Energy efficiency vs. renewable energy policies within the German Energiewende – What are the distributional implications for households?

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Abstract

The distribution of costs on the household level is prominently debated in the context of the German Energy Transition (‘Energiewende’) and specifically the surcharge for renewable energy (‘EEG surcharge’). This debate has gained ample political traction, also in the context of energy / fuel poverty. However, and to date the debate has lacked a comprehensive presentation of the underlying issues. Moreover, it has mainly focused on the costs of energy and climate policy and neglected their benefits, such as the merit-order effect of renewables or the cost saving potential of energy efficiency measures, which are also part of the German ’Energiewende’.

In this paper, we evaluate the income distribution of both costs and savings of major existing and planned policies and measures related to the ‘Energiewende’ in Germany, with particular focus on renewable and energy efficiency policies. An energy cost tool based on publicly available data from the German Income and Expenditure Survey (EVS) is applied to show effects of these policies on different household types. We assess the distribution of i) the burden associated with the renewable energy surcharge, ii) the potential of energy efficiency as well as iii) the net effect of both policy areas across household income groups. The results indicate that efficiency measures have the potential to alleviate the burden imposed by the EEG surcharge. The positive net effect is most pronounced for lower income households, where the combined impact of renewable and efficiency policies shows a progressive effect. It is important, however, to design tailor-made programs for differentiated target groups so they can turn these potentials into real savings.

Introduction

This paper addresses household level income distributional effects of renewable energy and energy efficiency policies in Germany. Concerns have been raised that policy related costs affect households differently and contribute to social imbalance. These income distributional effects are currently quite prominently debated in the context of the German Energy Transition ('Energiewende") and specifically the surcharge for renewable energy ('EEG surcharge'). The debate has gained ample political traction, also in the context of energy / fuel poverty – and to date has lacked a comprehensive presentation of the underlying issues.

Moreover, as Tews (2013) points out, the debate has solely focused on the costs of energy and climate policy and neglected their benefits, such as the merit-order effect of renewables or the cost saving potential of energy efficiency/savings measures. However, such energy savings measures are also part of the German Energiewende: 20 % of primary energy is to be saved by 2020 as compared to 2008, further increasing to 50 % in 2050. Sub-goals for buildings, electricity and transport are prescribed[1]. In fact, with the publication of its National Action Plan on Energy Efficiency (NAPE; BMWi 2014) and the German Climate Action Program 2020 (APK)[2] as well as the Climate Action Plan 2050[3], the German government has reinforced its commitment to achieve these goals. Many of the changes necessary will have to take place at the household level and have the potential to lower energy expenditure of households and therefore may be able to alleviate the costs imposed by renewable energy support policy.

The main question is how costs and benefits as well as physical saving potentials of these policies are distributed across income groups. From a social policy perspective and in light of ongoing discussions on energy poverty, it is important to understand whether policies are regressive or progressive in nature, in other words, do they put a relatively higher burden on lower income households than on higher income households? In this paper, we look at the income distributional effects across households of the renewable energy and EE policies separately, and then draw combined conclusions.

The remainder of this paper is structured as follows. We first give an overview of current energy consumption patterns in Germany to then discuss these in light of renewable energy and energy efficiency policies. We use data from the German Income and Expenditure Survey (EVS) to first investigate how the EEG surcharge is distributed amongst households. Secondly, we use the same EVS data to analyze the distributional effects of existing and planned energy efficiency policies in Germany and examine their potential to compensate for the additional burden imposed on households by the EEG surcharge. In the last section we sum up and conclude.

Data and method

We use the German Income and Expenditure Survey (EVS) for our analysis. The EVS is an administrative data source and contains detailed information on income sources and expenditure patterns of households, as well as information on other household characteristics, such as social status and age of the household members. The survey is published every five years and households are observed for one quarter, reporting individual income and household level expenditures. At the time of writing, the most recent available survey is the one held in 2008[4] which provides the basis for our analysis.

To get a more recent picture, information in the EVS is extrapolated based on various sources

1 The goals are outlined in the German Energy Concept ('Energiekonzept') (Deutsche Bundesregierung 2010/2011) as part of the German Energiewende.
2 http://www.bmub.bund.de/en/topics/climate-energy/climate/national-climate-policy/climate-action-programme/
3 http://www.klimaschutzplan2050.de/en/
4 At the time of writing, the 2013 survey had not been published yet.

of information so that it corresponds to the year 2014.[5]

In order to calculate the physical amounts of energy consumed from the consumption based survey, we use energy prices for the year 2008 to derive energy quantities from the information on expenditure as detailed in the EVS. Energy prices are taken from the second modelling round of the German ‘Climate Protection Scenario 2050 (Klimaschutzszenario 2050)’.[6] For electricity and natural gas, we use a combination of base price and variable price to adjust for the share of fixed costs. Moreover, we adjust for a quantity based rate structure following the method used in Neuhoff et al. (2013), which also takes account of costs for night-storage heating. We cross-check our approach by aggregating the quantities for energy consumption derived using this approach and comparing them to household energy consumption reported at the aggregated level by the national energy balance.[7]

Energy consumption patterns

Figure 1 shows electricity consumption of German households by net equivalent income decile.[8] While absolute consumption rises with income, the share of a household’s net income spent on electricity falls. Lower income households spend a considerably larger share of their net income on electricity. Electricity provides for basic needs (refrigeration, washing, TV etc.) which households will always need to spend money on, independent of their total income. Potential electricity savings would contribute to discretionary spending, i.e. spending on necessities, for lower income households compared to higher income households where it might contribute to savings or spending on luxury items. Conversely, an increase in costs for electricity presents a relative higher burden for low income households than for high income households. Changes in electricity prices have regressive effects.

Consumption of and expenditure for heating energy is plotted in Figure 2. This figure differentiates the type of heating that is used in households. District heating turns out to be much more common in low income households which tend also to be in multi-family buildings. Oil based heating is next to natural gas the most used heating fuel in higher income households, which are usually single family houses. Consumption of heating energy rises with income while at the same time expenditure as share of net income falls.

The pattern is similar to the distribution of the electricity consumption; however, it can be seen that heating energy consumption is more highly correlated with income levels. High income households use only about two times the amount of electricity compared to low income households, while they use about three times the amount of heating energy. Larger houses and higher room temperatures would explain this pattern. Again, as in the case of electricity, monetary savings related to heating energy would be much higher valued by lower income households than by higher income households. Physical and financial savings potentials are thus distributed asymmetrically.

