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Your guide to energy efficiency in buildings.

Why policy needs to assist building and appliance markets to become energy-efficient

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Buildings and appliances are crucial for sustainable energy development, because they offer an important energy **saving potential of 50 to 90 %** and **additional benefits** for energy security, development, employment, poverty alleviation, health, competitiveness, property value, and the environment. However, **market structures are complex** and many different actors will have to work together if optimal energy efficiency is to be achieved. Therefore, **policy is needed** to assist the various actors in overcoming their specific **barriers,** to strengthen their actor-specific **incentives** and thereby to make energy efficiency with its multiple benefits happen.

Large saving potentials for buildings and appliances – It’s really worth it

A building is a complex system whose annual energy use depends on many factors. These concern primarily heating and cooling but also lighting and appliances. With all these different end uses, large energy saving potentials can be achieved, but markets alone will realise less than half of these as we will see later. The following chapter summarises what we know about the overall energy efficiency potential (1) in buildings and (2) in appliances.

Energy efficiency in buildings is crucial for sustainable development, climate and resource protection and a low-risk worldwide energy system. Approximately 40% of global final energy demand and one third of the energy-related CO_2 emissions are related to buildings (IEA 2008). Early and comprehensive use of energy efficiency design and technology can substantially reduce both energy and emissions.

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

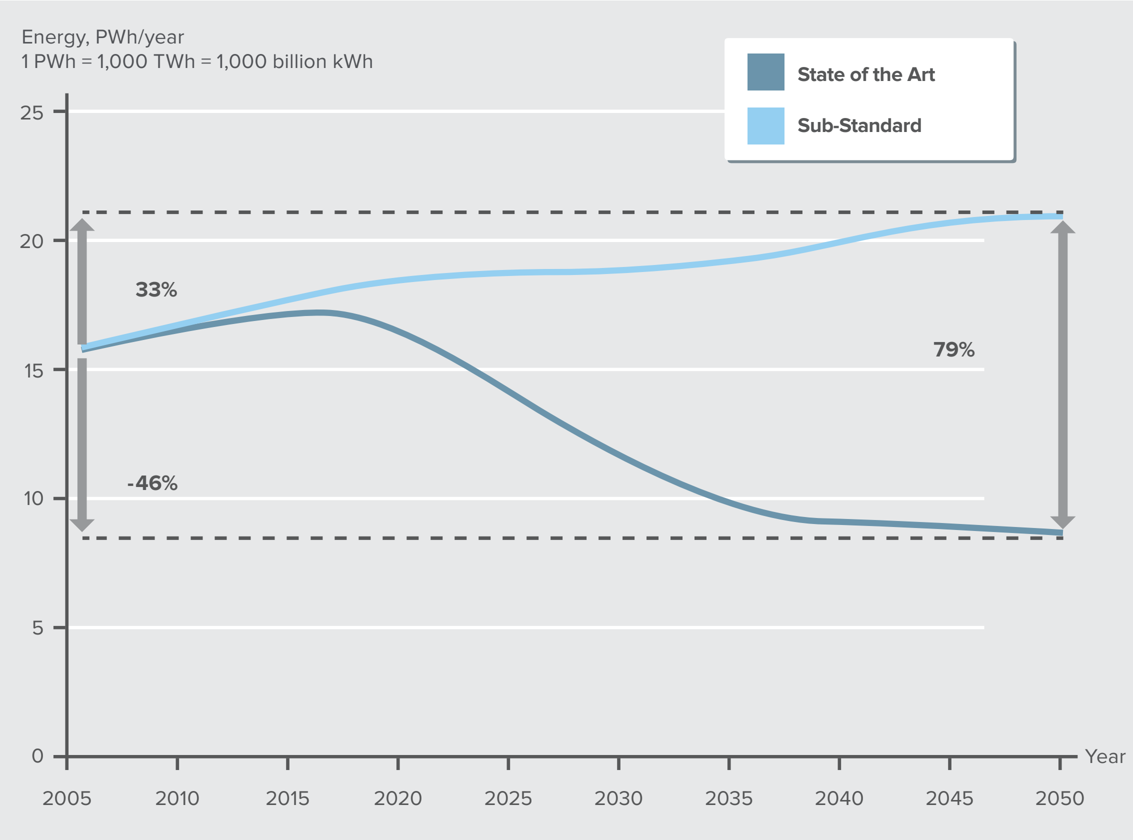

Figure 1: World space heating and cooling final energy use, 2005-2050, suboptimal and state-of-the-art energy efficiency scenarios

Source: GEA (2012)

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

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

Both paths are visualized in the figure above, the state-of-the art scenario in dark blue (with “deep renovation” in existing buildings and ultra low energy buildings) vs. the sub-optimal (described as “sub-standard” in the figure) development path in light blue. The overall difference in 2050 adds up to an implementation gap of 79% of the 2005 energy use or more than 12 PWh/year (12,000 TWh/year).

Regional differences

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

Building energy efficiency and climate change mitigation

Expressed in carbon emissions, the building sector, including electricity use, caused emissions of 8.6 gigatons (Gt) of CO2 in 2004 (IPCC 2007). Different projections calculate between 11.1 Gt and 14.3 Gt of carbon emissions in 2030. A survey of studies (IPCC 2007) shows that on a global scale, approximately 29% of the projected baseline carbon emissions can be reduced cost-effectively by 2020. In the long run, the IEA "Blue Map" Scenario in the figure below shows that out of the needed overall carbon emission reductions of 48 gigatons per year in 2050 for all sectors, 38% are attributed to the building sector (IEA 2008).

