

Applied policy measures for energy savings in end-use sectors in EU-countries: what is best?

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Abstract

Past and present policy measures to stimulate energy savings in the household sector in EU-15 countries are analysed as to their type (regulatory, financial, information, etc.), their coverage of different types of energy use and their estimated impact on energy consumption. Moreover, the matching of national and EU-based policy measures is looked at. Finally, a number of innovative policy measures are presented. This analysis comprises over 310 policy measures presently available for the residential sector in the MURE-database sponsored by the European Commission.

On the basis of these results and a theory on effective implementation of saving measures using policy measures, tentative conclusions are drawn on the amount and composition of policy measures in EU-countries, the role EU-policy can or should play and the effectiveness of the sets of policy measures in EU-countries.

Introduction

Energy savings are seen as the most important means to attain the European policy targets for reduction of greenhouse gases, limiting the dependence on uncertain fossil fuel resources and assuring a competitive economy [EC, 2007]. Primary energy savings of 20 % should be realised in 2020 with the help of new and improved EU directives and extra national efforts [EC, 2006a and b; EC, 2005]. To this end a directive on Energy End-use Efficiency and Energy Services (ESD) asks Member States

to realise 9 % energy savings in the period 2008-2016 [ESD, 2006]. Both energy saving targets regard extra savings beyond autonomous savings, thus implying the implementation of policy measures to stimulate energy efficiency.

In the EU-countries many policy measures have already been implemented to realise the extra energy savings. The MURE-database on policy measures for energy efficiency provides an up-to-date overview of deployed measures in European countries [MURE, 2006]. For each policy measure a number of attributes are specified, such as starting year, type of measure, targeted energy use and, recently added, an expert estimate of the impact on energy consumption, unless a full impact evaluation is available.

Given the ambitious policy targets it is important to know more about already available policy measures, possible new innovative measures and effectiveness of policy measures in general. The MURE-database offers the opportunity to analyse the following questions: How many measures are available per country, how has the number increased and which measure types are prevailing at which time? What is the lifetime of policy measures, i.e. the turnover of policy measures? Do policy measures cover all parts of energy use? How close is the relation between national measures and EU-directives or other policy papers? With respect to the impact of policy measures questions regard the total impact per country and the development of impact in time. Finally, the most interesting but most difficult question to be answered is the relation between the amount of policy impact and the realised energy efficiency increase. Due to the limited space in this paper the analysis is restricted to the sector Households. Results for all end-use sectors are presented in [ADEME, 2007].

In the first section an overview will be given of developments for policy measures in EU-countries, mainly for the period from 1990 on. In the following section the focus is on the impact of policy measures and, where possible, the relation between impact and observed efficiency increase. The third section presents a number of innovative policy measures, given specified criteria, found in the MURE-database. Finally the results are put into perspective, i.e. which (set of) policy measures score high on chosen criteria, and conclusions are drawn.

Policy measure patterns and characteristics

MURE-DATABASE ON POLICY MEASURES IN THE EU

The MURE-database contains policy measures to stimulate energy savings in the end use sectors households, industry, services and transport. The measures have been provided by experts from each Member State participating in a number of consecutive projects financed by the EU. Presently, measures are included for all “old” EU-countries, Norway as well as for measures introduced by the EU itself. An extension to all new member states is in progress. The 800 policy measures, of up to 50 measure types, regard policy measures that have been, or are still, applied in the period from 1990 onward [MURE, 2007].

In this analysis, some policy measures without known status or proposed only, have been omitted. Unless stated differently the analysis covers ongoing and completed measures. The analysis restricts itself to the EU-15 countries excluding Luxembourg, but including Norway (depicted here as “EU-countries”) and the EU itself.

POLICY MEASURES FOR HOUSEHOLDS

Overview of policy measures

In the MURE-database about 310 policy measures are present for the residential sector in EU-countries¹, or on average almost 21 policy measures per country. However, the number varies considerably, from 9 for Belgium to 41 for Germany (see figure 1). The large number of EU policy measures on household energy use overlaps with country measures because EU-legislation is transferred into national policy measures.

About three-quarters of all policy measures are ongoing, reflecting the present policy efforts of countries. Again the number varies considerably, between 9 (Belgium) and 30 (UK).

Dynamics of policy measures

Figure 2 shows the yearly additions for various types of policy measures. The total number of new policy measures per year has gradually increased. However, there also have been some “dips”, a strong one in 2004 and minor ones in 1990, 2005 and 2001. Standards (legislative/normative) were introduced often in the early nineties and obligatory labels (legislative/informative) in the later nineties. From 2000 on financial policy measures, such as subsidies for investments in energy savings, have been much more popular. However, very recently standards have gained weight again. For fiscal measures such as tax re-

bates, co-operative measures (e.g. voluntary agreements with social housing corporations) and energy or CO₂-based taxes no outstanding patterns are visible.

For completed policy measures (see figure 3) financial measures take the lead, probably because these measures have a short lifetime by nature. From figures 2 and 3 it can be concluded that taxes are introduced but not terminated in the period observed. A similar observation is valid for legislative/informative instruments, including labels. Actually, the same holds for standards, as the completed measures are generally replaced by stricter standards. Financial and fiscal measures are often introduced and often completed, suggesting a rather short lifetime of these measures. The same holds for information/education measures.

