Is it worth to deal with energy savings, especially in comparison to investment costs and in comparison to other products?

Table 2: Energy efficiency implementation strategies with their corresponding barriers tackled and incentives strengthened

5.3 Policy packages to realise the implementation strategies

As a next step, political decision makers must enact policies in order to put the implementation strategies to work.

Table 3 presents policy options how to put the different implementation strategies to work. Some instruments are alternative to each other, but usually already several instruments should be coordinated in an adequate policy package to establish synergy effects and realise each implementation strategy.

Since also a combination of implementation strategies is necessary to tackle the manifold barriers, these targeted policy packages must then be merged into a consolidated overall package, which is ultimately capable of kick-starting a real market transformation in the building sector. This "ideal policy package" will be presented in the next section.

Implementation Strategy	**Elements of policy package**
Bring down the first costs of energy-efficient appliances via market transformation/economies of scale	Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances Soft and/or subsidized loans Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes Energy efficiency public procurement for BAT or energy performance levels even better than BAT

	Technology procurement Bulk purchasing and co-operative procurement Online database with most efficient products on the market Calculation tools Focussed information, motivation and advice campaigns for manufacturers, investors, retailers, sales persons, end-users etc. Certification of providers Provision of standardized material, e.g. brochures, purchasing guidelines Information centres Governance and implementation infrastructure for all the above: Long-term strategies/political commitments Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Ensure manufacturers and retailers that there is a market for energy-efficient appliances	Mandatory energy labelling schemes *2nd best alternative:* Voluntary labelling schemes Certification of providers Focussed information, motivation and advice campaigns for investors, end-users, retailers, sales persons, manufacturers, etc. Provision of standardized material, e.g. brochures, purchasing guidelines Online database with most efficient products on the market Information centres Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances Soft and/or subsidised loans

	VAs on energy efficiency targets and actions with commercial or industrial organisations VAs with appliance manufacturers to improve energy efficiency of appliances sold in the market Energy audits for big consumers/ coaching of potential buyers Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Exemplary role of the public sector Pilot tests of the use of innovative appliances Energy efficiency public procurement for BAT or energy performance levels even better than BAT Bulk purchasing and co-operative procurement Technology procurement Super efficient appliance award competition Competitions and awards for households/companies Network of firms ('Energy Efficiency Cluster') Research programmes; promote technology development of efficient products Governance and implementation infrastructure for all the above: Long-term strategies/political commitments Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Enable buyers to compare the energy consumption of appliances with the same functionality	Mandatory energy labelling schemes *2nd best alternative:* Voluntary labelling scheme Online database with most efficient products on the market Focussed information, motivation and advice campaigns for investors, end-users, retailers, sales persons, manufacturers, etc. Certification of providers

	Information centres Energy audits for big consumers/coaching of potential buyers Provision of standardized material, e.g. brochures, purchasing guidelines Super-efficient appliance award competitions Competition and awards for households/companies Calculation tools Require use of LCC calculations in public purchasing
Inform investors about energy-efficientappliances, their benefits and net savings to be made, comparing the most energy-efficient models on the market (BAT) to less efficient ones	Mandatory energy labelling schemes *2nd best alternative:* Voluntary labelling scheme Online database with most efficient products on the market Calculation tools Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Require use of LCC calculations in public purchasing Energy audits for big consumers/ coaching of potential buyers Focussed information, motivation and advice campaigns for manufacturers, investors, retailers, sales persons, end-users etc. Certification of providers Provision of standardized material, e.g. brochures, purchasing guidelines Information centres Feedback measures (smart metering, feedback devices in combination with normative messages)

	Soft and/or subsidised loans Exemplary role of the public sector Energy efficiency public procurement for BAT or energy performance levels even better than BAT Use of behavioural approaches (social marketing, feedback devices in combination with normative messages) Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes Bulk purchasing and co-operative procurement Technology procurement Super efficient appliance award competition Competitions and awards for households/companies Governance and implementation infrastructure for all the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Ensure independent testing of energy consumption and quality	Energy agencies and testing agencies
Fund research and development on energy efficiency of appliances and train manufacturers' development staff, retail sales staff, and large buyers' procurement staff about energy-efficient technologies, solutions and net savings	Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Focussed information, motivation and advice campaigns for manufacturers, investors, retailers, sales persons, end-users etc. Provision of standardized material, e.g. brochures, purchasing guidelines Research programmes; promote technology development of efficient products Pilot tests of the use of innovative appliances Energy efficiency public procurement for BAT or energy performance levels even better than BAT Technology procurement Super-efficient appliance award competitions