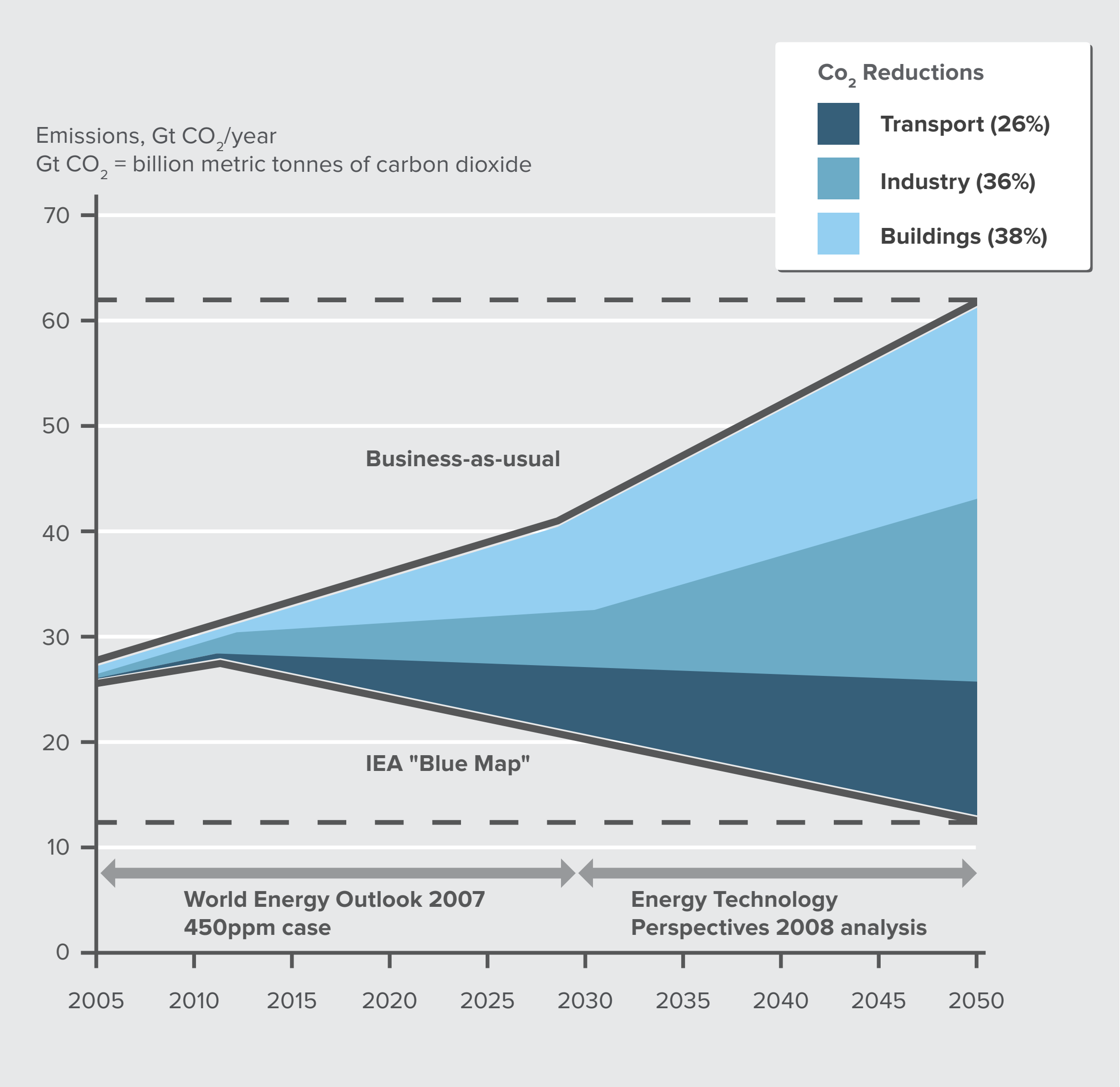

Figure 2: Carbon Emissions in the IEA Blue Map Scenario

Source: IEA (2008)

Energy efficiency in appliances used in buildings can bring further large energy savings. The most energy-efficient appliances already available today can save between 60 and 85 % of energy compared to inefficient models that are still on sale in many countries, while providing the same or better service. The potential for refrigerators and freezers is about 60 %, for television sets up to 65 %, and for computer monitors more than 80 % (www.topten.eu). Further energy efficiency improvements are likely in the future.

If this potential were harnessed by markets and supported by policy, more than 1500 TWh of annual worldwide electricity demand and 1,000 Mt of annual CO_2 emissions could be saved by 2030. In addition, energy efficiency in traditional biomass cooking stoves could avoid up to 1,500 Mt CO_2eq of greenhouse gas emissions per year. World electricity demand could thus be reduced by 4.6 % and CO_2 emissions by 6.5 % compared to business-as-usual by 2030. This will require policy to address the residential, commercial, and industry sectors with more stringent energy efficiency policy (CLASP 2011).

About 40 % of these savings could be achieved from the worldwide adoption of the most stringent energy efficiency regulations. Most energy efficient technologies are already far beyond existing regulations, so the other 60 % of the potential lies in reaching this “best practice” level. This emphasises that energy efficiency policy is incomplete.

Even in economies that already have policies requiring or promoting high energy efficiency levels, significant savings are possible. Where requirements are limited, the savings from accelerated adoption of leading policies would stimulate much larger savings.

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

Sub-optimal energy efficiency measures driven by short-term considerations are expensive in the long term. For example, once buildings are built or retrofitted they are usually not touched again during the following 20 to 40 years. High energy efficiency standards and deep renovation need to be integral to construction work from the start. They will then usually be cost-effective when incremental investment costs and higher cost savings are calculated over a reasonable lifetime of the building. It is the same effect with large appliances, which have a lifetime of 10-15 years (e.g. washing machines, refrigerators).

To tap this tremendous potential, appropriate and integrated packages of policies and measures are necessary, supporting ultra low energy buildings and very efficient appliances. This will avoid the “lock-in” effect of insufficient policies and measures encouraging sub-optimal energy efficiency.

Co-benefits of energy-efficient buildings and appliances

There is yet more to gain for policy from energy efficiency: A whole range of additional “co-benefits” can be achieved by improving a building’s energy performance or by making an appliance more energy-efficient, in addition to activating the largest cost-effective energy saving potential of all economic sectors. Such co-benefits may provide economic benefits in the same range as the direct energy cost savings. The most interesting of these co-benefits are improvements in health, higher workers’ productivity through better indoor climate and lighting, and higher living standards by making energy bills affordable.

For instance, triple-glazed windows not only keep the heat inside the building, but they also keep out traffic noise. And a properly insulated building envelope leads to a more stable, healthier indoor climate, with less cold or heat inflow, dampness, and draught from windows and walls.

Co-benefits increase social and/or individual welfare and come as a free add-on to the direct benefits of energy efficiency for investors and policy, which are reduced energy costs and climate change mitigation. They also contribute e.g. to further primary goals of energy efficiency policy – improved competitiveness and security of energy supply – and to other policy goals such as employment. Consequently, the co-benefits provide strong additional incentives for governments and investors alike to strive for energy-efficiency. Making people aware of the nature and extent of the non-energy benefits is therefore an important task for energy efficiency policy.

