Energy Efficiency Policies in the German Energy Transition

Barbara Schlomann, Clemens Rohde, Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe, Germany
Marc Ringel, Nürtingen-Geislingen University, Geislingen, Germany

ABSTRACT

Germany's energy system is currently undergoing a massive transformation. Besides the shift towards renewable energies in electricity generation and as fuel substitution, energy efficiency plays a key part in the transformation towards a green energy economy. Within our paper we will analyze the contribution of energy efficiency policies as part of the green energy system transformation in Germany. We will present the current energy efficiency policy framework in Germany and the intended developments laid down in the Federal Government's latest National Energy Efficiency Action Plan, designed to deliver considerable additional savings by 2020. Within our analysis we will show, how the building related measures are embedded in the overall framework on energy efficiency policies. We will analyze how the new and extended instruments fit into the current framework of energy efficiency policies in Germany. As a broad variety of approaches is used the interaction of instruments is of particular interest in the analysis. With a bottom-up approach we will quantify key energy saving effects both in primary and final energy as well as economic impacts, such as investments triggered by the various measures. Our analysis suggests that substantial energy savings can be achieved, if the proposed energy efficiency measures are implemented.

Introduction

With its Energy Concept from September 2010 and the decisions from summer 2011, Germany initiated a far-reaching transformation of its energy system, the so-called "Energiewende" meaning "energy transition" (BMWi and BMU 2010). Alongside intensifying the use of renewable energies, reducing energy consumption by increasing energy efficiency is a key pillar of the Energiewende. The Energy Concept also includes ambitious energy efficiency targets for Germany. The overall energy efficiency target demands a reduction of primary energy consumption of 20% by 2020 and 50% by 2050 (compared to the base year 2008). With regard to buildings, the heat demand should also be reduced by 20% (again compared to 2008). However, a remaining shortfall to meeting the primary energy target in 2020 was estimated to be around 10 to 13% of the total goal based on current forecasts and an extrapolation of the statistical development of primary energy consumption observed up to 2013 (Fraunhofer ISI et al. 2014). This is equivalent to an additional necessary decrease in primary energy consumption between 1440 and 1870 PJ. Germany's buildings contribute more than 30 percent of the total final energy demand. Therefore this sector will be an important pillar for the achievement of the energy savings targets in Germany.

As a member of the European Union (EU), Germany also has to contribute to the EU energy efficiency targets. By 2020 the European Union has committed to reduce its primary energy consumption by 20% relative to a projected baseline (European Commission 2008). In October 2014, the European Council decided on a new 2030 Climate and Energy Policy

Framework. With regard to energy efficiency, an indicative target at the EU level of at least 27 percent is set for improving energy efficiency in 2030 compared to the same projections as for the 2020 target[1].

In order to fill the current gap to the national energy efficiency target up to 2020 – and thereby also to contribute to the European targets – the German Federal Ministry for Economic Affairs and Energy (BMWi) presented the "National Action Plan on Energy Efficiency" (NAPE) in early December 2014 (BMWi 2014). The NAPE includes new and further developed policy measures to increase energy efficiency in buildings, industry and the service sector. At the same time, the German Federal Ministry for the Environment, Nature Conservation, Buildings and Nuclear Safety (BMUB) presented a "Climate Action Programme 2020" (BMUB 2014) which includes – among others - some further policy measures for buildings and transport.

Within this paper we will first show the past and present energy efficiency policy context for buildings in Germany. In the next section we present the key additional instruments put forward by the German government. We also give an overview of the energy savings and investments triggered by these policies. Finally, we draw conclusions about an effective energy efficiency policy design, which supports the achievement of ambitious energy efficiency targets and can be used by policy makers in other countries as well.