	Networks of firms ('Energy Efficiency Clusters') Calculation tools Competitions and awards for households/companies Exemplary role of the public sector Governance and implementation infrastructure for all the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Increasing motivation by making it as easy as possible to choose the energy efficient option – make appliance energy consumption and quality visible and comparable; use social marketing tools (e.g. norm appeals, vivid personalized communication, obtaining a commitment, etc.)	Minimum energy efficiency performance standards or Top- Runner Approach Mandatory energy labelling schemes *2nd best alternative*: Voluntary labelling scheme Online database with most efficient products on the market Provision of standardized material, e.g. brochures, purchasing guidelines Use of behavioural approaches (social marketing, feedback devices in combination with normative messages) Focussed information, motivation and advice campaigns for manufacturers, investors, retailers, sales persons, end-users etc. Information centres Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Require use of LCC calculations in public purchasing Certification of providers Energy audits for big consumers/coaching of potential buyers Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances

	Super efficient appliance award competition Competitions and awards for households/companies Calculation tools Energy agencies and testing agencies
Highlight benefits (first of all achievable cost savings, but also non-energy benefits like improved comfort, health, productivity), show how others are already benefitting from EE measures, frame recommendations in terms of money lost (or opportunity missed) through inaction rather than in terms of possible gains through action; disseminate information about real tangible good practice examples	Focussed information, motivation and advice campaigns for investors, end-users, retailers, sales persons, manufacturers, etc. Provision of standardized material, e.g. brochures, purchasing guidelines Online database with most efficient products on the market Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Use of behavioural approaches (social marketing, feedback devices in combination with normative messages) VAs on energy efficiency targets and actions withcommercial or institutional organizations Mandatory energy labelling schemes *2nd best alternative:* Voluntary labelling scheme Certification of providers Super efficient appliance award competition Competitions and awards for households/companies Research programmes: promote technology development of efficient products Exemplary role of the public sector Calculation tools Governance and implementation infrastructure for most of the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Improve access to capital, e.g., subsidise EE measures, establish innovative financing mech-	Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the

anisms	level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances Soft and/or subsidised loans Co-operation with banks Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes Governance and implementation infrastructure for all the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Find ways to align opposing incentives in such a way that win-win situations occur	Minimum energy efficiency performance standards or Top- Runner Approach Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes Competitions and awards for households/companies Super-efficient appliance award competition VAs with appliance manufacturers to improve energy efficiency of appliances sold in the market Economic incentives for very energy-efficient new appliances: *alternatively to each other*: direct subsidies, grants, rebates (if energy savings for one appliance and the purchase price are big enough compared to the level of incentive needed to attract buyers to the energy-efficient appliances) *alternatively:* Tax rebates and other tax incentives for very energy-efficient new appliances Governance and implementation infrastructure for most of the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Make energy efficiency the standard or at least reduce complexity by excluding the least efficient practices from the market	Minimum energy efficiency performance standards or Top- Runner Approach Energy agencies and testing agencies
Change incentive structures so	Minimum energy efficiency performance standards or Top- Runner Ap-

that chief executives also seek for long-term profit maximisation	proach Requirements to change internal incentive structures of companies (by law) VAs with appliance manufacturers to improve energy efficiency of appliances sold in the market VAs on energy efficiency targets and actions with commercial or institutional organizations Network of firms ('Energy Efficiency Cluster') Long-term strategies/political commitments
Qualification of supply chain actors so that they have the required knowledge to help customers choose the most energy-efficient and cost-effective option	Training and qualification for product developers, manufacturers, retailers and multipliers who have direct contact with end-users Provision of standardized material, e.g. brochures, purchasing guidelines Mandatory energy labelling schemes *2nd best alternative:* Voluntary labelling scheme Certification of providers Focussed information, motivation and advice campaigns for manufacturers, investors, retailers, sales persons, end-users etc. Information centres Promotion of innovative financing schemes such as on-bill financing, functional services, pay as you save (PAYS) schemes VAs with appliance retailers to improve energy efficiency of appliances sold in the market / to actively participate in training activities Networks of firms ('Energy Efficiency Clusters') Exemplary role of the public sector Governance and implementation infrastructure for all the above: Energy efficiency trusts and funds *alternatively:* energy-saving obligations for energy companies
Reorientation of political framework to increase energy efficiency by law	Governance and implementation infrastructure for energy efficiency: Long-term strategies/political commitments Energy efficiency trusts and funds