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5 In particular, household income is extrapolated based on information up to 2011 available from the German socio-economic panel (SOEP). The extrapolation is conducted by cluster, i.e. combining different household characteristics such as age of household members, social status of main income earner, size of household, and extrapolating for each of these combinations (=cluster). Subsequently, incomes are further extrapolated to the year 2014 with a fixed factor derived from the national accounts (VGR) which reflects nominal GDP growth between 2011 and 2013. We further assume 2% growth between 2013 and 2014. In addition, the grossing-up factors are adjusted via the method of ‘static ageing’ to reflect household structures in 2014. This implies that extrapolation to the whole German population correspond to the year 2014. Information on static ageing for 2014 stems from the national accounts and the micro census published by the German Statstical Office.

6 Ongoing project for the Federal Environment Ministry (BMUB) by Öko-Institut, Fraunhofer ISI, dezentec

7 http://www.ag-energiebilanzen.de

8 The new OECD scale is used to construct equivalent income weights (main income earner = 1, additional household member older than 14 = 0.5, younger than 14 = 0.3).

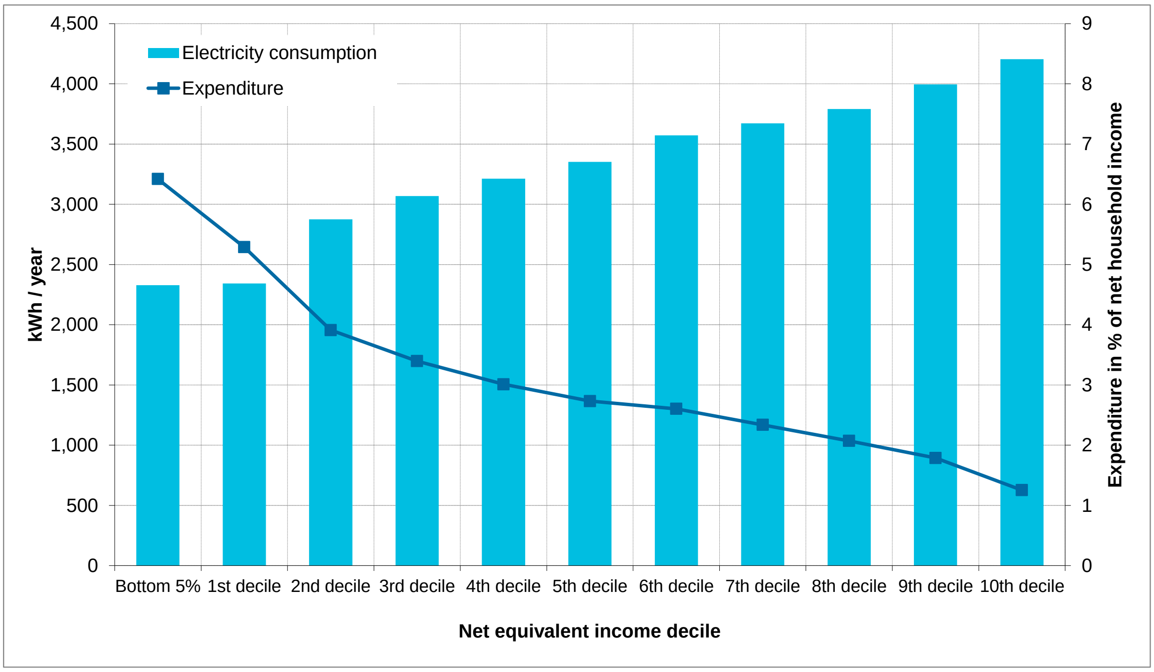

Figure 1 Electricity consumption by income group
Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

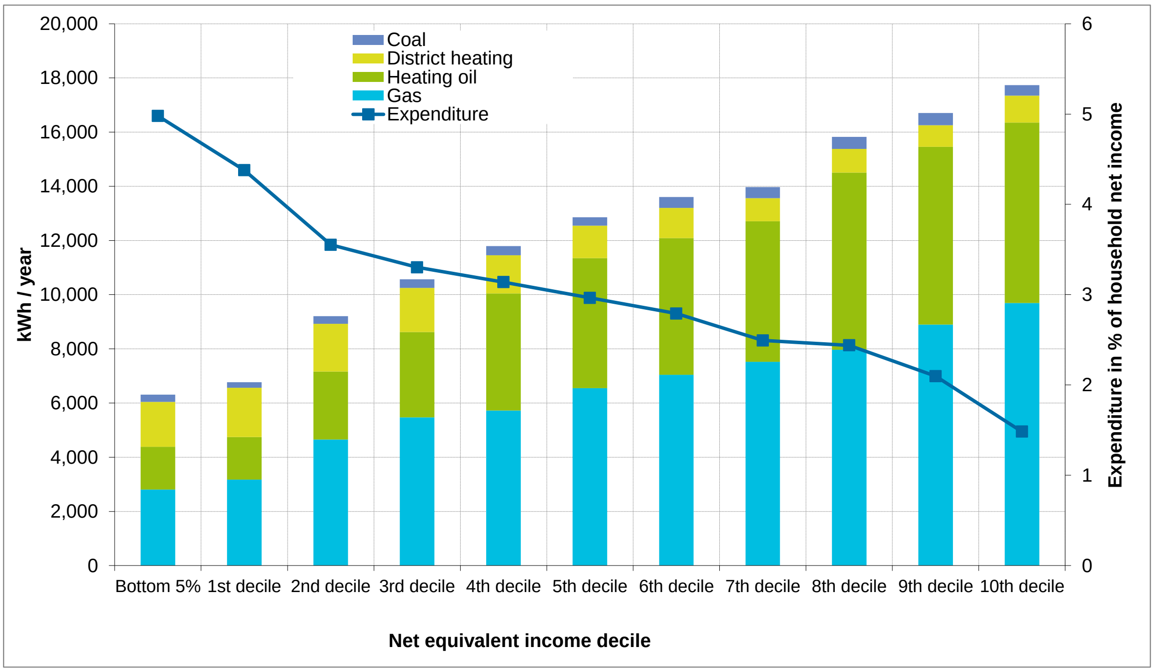

Figure 2 Heating energy consumption by income group
Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

Renewable energy support

Figure 3 shows the distributional effects of 2014 German renewable energy policy. The figure illustrates that the share of fees and charges in household electricity prices has risen considerably - in particular due to the rising EEG surcharge. These components are determined politically and their level depends, in part, on decisions made regarding industry exemptions to contributing to the cost. Similar developments regarding the policy costs contained in electricity prices are also observed in other jurisdictions (cf. Chawla & Pollitt 2013 for the UK). Due to the high share of policy costs embodied in electricity prices and the resulting increase in household expenditure, there is an expectation that government takes responsibility for these increases and introduces measures to address potentially undesired impacts – in contrast to price changes that are attributed to market developments (Elkins 2005). In order to reduce electricity expenditure by households or certain household groups, the government has different options, including influencing price components such as the EEG surcharge, reducing the amount consumed by households or channeling money through the social security system.