Coverage of policy measures

Policy measures on energy savings often regard a specific part of household energy consumption, e.g. new dwellings or appliances. The total set of policy measures will cover many parts of energy use, but some parts may not be covered by any measure. The coverage has been analysed for the following targets of policy measures:

- New dwellings
- Boilers for space heating and hot water
- Envelope of existing dwellings
- Electric appliances

Figure 4 shows the development over time of policy measures per part of household energy consumption for all EU-countries.

It can be concluded that each part of energy use is covered by an increasing number of policy measures, evenly distributed over the different parts of energy use. For the country scores (not shown here) it can be concluded that in almost all countries the set of policy measures covers all parts of household energy use. However, the distribution of policy measures over all energy use targets is sometimes uneven. For each country the difference from an even distribution, 25 % of all policy measures for each targeted part of energy use, was calculated. The mean divergence is large for Greece and Portugal and lowest for Spain and UK. Generally, countries with a larger number of policy measures tend to have a more even distribution over different energy use targets.

Specific and horizontal policy measures

Next to the specific policy measures, dealt with earlier in the analysis of coverage, so-called horizontal policy measures are used to stimulate energy savings. These measures aim by nature at all parts of energy use. The first one, general information (including awareness campaigns) is present in most countries (see table 1). However, for the second one, energy taxes, the opposite is true. Therefore most countries do not have this alternative to stimulate energy saving investments, in case specific policy measures, such as subsidy schemes, are lacking.

Most policy measures are aimed at influencing the purchase of more efficient devices and not the proper utilization of energy systems. Exceptions are measures aimed at inspection and/or maintenance of installed systems. These are applied by