Highlighting these co-benefits (or non-energy benefits) is a powerful argument for energy-efficiency both in the commercial and the residential sectors. In industry for instance, even slight productivity gains may yield even higher returns to manufacturers than a comparatively small saving in energy cost. Approaching the problem from this angle rather than from the mere environmental perspective may therefore increase the political feasibility and the public acceptance of energy efficiency policies and measures (UNDP 2010, p.14f.). Along these lines, it will be helpful to define, quantify and monetise as many of these benefits as possible so that governments and investors can factor them in when assessing costs and benefits of energy efficiency improvements. Existing research on the monetisation of co-benefits shows that they may amount to the same order of magnitude as the energy-related benefits (Jakob & Nutter 2003). This would make the case for even more investments in energy efficiency improvements than are already now proven to be cost-effective. Still, it may not be sufficient to overcome the many non-economic barriers to energy efficiency that are the reason why policy needs to assist markets with energy efficiency.

In the following paragraphs, we provide a little detail on the most important co-benefits for buildings and appliances:

Productivity and health benefits in non-residential buildings
Energy-efficient commercial buildings improve productivity and quality of work, and reduce sick-leave times, due to a healthier, more comfortable indoor environment (including noise reduction and daylighting). This of course is an important additional incentive for owners/occupiers of commercial buildings to invest in energy-efficient design or retrofit - especially so in industrialised countries where even a slight increase in productivity can lead to labour-cost savings many times higher than typical energy-cost savings. This is because energy costs, albeit significant in absolute terms – and even more so when aggregated at the national level –, are seen by many companies as almost negligible compared to labour costs. Research has shown that energy-efficient buildings can lead to important productivity gains:

- Indoor air quality: 6-9 per cent productivity gain;
- Natural ventilation: 3-18 per cent productivity gain;
- Local thermal control: 3.5-37 per cent productivity gain;

Similarly, productivity and health gains have been achieved in public buildings: improved indoor environments have led to improved student performance in schools, and to faster patient recovery in hospitals. (UNEP 2012, p.352ff.)

Comfort and health benefits in residential buildings
Not only at the workplace, but also in their homes, occupants of energy-efficient buildings can benefit in many ways: Increased thermal comfort, enhanced daylight exposure, less noise and improved indoor air quality all contribute to enhanced well-being and reduce health risks at the same time.

More than two million deaths each year have been reported as a consequence of indoor air pollution – many of these could be avoided through an accelerated diffusion of modern, energy-efficient and lighting devices (UNDP 2010, p.14). In the same vein, the risk of fire would be decreased.

Another positive health effect of energy-efficient buildings is through a reduction of outdoor air pollution especially in locations where energy use is traditionally based on fossil fuel combustion. This means healthier living for the people living in and near such buildings.

Economic co-benefits for investors
In addition to substantial savings in energy costs, investors in energy efficiency will benefit in the following ways:

- **Increased property value**
  A growing number of studies analyse the impact of a building's energy performance on its market value. In Switzerland, for example, residential buildings carrying the Minergie label (a voluntary endorsement label certifying high energy efficiency) are reported to achieve sales price premiums of 7% for single-family homes, and 3.5% for apartment buildings (Salvi et al. 2008). Similarly, tenants are willing to pay rent premiums of up to 6% for Minergie-certified dwellings (Salvi et al. 2010).

  Likewise for commercial buildings, empirical studies of US office space markets have found average rent premiums of 3% for LEED and Energy Star certified office spaces. As such offices, on average, also have higher occupancy rates, the so-called effective rents (i.e. rent multiplied by occupancy rate) were found to be "almost 8% higher than those of otherwise identical nearby non-rated buildings". The observed sales price premiums even amounted to 13% (Eichholtz et al. 2011).

- **Increased competitiveness and new business opportunities**
  Both individual businesses and economies as a whole can improve their competitiveness if they use energy more efficiently than their competitors, for instance, by improving the energy performance of their building stocks.

  While this sort of competitiveness effect can be achieved by literally every business, there is also an effect related to specialised suppliers of energy efficient solutions: by offering innovative products and services they can open up new (niche) markets, which will likely have a positive effect on the economy as a whole too.

  Then again, there is the effect that a business can achieve competitive advantages and increase its profits through offering more energy-efficient products/services than its competitors (e.g. building systems manufacturers, architects). Being a frontrunner here may even lead to market leadership.

- **Reputational benefits**
  As more and more people grasp the urgency of fighting climate change and transforming our societies into low-carbon ones, businesses see themselves confronted with rising public expectations to include environmental aspects in their corporate social responsibility (CSR) policies. Therefore, not only suppliers of energy-efficient solutions can benefit from an improved public image, but all companies that choose to make their buildings and production processes state-of-the-art in terms of energy-efficiency.

Economic co-benefits for society

Saving energy through energy-efficient buildings will obviously reduce a country's collective energy bill. And it will have further positive consequences:

- **Increased energy security**
  In the light of ever-growing global energy needs, and at the same time rapidly decreasing supplies of fossil fuels (particularly oil and natural gas), making economies more energy-efficient becomes much more important than for environmental reasons alone. Not only does a lower energy intensity reduce an economy's dependence on energy imports and the associated risk of political conflicts, it also makes businesses and households more resilient to energy price shocks.

- **Economic Development**
  Especially for fast-growing countries like China and India, energy efficiency is a major challenge to reduce the high energy demand. In this context, energy efficiency is necessary and a key to keep up sustainable economic growth.

- **Poverty alleviation**
  Less developed economies typically suffer from insufficient or instable energy supplies, particularly for electricity. Such lack of access to energy services is an important reason for poverty. A more rational use of electricity will increase both energy security and access to energy, as it allows to supply more end-users with the same electricity production capacity (UNDP 2010, p.14)

  In addition, it is also the poor that will benefit most from the aforementioned health improvements and mortality reductions due to improved indoor air quality, since these will be occurring, to a large extent, in developing countries.

  Making homes more energy-efficient also increases the ability of low-income households to pay their energy bills, thus alleviating so-called fuel poverty, which in the light of ever rising energy prices is affecting more and more people also in developed countries. At the same time, it can decrease low-income households' need for social benefits and/or subsidised energy prices, and thus have a positive effect on public budgets too.

Furthermore in some countries like Brazil and Cuba, the government also introduced low-income energy-efficiency programmes to change old and inefficient products at lower or no costs.

- **Additional Employment**
  Making energy-efficient buildings the standard can create jobs in various ways:

  Firstly, there is a direct employment effect because a large number of skilled workers will be needed for the following tasks: new construction and refurbishment of buildings, increased production of energy-efficient materials, products, building components and appliances, building (retro-)commissioning, supply of energy services, energy management etc.