In order to estimate the distributional effects of German renewable energy policy, we use the EEG surcharge as of 2014 of 6.24 ct/kWh (in 2015, the surcharge was reduced to 6.17 ct/kWh and is 6.35 ct/kWh in 2016). Households also have to pay value-added tax (VAT) on top of the total electricity price – and therefore also on the EEG surcharge. The EEG surcharge of 6.24 ct/kWh in 2014 is therefore multiplied with 1.19 to arrive at a total additional burden of 7.43 ct/kWh. On the other hand, one should consider merit-order effects, i.e. a reduction in the wholesale price of electricity, induced by wind and PV supported through the EEG. The combined effect of wind and PV is estimated at 1.64 ct/kWh in 2014 (Cludius et al., 2014). Again adding the VAT, this would reduce the burden imposed by the EEG surcharge to 5.47 ct/kWh.

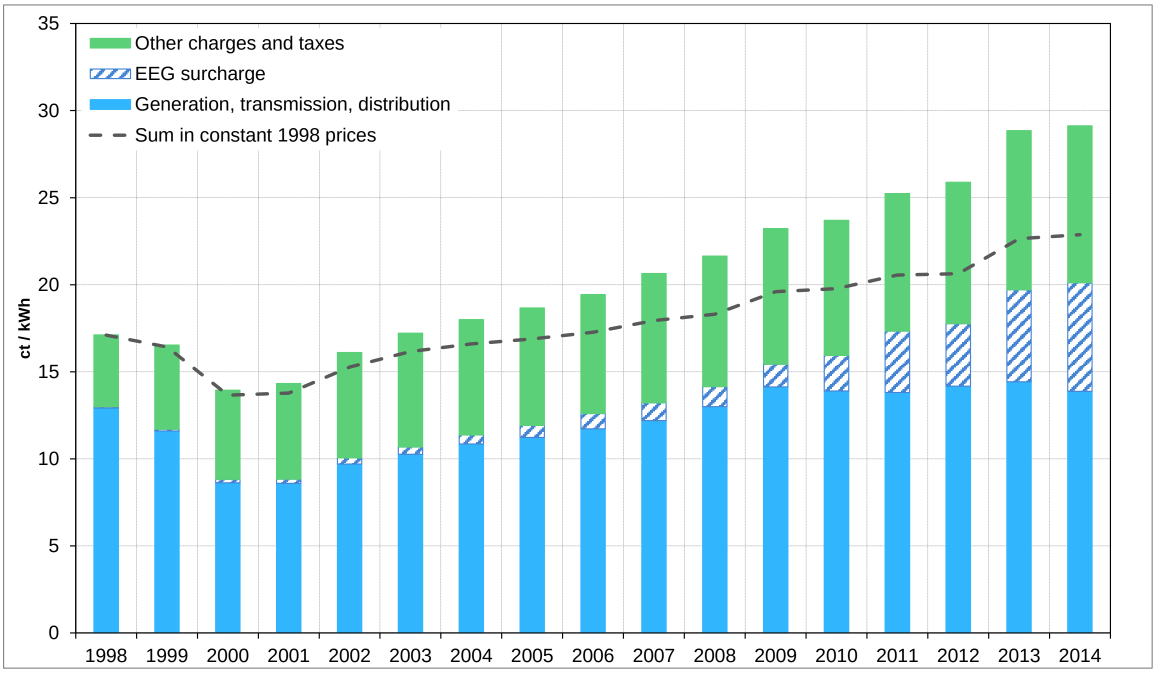

Figure 3 Household electricity price components
Sources: Öko-Institut (2012); BDEW (2014); own illustration

Energy efficiency

For the analysis of distributional effects of energy efficiency policy, we consider all major existing and planned energy efficiency policies in the buildings and electricity / appliances sector. We investigate the effects of national as well as EU policies (EU Directives). Although the EEG surcharge only affects electricity costs, we also take into account legislation targeting energy efficiency of new and existing residential buildings. These policies reduce fuel costs in buildings and can thus substantially contribute to the reduction of overall energy costs for households. We furthermore check how the impacts of these policies are distributed among different household types. We both include policies legislated before the release of the National Action Plan on Energy Efficiency (NAPE; BMWi 2014) in December 2014 and those policies included in the Plan, as well as policies from the German Climate Action Program 2020 (APK)[9]. For each of the policies, we only consider the part that is applicable to households (e.g. in the buildings sector, only those energy savings and investments affecting residential buildings).

Table 1 shows the policy instruments considered in this analysis. It further shows associated saving potentials and annualized investment costs at the household level, i.e. after deducting support from the German government, expected in the year 2020.

In the buildings sector, we consider

- the existing Energy saving legislation (EnEV 2013) and its further development planned for 2019. The legislation sets minimum efficiency standards for the renovation of existing, as well as for the construction of new buildings.
- low interest loans or subsidies available for the renovation of existing or construction of new buildings adhering to certain efficiency standards, (the KfW ('Kreditanstalt für Wiederaufbau').
- NAPE policies that are to be implemented, including tax incentives for energy-efficient renovations that surpass the standards set out in the EnEV, several consulting programs and a national energy-efficiency label for old heating installations.
- New Climate Action Program (APK) instruments which relate to a strategy of climate friendly buildings construction and living including support for low income households.
    - In the electricity / appliances sector, we consider
- two EU Directives; on Ecodesign (2009/125/EC) and Labelling (2010/30/EU) of appliances, and the installation of smart meters as inscribed in the Energy Efficiency Directive (2012/27/EU) that is currently passed into German law.
- additional NAPE measures, such as the Top Runner Initiative, which would – at the national level – strengthen the incentives for efficient product design and adequate information on efficient appliances. Furthermore, the NAPE envisages the setting up of competitive tenders for the reduction of electricity consumption in all sectors of the economy. In this context, funds that support the achievement of these reductions would be tendered competitively and bid for by parties representing a program to carry out these reductions. We include the part of this program into our analysis that is expected to lead to reductions of electricity consumption at the household level.

Finally, we investigate an instrument directly targeted at low-income households, namely the Electricity Saving Check ('Stromsparcheck'). Under this program, households that receive government transfers are eligible for free-of-charge energy consulting and ad-hoc measures, such as the replacement of inefficient lightbulbs. A part of the program also provides subsidies for the replacement of old fridges. An extension of this program is planned with the frame of the APK.

The energy saving potential and the resulting energy cost savings and annualized investment costs for each of the energy efficiency policies are mainly based on calculations carried out for the accompanying, scientific study on the NAPE (Fraunhofer ISI et al. 2014).

- For already existing or further developed policies (e.g. the KfW programmes, the Energy saving legislation for buildings or the Top Runner Initiative), the energy savings up to 2020 are estimated based on available program evaluations and calculations made for the 3rd German National Energy Efficiency Action Plan (NEEAP) submitted under the EU Energy Efficiency Directive (2012/32/EC) and the German projection report submitted in accordance with Decision 280/2004/EC (Deutsche Bundesregierung 2013).