The policy landscape for buildings in Germany

Over the last 10 to 15 years, the mix of energy efficiency policies in Germany has been made up of regulations (e.g. building codes, end-use products), financial incentive instruments (e.g. soft loan and grant programs for building refurbishment) as well as information campaigns and energy audits, fostered by the national and regional energy agencies. The financial instruments are solely financed by funds from the federal government and reflect its reluctance to oblige utilities to support energy efficiency development e.g. by introducing energy efficiency obligations for energy suppliers (Markandya et al. 2015). The main sectors which are addressed by these policies are buildings,, services and industry. Yet their success has been limited when looking at the energy efficiency progress made in Germany in the period 2000-2013. When calculated using the energy efficiency index ODEX[2], the energy efficiency progress in Germany at the level of the whole economy amounted to 1.2% annually on average in the period 2000-2013 and has slowed down to 0.7% annually since 2008, the base year of the national energy efficiency targets (Figure 1). Compared to the relatively slow energy efficiency progress of industry and transport during that period, the household – and at least since 2009 – the service sector ODEX showed a more favorable development. This is mainly due to the policy efforts in the past addressing the building sector in Germany. In the following, we give an overview of the most important energy efficiency policies for buildings in Germany in the last 15 years.

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[1] It should be noted that this target was a political top-down decision and not based on cost-effective energy efficiency potentials that will drive ambition far beyond a business-as-usual development. This method of target calculation would justify a considerably higher energy efficiency target for the European Union up to 40 percent by 2030 (Schlomann and Eichhammer 2014).

[2] The ODEX is a re-aggregated energy efficiency indicator first calculated at the level of sectors and then re-aggregated to the whole economy. It is adjusted for temperature, structural (e.g. changes in sector or product structure in the industrial and service sectors), and some comfort effects (e.g. larger living area per household, higher room temperature, larger appliances) which cannot be attributed to energy efficiency. It is therefore a better proxy for energy efficiency developments than pure energy intensities (Enerdata 2010).

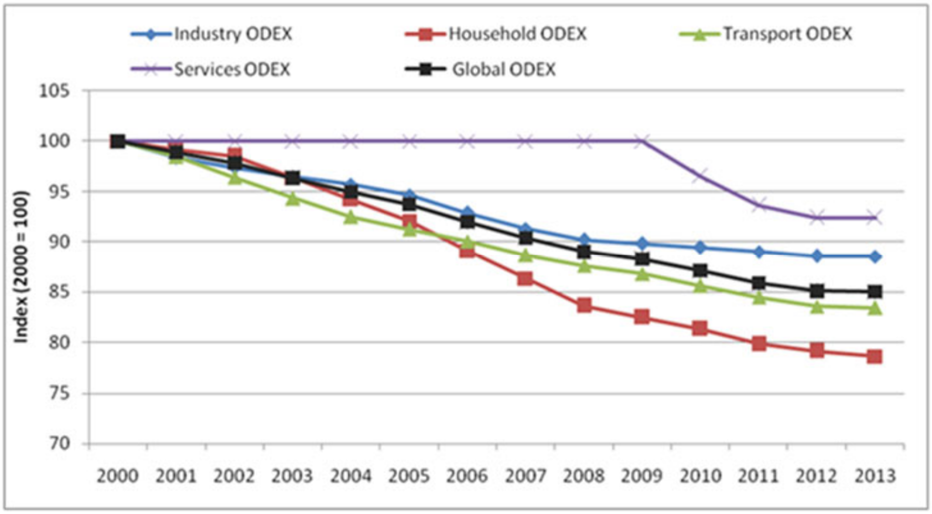

Figure 1. Energy efficiency progress in Germany measured by the ODEX *Source*: ODYSSEE database.

The building sector, i.e. mainly residential buildings (though non-residential buildings are mostly addressed by the same policies), is regarded as the sector with the greatest energy efficiency improvements over many years. The key policies in this area are building codes which were introduced in Germany in the 1970s and the funding schemes for new buildings and the refurbishment of existing buildings offered by the German promotional bank KfW which have been running for many years and which have been extended several times. The German building stock is characterized by a high rental rate, which is unique in Europe. 55% of the dwellings are rented, only 45% are owner occupied. This makes the landlord-tenant dilemma a major barrier towards the uptake of energy efficiency measures in buildings. Whereas building codes and schemes targeting new buildings are also effective for this target group, renovation of existing buildings is harder to address with those measures. The main policies promoting energy efficiency in buildings at the national level are further described below[3].