	alternatively: energy-saving obligations for energy companies
	Energy agencies and testing agencies
	Single legal instruments
	Minimum Energy Performance Standards or Top-Runner Approach
	Requirements to change internal incentive structures of companies (by law)
	Mandatory energy labelling schemes
	Require use of LCC calculation in public purchasing
	Tax rebates and other taxes incentives for reducing energy end-use consumption
	Exemplary role of the public sector
	Network of firms ('Energy Efficiency Cluster')
	Energy efficiency public procurement for BAT or energy performance levels even better than BAT
	Energy taxation and/or carbon pricing
	Removal/reduction of subsidies on end-user energy prices
	Removal/reduction of subsidies on energy extraction, import, or conversion, or on disposal/treatment of spent fuels, residues, and shut-down plants
	Research programmes; promote technology development of efficient products

Table 3: Policy packages for each implementation strategy

6. The ideal policy package resulting from the theoretical analysis

Resulting from the theoretical analysis, we can derive the elements that should ideally be included in a comprehensive policy package to achieve the goal to make best available energy efficiency levels the standard. They are in line with the results from literature that we presented above, but now they are more complete. We can now provide an overview of these elements and how they should interact for fast and lasting market change towards that goal:

- A policy roadmap towards very efficient appliances should guide policy-making, with a clear timetable and targets towards best available technologies.
- An infrastructure and funding for the policy elements need to be in place (i.e. an energy agency or similar and government funds, and/or energy companies with the task to implement incentive programmes).
- A basis for an effective policy package are minimum energy performance standards (MEPS). They should be created by law. In a transition period before a law can be passed, a voluntary standard may help. MEPS reduce transaction costs as well as the investor-user barrier by removing the least energy-efficient appliances from the market. They should, however, always be at least as stringent as the level of least life-cycle costs.
- Labelling schemes work perfectly with efficiency standards. MEPS usually eliminate the worst products from the market but do not harness additional saving potentials. Labels present the best products on the market and are primary made for buyers and end-users. Mandatory labelling schemes mostly compare the products to show the best but also the worst products on the market. Furthermore, an information campaign is needed in order to promote the label and to raise the consumers' awareness towards energy efficiency. Furthermore, an energy label but also information campaigns and rebate programmes can prepare the ground for an effective minimum energy efficiency standard or voluntary commitment.
- In accordance with MEPS and labelling schemes manufacturers, sales staff, investors and end-users should be included in the policy package by training and educational programmes. Easy-to- use design and life-cycle cost calculation tools are essential. Certification of training can make it more attractive for both the qualified market actors and their customers.
- The next step should be the marketing of demonstrated good practice, advice and support for investors, and financial incentives for broad market introduction. Rebate programmes are dependent on information campaigns for reaching their full effect.
- To push the market towards energy efficient appliances and create first markets for them, public and technology 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.

- Once a certain market share of (highly) energy-efficient appliances above a specific energy performance level is reached, the professionals are trained and used to the required practices, and the cost-effectiveness of the next step is proven, then this next step can be mandated by the MEPS regulation.
- The steps after the next step should be prepared by R&D funding, demonstration, award competitions, and maybe also already by financial incentives for broad market introduction.

For more information on policy interactions, c.f. Michelsen 2005.

7. The empirical proof: policies and measures used by successful countries

To create successful policy packages and to guarantee lasting results single policies and measures must be successfully implemented and coordinated with other policies which were already implemented. An effective policy package consists of several innovative and successful P&Ms.

Numerous programmes to promote the energy efficiency of appliances exist. For example, minimum energy performance standards and voluntary or mandatory labelling schemes were already implemented in many countries worldwide (overview: see inter alia www.clasponline.org or www.iea.org). Furthermore, financial incentive programmes and awareness-building measures were implemented in many countries in addition to regulatory instruments to lead consumers to buy the most energy-efficient products. Nevertheless, full analytical assessments which of these strategies and instruments were most successful are not available until now. The first part of this paper dealt with the actor-centred theoretical analysis and the development of implementation strategies and policy packages to increase energy efficiency.