9 http://www.bmub.bund.de/en/topics/climate-energy/climate/national-climate-policy/climate-action-programme/

- For new measures in the NAPE (especially the competitive tenders for electricity savings), the calculations are based on energy saving potentials calculated by Fraunhofer ISI et al. (2014) and assumptions about the extent to which the specific policy instrument addresses these potentials.
- The resulting energy cost savings were calculated by applying energy prices taken from the second modelling round of the 'Climate Protection Scenario 2050 (Klimaschutzszenario 2050)'.[10] Energy cost savings are estimated over the whole lifetime of the measure at hand and a discount rate of 0.75% (which is equivalent to the rate of the KfW building programs) is applied.
- The additional investment costs induced by the policies were again calculated based on information from existing program evaluations, as well as from Fraunhofer ISI et al. (2012). Further investment cost calculations - in particular for existing policies in the buildings sector - stem from the ongoing study for the Federal Environment Ministry.

Table 1. Energy efficiency policies considered, energy and expenditure saved and annualized investment costs in 2020

	Instrument	**Energy savings potentials in 2020 (TWh)**	**Energy cost savings over lifetime (Mrd. €)**	**Annualized investment costs (Mrd. €)**[11]
Buildings – existing instruments	EnEV 2013	-20.5	-2.5	0.8
	KfW renovation of existing buildings, KfW construction of new buildings	-18.8	-2.5	1.9
Buildings - new instruments - NAPE and APK	Savings law, energy advice, heating check, efficiency lable, APK measures	-11.5	-1.3	0.7
Electric appliances – existing instruments	Ecodesign, Labeling	-15.0	-4.2	0.7
Stromspar-Check	Electricity Savings Check (ongoing and extension)	-0.2	-0.1	0.003
Electric appliances – NAPE	Top-Runner, Pay as you save	-5.3	-1.5	0.2
	Competitive tendering scheme (electricity)	-2.5	-0.7	0.1

Source: ongoing research project by Fraunhofer ISI, Öko-Institut et al. for the Federal Environment Ministry (BMUB) entitled „Entwicklung eines Konzepts für das Erreichen der nationalen Energieeinsparziele bis 2020 und bis 2050 auch unter Berücksichtigung relevanter EU-Vorgaben im Kontext einer ganzheitlichen Klima- und Energiepolitik", short: „Action Plan Energy Efficiency"

Similarly to the analysis of the EEG surcharge, energy cost savings and annualized investment costs are distributed amongst households in order to investigate who is most affected. We apply assumptions as follows:

- All building measures affect owner-occupiers and renters equally, as owners will carry out those measures and pass the cost forward to their tenants. Investment costs are distributed according to square meters of the dwelling in question.[12]
- All measures relating to appliances lead to the same relative reduction in electricity consumption for all households. Investment costs are distributed according to the electricity saved (i.e. each kWh saved requires the same amount of investment). Savings and investments related to the Electricity Saving Check are distributed to households that receive social transfers above a

10 Ongoing project for the Federal Environment Ministry (BMUB) by Öko-Institut, Fraunhofer ISI, dezentec.
11 Investment costs are taken from existing program evaluations (see e.g. Fraunhofer ISI et al. (2012). They are annualized based on a discount rate of 0.75% and individual assumptions on average lifetimes for each measure (ranging from 8 to 30 years).
12 Please note that this analysis considers annualised investment costs (as is routinely done in economic analysis) and therefore aims to give an overview of the impact across the whole lifetime of the measure rather than a snapshot of actual costs in a given year.

threshold value of 100 € / month for general transfers (‘Grundsicherung’) and 50 €/month for transfers relating to living costs (‘Wohngeld’).

Results

Figure 4 displays how the EEG surcharge in 2014 is distributed among households by income group. Households with higher incomes face a higher absolute burden (in terms of monthly surcharge related costs), rising from 14 €/month for the lowest income group to 27 €/month for the highest income group – or from 10 €/month to 20 €/month when merit-order effects are considered. However, when looking at the share of their net income spent on the EEG surcharge, the picture is reversed. While the lowest income group spends 1.2 % (0.9 %) of their net income, households in the highest income group spend, on average, 0.5 % (0.3 %) of their net income. Therefore, the effect is clearly regressive. This is not a novel result and has been confirmed many times in the literature (Chawla & Pollitt 2013; Grösche & Schröder 2014; Neuhoff et al. 2013; Tews 2013).[13]

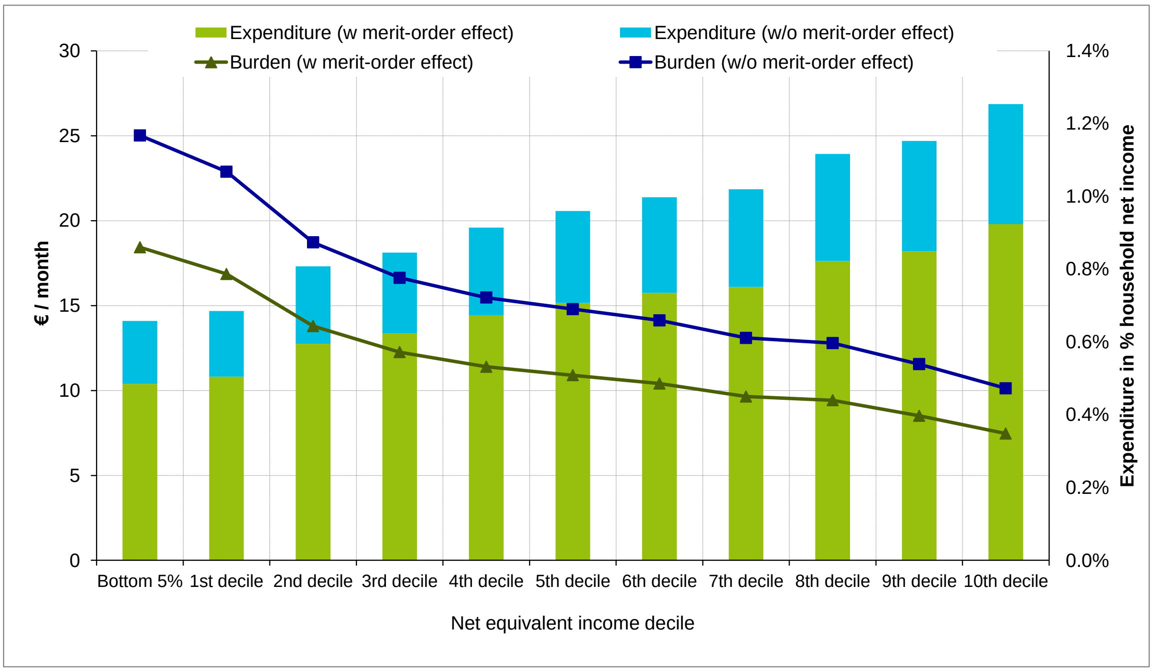

Figure 4 Impact of the EEG surcharge on German households by income group
Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

