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Energy Saving Policies and Energy Efficiency Obligation Schemes

D5.1 Combining of Energy Efficiency Obligations and alternative policies

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1 Introduction

National governments have produced reports showing how they will meet Article 7 targets through energy efficiency policies. They have taken a wide range of approaches, from reporting a single policy which will meet the Article 7 targets (e.g. Sweden, Denmark) to combinations of tens of different policies (e.g. the Netherlands, Germany). These different policy mixes are described in detail in ENSPOL reports (ENSPOL 2015a, 2015b, 2015c). Most Member States (MS) have employed a mix of policies, rather than single policies, but the composition of these policy mixes varies considerably. The reasons why MS have chosen the mixes they have are rooted in many different contextual factors, including history, geography, politics and broader policy goals. Nonetheless, most MS are trying to encourage the adoption of similar technologies and it is worthwhile trying to understand the advantages and disadvantages of different policy mixes employed for doing this.

This report is based on a mixture of literature review and empirical analysis, to get a better understanding of the types of policy mix being currently used in the EU, and to develop an analysis of the different types of mix. The focus is on policies which deliver Article 7 savings, which means that it does not encompass all forms of efficiency policy. Policies which were already mandatory within the EU, e.g. energy labelling, minimum standards for buildings, are not included as they are not additional and the Directive excludes those from being used for the purpose of Article 7. Neither are policies which occur in the early stages of technology innovation, e.g. RD&D support. The focus is on national (and sub-national) policies which affect the uptake of energy efficiency options already available on the market.

1.1 Task Objective

Rather than aiming for the optimal policy mix the endeavour of this report is to identify distinctive typologies of policy mixes and design features that appear to deliver the desired outcomes in a variety of contexts.

This report makes a contribution by providing an empirical analysis of the policy mixes used in one specific policy domain, energy efficiency. It investigates how MS comply with Article 7 of the Energy Efficiency Directive using the expertise across the ENSPOL team.

1.2 Report structure

The report is structured as following: First, the literature on the policy mix in general and energy efficiency in particular is reviewed. Second, the different types of policies are defined. Third, a theory-based appraisal of policy instrument combinations is presented. Fourth, the results of the survey including which types of instruments are used, which instrument combinations are prevalent, and where specific instruments focus in each sector is presented. Finally, findings are discussed followed by conclusions. For all MS surveyed the policy mix profiles are presented in the appendix.

2 Literature review

2.1 Public policy and the policy mix

So far, the primary focus of the policy literature has been on evaluating single policy instruments and relatively few studies have systematically explored interactions between different instruments (Bressers and O'Toole 2005, Cunningham et al. 2013, Edler et al. 2012, Fankhauser et al. 2010, Flanagan et al. 2011), although there is now an increasing number of economic assessments of policy interactions (Fankhauser et al. 2010, Oikonomou et al. 2014, 2010, Oikonomou and Jepma 2007, Sorrell et al. 2003).

The main reason for investigating individual instruments (rather than the policy mix) is that policy instruments were traditionally seen as supplementary rather than complementary (Swanson 1995). More recently, there has been a shift of interest towards policy coordination, complexity, and the role of the policy mix.

The term 'policy mix' first emerged in the economic policy literature in the 1960s dealing with the relationship and interaction between fiscal and monetary policies (Mundell 1962). It was mainly used within the economic policy literature until the late 1980s and early 1990s when the concept started being discussed by political scientists (Flanagan et al. 2011). Since then, there has been an increasing use in other fields of public policy, particularly in environmental policy (e.g. Gunningham and Sinclair 1999, Fankhauser et al. 2010, Sorrell et al. 2003).

Generally, there are two types of literature on the policy mix. First, there is a rich body of evidence on how policy, including the policy mix, emerges and changes over time (for a compendium of the most prominent theoretical approaches see Sabatier 2007). Second, there is an emerging literature on how to design an effective policy mix (Borras and Edquist 2013, OECD 2010, Rogge and Reichardt 2013). This paper focuses on the latter question whilst acknowledging the importance of the political dynamics and their impact on the policy mix over time.

In an idealised world where policy makers consider the optimal policy mix to address an issue (for example unemployment), three steps are involved in designing the policy mix (Borras and Edquist 2013): (1) a primary selection of the specific instruments most suitable among the wide range of different possible instruments; (2) the concrete design and/or 'customisation' of the instruments for the context in which they are supposed to operate;

and (3) the design of an instrument mix, or set of different and complementary policy instruments, to address the problems identified.