For the verification of the described theoretical approach and the resulting ‘ideal’ policy package, policies already implemented in different countries will be analysed in the bigEE project to find out, which preconditions are necessary to name a policy a “good practice example”, and to create the basis for a successful policy package that consists of several well implemented policies. Consequently, a method how to find good practice policies is necessary. A new multi-criteria assessment scheme was developed to rate policies and measures and to judge whether a policy was successfully implemented and can be named a good practice policy or not.

7.1 Criteria to rate the policy instruments

To evaluate, compare and decide which policy or policy combinations have worked best and can be called 'good practice', the Wuppertal Institute developed a new multi-criteria assessment scheme. The function of the assessment scheme is to compare policies and to highlight worldwide good practice policies. A comprehensive system to rate policies and measures has the chance to demonstrate success factors and potentials (energy savings, cost-effectiveness etc.). The aim is to present good practice examples to policy makers and to provide incentives to transfer these policies (especially to emerging countries).

The scheme is based on ten criteria. Main criteria are the already mentioned integration of all relevant market actors and the analysis of existing barriers and incentives. The ideal policy addresses all market players and barriers, avoids lost opportunities and lock-in effects, has dynamic efficiency levels, lasting results and spill-over effects. Other aspects are the innovative structure of the policy or the policy package and the promotion of high energy efficiency standards (according to the best available technology or the least life cycle costs). The policy must have been evaluated to be a model example. The calculated cost-effectiveness and the achieved high energy savings (per unit and overall) demonstrate the successful implementation. Finally, the measures should not have significant negative side-effects like rebound effects, snap-back effects and free-rider effects to be ranked as good practice policy.

Table 3 shows this multi-criteria assessment scheme for good practice policies. Next to the ten selection criteria, the operationalisation is described and the weight for the selection is presented. The assessment scheme differentiates between proven policies, which are already in place for several years, and innovative policies, which were implemented short time ago. Some of the selection criteria require a ranking between 0 and 10. This ranking will play a role in the overall assessment of the policy and during the decision whether the policy can be named good practice policy. The comments on the right side give some explanatory remarks.

No	Criteria	Explanation	Rating	Weight for selection	
				P&M with proven effectiveness	Innovative P&M
1	Implementation of the policy/ transferability	The policy is not older than ten years or a justification is required. The last revision date of the policy or measure counts. The reason for this criterion is that market players and policy-makers are often not so keen on "old stuff" and easier to convince with up-to-date information.	none	Precondition; no weighting	Precondition; no weighting
2	Recent P&M	Not older than 10 years before date		If not, justi-	If not, justi-

		of website publication		fication required	fication required
3	Appropriate design of the P&M	Policies need to be well-designed to be effective and should not fall short of the energy saving potential or promote suboptimal solutions, and should avoid negative side effects. Therefore the policy was designed to address all relevant market actors and the most relevant barriers and incentives. Furthermore the policy aims to foster a dynamic market transformation, for example by promoting innovations to make the best available technology (BAT) even more energy-efficient and/or increasingly removes inefficient technologies from the market. The policy should be designed to address relevant side effects like minimising free-rider effects, snap-back effects and rebound-effects and to maximise spill-over effects.	as a whole on a scale between 0 and 10	30%	40%
4	Innovative elements	In many areas, energy efficiency policies need innovation to become more effective. Therefore the policy or measure includes innovative elements or combines them to an innovative policy package. Example: Different market actors are addressed and included in the policy design and implementation phase or there is an innovative way to combine policies and to overcome barriers (like financial barriers or knowledge barriers).	on a scale between 0 and 10	10%	30%
5	Policy or measure fosters worldwide BAT	Promoting suboptimal solutions will create lost opportunities for savings and lock in inefficient designs and technologies. Therefore the policy should be designed to foster worldwide best available technology (BAT) or country-specific least life-cycle cost (LLCC) solutions. This	close to BAT/LLCC = 10; substantially different = 0	10%	15%