Households generating electricity from rooftop PV panels or through investing in a large-scale renewables project also receive financial benefits. Grösche and Schröder (2014) found that the aggregate effect of the surcharge and the income from renewables generation is regressive regardless of which inequality measures is applied. This is due to the fact that high-income households are more likely to own PV panels (for example because they own rather than rent a house and therefore have the possibility to decide to put PV panels on their roof and can afford them). Doing so in the early years of the EEG guaranteed a large return on investment due to the high support rates. The authors furthermore isolate the two effects and show that the effect of the surcharge on the income distribution is much larger than the effect of the income from PV panels. Finally, they comment on

13 Note that this is a static analysis. If one took into account reactions by households or by the wider economy, these effects may be alleviated or exacerbated.

the overall magnitude of the effect, which seems rather small for the average household to date, but is already problematic for those households at the bottom of the income distribution. This is due to the fact that those households do not have ‘discretionary income’, i.e. income that is not allocated to cover recurring costs, which they could shift between different consumption goods.

Turning to the analysis of distributional effects of energy efficiency policies, we consider three instruments in detail and then give an overview of all instruments given in Table 1.

First, we present results for the new NAPE and APK instruments in the buildings sector. These instruments tackle heating labelling, heating checks, strategies and support for climate friendly housing etc. Physical energy savings for these instruments are higher for higher income households, in particular relating to natural gas, while energy cost savings in relation to net income are substantially higher (four times as high) for low income households. Savings in energy cost are higher than annualized investment costs throughout all income groups. The net cost of savings (in relation to net household income), i.e. the difference between the two lines in Figure 5, however, are highest for middle to low income households. This shows that households with relatively lower income benefit more from these policy instruments than households with higher incomes. However, despite these net benefits long payback periods and high initial capital needs might prove to be a significant barrier for households to carry out investments.

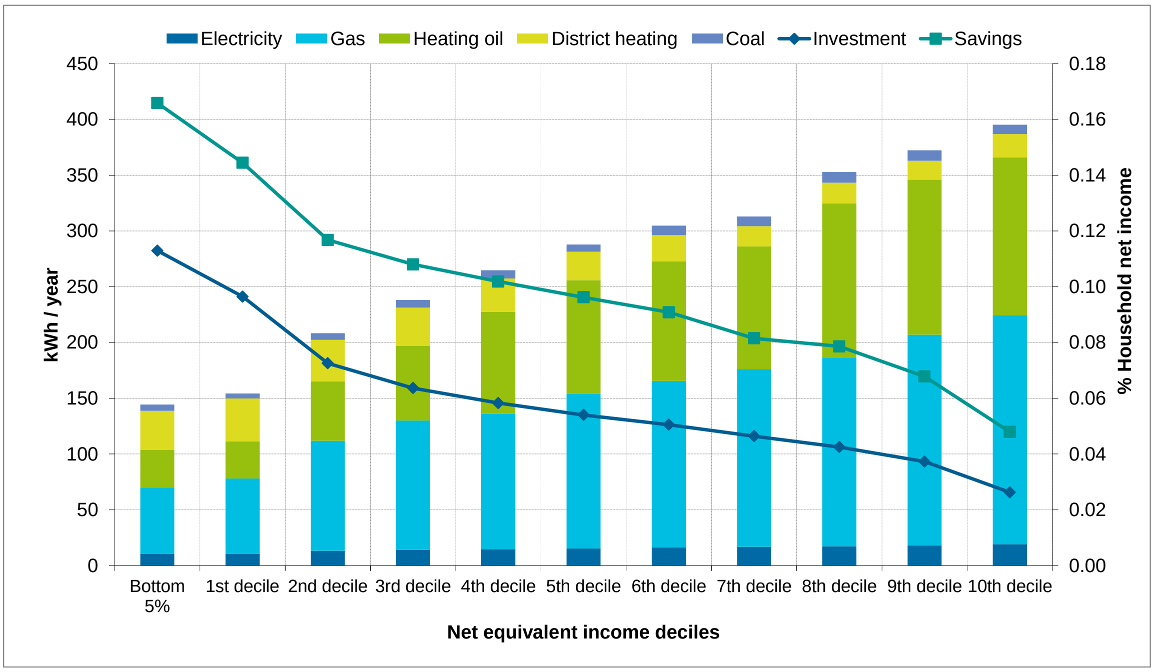

Figure 5 Impact of the NAPE and APK programs on German households by income group
Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

Second, we present results for the instruments addressing electric appliances (Ecodesign and Labeling). For these instruments, we find a particularly positive net effect for low income households as well as single parents and unemployed (latter two not shown here). This relates back to the fact that electricity is the most expensive energy carrier in household energy consumption while at the same time its characteristic is of a basic-needs good. Thus, any relief in costs is most beneficial to lower income households. The savings potential both in terms of physical energy and energy costs is higher than for the above mentioned buildings instruments.

Despite this positive net balance, a number of barriers prevent making use of these potentials, including lack of knowledge about electricity expenditure and potential savings. Also, as an average household only spends 2% of its net income on electricity, financial savings do not provide much of an incentive, at least for average and higher income households. Other barriers include non-monetary preferences regarding function or design of appliances as well as information and transaction costs.