In reality, the process of 'designing' policy mixes is much more complex and by definition inherently political (Bressers and O'Toole 2005, Howlett and Rayner 2013, Rogge and Reichardt 2013); Energy efficiency policy is no exception (Varone and Aebischer 2001). Interpretive flexibility of policy instrument types (Bijker, Hughes and Pinch, 1989) leads to implementation in many different ways (e.g. Slembeck, 1997). Policy instruments are often not selected as part of a holistic and visionary approach to policy making but in an ad-hoc manner responding to issues that occur at the time of decision-making. Furthermore, policy instruments emerge depending on the political dynamics within a country with the potential of having unintended consequences which in turn impact on the development of the policy instrument itself (Béland 2010). Due to the idiosyncratic nature of different political systems, one could argue that attempts to understand different policy mix typologies with the aim of supporting policy design are bound to failure.

This report takes the view that policy mixes indeed evolve over time and are highly dependent on national circumstances. Policy mixes are usually not designed but emergent (Cunningham et al. 2013) and interactions between the different policy instruments in the mix are characterised by both complementarities and tensions resulting for example from conflicting goals in public policy.

This report is also based on the premise of Flanagan et al. (2011), who stress that the aim of designing an 'optimal' policy mix is problematic. Assessing the degree of 'optimality' of different policy mixes using a narrow framework, following economic definitions of optimality faces significant difficulties as a recent review the matter within the context of climate policy mixes (including energy efficiency) has shown (Görlach 2013). Instead, evaluating which combinations are associated with synergies or trade-offs is a more promising avenue to explore. Recent work by the OECD (2010) emphasizes coherence and appropriateness of the policy mix rather than optimality, although the definitions of those terms vary across policy mix studies. An extensive literature review by Rogge and Reichardt (2013) concludes that coherence goes beyond consistency (absence of contradictions) by focusing on synergies. Furthermore, a much better understanding is required of how tensions in the policy mix can be minimised and complementarities can be maximized. At a high level Gunningham and Sinclair (1999) have developed typologies of different kinds of policy mixes: (1) mixes that are inherently complementary; (2) mixes that are inherently incompatible; (3) mixes that are complementary if sequenced; and (4) mixes whose complementarity or otherwise is essentially context specific. Howlett and del Rio (2013) also

develop policy mix typologies proposing eight policy mix types determined by whether or not the mix involves multiple governments, consists of multiple policies and addresses multiple goals. Rather than aiming for the optimal policy mix this report's endeavour is to identify distinctive typologies of policy mixes and design features that appear to deliver the desired outcomes in a variety of contexts.

While the theoretical conceptualisation of the policy mix has advanced in recent years, few studies systematically analyse policy mix typologies in specific policy domains. As a recent review by Cunningham et al. (2013) has shown and some scholars argue that this is a promising research avenue rather than an attempt to develop all-encompassing generic typologies (Daugbjerg and Sønderskov 2012). The majority of this emerging body of literature focuses on policy design and the policy mix at a more general level rather than policy subsystems.

2.2 Energy efficiency and the policy mix

Energy policy is probably the sector most studied regarding the policy mix and innovation (Cunningham et al. 2013) with most studies analysing interactions of policy instruments within the energy intensive sector.

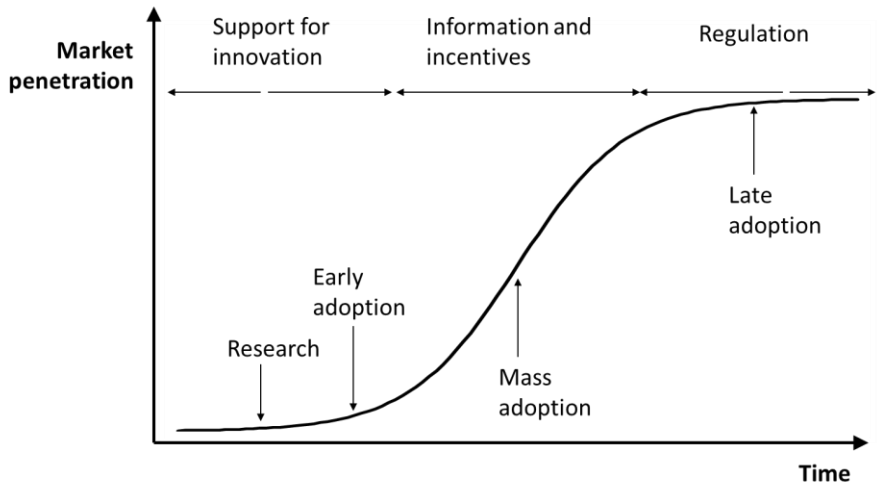
There is now some work on energy efficiency including one paper that deals explicitly with the policy mix and buildings energy efficiency (Lee and Yik 2004). However, the analysis is largely based on theoretical expectations and undertaken within a cost-benefit framework. Trade-offs, tensions, and complementarities between policy instruments that form the mix are only marginally discussed with the focus on advantages and disadvantages of individual policy instruments rather than their interaction.