1. Here EU-countries covers EU-15, excluding Luxembourg and including Norway

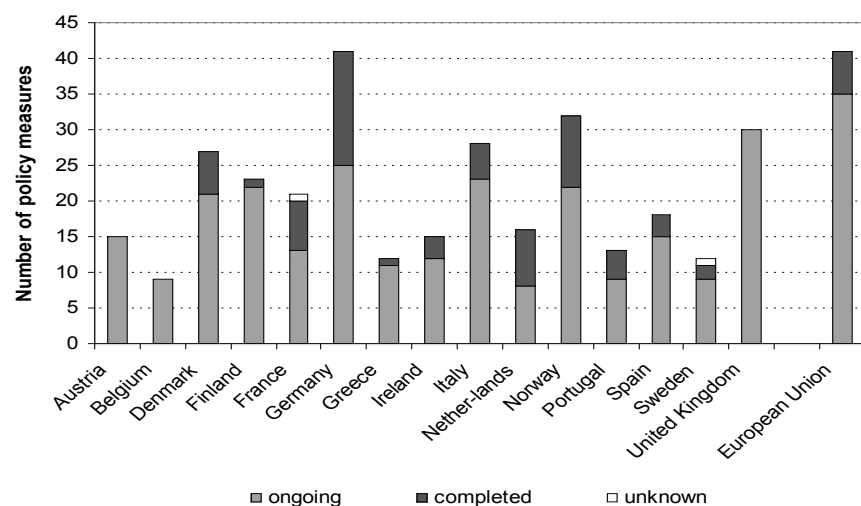


Figure 1. Number and status of policy measures for EU-countries and EU

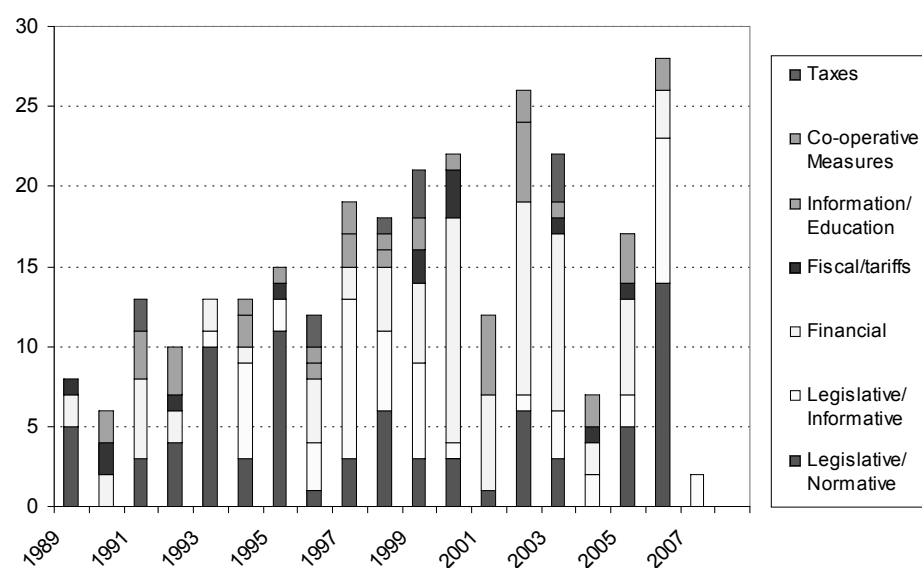


Figure 2. Yearly implemented new policy measures per type for all EU-countries

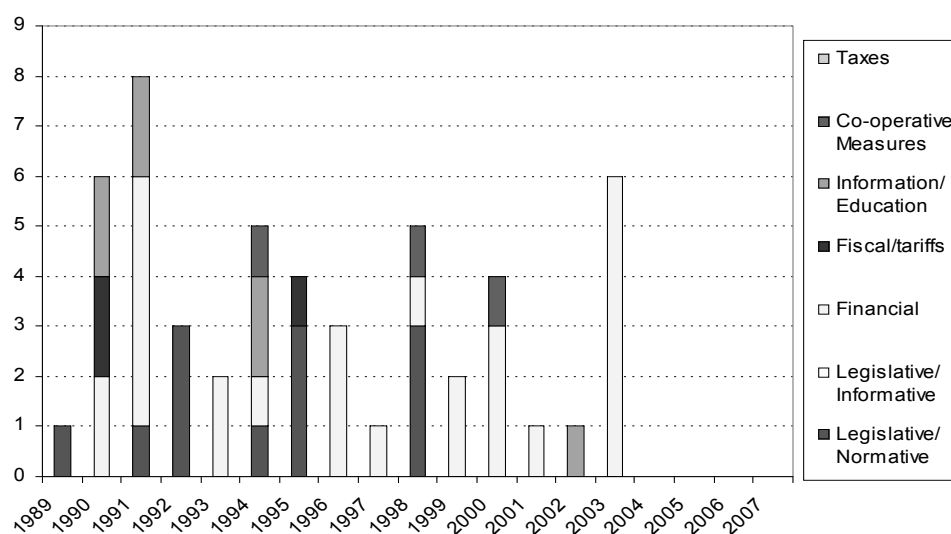


Figure 3. Yearly completed policy measures per type for all EU-countries

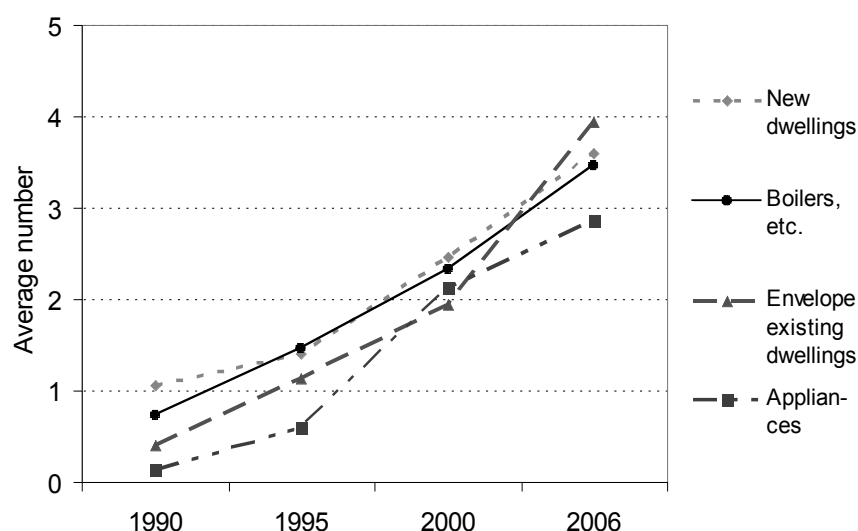


Figure 4. Average number of policy measures aimed at parts of energy use for 1990-2006 (all EU-countries)

Table 1. General policy measures and measures aimed at influencing energy utilization in EU-countries

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Norway	Portugal	Spain	Sweden	United Kingdom
General information	4	0	5	8	3	6	1	2	5	2	7	2	1	4	5
Energy taxes and tariffs	1	0	1	0	0	6	0	0	0	1	2	0	0	1	0
Proper utilization	1	0	0	1	1	1	3	1	4	0	0	2	0	0	0

about half of the countries (see last row in table 3). General information, taxes and the tariff structure can influence the proper use of energy systems as well. The table shows clearly that, except for Belgium, most countries have only one or two policy measure types at their disposal; only Germany can influence daily energy use after implementation with all three policy measure types.

Matching of EU- and national policy measures

The European Union has introduced a number of policy measures to stimulate energy savings in households and dwellings, the most important being:

- Energy performance of buildings directive (EPBD);
- SAVE-directive on individual billing of energy costs (now replaced by the Energy Service Directive);
- Minimum-efficiency standard and CE-label for boilers;
- Obligatory labels for various electric appliances; minimum standards for refrigerators/freezers;
- Other information (as part of the Energy Efficiency Action Plan EEAP and ESD). "Other information" regards general information campaigns and specific information, not being billing or labels;
- Voluntary agreements with manufacturers.

The match between national measures and EU-policy is shown in table 2. All Member States had already implemented either insulation or performance standards that are demanded in the EPBD. Therefore the match between both is quite good. Concerning certificates, the EPBD still requires major efforts from many MS forcing them to implement these certificates by 2007. As regards inspection, half of the countries have already implemented national policy measures; however, these national measures have to be adapted in line with the EPBD. More detailed analysis shows that many Member States have problems in building up sufficiently rapidly a qualified infrastructure for certification and inspection and have therefore asked for the maximum transition period allowed for by the EPBD, i.e. up to 2009.

For the SAVE-directive (superseded recently by the ESD) the table shows that national policy measures on individual billing are lacking in many cases. This is partially due to the introduction of national measures before the start of the MURE-database. In many countries, individual billing has already become standard after the first and second oil crisis due to the need for a fair distribution of (high) energy costs. Lacking national measures could also be due to the low share of collective buildings in the building stock of many countries.