		includes a dynamic life-cycle cost analysis including typical interest rates.			
6	An evaluation exists	An evaluation is crucial for policy assessment and learning. A comprehensive ex-post evaluation exists including an analysis of the status quo and the results in terms of energy savings, emission reductions, cost-effectiveness or other plausible criteria for measuring a P&M impact.	yes =10; no = 0	10%	n/a
7	The policy is cost-effective	Most policy-makers prefer cost-effective policies; these will therefore be more appealing and convincing. The project considered policy cost-effectiveness for energy-efficiency investors, energy end-users or others expected to act due to the policy (usually called 'participants' in the case of an energy efficiency programme), and for the national economy (total resource cost) or better the societal perspective[1]. This includes a benefit-cost analysis including net to gross correction factors and typical lifetimes and interest rates.	Policy must be cost-effective; Benefit-cost ratio from different perspectives	if no data or not cost-effective justification required	n/a ex-ante data if possible
8	The P&M leads to energy savings per unit	The P&M leads to energy savings per unit (per appliance, per building) compared to a reference case. Expected additional, annual energy savings in %/year and in kWh/year per unit compared to baseline (e.g. business as usual) projections.	only if energy savings/ unit are available	Precondition; no weighting	n/a ex-ante data if possible
9	The overall effectiveness is high	Energy efficiency policies should aim for large overall energy savings and should not fall short of at least the cost-effective potential. This criterion measures what they actually achieved in this respect. 'High' means: have at least 30 % of	on a scale between 0 and 10	30%	n/a ex-ante data if possible

[1] We relied on the California Standard Practice Definition for these perspectives of cost-effectiveness, cf. www.cpuc.ca.gov

		the energy savings potential available within a specific time frame due to usual investment/refurbishment cycles in the target area (region/country) been implemented. If that is not easy to evaluate, effectiveness could also be measured by the following: the share of energy-efficient technology has at least doubled; or the price premium on energy-efficient technology has decreased at least 30%; or a service has saved on average at least 30% of the customers' energy consumption.			
10	Sustainability aspects	It is not only energy savings that matter. The policy is in line with other sustainability aspects like material efficiency, health or employment aspects.	on a scale between 0 and 10	10%	15%

P&M = Policies and Measures; BAT = Best Available Technology; LLCC = Least Life-Cycle Cost; correction factors = factors correcting the gross savings for rebound, free-rider and spill-over effects, as well as to eliminate double-counting between P&M

Table 4: bigEE evaluation criteria for good practice of policies and measures (P&M)

7.2 A model example of a good practice policy

To analyse the feasibility of the multi-criteria assessment scheme, the EnergiePremieRegeling (energy premium scheme), which was developed in the Netherlands in 2000 is used as an example. The Dutch programme was implemented from 2000 to 2003, aiming at, inter alia the purchase of appliances at the top levels of efficiency and performances by creating favourable conditions for consumers. The programme offered cash rebates for the purchase of higher energy efficiency household appliances, like refrigerators (e.g. in 2002, customers received 50€ for each appliance with energy label A and 100€ for super-efficient A+ appliances; in 2003, only A+ and A++ models were eligible for rebates). Therefore, the target group were buyers and users of residential appliances. The rebates, funded by an energy tax (Regulating Energy Tax; Regulerende Energie Belasting REB) were channelled back to the consumer through the utilities. 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 customers had the possibility to get a rebate paid out by the energy company for specific energy efficiency measures. This ended up, as an example, in 94.4% of the market of washing machines being Class A and higher, i.e. the highest pene-

tration in Europe at that time. The energy companies subtracted these energy rebate payments from their ecotax debt (Thomas 2006).

These first impressions of the programme promise success for the identification of a good practice policy according to the newly created multi-criteria assessment scheme. The next chapter analyses the criteria in detail to decide whether the policy was successfully implemented and can be named a good practice policy.