In a similar fashion, del Río (2010) investigates interactions between energy efficiency and renewable energy support schemes focusing on whether different support schemes and design elements lead to different interaction results. The analysis is carried out at an abstract level and considers potential theoretical policy combinations including their complementarities and trade-offs. Del Río concludes that the 'focus should not be on the functioning of specific instruments with respect to one specific criteria, but on the functioning of the whole policy mix and the interactions leading to conflicts and synergies with respect to several objectives and criteria in this mix' (ibid, p. 4988). Similar studies by Oikonomou et al. (2014, 2010) assess renewable and energy efficiency policy as well as climate and energy instrument combinations against a number of criteria. However, the level of detail on combining different energy efficiency policy instruments does not allow for

a more sophisticated understanding of the complementarities and trade-offs either, largely due to the focus on the focus on the interaction of renewable energy and energy efficiency policies.

Another body of literature relevant to the policy mix and energy efficiency is market transformation research. Whilst not explicitly using the concept of the policy mix, Geller and Nadel (1994) analyse the role of different policies and programmes within the context of market transformation. The authors investigate the impact of different policy instruments and their combinations on new energy efficiency products such as appliances, building components such as windows, vehicles, motor systems, and other major energy-consuming devices. Geller and Nadel describe the policy instruments used sequentially following the S-shaped logistic diffusion curve. They conclude that four types of policies and programmes are typically used to achieve a higher penetration of energy efficiency products: (a) R&D to develop new energy-efficiency measures, (b) market-pull or bulk purchase programs to facilitate commercialization, (c) financial incentives to stimulate early adopters, and (d) efficiency codes and standards to eliminate inefficient technologies and practices (Figure 1).

Figure 1: Market transformation as innovation and appropriate policy support



Using the market transformation literature, Tholen and Thomas (2011) as well as Höfele and Thomas (2011) propose 10 criteria for judging the quality of energy efficiency policy packages. Whilst they make important considerations around the different policy requirements depending on the maturity of energy efficiency technologies and the different actors involved, an analysis of the complementarities and trade-offs between policy instruments is missing.

Applying market transformation theory to some sub-sectors (such as building refurbishment) is more demanding compared to appliance markets where this approach is mainly used within the energy efficiency domain. For example, the construction industry is highly distributed and the structures for standardisation are less well developed as in appliance markets where international standards and testing procedures exists involving a much smaller number of players (Killip 2013). It is, however, still a useful concept when considering the policy mix.

Only few papers analyse case studies of the policy mix within the energy efficiency policy domain. A recent review of the literature on the policy mix and innovation policy (Cunningham et al. 2013) contains a high-level discussion of the policy mix approach the French Agency for Environment and Energy Management (ADEME) takes for the purpose of targeting energy efficiency improvements. Schnapp (2015) looks at policy packages for the renovation of buildings, and presents best practice examples worldwide, where best practice is defined in relation to a number of indicators. An 'ideal' policy package was developed in two stages: (1) desktop study (2) review by local experts. Vringer et al (2015) carried out an impact assessment of Dutch policy to reduce the energy requirements of buildings. They concluded that it was not possible to establish the effectiveness and efficiency of individual policy instruments due to a lack of evaluation studies. However, they were able to assess the total policy mix using high level empirical data. This approach cannot be used for the EED Article 7 reporting purposes, where the policy mixes have only recently been introduced.

Through efforts by the International Energy Agency (IEA) and the MURE (Mesures d'Utilisation Rationnelle de l'Energie) project there is now robust data on the types of policies employed by EU MS. Using the IEA database Costantini et al. (2015) carry out an analysis of the frequency and timing of policy instruments targeting energy efficiency in OECD countries showing an increasing policy heterogeneity. Using the MURE database Eichhammer et al. (2012) present 'coherent combinations of policy instruments' to address the upfront cost barrier to energy efficiency improvements. However, they do not develop their analysis further on synergies and trade-offs. Furthermore, while this evidence contains useful information on individual policy instruments and their popularity it does not, however, provide an analysis of the policy mix and whether specific types of instruments are typically used for particular energy efficiency improvements. Boonekamp (2006) also uses the MURE database focusing on the Netherlands, investigating the interaction effects of various energy efficiency policy measures. The paper systematically analyses whether or not combinations of policy instruments lead to higher or lower energy savings compared to using those instruments individually.

In summary, even though energy is probably the sector most studied regarding the policy mix, the evidence on energy efficiency and the policy mix is thin. In particular, there is a lack of research that a) describes the policy mixes used in different countries, b) derives typologies of typical policy mixes, c) analyses complementarities and trade-offs between policy instruments.