Building Codes

Energy related building codes are promulgated via federal legislation in Germany. In 1977, the first energy related building codes for new buildings were introduced in Germany. Starting with a regulation of building components, the approach has evolved over time into a holistic requirement covering the primary energy demand of the building including HVAC and lighting. Requirements have also been tightened over time. The current requirements lead to a primary energy consumption of new buildings of about 45 kWh/m^{2}a (~15 BTU/sq ft a). For new buildings, a partial use obligation for RES is in place. In parallel, requirements for retrofits are in place. No requirement to perform a renovation exists, but if an owner does a renovation, it has to meet minimum standards. These standards are component specific regulations. Furthermore for heating systems, some renovation obligations apply for very old systems (>30 years). If new heating systems are installed in existing buildings, some federal states[4] have a use obligation for renewables. With the recast of the Building Performance Directive (EBPD), the European Union

[3] For more information see the detailed descriptions of energy efficiency policies in Germany (and the EU, all EU Member States, Norway and Switzerland) in the MURE database on energy efficiency policies (MURE database).
[4] Germany is a federal republic consisting of 16 federal states.

has set a stringent framework for the further developments of building codes in the member states. .The EBPD requires all new buildings after 2020 to be nearly zero energy buildings (NZEB).

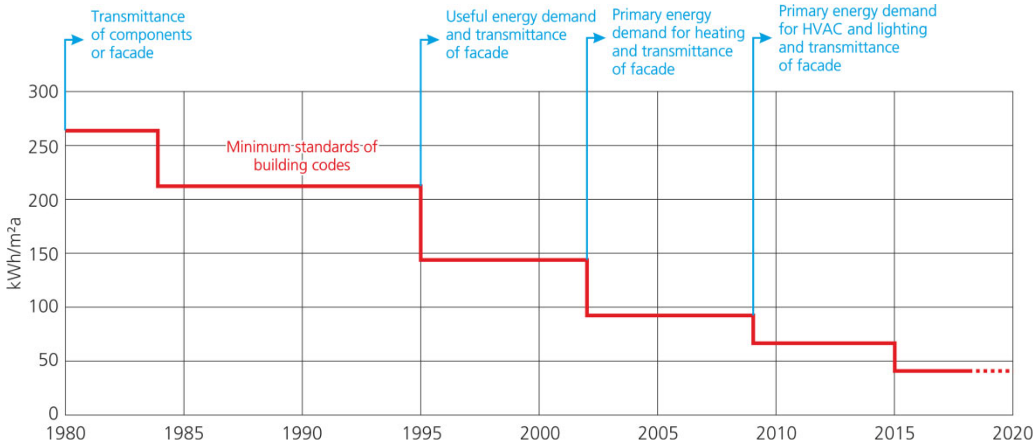

Figure 2. Minimum energy performance standards for new buildings in Germany.

The KfW funding schemes

The major funding scheme for building efficiency is operated by the KfW, the German development bank. The minimum requirements to receive funding go beyond the minimum standards of the building codes. The funding mechanism is characterized by stepped incentives to stimulate ambitious measures. For new buildings the funding mechanism is a combination of soft loans and grants. The following table shows the requirements as well as the grants linked to the soft loan. At the moment, the interest rate for the soft loans is 0.75% (March 2016).

Table 1: stepped incentives in the KfW funding scheme (new buildings)

Category	Indicative primary energy demand	Grant
KfW-Effizienzhaus 40 Plus	~28 kWh/m²a + RES, electricity storage and heat recovery	15% of loan, up to 15.000 € for every dwelling
KfW-Effizienzhaus 40 / Passivhaus 40	~28 kWh/m²a	10% of loan, up to 10.000 € for every dwelling
KfW-Effizienzhaus 55 / Passivhaus 55	~38 kWh/m²a	5% of loan, up to 5.000 € for every dwelling

For renovation of buildings two funding opportunities exist: a component based approach with soft loans or grants and a holistic approach with a combined soft loan and grant approach (comparable to the approach for new buildings). In 2014, 230,000 buildings have been renovated and 110,000 new buildings (~45% of all new buildings) have been built under the KfW scheme. This means that nearly half of all new buildings in Germany exceed the requirements of the national building codes substantially. Regarding renovations, more than 50 % of the funded projects included a thermal insulation of the façade. More popular were window replacement and boiler renewals. Still, even those very impressive results are only partially in line with the 2050 targets, where the whole building stock will have to reach passive-house level. The retail banks have to provide these loans when requested by customers. Still, there is no real incentive for them to do extra marketing to secure new loans because they don't benefit.