Policy measures on minimum efficiency standards for boilers should match because European legislation must be transposed into national standards. The lacking standards for some

Table 2. Policy measure per country related to different EU-policy measures

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Norway	Portugal	Spain	Sweden	United Kingdom
EPBD:															
- standards new dwellings	1	1	3	2	4	4	1	3	2	3	4	3	4	1	4
- certificates dwellings	0	1	6	2	0	0	0	0	1	0	0	2	0	0	0
- inspection heating devices	1	0	2	0	0	1	2	0	3	0	0	2	0	0	0
SAVE-individual billing	2	0	0	0	0	1	1	0	0	0	1	0	0	0	0
Eff. standard boilers	0	1	0	1	1	3	2	1	2	0	0	1	1	0	2
Labels appliances	1	1	1	1	1	1	1	0	6	1	6	1	1	1	1
Other information	2	0	4	7	3	4	0	2	3	2	6	2	0	3	4
VA manufacturers	0	0	1	1	0	0	0	0	0	3	0	0	0	0	1

countries, notably the ones with a long history on energy efficiency policy, is probably due to not inserting them in the database because they were regarded as irrelevant in the present circumstances.

National policy measures on labels for appliances are always present because EU-legislation has been transposed into national policy.

For information campaigns countries can make their own choices, e.g. whether to pay attention to specific issues in their country. However, an information campaign at the European level, which is part of the Energy Efficiency Action Plan (EEAP) 2006 of the European Commission, supports MS in this field. The adopted Energy Service Directive (ESD) asks MS to disseminate information on possible energy efficiency measures and requires energy distributors to offer audits to energy users. Many countries already stimulate audits and supply information on saving possibilities.

Many voluntary agreements at the national level regard energy efficiency in industry; for the household sector it regards agreements with municipalities or social housing corporations on energy savings in dwellings. In these cases the actors are working at the national level. However, voluntary agreements with manufacturers of efficient appliances, electric motors, etc. will generally regard the EU-level; therefore it cannot be expected that these agreements are introduced at the national level as well.

Impact of policy measures

CALCULATION OF THE IMPACT OF POLICY MEASURES

For most policy measures in the MURE-database a qualitative impact rating "low", "medium" or "high" has been specified through expert estimates, unless a full quantitative impact evaluation was available. These ratings represent different ranges of energy savings, expressed as a percentage of the total consumption in the sector regarded. Low is given for 0-0.1 % reduction of total use, medium for 0.1-0.5 % and high for > 0.5 %. These ranges resemble the known quantified contributions of individual policy measures and fit into the overall contribution of savings policy. For instance, a set of fifteen policy measures divided equally over 'high', 'medium' and 'low' will

deliver on average 5 % energy savings, which is less than half of total household savings of 12 % found in Odyssee for the period from 1990 on.

In order to calculate the total impact of a set of policy measures, the measures are weighted according to their relative amount of energy savings. Given the ranges mentioned for the ratings relative weighting factors of 5 (high), 3 (medium) or 1 (low) have been chosen.

IMPACT TRENDS FOR HOUSEHOLDS

Figure 5 shows the total number and total impact of policy measures with a rating and the average impact for EU-countries. The results are presented against the EU-average.

For three countries (Denmark, Finland and Sweden) no average impact is given because too few impact rates were available. Germany has the largest number of policy measures, France and Greece the largest average impact per measure and the UK the highest overall impact. The lower total impact for Germany, despite the largest number of policy measures, is due to an average impact that is two-thirds of that of the UK.

Figure 6 shows the development of total impact and total number of policy measures for all EU-countries together. As they both increase at the same pace it must be concluded that the average impact of policy measures has not increased. If the total impact is calculated with weighting factors representing the final energy use of countries, in order to account for the different weight of the countries in energy consumption, a slight increase in the average impact per policy measure is visible.

IMPACT AND EFFICIENCY INCREASE FOR HOUSEHOLDS

In the Odyssee-project on energy indicators, a number of indicators on trends in household energy consumption are calculated [Odyssee, 2006]. These indicators show efficiency improvements since 1990 for various parts of energy consumption, e.g. for space heating or clothes washing. The combined set of indicators, called ODEX-Households, provides an estimate of the realized total energy savings. These range from 4 % for Belgium to 24 % for Ireland (see figure 7). For the period 1990-2004 the realized energy savings per country are traded against the total impact of policy measures per country, as presented earlier (see figure 5). Due to lacking impact figures for

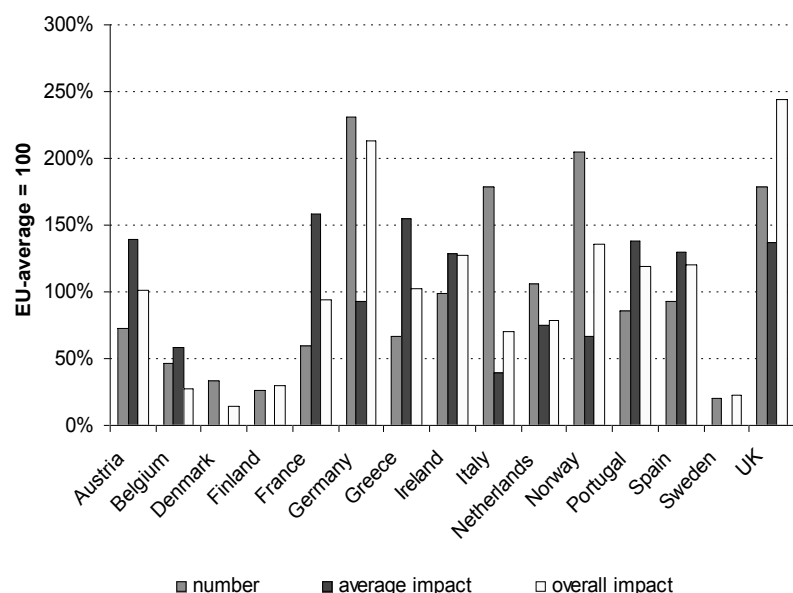


Figure 5. Number of policy measures, average impact per measure and total impact for EU-countries (% of EU-average)