  Then, there is indirect job creation by way of the income effect: end-users saving on energy costs due to energy efficiency improvements will have more income at their disposal, a portion of which they are going to spend on other goods and services. These again require labour to be produced and sold. Similarly, if increased energy efficiency reduces the need for energy imports, a greater share of national consumption will be directed towards domestic products, which also creates jobs.

  The job gains from energy efficiency can be substantial. The European Commission has estimated that reaching the EU's target to save 20 % of primary energy by 2020 compared to baseline projections will lead to a net increase in employment of around two million persons (European Commission 2011, p. 3). The German KfW soft loan programmes to support energy efficiency in existing buildings had secured or created 111,000 jobs in 2009 (BEI et al. 2010).

  This effect is explained by the fact that energy efficiency investments redirect funds from less labour-intensive sectors (like energy-imports and distribution) to more labour-intensive sectors (like construction, installation and services). This is illustrated by the following graph which is based on statistics from the USA but is applicable also in many other countries.

- **Environmental benefits**
  The major environmental benefit of energy-effcient buildings is their contribution to mitigating climate change, because less energy consumption means less greenhouse gas emissions. Yet, there are more environmental benefits:

  Increased resource efficiency
  Energy-efficient, but especially green buildings save not only energy but other resources as well. For example, construction and demolition wastes of green buildings may be in excess of 50% less than is the case with conventional buildings. Water consumption and sewage output can also be considerably reduced through the use of energy-saving devices such as low-flow showerheads or faucet aerators (Global Energy Assessment, forthcoming).

  Ecosystem benefits
  Pollution of outdoor air, and in further consequence that of soils, waters, and crops, can also be alleviated if buildings are built in accordance with high energy performance standards. This is because the use of more energy-efficient combustion systems reduces emission of pollutants like nitrogen oxides (NOX), sulphur oxides (SO_2), and particulate matter (PM) (Global Energy Assessment, forthcoming). Obviously, the higher the share of such buildings within a certain area, the stronger the positive ecological effects will be.

  Further reading on these and yet other co-benefits and an overview of existing research on monetising co-benefits: Ürge-Vorsatz et al. (2009).

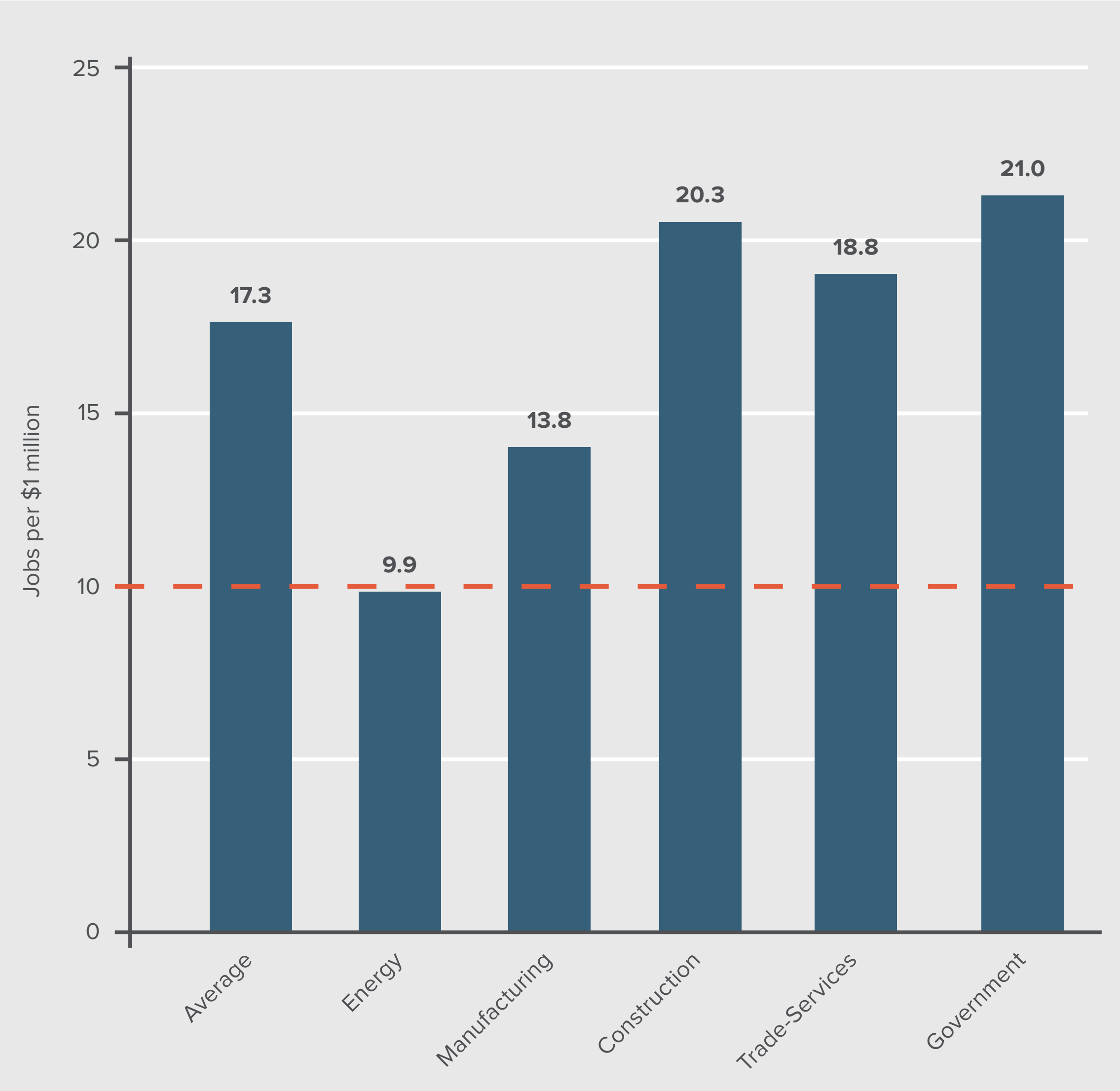

Figure 3: Jobs per million dollars of revenues by key sectors of the US Economy

Source: ACEEE

For further details on how energy efficiency creates jobs, please see the corresponding fact sheet provided by the American Council for an Energy-Efficient Economy (ACEEE).

Complex value chains and actor constellations in the building and appliance sectors

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

Due to the differences in the building and appliance sector, this chapter will first analyse the value chain and the relevant actors in the building sector and then do the same for the appliance sector.