Lighting and appliances

Apart from the building envelope and the heating systems, lighting and other appliances used within the building contribute to the buildings energy balance. Those energy using products are mainly addressed by European Legislation. In 2009, the first EU-Directive on Eco-Design of Energy-using Products from was revised and extended to all energy-related products (2009/125/EC) and transposed into German law in 2011. Energy-relevant products covered by the eco-design requirements may only be placed on the market if they comply with the relevant requirements. Furthermore they need to obtain the CE-Label. This is valid for all products regardless of their origin. The directives cover a wide range of products including lighting, ICT, white goods and consumer electronics.

Energy labels are a complementary instrument for minimum energy efficiency requirements. Whereas efficiency standards remove the less energy-efficient products from the market, energy labels help consumers choose the most energy-efficient products and also provide incentives for the industry to develop and invest in these products. In 2010, the EU Directive on appliance labeling from 1992 was revised and extended to energy-related products (Directive 2010/30/EC) and transposed into German law in 2012. Consumer information by means of energy labeling has proven successful in transforming the market in Germany for energy using products. The German market is among the most progressive regarding the sales of highly energy-efficient products. However, what was missing in the past in Germany, were accompanying policies and measures to promote the actual purchase of the most efficient products. Some of the new policies, which will be described in the next section, start to address this policy gap.

Building performance certificates

The triangle of regulation, financing and information is completed by the building performance certificates. Energy labels for buildings are a rather new development in Germany. Although they were first introduced in 2008, widespread use has only been achieved within the last two years after their revision. However, the design of those certificates had some shortcomings. The original design allowed either a consumption or demand based approach. The performance evaluation based on actual consumptions was highly dependent on the actual user behavior and could produce misleading results. Another shortcoming was the lack of a classification in a discrete scheme alike the A-G rating from the product labels which is well known to customers. After the revision of the label in 2015 most of these shortcomings have been addressed. A classification scheme has been introduced and the use of the energy performance classification is now mandatory in all transaction related advertisements leading to more market transparency regarding energy efficiency. The demand based calculation is now the standard methodology for the energy use. However, there are still huge differences and uncertainties due to lack of data on the actual compliance with the building performance certificates and many EU Member States, which also includes Germany (European Commission 2015).

The national energy efficiency action plan

The slow energy efficiency progress at the level of final energy since 2008 (see Figure 1) is also reflected in the development of primary energy. In spite of a considerable increase in the share of renewable energies, temperature-corrected primary energy consumption only fell from 14,578 PJ in 2008 to 13,800 PJ in 2013, i.e. by around 5% (AGEB 2015). This pace will not be sufficient to achieve the ambitious saving target of 20% reduction by 2020. On the other hand, various studies for Germany show that the energy efficiency potentials needed to bridge this gap and meet the target already exist (Schlomann et al. 2013, Fraunhofer ISI et al. 2014). In addition, these studies consistently show that these efficiency potentials are cost-effective both on macroeconomic and individual levels. The remaining shortfall to meeting the primary energy target was estimated to be around 10 to 13% based on current forecasts and an extrapolation of the statistical development of primary energy consumption observed up to 2013 (BMWi 2014). This means that an additional decrease in annual primary energy consumption of between 1440 and 1870 PJ is necessary to reach the target in 2020. In order to fill this gap by exploiting the existing economic saving potentials, the German government drew up and presented the "National Action Plan on Energy Efficiency" (NAPE) in early December 2014 (BMWi 2014). The NAPE includes new and further developed policy measures to increase energy efficiency in buildings, industry and the tertiary sector (Figure 3). At the same time, the German government presented a "Climate Action Program 2020" which includes some further policy measures for the buildings and transport[5] (BMUB 2014).