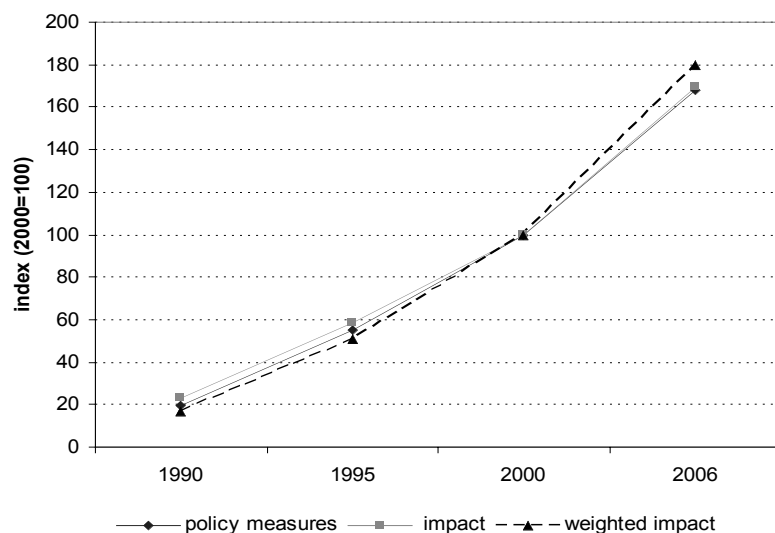


Figure 6. Trend for number and (weighted) total impact of policy measures (all EU-countries, 2000=100)

Denmark, Finland and Sweden these countries have been omitted from the analysis (see figure 7).

Germany and the UK prove to have modest energy savings despite their claimed large policy impact (see figure 5). Ireland and the Netherlands on the other hand realize high savings with half the policy impact. Belgium has both low savings and a low impact. If the impact of a set of policy measures represents the total policy effort, an overall correlation between policy effort and realized energy savings emerges from the figure. However, a number of remarks can be made:

- the efficiency indicator shows not only the effect of policy measures, represented by the impact, but also the autonomous savings, due to technological development and energy prices. Especially at the end of the period rising prices probably have contributed to increased energy efficiency, thereby distorting the relationship with total impact;

- the calculated ODEX-indicator for households may contain non-saving effects, e.g. changing occupation rates of dwellings due to higher or lower employment levels;
- the total impact will not exactly represent the total policy effort, e.g. substantial subsidies can be spent on saving measures with few extra energy savings due to free riders;
- the registered impact of policy measures does not always fit their actual effect in 1990-2004. Some measures, applied in the eighties, have contributed to total savings after 1990, but their impact has not been registered. For measures, active after 2000, the impact has been registered but the full saving effect might come after 2004;
- the impact ratings high, medium and low have often been estimated by qualitative judgement.

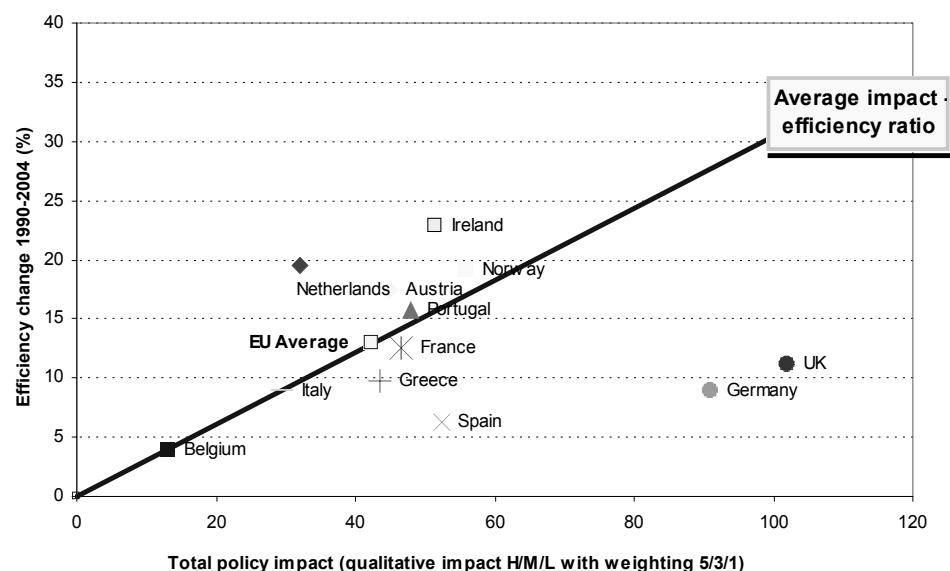


Figure 7. Efficiency change 1990-2004 versus total policy measure impact for EU-countries

Another uncertainty is created by the choice of the impact factors attached to the impact ratings high, medium and low. However, from further analysis with different weighting factors the same overall qualitative picture emerges.

Innovative policy measures

CRITERIA AND METHOD TO SELECT INNOVATIVE MEASURES

The EU [EC, 2006] applies the following criteria when deciding on how to promote energy (saving) policy:

- Effectiveness in stimulating energy efficiency;
- Contribution to other policy targets;
- Contribution to the Lisbon-strategy.