The actor constellation in the building sector

New construction of a building is an extremely complex process. In each of the three main phases of development, construction, and operation, there are several interlinked steps in the value chain that have to be co-ordinated. This process involves a correspondingly large number of different market actors, the most relevant of which are architects, developers, financiers, builders, contractors, component suppliers, and last but not least investors, building owners, tenants, and individual users. In addition, there are also some actors that are not part of the value chain itself, but nevertheless play important roles in influencing market decisions, such as public authorities, energy agencies, and energy service companies (ESCOs) – to name just a few. The following figure illustrates the distinctive complexity of the building sector and shows how the different phases, tasks that form the links of the value chain, and respective influencing factors interact.

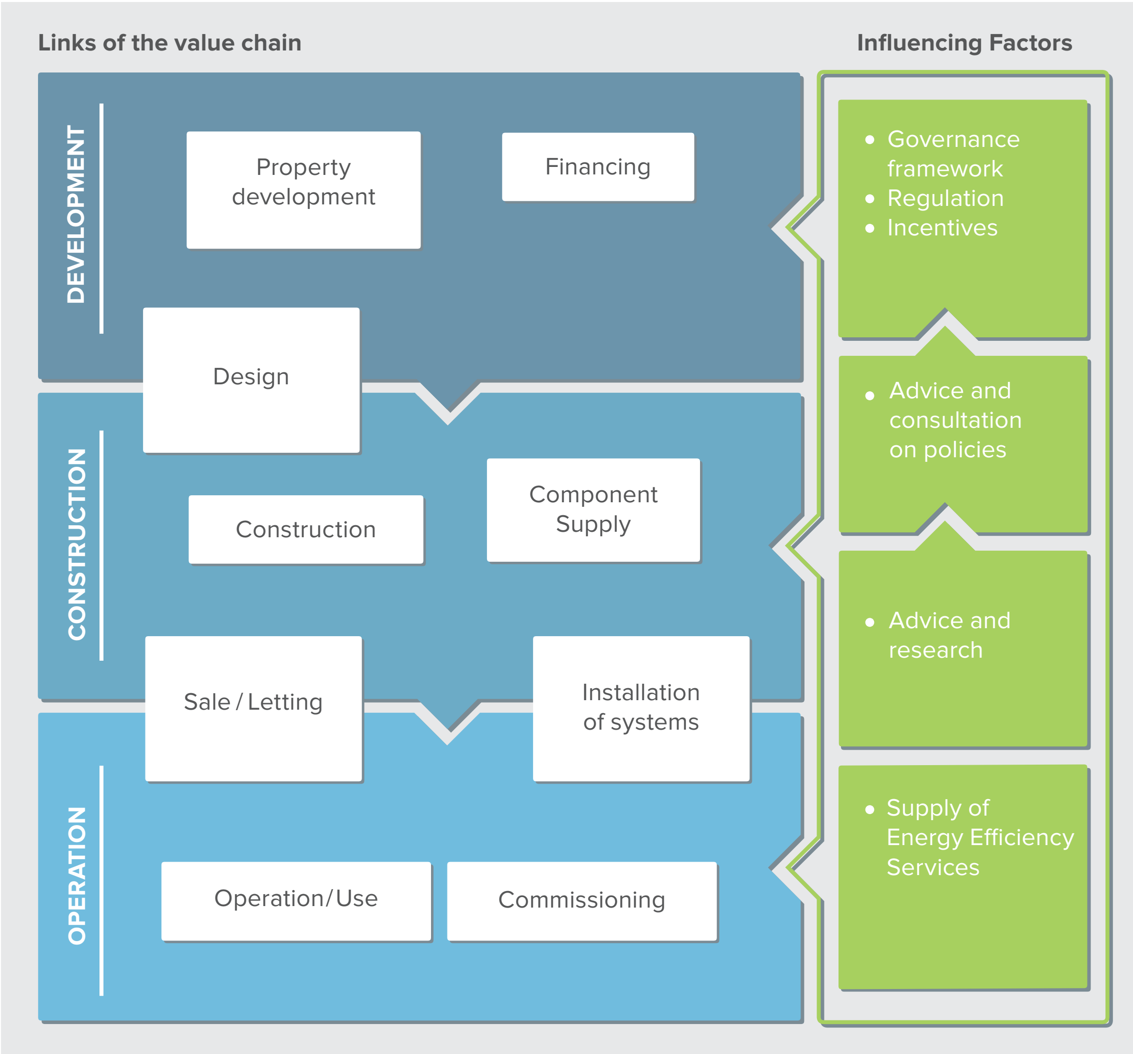

Figure 4: Value chain and influencing factors in the building sector

Source: Wuppertal Institute (2012)

Throughout the three phases of development, construction, and operation, a great number of actors take decisions that can influence the eventual energy performance of a building. They all have some inherent incentives to develop, offer, demand or invest in energy-efficient building solutions, but are on the other hand also facing strong barriers or disincentives that prevent them from choosing these energy-efficient solutions. The following table shows which actors are involved in the different steps of the value chain or have an influence on the value chain.

Value chain links and corresponding actors

Property development	• Property development companies • (Social) Housing companies • Investor-occupier
Financing	• Banks • Equity funders • Public-private partnership (PPP) • Insurances • Property valuers
Design	• Architects • Engineering consultants
Component supply	• Component manufacturers • Wholesale and retail
Construction	• General management companies • Construction companies and contractors • Manufacturers of pre-fabricated houses
Installation of systems	• System suppliers • Installation contractors
Sale/Letting	• Property development companies (as sellers or landlords) • Manufacturers of pre-fabricated houses • Housing corporations • Real estate agents • Landlords/landladies • Buyers, tenants
Commissioning	• Commissioning providers • Engineering consultants • Facility managers
Operation/Use	• Investor-occupiers (as developers or as buyers of completed buildings) • Landlords/landladies • Tenants • Employees, customers, visitors, guests etc. • Facility managers

Influencing factors and corresponding actors

Governance framework Regulation Incentives	• National / local authorities • Building Permission Authorities • Energy agencies
Advice and research	• Consumer organisations • Science • NGOs
Supply of Energy Efficiency Services	• ESCOs • Energy agencies • Energy consultants/ assessors

Processes for **energy-efficient building refurbishment** are quite similar to new build and involve many of the same actors, although they normally exclude the tasks and actors of property development and sale or letting. Such renovation processes and actor constellations are thus almost as complex as those for new build. As the complexity of the building sector requires that all members of the value chain act in favour of energy-efficient designs and choices, it is not sufficient to merely look at the end-users (i.e. building owners and tenants). Instead, it is crucial to identify and closely examine the barriers and incentives of all relevant actors in the value chain (including supply, demand, and use of energy-efficient buildings). This enables political decision makers to first understand more thoroughly why energy efficiency is often not implemented by 'the market' alone – and thus needs policy support – and then to develop appropriate remedies in the form of tailored policy packages.