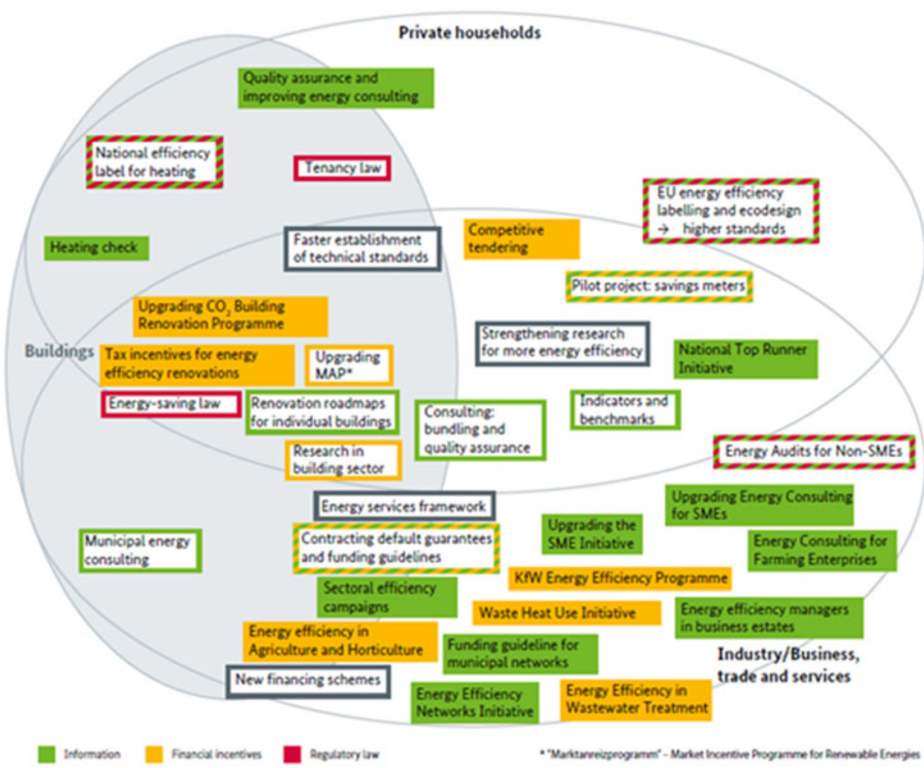

Figure 3. energy efficiency policies of the NAPE. *Source*: BMWi 2014.

[5] The latter is not addressed in the NAPE.

Core instruments targeting buildings

As shown in Figure 3, the NAPE includes a mix of different types of instruments (financial, regulation, advice and information), which are, however, mainly a further development of the existing policy landscape in Germany. In the following, key policy instruments targeting buildings are shortly described:

- *Upgrading, continuation and increased funding of the CO_2 Building Renovation Program*. The funds for KfW building renovation programs are increased by 200 million EUR/a from 2015. These funds are exclusively intended for energy saving measures in non-residential buildings in order to exploit the large saving potential in this area (more than 30% of buildings in Germany are non-residential in nature).
- *Energy saving legislation.* A further development of the existing energy saving law with stricter requirements for renovations related to building components is foreseen with effect from 2019. The stricter requirements are oriented on technically feasible solutions complying with the principle of economic viability.
- *Quality assurance and optimizing of energy consulting*. Various information and energy advice programs have been set up in Germany over the course of time. These programs will be further developed for example by linking together the measures and increase the consistency, transparency and avoiding overlaps.
- *Heating check*. The objective of the measure is to initiate additional heating modernization by a novel method for heat inspections. The heating check has been conceptualized as a voluntary non-binding integrated service. It thus requires a corresponding contract on behalf of the owner of the heating system.
- *National energy efficiency label for old heating installations*. The national efficiency label for old heating systems has been launched to motivate the building owner to replace the old inefficient heating systems and to increase the rate of change. With the new label, the boiler will be assigned a certain energy efficiency class and the building owner will receive information about the energy costs savings and the description of possible further energy consultancy offers.
- *Climate-friendly building and housing strategy*. This strategy is an additional instrument from the Climate Action Program 2020 (BMUB 2014). It links the energy efficiency strategy for buildings outlined in the NAPE with more far-reaching climate-relevant measures. Examples of specific measures include extending support for district-based approaches to urban energy modernisation and for local climate action projects. Cultural and social aspects, such as specific demands of low-income households, the specific characteristics and challenges of villages, towns and districts and their infrastructures as units, are incorporated into the strategy, too.
- *Top Runner Strategy*. With its National Top Runner Initiative (NTRI), the Federal Government bundles measures for speeding up the market penetration of high-quality services and products (top runners) that contribute to reducing energy consumption. NTRI aims at increasing the motivation for electrical and product-specific energy efficiency and the rational use of power and extend it along the value chain – from appliance manufacturers to dealers to consumers – in product lines and across sectors. At the European level, Germany will advocate an ambitious design of the EU Energy Labelling and Ecodesign Directives. This includes informative labels for consumers,

faster decision-making processes, a stronger EU Top Runner Strategy and a high standard of the requirements for products under the EU Ecodesign Directive.