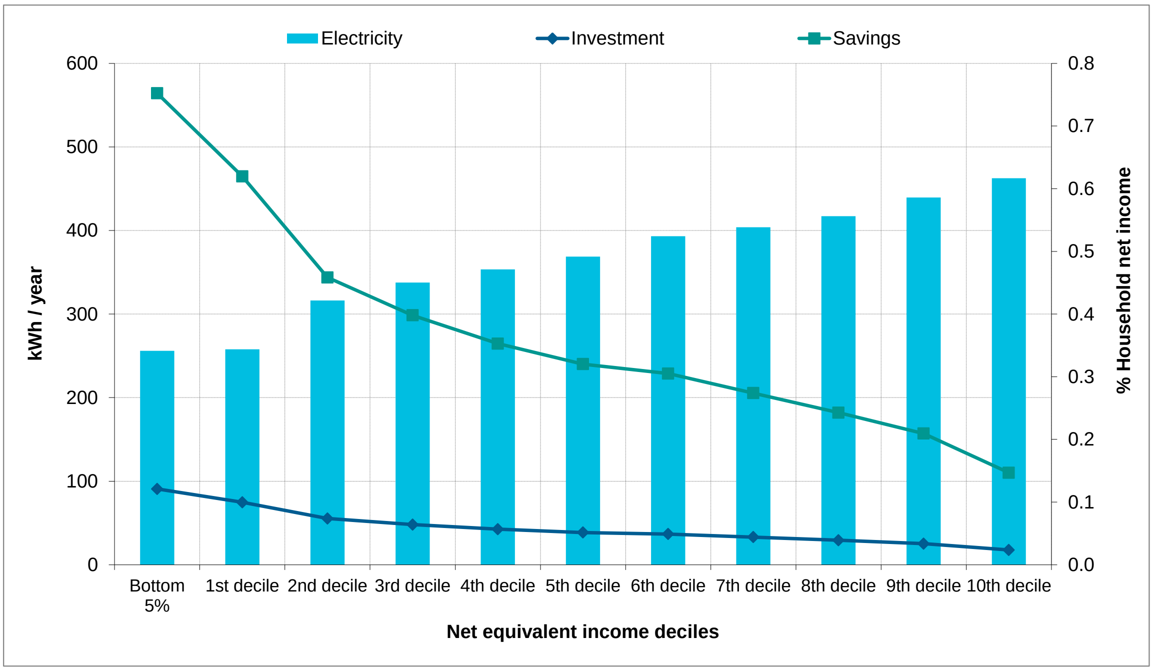

Figure 6 Impact of existing policies for appliances/electricity on German households by income group

Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

Thirdly, we present results for an instrument that tackles a particular target group, i.e. low income households (Stromspar-Check). It provides at-home advice on electricity savings and supplies electricity saving devices to low income households that receive social transfer. In its extension it also provides financial subsidies for purchases of high efficiency refrigerators. The benefits of this program in terms of electricity savings by far outweigh the associated investment costs (investment costs only occur in the extension part for refrigerator purchase). It thus has a highly progressive effect. In addition to costs savings, the program also provides for employment as electricity checks are performed by long-term unemployed who receive an electricity consultant training course within this program (Seifried 2015). The instrument stimulates changes in user routines and low-budget investment. An evaluation revealed that in the previous two phases, participants managed to reduce their electricity consumption by around 16% which is complemented by learning effects for future applications (Öko-Institut et al. 2012). Our analysis reveals that for households making use of the program an average electricity savings of 390 kWh/a for the existing program and an additional 398 kWh/a can be reached which is equivalent to a cost saving of about 221 Euro per year and about 3% of the net income of the lowest income group (bottom 5% of net equivalent income), 2% for the first income decile.

The Stromspar-Check is the only instrument we analyze in detail that specifically addresses low income households. It has a very positive distributional effect. However, the actual number of households that has been reached with this instrument is still small. Therefore average savings (for households covered by program and those not covered) in the lowest income decile are still small. On average the 1st income decile only saves about 19 Euros/a, i.e. 0.04% of the net income (compare Figure 7). However, the instrument will be further expanded and information will be spread through multiplier processes so that more savings are to be expected throughout the income group.

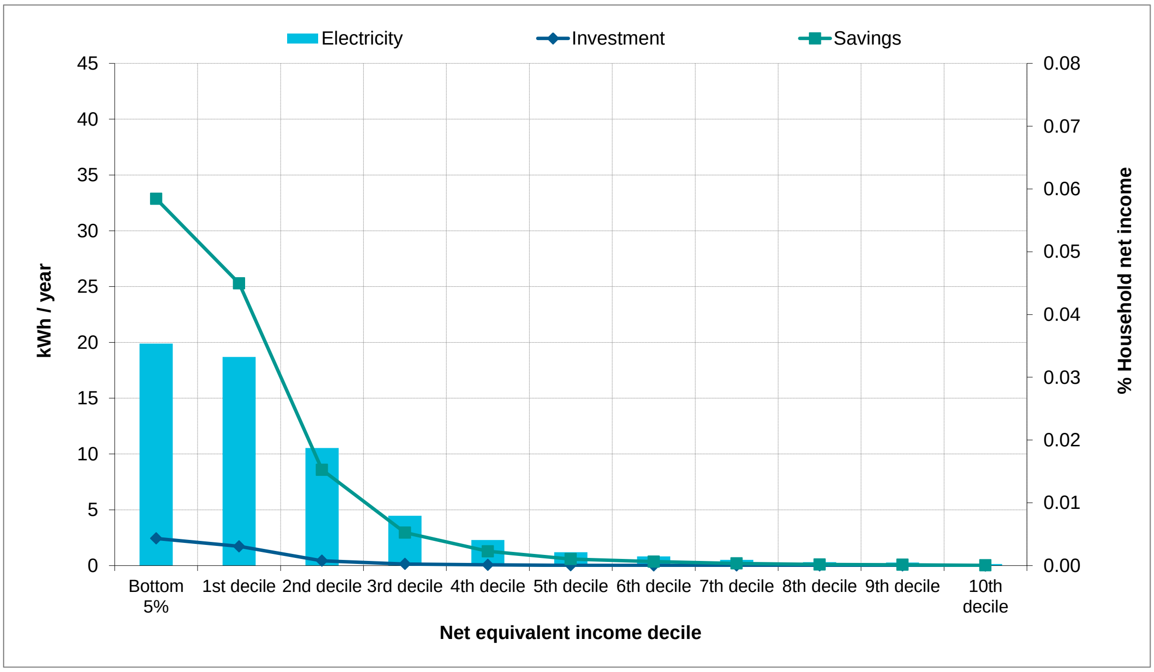

Figure 7 Impact of existing policies for appliances/electricity (Stromspar-Check) on German households by income group

Source: Destatis/Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration

A summary of the net effects of benefits-costs across all investigated efficiency instruments is provided in Table 2. The numbers are presented as net savings as a percentage of net household income. The summary shows a positive net effect for all instruments or groups of instruments with higher relative savings for low income households than for high income households. This progressive effect is most pronounced for the instrument tackling electricity appliances (because of electricity being the most expensive energy carrier compared to other energy prices).

It should be noted that the analysis does not represent an evaluation of the policy instruments in terms of likelihood of implementation in different household groups. It rather shows the distribution of efficiency potentials related to energy consumption and expenditure across the population. The estimated effects obviously depend on the assumptions taken with regards to which income groups actually carry out those measures. We believe that the assumption that policies in the building sector affect owner-occupiers and tenants equally holds. However, it may be necessary to account for the fact that low-income owners are less likely to carry out efficiency measures that require investment. Since in the electricity / appliances sector, the measure with the highest potential by far is the Ecodesign Directive, it should also have a comparable impact (in relative terms) on both low- and high-income households. However, we would like to underline that it is important to check who really carries out those measures during the course of the evaluation of these policies. In this context, Tews (2013) notes that energy efficiency policies that rely mainly on providing information, rather than investment subsidies (e.g. for new appliances) have the potential to worsen rather than alleviate regressive effects. It is therefore crucial to continue to build an evidence base on the beneficiaries of these policies that would allow further refining the present analysis. Information on the distribution of potentials as in our analysis and evaluation of who carries out these measures are crucial ingredients in designing targeted policy instruments.