The actor constellation in the appliances sector

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

Before creating policies to increase the energy efficiency of residential appliances, it is therefore 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. In each of the main life-cycle phases from development to recycling, there are several interlinked steps in the value chain that have to be co-ordinated. Consequently, this process involves a large number of different market actors like manufacturers, retailers, wholesale companies, investors, and users. As with buildings, there are also some actors that are not part of the value chain for appliances itself, but nevertheless have an important role to play in influencing the decisions of the market actors - for instance: public authorities, energy agencies, research institutes, and interest groups.

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

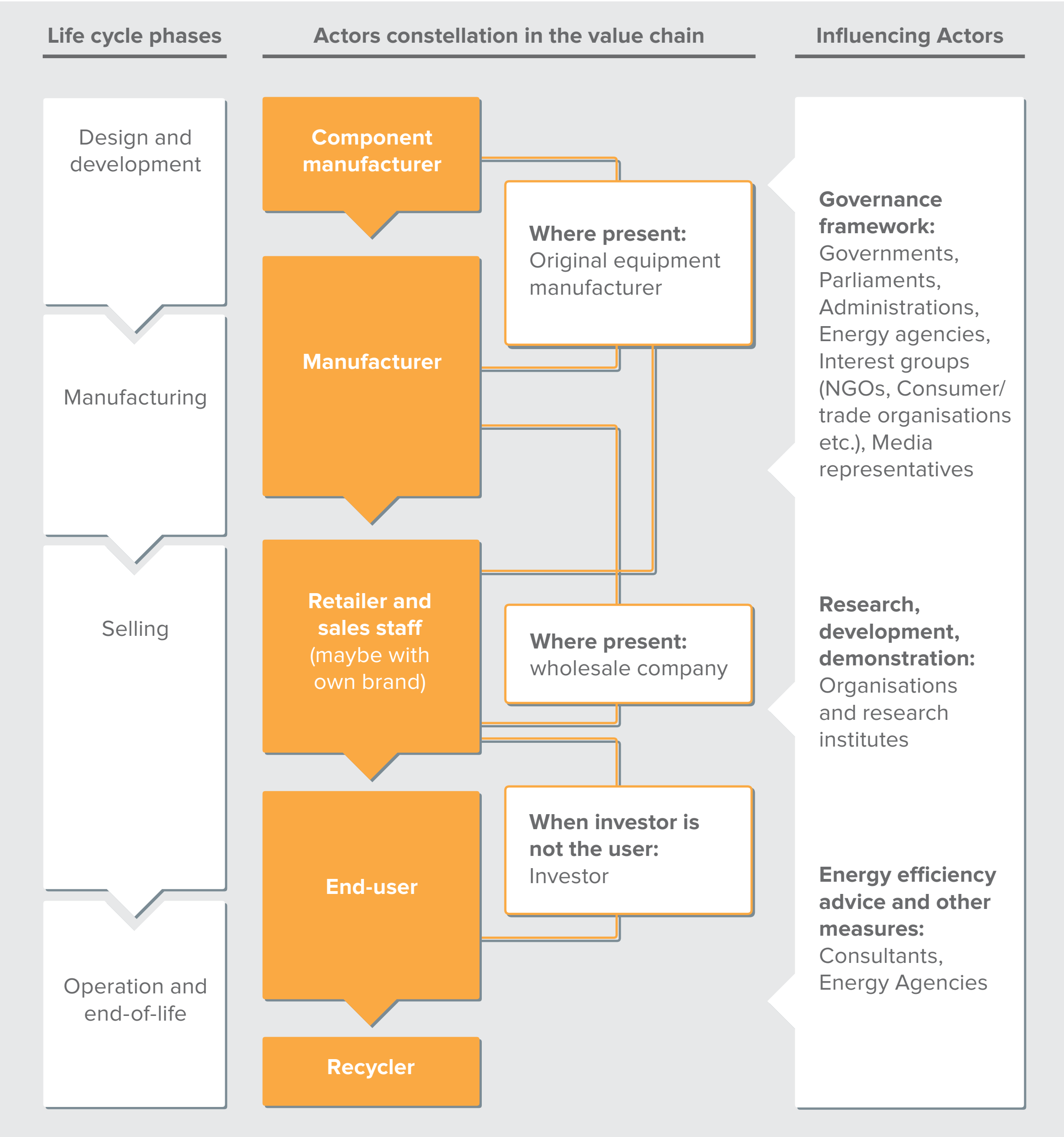

Figure 5: Actors constellation in the supply chain of appliances

Source: Wuppertal Institute (2012)

As with buildings, we must identify and analyse carefully all incentives and disincentives of all relevant actors involved in the supply, demand, and use of energy-efficient appliances. Such an analysis will enable political decision makers to understand why energy efficiency is often not brought about by market forces alone, but needs support through custom-tailored policy packages.

In principle, policy-makers in every country have to do such an analysis of the specific barriers and incentives for the value chain and actor constellations existing in their country. The next chapter will focus on this topic.

Barriers and incentives in the building and appliances sectors and how to address them through implementation strategies

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

Numerous studies have confirmed that enormous energy saving potentials can be realised by improving the energy efficiency of buildings and appliances. These studies also show that most of the available improvement options will be cost-effective from a life-cycle perspective if they are realised in new build or as integral part of normal reinvestment cycles. In this case the incremental initial investment costs are more than offset by the energy cost savings throughout the lifetime of the building or the appliance – and often already within a few years.

Yet many studies have also shown that, despite their cost-effectiveness, these savings are not realised by market forces alone, because of a **variety of barriers and market failures**. These obstacles are especially powerful and persistent in the building sector because of its complexity and the multitude of actors involved in it. Many different actors have to work together for an optimal outcome. But also in the appliance sector there are several barriers available to manufacture, sell or buy energy efficient products. Each actor group has its own characteristics, and therefore policy has to pay attention to these.

By knowing the barriers and incentives of each type of actor, the policy package can be adapted to guarantee desired results and achieve the greatest possible energy savings. Several factors influence an energy-efficient behaviour, including: country-specific incentive structures, consumer preferences, rules and regulations, decision-making practices and even cultural considerations. A number of factors can be identified that hamper energy efficiency. Overcoming such barriers is the key challenge for energy efficiency policy (IEA 2010b).

The barriers, which are listed below, are the major reason why there is a gap between even a cost-effective potential and energy savings actually realised by markets alone. The following barriers and incentives are based on the 'EE best practices' project (www.eebestpractices.com), IEA (2008) and Thomas (2006).