7.2.1 EnergiePremieRegeling – a good practice policy?

The ten criteria of the assessment scheme will be taken up by the policy example to identify a good practice policy. Firstly the policy was successfully and durably implemented in the Netherlands from 2000 – 2003 and the end of the programme is not longer ago than 10 years. Therefore the EPR, EnergiePremieRegeling was successfully implemented and is a recent P&M. The next aspect of the assessment scheme deals with the appropriate design of the policy. The programme aims to avoid lost opportunities by providing financial benefits to buy an energy efficient product. Consumers and investors were successfully addressed to overcome existing barriers and to strengthen incentives. Barriers are for example the lack of capital, low energy savings compared to the costs and the lack of knowledge. Furthermore the rebound effect could be minimised because the programme went along with information campaigns and social marketing mechanisms. However, the free-rider effect was high in the early years, because apart from saving energy (Thomas 2006), the main goal of the EPR was to channel back the energy tax to the tax payer (households). Regarding snap-back effects, the programme was effective for only a few years. After this period no supports were offered anymore but the increase in sales has also produced a decrease in the prices of A-labelled white goods. Their market shares remained at a significantly higher level than before.

Furthermore, the policy included innovative elements by using an intelligent policy package including a wide scale of information campaign, like national campaigns on television, national newspapers, advertisement in shops, actions targeting installers, and websites. Moreover the programme is in accordance with the EU energy labelling scheme and the Energy+ campaign that prepared the label sub-classes A+ and A++. If a customer decides to buy an energy-efficient appliance, the energy label provides information, whether a funding is possible or not. The same mechanism was offered by the Energy+ campaign. The subsidies funded by an energy tax which was channelled back to the consumers through the utility is also an innovative element.

The EU energy label demonstrates the best available products on the market. The Energy+ campaign allowed to distinguish even higher energy efficiency within class A of the label. The energy premium scheme offered cash rebates for the purchase of these very energy-efficient household appliances. That is why the policy was close to a best available solution and fostered worldwide BAT.

To come back to the assessment scheme, a satisfying evaluation exists and the cost-effectiveness was calculated. In total, about 15% of the ecotax is used for the energy credit scheme. The amount of funds available to the citizens for 2000 and 2001 were 158 million €, of which 97% was actually spent. Another important measurable side effect were increases in VAT and taxes on profit and the avoided unemployment benefits. They were calculated for the case of washing machines: extra company profit tax: 1.9 million €/year and extra VAT: 6.6 million €/year (Wuppertal Institute et al. 2003).

Regarding cost-effectiveness, the energy savings were also high. In November 2001, almost two years after the start of the programme, one third of Dutch households had applied for the rebates. Around two thirds of these rebates concerned domestic appliances. The introduction of the premium scheme has led to an enormous growth of the supply of A-labelled and later A+ and A++-labelled appliances. The market share of A-labelled washing machines grew from 40 to 88% over the 1999- 2001 period. This means the proportion of A-labelled appliances doubled and prices decreased (up to 25%). This increase is most likely due to the energy premium scheme and led to a situation where retailers very often advice their customers to buy an A-labelled appliance as the best on offer. An analysis of the Wuppertal Institute calculated that energy savings for household appliances of 300 GWh/year, plus 500 GWh/year in heating energy for buildings and 0.3 million tons of CO2 were realised with the energy premium scheme programme until 2002 alone (including the market transformation effect and other side effects) (Thomas 2006).

According to this analysis and the positive results, the programme addressed selected market players and overcame existing barriers. It avoided lost opportunities and fostered lasting results. The policy had an innovative structure and promoted high and rapidly increasing energy efficiency standards, particularly for refrigerators and freezers (only A+ and A++ received rebates in 2003). The calculated cost-effectiveness and the achieved high energy savings confirm the successful implementation. Therefore the energy premium scheme can be named a good practice policy.

Summarising, the assessment scheme was successfully tested for a policy example– a financial incentive programme, which can be an essential element of the 'ideal' policy package –with the result that it is possible to identify good practice policies. The main barrier for the application of the bigEE assessment scheme is the availability of relevant data. For many policies, there is a lack of data due to the lack of attention to and funds for evaluation. Adequate information is often not available and national experts may be essential with appropriate background knowledge.

7.3 A good practice policy package

In the previous chapter, the EnergiePremieRegeling was tested as a successful single instrument. Furthermore, the programme was also part of an effective policy package, which is a proof of our actor-centered analysis. The rebate scheme was developed in accordance with minimum energy performance standards, the European energy label, voluntary labelling schemes and information programmes. Particularly, the EU Energy label and the procurement programme Energy+ formed the basis for the EPR. They provided information, whether a consumer was entitled to a rebate when buying a specific model or not. The dynamic tightening of the requirements for award of a rebate (from A to only the equivalent of what became A+ and A++ later on), in turn, prepared the revision of the EU cold appliance label to include A+ and A++ subclasses, by enabling manufacturers to start mass production to meet the demand created by the EPR scheme. The package thus comes close to the 'ideal policy package' presented in figure 2.