Table 2. Net effect of benefits-costs (in % of household net income) for German energy efficiency policies

Decile net equivalent household income	Max income (percentile)	EnEV 2013	KfW building insulation and new construction	Savings law, energy advice, heating check, efficiency label, APK measures	Eco-design Label-ing	Stromspar-Check (on-going and extension)	Top-Runner Pay as you save	Competitive tendering scheme (electricity)
	Euros/ month	Savings in % household net income						
Below 5 %	855	0.21	0.04	0.05	0.63	0.05	0.23	0.10
1. Decile	1 043	0.18	0.04	0.05	0.52	0.04	0.19	0.09
2. Decile	1 329	0.15	0.04	0.04	0.38	0.01	0.14	0.06
3. Decile	1 552	0.14	0.04	0.04	0.33	0.01	0.12	0.05
4. Decile	1 771	0.13	0.04	0.04	0.30	0.00	0.11	0.05
5. Decile	1 994	0.13	0.04	0.04	0.27	0.00	0.10	0.04
6. Decile	2 244	0.12	0.04	0.04	0.26	0.00	0.09	0.04
7. Decile	2 564	0.11	0.03	0.04	0.23	0.00	0.08	0.04
8. Decile	3 021	0.10	0.03	0.04	0.20	0.00	0.07	0.03
9. Decile	3 854	0.09	0.03	0.03	0.18	0.00	0.06	0.03
10. Decile	.	0.06	0.02	0.02	0.12	0.00	0.05	0.02
Total	.	**0.11**	**0.03**	**0.03**	**0.23**	**0.003**	**0.08**	**0.04**

Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration. Note: Positive values indicate net savings

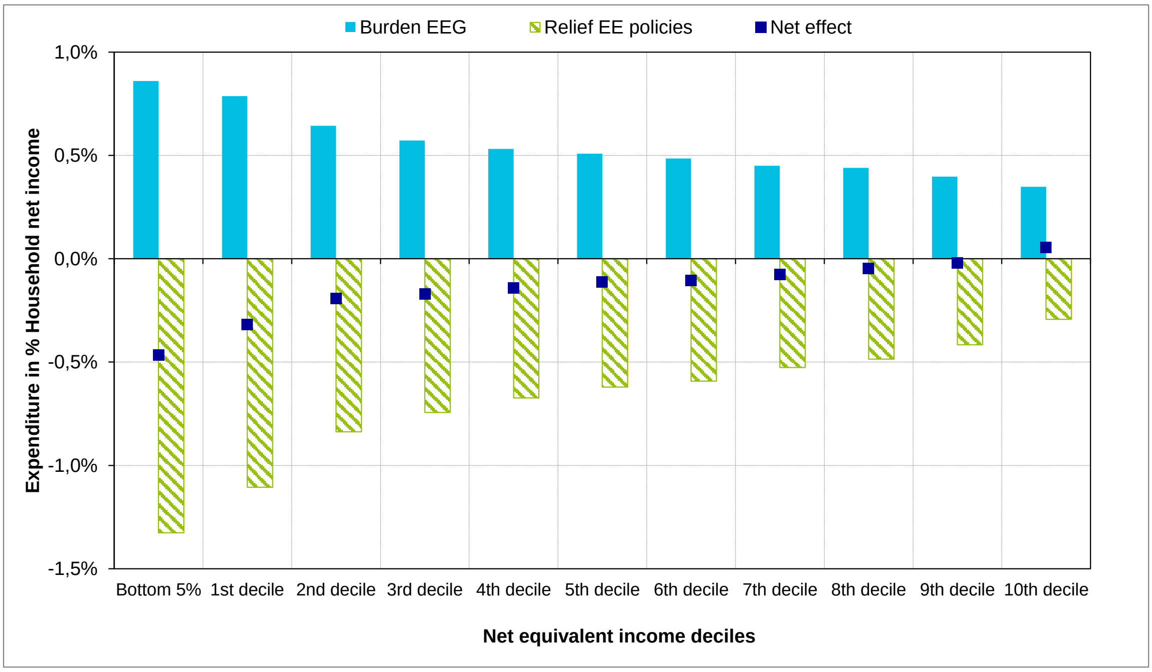

Figure 8 Net effect of German renewable energy and energy efficiency policy on German households

Source: Destatis / Research Data Centre (FDZ): EVS 2008 (80 % scientific use file) extrapolated to 2014; own estimation and illustration. Note: Negative values indicate net savings

Bringing the effects of energy efficiency measures and the renewable energy surcharge together, we show in Figure 8 the net effect in percentage of household income. As explained above, the impact of the EEG surcharge is analyzed including merit-order effects. It is regressive in nature, providing a relatively higher burden on lower income households. Estimated effects of energy efficiency policies, however, are of opposite nature. They provide net benefits and are progressive, i.e. lower income households experience a higher benefit in relation to their net income[14]. Analyzing the renewable surcharge related burden against the efficiency related relief, we find that energy efficiency policies that are currently legislated or planned in Germany have the potential to counterbalance the (monetary) burden imposed by the EEG surcharge. We furthermore find that if households across all income groups carry out the measures associated with those policies, they have the potential to also level out the regressive effect imposed by the EEG surcharge. In fact, when comparing the effects of the EEG surcharge to those of the efficiency policies, the net effect of the combined policies on households (in % of household income) is positive[15] and distributed progressively.

Discussion

The analysis in this paper has shown that energy consumption and expenditure as a percentage of net income are inversely distributed across household income groups. Electricity consumption is about two times lower in low income groups than in high income groups while expenditure in relation to net household income is up to four times higher in low income groups. For heating energy, the pattern is similar but to a different extent. Heating energy consumption is about three times lower in low income households while in relation to their net income they spend about twice as much as high income households. Electricity is the most expensive household energy carrier while at the same time it provides basic needs for refrigeration, washing, etc. The distribution of electricity use is much more even than the distribution of costs in relation to net income. This insight provides the basis for the analysis in this paper. We compare the effects of the renewable energy policy in Germany in form of a surcharge to the potential savings related to energy efficiency policies.

The impact of the EEG surcharge on households is non-negligible. It is crucial to distinguish between different groups of households, as effects vary considerably between the different groups. The impact of the EEG surcharge in 2014, for example, ranges from 0.3 % of net household income for the highest income group to 0.9 % for the lowest income group (including the merit-order effect).