Cross Cutting Instruments

Among the new instruments in the NAPE, especially two cross-cutting measures stand out as representing a departure from conventional policy pathways: First, the introduction of competitive energy efficiency tendering scheme, which introduces quantity-based mechanisms into the German policy mix. Second, a new program for energy savings meters (see Table 2). As is typical for German energy policies, before full implementation, these instruments are calibrated by first running pilot projects. Full implementation then adopts the design features which were found to work best in the pilots.

Based on the experiences with competitive tendering schemes in Switzerland and some States in the U.S. (e.g. Vermont), Germany will first try out *competitive tendering* by running pilot projects in 2016 with a planned governmental funding volume of €15m for the financial support of energy efficiency measures. This amount will increase continuously until 2018 up to a maximum volume of €150m (Seefeldt et al. 2015). The pilot project will consist of two different types of tenders: open and closed. The open tenders will support different technologies, actors and sectors. Within the open tenders of the pilot project, eligible measures will be restricted to electrical applications only. The closed tenders will address specific technologies or actors that have large potentials for energy demand reduction but are associated with barriers hampering their inclusion in the open tenders. For both types of tenders, the most cost-effective measures will be funded in terms of saved energy per euro spent.

With the help of smart plugs, terminals or meters or energy management systems it is possible to meter the consumption profile of specific installations and devices and to measure savings at low cost under real conditions of use for the first time (before – after measurement). Instead of promoting savings through pre-selected technologies or in specific sectors, the new *pilot program for energy saving meters* will support technology-neutral energy savings to incentivize the search for the most cost-effective methods, reduce transaction costs and try out new business models. In an initial phase, accounting for data protection aspects the pilot trial will explore the technical and organizational possibilities of introducing a financing scheme for energy efficiency based on these energy savings meters that quantifies energy savings so as to provide a technology-neutral funding instrument. It will also assess whether energy efficiency investments can be refinanced from the economies made.

Savings and investments triggered by the policies

Table 2 gives an overview of the primary energy savings and investments triggered by the key policy instruments described above in 2020. Allocation of savings and investments within a policy mix is not easy. Some basic principles of the following savings have to be taken into account:

- All savings are given as cumulative annual savings in 2020 (for the details on savings calculations see e.g. Schlomann et al. 2015).
- Baseline for regulatory instruments is the previous regulation; therefore only additional savings are accounted.

- Baseline for funding schemes is the minimum standard defined by the building codes in the year of the implementation.
- Investments are given as cumulative additional investments until 2020.
- All savings calculations are based on a measure-by-measure bottom-up approach (see Fraunhofer ISI et al. 2014). Input data is usually an activity (such as a funding volume, construction or renovation rates etc.) and a specific saving (derived from an engineering estimate or program evaluations).
- Those savings are combined with compliance and instrument factors to reflect incomplete implementation and potential double counting.

Table 2. Contributions of key policy instruments designed to meet the 20 percent primary energy savings target by 2020

Key policy instruments of NAPE and Climate Action Program addressing buildings	Type of instrument	Primary energy savings in 2020 [in PJ/a]	Investments triggered in the period 2014-2020 [in billion EUR]
Building policies			
Upgrading, continuation and increased funding of the CO_2 Building Renovation Programme	Financial	12.4	9.6
Energy saving legislation	Regulation	13.5	11.6
Quality assurance and optimising of energy consulting	Advice/Information	3.8	3.3
Heating check	Financial	0.2	0.1
National Energy-efficiency Label for Old Heating Installations	Advice/Information	10.0	4.2
Climate-friendly building and housing strategy	Financial	28.1	2.5
Top Runner Strategy – at national and EU level	Advice/Information	85.2	3.6
Cross-cutting policies			
Support of energy performance contracting“	Financial	5.4	1.8
Introduction of a competitive tendering scheme for energy efficiency	Financial	25.7-51.6	4.3
Pilot program for energy savings meters	Financial	35.8	1.5
Total contribution of building policies		220.1-246.0	40.3-42.5

Source: BMWi 2014; Fraunhofer ISI et al. 2014; own calculations by the authors.