The Lisbon-strategy aimed at increasing Europe's competitiveness is important for the sector industry only and therefore not used as a criterion here, although it is clear that stimulating the demand for products could make an important contribution to the Lisbon strategy. "Other policy targets" refers among others to enhancing **security of supply** and reducing "**energy poverty**". This last criterion will be taken into account, but security of supply is only used as a criterion if policy measures contribute more to security of supply than saving measures do in general. The main focus, however, is on **effectiveness**: policy measures that have been, or are thought to be, relatively successful in realizing energy savings.

In table 3 four main conditions for a successful implementation of saving measures are defined [Boonekamp, 2006]. The measure should be available (market ready) and known to the potential applier. Restrictions, such as the landlord/tenant conflict of interest, should be lifted and finally the investor or buyer should get enough incentives to choose the efficient solution. The fifth condition regards the utilization phase after implementation, e.g. maintenance or avoiding unnecessary use

of systems. It is shown that most policy measure types² meet one or two conditions only. Innovative policy measures should **meet all relevant conditions**, on their own or as part of a well-chosen combination.

Other characteristics of innovative measures are a focus on "**difficult**" **target groups**, a focus on the **right moment** for influencing energy users, or making use of **relevant actors** in a smart way. Innovative measures should not contradict **other targets**, such as a healthy indoor climate. Finally, criteria for policy measures can be **integration with R&D-policy** and an extension of the scope to **influencing energy use** itself (instead of focusing on energy savings only).

INNOVATIVE POLICY MEASURES FOR HOUSEHOLDS

From the MURE-database a number of innovative policy measures have been selected, based on the criteria for successful ways to stimulate energy efficiency (see table 4).

The Austrian policy measure "chimney sweepers as climate ambassadors" creates a new and cost effective way to address energy users at regular time intervals about their energy use, their saving options and their energy use in general.

Most policy measures focus on installing new, more efficient energy systems (see table 3). The Danish policy measure "Heat Consulting" assures that these new systems remain efficient during their lifetime. The "Agreement with manufacturers on efficient windows" is one of the few policy measures that assures a continuous availability of ever more efficient systems, thus preventing exhaustion of the saving potential. The specific support for pensioners combines energy and social goals, such as comfortable living conditions with affordable fuel use.

The Finnish "Orders for indoor climate and ventilation in new buildings" addresses both the increasing interest in a healthy indoor climate and the need to save energy. The approach prevents a possible conflict between both goals and creates new ways to put saving options in place. The "Promotion

2. The composition of measure types in [Boonekamp, 2006] differs somewhat from that in MURE

Table 3. Relevance of policy measures in meeting conditions for implementation and use of saving measures

Measure type	Implementation Measure available	Known to Applier	Lift restrictions	Enhance motivation	Proper energy utilization
Legislation:					
- Implementation	x	x	x	x	
- Utilization				x	x
- Labels		x		x	
Taxes				x	x
Support					
- Financial		x		x	
- Audits		x			
Information					
- Implementation		x		x	
- Utilization					x
Agreements		x	x	x	
Procurement	x	x		x	
R&D-facilities	x		x	x	
Emission trading				x	

(source: Boonekamp, 2006)

Table 4. Innovative policy measures for households from the MURE-database

Country	MURE code	Application	Description
Austria	AU14	Heating	Chimney sweepers as energy advisors
Denmark	DK2	Heating	Grants for savings in pensioner's dwellings
Denmark	DK4	Collective	Heat consulting (maintenance, control)
Denmark	DK9	Heating	Agreement on efficient windows
Finland	FIN4	Heating	Orders for indoor climate and ventilation
Finland	FIN8	Heating	Promotion of wood pellet heating
France		All use	White certificate scheme
Germany	GER28	All use	Ecological tax reform
Italy		All use	White certificate scheme
Netherlands	NLD1	All use	Regulatory energy tax (REB)
Netherlands	NLD5	All use	Environmental action plan (MAP)
Norway	NOR11	All end use	Mandatory activities information centers
Norway	NOR17	All end use	Energy act on informative billing
Sweden	SWE1	Heating	Grants for reduced use of electricity
Sweden	SWE4	Heating	CO ₂ and energy taxation
UK	UK5	Heating	Fuel poverty schemes
UK	UK17	All end use	Energy efficiency commitment (EEC)

of wood pellet heating” increases security of supply. A special characteristic is that it reverses an earlier trend from wood to fuel oil or electricity, but in a way that suits modern lifestyles.

The “White Certificate scheme” of both France and Italy oblige energy distribution companies to realize energy savings at their customer's place. Certificates are given for proven energy savings. The distributors either realize the savings themselves or they buy certificates from so-called ESCO's (Energy Service Companies). It is expected that this scheme will lead to a structural commitment of parties to the subject of energy savings and an integrated set of activities that meets all conditions (see table 3). Moreover, the commercial approach will lead to a more effective way of realizing energy efficiency in households.

The German “Ecological tax reform”, the Swedish “CO₂/energy tax” and especially the Dutch “Regulatory energy tax (REB)” all represent a greening of the tax system. The tax burden is substantially shifted from labour to energy. Contrary to most other policy measures the tax can influence the proper

use of energy system put in place as well (see table 3). It can even change the socio-economic structure in a more energy saving direction. However, these effects are dependent on the price elasticity of energy demand.

The “Environmental action plan (MAP)” of the energy distribution sector in the Netherlands can be seen as a front runner of the proposals in the recent EU-directive on offering energy services. As with present white certificate schemes it represented a structural activity that combined different means to overcome the hurdles for energy efficiency. However, this voluntary plan did not survive liberalization of the energy sector.