Other examples for successful and coordinated policy packages for energy-efficient domestic appliances can be found, e.g., in Japan, Brazil and California. They, too, include innovative elements and

demonstrate the successful interaction of different policies, like MEPS, labels, financial mechanisms, replacement programmes, procurement measures and information campaigns.
For example in Brazil, the Federal Law 10.295 was installed to introduce MEPS. Previously an energy label for refrigerators and freezers and other appliances was introduced. It is similar to the European energy label. As an additional label, an endorsement label exists to emphasise the best available products on the market. Furthermore, the federal government created an electricity social tariff in order to provide low-income families with affordable electricity. The families that obtain the social tariff are also able to take part in the refrigerator replacement programme for low-income households. From July 2006 till the beginning of 2008, 17.000 refrigerators were replaced, together with approximately 90.000 CFLs. The expected electricity savings through this measure are around 19 GWh/yr. The programme was combined with a recycling programme for old refrigerators.
Other examples are available and will be described and uploaded on www.bigee.net.

8. Conclusion

Energy efficiency is one of the most important issues in order to protect the climate and to stop the growing consumption of energy. For that reason, policy makers face the challenge to develop and implement appropriate instruments to increase energy efficiency of residential appliances. Such programmes are already in place in many countries. Especially minimum energy performance standards and labelling schemes were already implemented in industrialised but also developing countries. Different databases list these instruments and describe them briefly (see inter alia databases developed by CLASP and the International Energy Agency). It is also known that the interaction of several instruments guarantees the greatest success with push- and pull factors to influence all relevant actors and to tap all the available potential.
The refined approach, which was presented in this paper, illustrates how an actor-centred analysis enables developing an 'ideal' policy package, looking at the relevant market actors, their specific barriers and incentives, and concluding on implementation strategies which are derived from the earlier analysis. Based on this analysis, packages of policy instruments were identified, which are consistent with these implementation strategies. Since they address all relevant barriers, the package can be expected to transform the market towards high levels of energy efficiency.
This theoretical result was proofed by an empirical analysis, illustrated by a concrete example. To identify which policies and measures were successfully implemented and which factors were crucial to develop this policy, a multi-criteria assessment scheme was created and presented. The new scheme is justified by the fact that although several implemented policies are already in force, the effects of energy efficiency programmes are often poorly documented. Advantages and disadvantages are often unknown. That is why policy makers often rejected policy proposals because it seems too difficult to implement adequate measures. The empirical analysis tries to close this information gap by assessing the success and effectiveness of existing policies.
The newly created multi-criteria assessment scheme takes the analysis a step forward to rate policies and to define success factors. Criteria of the assessment scheme are primarily the energy savings and the cost-effectiveness of the policy but also the avoidance of negative side effects and the promotion

of best available technologies. The new method rates policies and measures in more detail compared to already known schemes, which mainly focus on the effectiveness, the efficiency, the political feasibility and the innovation potential (see e.g. Michelsen 2005). It goes beyond these approaches and considers the realised energy savings compared to the existing potentials, the cost-effectiveness and the design of the policy. The assessment scheme illustrates benefits of different policies and measures and thus aims to convince policy makers worldwide to transfer the policy from other countries in order to achieve similar results.

In the empirical part of this paper, the assessment scheme was exemplarily illustrated with the Energy Premium Scheme, which was implemented in the Netherlands in 2000. The review demonstrated the feasibility of the new method. According to the assessment scheme, the programme can be named a good practice policy and has therefore been successfully implemented. It is also a part of a policy package that comes close to the 'ideal package' and significantly accelerated energy efficiency in the market for cold appliances.

A precondition to use the assessment scheme is the availability of data. A comprehensive evaluation is essential to fill in the list of criteria. This is a precondition and therefore the biggest barrier of the scheme. Experts are necessary with a high level of knowledge about the policy-specific data and the design of the policy. A comparison of different measures is, therefore, still only feasible with considerable effort. However, the resulting comprehensive assessment and identification of what is really good practice will be worth the effort.

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