On the other hand, the German Energy Concept (‘Energiekonzept’) also contains ambitious energy saving goals. In order to check whether policies in this field have the potential to lower the burden imposed by the EEG surcharge, we have investigated major relevant existing or planned energy efficiency policies related to buildings and electricity / appliances. The results indicate that those policies have the potential to substantially alleviate the burden imposed by the EEG surcharge because they reduce overall household energy costs. Measures both in the buildings sector and in the area of electricity consumption / appliances achieve net savings at the household level, the saving being most pronounced for measures relating to ecodesign and labeling of appliances. Therefore, an assessment of the distributional effects of measures within the German Energiewende should take into account both the additional costs (as, for example, imposed by the EEG surcharge), but also the (monetary) benefits related to energy efficiency and saving policies.[16]

We have shown that the burden imposed by the EEG surcharge is distributed regressively amongst households. The distributional effects of the investigated energy efficiency polices on the other hand, show a progressive pattern. Together, the effects of the two policy areas are distributed

14 We understand that some of the energy efficiency policies overlap and the total effect on energy savings might be lower than the sum we take. In the associated research project, the overlap is estimated to be 10% maximum, thus savings effect might be up to 10% lower.

15 Only the highest income decile shows a net cost of combined policies. However, the effect in relation to household income is negligible.

16 Note that we do not account for additional benefits (e.g. health, biodiversity) related to the reduction of CO_2-emissions, which would increase the overall benefits for all households.

progressively amongst households, i.e. lower income households benefit relatively more in relation to their net income than higher income households. Efficiency policies are thus able to counterbalance the regressive burden of an energy price increase relating to renewable energy policy.

We have stressed that the distributional effects of the policies investigated certainly depend on which households carry out those measures. We have explained the choice for the assumptions we have taken in this context, but have argued that it is important to continue to build an evidence base with regards to the beneficiaries of these policies in order to carry out more refined analyses. Evaluations of the existing and planned policy programs discussed should take into account these issues, since a one-sided involvement of high-income households may indeed increase rather than alleviate regressivity of the Energiewende policies at the household level.

Our analysis also shows that physical and monetary energy savings potentials are unevenly distributed. The highest physical savings potentials occur in households that are least likely to appreciate related financial savings. Moreover, monetary savings are rather small compared to household income for high income groups. Thus, differentiated incentives might be needed within policies and measures to address barriers or provide additional motivation to implementing these potentials. Differentiating target groups and understanding their distinct characteristics and incentive structures is therefore indispensable. It is important to design tailor-made, target group specific policies to trigger potentials.

References

BDEW (2014). BDEW-Strompreisanalyse Juni 2014 - Haushalte und Industrie, last accessed on 05 Jan 2015.

BMWi (Federal Ministry for Economics and Energy) (2014). Nationaler Energieeffizienz-Aktionsplan (NEEAP) 2014 der Bundesrepublik Deutschland gemäß der Richtlinie des Europäischen Parlaments und des Rates vom 25. Oktober 2012 zur Energieeffizienz (2012/27/EU). Available at: http://www.bmwi.de/DE/Mediathek/publikationen,did=649712.html

BMWi (2014): Mehr aus Energie machen. Nationaler Aktionsplan Energieeffizienz. December 2014. Available at: http://www.bmwi.de/EN/Topics/Energy/Energy-Efficiency/nape.html

Chawla, M. & Pollitt, M. G. (2013). Energy-efficiency and Environmental Policies & Income Supplements in the UK: Evolution and Distributional Impacts on Domestic Energy Bills. Economics of Energy & Environmental Policy, 2(1).

Cludius, Johanna, Hauke Hermann, Felix C. Matthes, and Verena Graichen. 2014. “The merit order effect of wind and photovoltaic electricity generation in Germany 2008–2016: Estimation and distributional implications.” Energy Economics 44:302–13. doi:10.1016/j.eneco.2014.04.020.

Destatis / Research Data Centre (FDZ): German Income and Expenditure Survey 2008 (Einkommens- und Verbrauchsstichprobe - EVS 2008); 80 % scientific use file

Deutsche Bundesregierung (2010/2011). Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung.: Energiekonzept der Bundesregierung vom September 2010 und Änderungen durch das Energiepaket vom Juni 2011. Berlin.

Deutsche Bundesregierung (2013): Projection Report 2013 of the Federal Republic of Germany according to Decision 280/2004/EC.Fraunhofer ISI, Ecofys, Öko-Institut e.V. (2012).

Kosten/Nutzen-Analyse der Einführung marktorientierter Instrumente zur Realisierung von Endenergieeinsparungen in Deutschland. Study on behalf of the BMWi. Summary in English available. Available at: http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/kosten-nutzen-analyse-einfuehrung-marktorientierter-instrumente-endenergieeinsparung.pdf

Elkins, S. (2005). Soziale Gerechtigkeit als umweltpolitisches Steuerungsproblem. In M. Corsten, H. Rosa, & R. Schrader (Eds.), Die Gerechtigkeit der Gesellschaft. . Wiesbaden: VS-Verlag.

Fraunhofer ISI, Fraunhofer IFAM, Ifeu, Prognos & Ringel (2014): Ausarbeitung von Instrumenten zur Realisierung von End-energieeinsparungen in Deutschland auf Grundlage einer Kosten-/Nutzen-Analyse. Wissenschaftliche Unterstützung bei der Erarbeitung des Nationalen Aktionsplans Energieeffizienz (NAPE). Summary (German). November 2014. http://www.bmwi.de/DE/Mediathek/publikationen,did=677320.html

Grösche, P. & Schröder, C. (2014). On the redistributive effects of Germany's feed-in tariff. Empirical Economics, 46(4), pp. 1339–1383. doi:10.1007/s00181-013-0728-z.

Neuhoff, K.; Bach, S.; Diekmann, J.; Beznoska, M. & El-Laboudy, T. (2013). Distributional Impacts of Energy Transition: Impacts of Renewable Electricity Support in Germany. Economics of Energy & Environmental Policy, 2(1), pp. 41–54.

Öko-Institut (2012). Strompreisentwicklungen im Spannungsfeld von Energiewende, Energiemärkten und Industriepolitik. Der Energiewende-Kosten-Index (EKX): Kurzstudie. Berlin. Available at www.oeko.de.

Öko-Institut; Arepo Consult; FFU; Ecologic; FiFo Köln & Dr. Hans-Joachim Ziesing (2012). Evaluierung des nationalen Teils der Klimaschutzinitiative des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit: Zusammenfassung Endbericht 2012 Kennzeichen 03KSE009.

Tews, K. (2013). Energiearmut definieren, identifizieren und bekämpfen - Eine Herausforderung der sozialverträglichen Gestaltung der Energiewende: Vorschlag für eine Problemdefinition und Diskussion des Maßnahmenportfolios (FFU-Report No. 04-2013).

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