The “Energy act on informative billing” in Norway forces suppliers to inform their customers at regular intervals on their energy use in a clear manner. From earlier studies [Jensen, 2003] it is known that this approach is far more effective than a yearly, hardly comprehensible, bill. The “mandatory information activities of regional centers” have evolved into a “market” based system, which resembles the ESCO approach (see White Certificate scheme).

The Swedish “Grants for reduced use of electricity for heating” combines (primary) energy savings with substituting electricity by gas or wood. This substitution in order to enable the closure of nuclear plants does not contribute to increased security of supply because it replaces electricity from nuclear or hydropower. However, in countries with much electricity production from natural gas the use of wood or biomass can increase security of supply.

The UK “Fuel poverty scheme” has a special focus on low-income households. Next to energy savings the lack of comfort due to too high energy bills is addressed too. The focus increases the effectiveness of support, as higher income households can invest into savings without support. The UK “Energy efficiency commitment” provides a successful example of offering energy services to clients of energy distribution companies.

From these set of selected policy measures it can be concluded that few policy measures show a dedicated contribution to alleviating energy-poverty or enhancing substitution for security of supply. The same is true for meeting other targets, such as a healthy indoor climate. Some measures are innovative as to the target groups, the right moment for influencing energy users, making use of relevant actors, integration with R&D-policy and extension of the scope to regulating energy use itself. New measures, like white certificates, are innovative because they cover all conditions for a successful implementation of saving measures.

Analysis of best policy measures and conclusions

DEFINING BEST POLICY MEASURES

In the preceding sections various policy measure types have been dealt with (see table 3 for overview). Actual quantitative developments for policy measures in EU-countries were analysed with respect to a number of subjects, such as impact on energy use, coverage of energy use and relation with EU-policy. A qualitative analysis revealed innovative measures in the MURE-database, based on a number of criteria such as effectiveness and contribution to other policy targets. These results are used to find out what could be best policy measures, using the same subjects and aspects as criteria.

When discussing policy measures and criteria a distinction has to be made between individual measures types and a group of measures. For individual measures the criteria used are:

- Conditions for implementation or use to be met
- Broadness of scope (part of energy use)
- Impact on energy use
- Robustness of introduced policy
- Interplay with EU-policy
- Contribution to other policy targets
- Rebound effect and structural change

For a group of measures the relevant criteria are:

- Coverage of energy use per sector
- Total impact of the set of policy measures

- Effectiveness as to realised energy savings (incl. overlap between individual measures in the measure set)

Interaction between policy measures (see [ADEME, 2005]) will be dealt with under effectiveness. Other aspects, such as the administrative burden of implementing policy measures and acceptance by society, have not been treated in this paper and are left aside in this analysis.

DISCUSSION ON BEST POLICY MEASURES

Individual policy measures

Meeting conditions for successful implementation

The conditions for a successful implementation of saving measures have been given earlier. From table 3 it is obvious that only the type “legislation/implementation” meets all conditions. All other measure types need a second, or even a third complementary measure to meet all conditions. However, for proven saving measures the measure type “agreements” meets all relevant conditions as well.

As to a proper utilization of efficient energy systems table 3 shows that most policy measure types are not fit to accomplish this. Measure types “legislation/utilization” (e.g. obligatory maintenance), “taxes” and “information/ utilization” (on energy use patterns) are the most suitable measures.

Scope

From the MURE-analysis of coverage and horizontal measures it appears that three-quarters of the policy measures focus on specific parts of energy consumption only, e.g. new dwellings or appliances. Some measures even focus on one energy system, e.g. the standard for minimum boiler efficiency. Only taxes, emission trading, general information and, probably, sector wide agreements have a broader scope.

Impact on energy use

In the MURE-database the impact of policy measures has been qualitatively rated high, medium or low. The measure type “legislative/normative” (e.g. standards) is relatively often rated “high” and has the highest average impact. The measure type “co-operative” (agreements) is most often rated “low” and “legislative/informative” (obligatory labels) has the lowest average impact. Measure types “financial support” and “taxes” have mixed ratings and a rather high average impact.

Policy robustness

On the one hand policy measures on energy savings should be flexible, as to respond to changing market conditions. E.g. subsidies on A-label appliances must be terminated when the market share of these appliances is sufficiently large. On the other hand policy measures should be robust, as to give manufacturers and appliers of saving techniques a stable investment environment. From the MURE-analysis of policy measure dynamics it is shown that regulation and taxes are robust measure types. Here the only change is that standards are strengthened and taxes increased. Policy measures on information and financial support generally have a limited lifetime, probably because the goal has been reached or due to budget problems.

Interplay with EU-policy

The relation between EU-policy and national policy measures is threefold:

- transposition of EU-policy in national policy measures
- EU-targets forcing countries to introduce more policy measures
- overlap between EU- and national measures or reinforcing combinations

Given the lack of choice for transposition, analysis on best policies regarding this issue is not useful. EU-targets regard the Energy Service directive [ESD, 2006], the Green Papers on Energy Efficiency [EC, 2006b and EC, 2005] and the EU Energy Efficiency Action Plan [EC, 2006a]. As best policies to reach national targets will generally be of help in meeting the EU-demands, no special analysis is needed on this issue. Thus the analysis restricts itself to interplay between national and EU measures (see table 2), especially the way they complement each other regarding the conditions for successful implementation (see table 3). Obligatory appliance labels and building certificates at EU-level take care of the condition "known to applier". If countries combine this with own national measures, such as financial support schemes (motivation) or agreements (lifting restrictions), the main conditions for a successful implementation of saving measures are met.