Barriers

- **Economic/financial barriers:** Capital constraints and risk aversion can inhibit uptake of energy efficiency measures. On the demand side of energy efficiency markets, these barriers relate to the required upfront investments and the relatively lengthy payback periods, combined with uncertainties about the future and the fact that building investments tend to be irreversible.
  For suppliers, there is a risk of new energy-efficient solutions not meeting with sufficient demand.

- **Knowledge/information barriers:** Most people are simply not aware of the manifold energy saving options; and even if they know about such options, they are usually not sufficiently informed about the costs and the benefits. Such lack of knowledge is also common among financiers, which makes it difficult to acquire funding for energy efficiency projects – thus reinforcing the afore mentioned financial barriers.

- **Lack of interest and motivation for energy efficiency improvement:** For the majority of actors energy costs are only a small item of their total budget, so that energy efficiency improvements are not regarded as a priority or may not even be taken into consideration at all. The transaction costs of searching for and implementing energy efficiency improvements make the achievable energy cost savings seem even less significant. There is a tendency among companies, organisations and households to focus on their core activities or to give priority to other features of buildings and appliances. Most people tend to resist behavioural changes and thereby favour the status quo, which is another barrier.

- **The landlord-tenant, developer-buyer or investor-user dilemma:** So-called split incentives occur when the investor bearing the costs of an energy efficiency improvement is not the one directly benefitting from it. In the case of buildings this is quite common – the owner or landlord, for instance, having to pay for the thermal insulation while it is his or her tenant whose energy bills are reduced. Similarly, a developer of new buildings facing price competition has a strong disincentive to increase design and construction costs for higher energy efficiency, while the buyer would benefit from the energy cost savings. An example from the appliance sector is the user of the printer in a public administration. He or she is not the one who will pay the energy bill.

- **Technical barriers:** In some cases, energy efficient solutions may not yet be available (or affordable), or actors may be uncertain as to whether new technologies perform as reliably as conventional ones.

- **Market distortions and regulatory barriers:** Subsidised energy prices and lack of inclusion of externalities will distort energy prices and disguise the true value of energy efficiency. Moreover, typical energy market regulation encourages energy suppliers to sell as much energy as possible rather than provide customers with cost-effective energy services. Tariff structures such as declining block rates (i.e. the price per kWh decreases as consumption increases) reduce the cost-effectiveness of investments in energy efficiency (IEA 2010, p.10f.).

Incentives

On the other hand, there are also some market-inherent incentives for higher energy efficiency, even if they are usually too weak to counterbalance the barriers. These incentives are important "entry points" for energy efficiency policy and should be used as such: by addressing and emphasising the achievable benefits, such as the improved reputation and competitive edge derived by suppliers from making energy-efficient solutions available. This may provide more effective motivation to them than offering a small financial incentive for their energy-efficient solutions. Market-incentives for energy efficiency improvements that policy-makers can harness and strengthen include the following:

- **Saved energy costs:** This will be an important incentive for investing in energy efficiency improvements, unless there are split incentives (see barriers above).
- **Co-benefits:** Health and comfort increases due to improved indoor climate, productivity gains in commercial properties due to better lighting and noise reduction are just some of the many positive side effects (see above chapter on co-benefits).
- **Direct increased earnings or profits for suppliers:** The price premium and additional investment in energy efficiency increase turnover and profits for the suppliers.
- **Unique selling proposition for suppliers:** This is a strategic benefit. It can lead to competitive advantages or even market leadership with increased profits.
- **Improved reputation:** End-users as well as the environment benefit from energy-efficient solutions: they serve to underpin a company's Corporate Social Responsibility (CSR) goals, which also yields competitive advantages.
- **Contribution to protect the environment:** This may be an intrinsic motivation for any actor.
- **Higher occupancy rates and market value of the property:** If the total rent (basic rent plus energy costs) is lower for energy-efficient buildings, it may be easier to find tenants. This is, however, mainly relevant in renting markets with oversupply. Attaining a higher re-sale value may be an incentive for owners and investors, albeit with some uncertainty. In addition to the financial benefits of improved energy performance and lower energy bills, the increased comfort and healthier indoor environment that (ultra) low energy buildings offer will contribute to price/rent premiums and higher occupancy.

How policy can address the barriers and incentives

Energy-efficient buildings and appliances already exist in many countries. The technologies and the design know-how to cost-effectively build and produce them are also available – what is still lacking is their wider dissemination regarding both the know-how and the implementation.

Given the high energy-saving potential and co-benefits presented above, the challenge is for policy and market actors together to transform the appliances and building sectors in a way that efficient products and buildings will no longer be an exception but become the standard choice of market actors. We need a paradigm shift towards more sustainable, integrated design concepts.

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

Having identified all relevant actors and their specific barriers the question is: How can these barriers - that market actors face - be overcome and how can the immanent incentives be strengthened?

The task is to address each of the relevant actors as much as possible, to tackle their barriers and tostrengthen their incentives, and thus to maximise the energy savings. The ways to do this can be named implementation strategies. An **implementation strategy** may act on several incentives and barriers. At the same time, it is often more effective to tackle one barrier with a combination of strategies. The following bullet points list some examples for implementation strategies:

- Bring down the first costs of energy efficient appliances, building concepts and technologies via market transformation/economies of scale.
- Ensure developers, architects, contractors, manufacturers and retailers that there is a market for energy-efficient buildings and products.
- Enable buyers to compare the energy consumption of equipment with the same functionality and inform investors about energy efficiency and its benefits and net savings.
- Increase motivation by making it as easy as possible to choose the energy-efficient option.
- Improve access to capital, e.g. provide financial incentives for the purchase of energy-efficient appliances and establish attractive financing mechanisms for energy efficiency in buildings.
- Make energy efficiency the standard or at least reduce complexity by excluding the least efficient practices from the market.

As next step, political decision makers must enact policies in order to put the implementation strategies to work. An implementation strategy often requires **a set of specific policies and measures** with well-orchestrated functions to make it work. For example, in order to effectively ensure developers, architects, and contractors that there is a market for energy-efficient new buildings, we recommend the following set of policies and measures:

- Long-term strategies/political commitments: e.g. Zero Net Energy buildings targets and roadmap
- Information and advice programmes both for building investors and for architects, construction companies, and contractors
- Financial incentives for very energy-efficient new buildings (in order to increase the demand)
- Social housing investment (to provide a first visible demand)
- Dynamic building codes: Step 1 - remove conventional practice from the market; Step 2 - announce future tightened levels to create expectation of future market for energy-efficient designs
- Mandatory (initially maybe also voluntary) building energy performance or green building certificates to enable and prove differentiation.