The largest contributors of energy savings are the climate-friendly building and housing strategy, the Top Runner Strategy and the two completely new instruments, i.e. the competitive tendering scheme and the pilot program for energy savings meters (see Table 2). However, especially the estimate of potential savings of fully new schemes shows a high uncertainty associated with the implemented measures. This is reflected by the range of savings associated to the new tendering scheme.

In total, around 220 – 246 PJ of primary energy are saved in 2020 by applying all new policies addressing the building sector (Table 2). This means that these policies in the high variant contribute around 15 percent of the savings needed to bridge the primary energy gap of 1440 and 1870 PJ by 2020. Additional savings of around 160 PJ are expected from energy efficiency policies addressing the industry and service sectors which were not discussed in this paper (see BMWi 2014; Fraunhofer ISI et al. 2014b). However, additional, substantial contributions have to come from the transport and energy sectors, which were not part of the NAPE package of energy efficiency policies, but of the "Climate Action Programme 2020" (BMUB 2014).

Regarding the competitiveness of an economy, investments triggered by the instruments are as important as the energy savings. Table 2 shows the additional investments triggered by the instruments compared to the baseline. The investments not related to energy-efficiency are not covered by this overview. For example, regarding new buildings, only the additional investments for the more ambitious buildings standard compared to the baseline are considered. Most investments are triggered by the policies directly addressing the refurbishment of existing buildings; i.e. the upgrading of the KfW programs for the refurbishment of buildings and a strict energy savings legislation for building renovation.

Conclusions and outlook

Like all countries that already have energy efficiency policies in place, Germany may find it increasingly difficult to integrate new measures into this existing pool, or to achieve additional energy savings with the existing measures. Great care needs to be taken to trigger synergies and additional benefits rather than undermine existing policies. In the case of Germany and Europe, the Financial Stability Pact limits public spending and thus places an implicit cap on mobilising financial resources in the public sector. In this respect, it might prove promising to scale up energy savings as targeted by the competitive tendering, energy efficiency obligations and the development of energy service markets could deliver energy savings in a much more systematic manner. In this sense, the efficiency measures proposed by the government are a necessary but not a sufficient condition for the energy transition.

With regard to buildings, the German policy mix traditionally comprises three major pillars. Based on a strong basined defined by building codes for renovation and construction, more ambitious measures are incentivised by the strong funding scheme run by the KfW. Those measures are accompanied by information and advice provided by craftsmen and engineers as well as the building performance certificates. As the building codes already require high energetic standards for new buildings as well as renovations, the funding schemes are designed to stimulate very ambitious renovations. Therefore, their impact on a increasing the renovation rate is limited. Therefore future developments of this policy mix will focus on the strengths of the currents system but have to consider target groups, which are not in the main focus of the current policy mix. Germany's as well as the EU's targets can only be achieved, if the renovation rate will be increased significantly. For this purpose, the current policy mix lacks a proper instrumentation. The landlord-tenant dilemma still remains unsolved as well as the problems of low-income and aged home owners. Whereas the first will have to be resolved by legal adjustments, the second will need new and innovative incentives and support schemes to tackle the specific barriers of those target groups.

We could also show that the new energy efficiency policies for the building sector trigger substantial investments in energy efficiency. As it was recently shown by literature (e.g. IEA 2014; Ringel et al. 2016), these investments are not only beneficial for the environment, but trigger tangible economic and social benefits as well, even in a short time horizon.

With buildings contributing to more than one third of Germany's energy demand and the large potentials for energy conservation in this sector, the success of the "Energiewende" strongly depends on this sector. Nevertheless, in order to achieve the ambitious national energy savings targets by 2020 and beyond, substantial contributions have to come from industry, the transport and energy sectors as well.

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