Contribution to other policy targets

Alleviating energy poverty is best realised by financial support for investment in saving measures. However, higher energy taxes are especially cumbersome for the poor families. The other measure types may work out positive provided that the poor do not have to pay the implementation costs, e.g. audits or investments, by requesting that a substantial share of measures carried out is directed towards low-income households (see the example of the UK Energy Efficiency Commitment).

For enhancement of energy security no general statements can be made about the contribution of measure types. It depends to a great extent on the formulation, e.g. a higher tax on oil contributes more than a higher tax on coal. It depends as well on the supply structure, e.g. the effect of subsidies for electric heat pumps (instead of gas boilers) is less positive if power stations run on gas instead of coal or nuclear.

Rebound effect and structural change

Most policy measures stimulate saving measures that are profitable, thus generating extra income for the user. As this extra income is spent on goods and services that demand energy, these measures cause an economic rebound effect. Especially financial support measures cause a rebound effect because the costs for the energy user are lowered. Strict standards can limit the rebound effect if the costs equal the benefits over the lifetime of the saving measures. Energy or CO₂ taxes cause no rebound effect, even if the collected money is given back to the energy users (e.g. via a lower income tax), because there is no extra income to be spent.

Taxes and, probably, strict standards can redirect the economic development in a less energy-intensive direction. They constitute the few policy measure types that can save energy at the national scale via structural changes in the economy.

Groups of policy measures*Coverage of energy use*

If parts of total energy consumption are not covered by policy measures, no (policy induced) energy savings can be attained and total energy savings will be lower. Full coverage of energy consumption can only be realised with many measures because most measure types focus on specific parts of energy use only. If the amount of specific policy measures is limited general measures, such as taxes and information campaigns, are needed to cover all parts of energy use.

Total impact

For EU-countries the total impact has increased in line with the number of measures in the period from 1990 on (see figure 6). This lack of increase in average impact suggests that countries focus too much on policy measures with a low impact, such as information and agreements (see analysis for individual measures). The average impact could be increased by applying the measure types standards and taxes more extensively. However, it is possible that low-impact measures are useful in combination with other policy measure types and should not be rated at their individual effect.

Effectiveness

A set of policy measures is more effective if it leads to more energy savings for the same total policy effort (represented here by the impact). The trade-off between total impact and total efficiency increase (see figure 7) suggests that more policy measures do not always deliver more energy savings. The reason could be an overlap between the effects of different policy measures. In [Boonekamp, 2006] this overlap is quantified for households in the Netherlands. For [ADEME, 2005] the interaction in sets of policy measures for all EU-countries was analysed. It was observed that there were more overlapping combinations of policy measures in countries with a large number of measures.

CONCLUSIONS

Given the restricted scope of this analysis it is not intended to make a final statement on best policy measures, but to highlight advantages and drawbacks of policy measure types, thereby contributing to a sound choice by policy makers and analysts.

If applicable, standards seem to be the preferred policy measure type. They cover all conditions for a successful implementation of saving measures, without the need to combine them with other policy measure types. They generally have a high impact on energy use and are robust, i.e. are not easily abandoned. If standards are sufficiently strict their costs will equal the benefits and no rebound effect will occur that erodes initial savings. A drawback of standards is the limited scope, i.e. homogenous energy using systems such as new dwellings and appliances.

Energy and CO₂ taxes are important policy measures as well for the following reasons. They cover all parts of energy use, thus increasing the effect on total energy use. They even work outside the domain of energy savings as they push the economy in a less energy-intensive direction. Taxes are generally robust because the collected money becomes part of the regular government budget. They do not cause a rebound effect and have

very low implementation costs. One drawback is the influence of taxes on income distribution (energy poverty); another drawback is that taxes need other policy measure types to meet the conditions for implementation of saving measures ("knowledge of saving measures" and "lifting restrictions", see table 3).

For policy measures on information the role depends to a great extent on the specific form. General information, such as awareness campaigns, do not provide information at the place and on the moment where it is needed. Moreover, this measure type has a limited lifetime and the effect often disappears soon. Focused and obligatory information, such as labels for appliances, are much more effective because they provide information at the right place and time. The same is true for information on daily energy use that becomes available directly, e.g. on-line via internet. Audits can be an effective information measure as well, provided that other policy measures assure that the potential energy savings from the audit are implemented. This is also true for other types of information; without the possibility and incentive to act information has no saving effect.

Financial support is not a very robust policy measure type, as the amount of completed measures in the MURE-database shows, due to its dependence on the government budget. This measure can be less effective because of the free rider effect. Moreover, it causes by nature the largest rebound effect of all measure types. However, it can be very effective for market transformation, as the combination with appliance labels has shown in the Netherlands. In only a few years A-labels dominated the market and subsidies were not needed any more. However, there are also successful examples of long-term financial efforts, such as the German KfW subsidy programmes for existing buildings which had considerable impacts in terms of energy savings and CO₂ emission reductions, especially for low-income groups.

Broad energy saving programs can be more effective than a set of different policy measures because they generally combine the measures that are needed to meet all conditions mentioned earlier. E.g. white certificate systems, that force energy suppliers to realise energy savings at the site of their customers, often use a combination of information and incentives. They can make an agreement with manufacturers to bring new saving options on the market, or an agreement with social housing bodies to lift restrictions (landlord/tenant conflict of interest). In this way all conditions for implementation of saving measures are met. Another way to do this is providing energy services, e.g. heating or cooling of buildings, instead of providing energy carriers.

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