Finally, since a combination of implementation strategies is necessary to tackle the manifold barriers and strengthen incentives, these targeted combinations of policies and measures must then be merged into a consolidated overall policy package that is ultimately capable of creating a real market transformation in the building sector.

In principle, every country has to do such a barriers and incentives analysis for its own value chain and actor constellations in the building and appliance sectors. We have done such an analysis for the general actor constellations shown in the graphs above to derive our recommendation for the overall policy packages for energy efficiency new buildings, energy-efficient retrofit and operation of existing buildings, and energy-efficient appliances. We have then validated it with the model examples of policy packages from countries successful in advancing energy-efficient new build, renovation, and appliances. Our analysis could thus be used as a starting point for a country-specific analysis.

Get further tips for policy design and implementation
Are you interested in more details how to implement policies and measures and how to combine policies to an overall policy package than read the other bigEE documents “How to design and implement energy efficiency policies” and “How policies need to interact in packages”.

References

American Council for an Energy-Efficient Economy (ACEEE) n.y.:
How Does Energy-Efficiency Create Jobs? Fact Sheet.
www.bigee.net/s/nxwd55

Bremer Energie Institut (BEI); Institut Wohnen und Umwelt GmbH (IWU); Universität Bremen, Institut für Statistik (2010):
Effekte der Förderfälle des Jahres 2009 des CO2-Gebäudesanierungsprogramms und des Programms „Energieeffizient Sanieren".

Center for Corporate Responsibility and Sustainability (CCRS) (ed.) (2008):
Der Nachhaltigkeit von Immobilien einen finanziellen Wert geben – Minergie macht sich bezahlt. Edited by Meins, Erika.
www.bigee.net/s/w3b1zn

Center for Corporate Responsibility and Sustainability (CCRS) (ed.) (2010):
Der Nachhaltigkeit von Immobilien einen finanziellen Wert geben – Der Minergie-Boom unter der Lupe. Eine Marktanalyse der ZKB. Edited by Meins, Erika.
www.bigee.net/s/uvev3r

Collaborative Labeling & Appliance Standards Program (CLASP) (2010):
Opportunities for Success and CO2 Savings from Appliance Energy Efficiency Harmonization.
www.bigee.net/s/2jfhrs

European Commission (2011):
Energy Efficiency Plan 2011. COM(2011) 109 final.
www.bigee.net/s/px3vqd

European Parliament (2006):
Employment Potential of Renewable Forms of Energy and increased Efficiency of Energy Use. Briefing Note (IP/A/EMPL/FWC/2006-03/SC3).
www.bigee.net/s/cde15v

Global Energy Assessment (GEA) (2012):
Global Energy Assessment – Toward a Sustainable Future.

Institute of Business and Econonomic Research (iber); Fisher Center for Real Estate and Urban Economics (2011):
The Economics of Green Building. Working Paper No. W10-003, Program on Housing and Urban Policy Working Paper Series.
www.bigee.net/s/6u3pgp

International Energy Agency (IEA); Agence Francaise de Développement (AFD) (2008):
Promoting energy efficiency investments. Case studies in the residential sector. France.
www.bigee.net/s/f1kx67

International Energy Agency (IEA) (2010a):
Energy Technology Perspectives, Scenarios and Strategies to 2050. France.
www.bigee.net/s/m7fwqi

International Energy Agency (IEA) (2010b):
IEA Policy Pathway. Monitoring, Verification and Enforcement. Improving compliance within equipment energy efficiency programmes.
www.bigee.net/s/bt6qwr

International Energy Agency (IEA) (2011):
Technology Roadmap, Energy Efficient Buildings: Heating and Cooling Equipment. France.
www.bigee.net/s/vzmudq

Jakob, Martin; Nutter, Sharon (2003):
Marginal costs, cost dynamics and co-benefits of energy efficiency investments in the residential buildings sector. eceee 2003 Summer Study proceedings.
www.bigee.net/s/a2px5j

Klessmann, Corinna; Graus, Wina; Harmelink, Mirjam; Geurts, Fieke (2007):
Making energy-efficiency happen: from potential to reality. An assessment of policies and measures in G8 plus 5 countries, with recommendations for decision makers at national and international level. Ecofys. Commissioned by WWF International.
www.bigee.net/s/nkn1ie

Levine, Mark; Ürge-Vorsatz, Diana; Blok, Kornelis; Geng, Luis; Harvey, Danny; Lang, Siwei; Levermore, Geoffrey; Mongameli Mehlwana, Anthony; Mirasgedis, Sevastian; Novikova, Aleksandra; Rilling, Jacques; Yoshino, Hiroshi (2007):
Residential and commercial buildings. In: Metz, Bert; Davidson, Ogunlade; Bosch, Peter; Dave, Rutu; Meyer, Leo (2007): Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. United Kingdom; USA.

Thomas, Stefan (2006):
Aktivitäten der Energiewirtschaft zur Förderung der Energieeffizienz auf der Nachfrageseite in liberalisierten Strom- und Gasmärkten europäischer Staaten: Kriteriengestützter Vergleich der politischen Rahmenbedingungen. Wuppertal

United Nations Development Programme (UNDP) (2010):
Promoting Energy Efficiency in Buildings: Lessons learned from international experience.
www.bigee.net/s/14mn9x

United Nations Environment Programme (UNEP) (2011):
Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication.
www.bigee.net/s/ihs59n

Ürge-Vorsatz, Diana; Novikova, Aleksandra; Sharmina, Maria (2009):
Counting good: quantifying the co-benefits of improved efficiency in buildings.
eceee 2009 Summer Study proceedings.
www.bigee.net/s/nmnfny

Ürge-Vorsatz, Diana, Eyre, Nick; Graham, Peter; Harvey, Danny; Hertwich, Jiang, Yi; Hertwich, Edgar; Kornevall, Christian; Majumdar, Mili; McMahon, James E.; Mirasgedis, Sevastianos; Murakami, Shuzo; Novikova, Aleksandra (2011): Energy End-Use: Buildings.
In: Johannson, Thomas B.; Patwardhan, Anand; Nakicenovic, Nebojsa; Gomez-Echeverri, Luis (2011):
The Global Energy Assessment: Toward a more Sustainable Future. United Kingdom; USA.
www.bigee.net/s/3ye4ak

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

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

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Wuppertal Institute for Climate, Environment and Energy

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Financial support

Federal Ministry for the Environment, Nature Conservat and Nuclear Safety

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