3 Definition and characterization of policy instruments

There is a wide range of energy efficiency policy instruments that are used across the world to deliver energy savings from buildings. However, the categorisation of those policy instruments is not consistent and differs between studies and countries. This study uses a recent classification which is followed by all EU MS in order to comply with the Energy Efficiency Directive. Article 7 of the Directive provides a list of policy instrument types which was adopted for this study:

- Energy Efficiency Obligations
- energy or CO2 taxes
- grants
- loans
- on-bill finance
- tax rebates
- regulations
- voluntary agreements
- standards and norms
- energy labelling schemes

The advantage of using the same policy instrument categories as in the Article 7 of the EED is that the number of categories is manageable in terms of potential instrument combinations whilst providing sufficient granularity. Furthermore, all EU MS have provided the most recent information on which policy mix they are going to employ in order to reach the energy saving targets required by Article 7 of the EED. This means that there is relatively consistent empirical data that can be analysed as all MS use the same categories when reporting to the European Commission.

To inform the policy mix appraisal, various characteristics of each policy types are described in Table 1. For each policy type, its function, the underlying theory of change, behaviour type and governance level are described. Most policy types solely affect purchase decisions, with two potentially also influencing habitual behaviours. Governance level describes the geographical scale at which these policies currently operate – with a split between national and EU level policies. However, it can vary with the policy target - e.g. minimum standards

for appliances are governed at EU level, whereas for buildings these are national standards, with some regional and local standards (e.g. passive house standards for new construction (IPHA 2015)).

The concept of a 'policy class'[1] has been developed, in order to help with the theoretical appraisal of policy mixes. Policies which deliver very similar interventions from the end user's point of view are assigned to the same class, even if these policy instruments are different in important ways, for example in terms of total cost, public vs private cost, equity, or who delivers the policy. This is because the theoretical analysis concerns the effectiveness of the policy mix (see the following section), so effects on end-users are of key concern. Policy class is assigned based on both the policy function and theory of change columns. The eleven policy types listed fit into six policy classes:

- Taxation - energy or carbon taxation
- Purchase subsidy - policy which makes purchase of energy efficient options cheaper for the end user
- Access to capital - policy which gives easier / cheaper access to capital finance to facilitate the purchase of energy efficient options
- Minimum standards - removing energy inefficient options from the market
- Underpinning measurement standards - policy which sets test procedures, product definitions and classes etc. and delivers agreed international standards
- Information and feedback - policies which provide additional information, advice, feedback or smart metering and billing, which enable and facilitate more energy efficient decisions

[1] Policy class defines a set of policy types which appear similar to the end user and which aim to change behaviour using the same mechanism. So, for example, Energy Efficiency Obligations, grants and tax rebates are all classed as purchase subsidies: they deliver energy efficiency subsidies to recipients, whose purchase behaviour is thereby changed.

Table 1: Policy instruments and policy functions

Policy type	Policy class	Policy function	Theory of change (for end user)	Behaviour type	Governance level
energy or CO2 taxes	Taxation	To increase the price of energy or carbon-based energy in line with the polluter pays principle.	Response to economic incentives (dependent on elasticity of demand)	Purchase & Habitual	National*
Energy Efficiency Obligations	Purchase subsidy	To reduce the price of energy efficient options (UK model)	Response to economic incentives	Purchase	National
Grants	Purchase subsidy	To reduce the price of energy efficient options.	Response to economic incentives	Purchase	National
tax rebates	Purchase subsidy	To reduce the price of energy efficient options to tax payers.	Response to economic incentives	Purchase	National
Loans	Access to capital	To give people / organisations access to capital so they can buy energy efficient options	Lack of access to capital / high cost of capital as a barrier to investment	Purchase	National
on-bill finance	Access to capital	To give people / organisations access to capital so they can buy energy efficient options	Lack of access to capital / high cost of capital as a barrier to investment	Purchase	National
Regulations	Minimum standards	To set legally enforceable minimum standards of energy efficiency for products, vehicles & buildings.	Inefficient options no longer available.	Purchase	EU / national / regional - depending on target of regulation
voluntary agreements	Minimum standards	To set minimum or fleet average standards of energy efficiency for products, vehicles & buildings.	Inefficient options no longer available. (or fewer available in a fleet average scheme)	Purchase	EU / national / regional - depending on target of regulation
standards and norms	Underpinning measurement standards	To enable other efficiency policies to work.	n/a	Purchase	EU / national depending on target of regulation
energy labelling schemes	Information & feedback	To enable individuals and organisations to take account of energy in their purchase decision-making.	Relevant information / advice provided at the right time can influence choices	Purchase	EU
information, advice, billing feedback, smart metering	Information & feedback	To enable individuals and organisations to take account of energy in their purchase decision-making and/or habitual behaviours / practices.	Relevant information / advice provided at the right time can influence choices	Purchase and /or habitual (depends on instrument)	National / regional / local

* There are mandatory minimum energy taxes at EU level (Directive 2003/96/EC), but these are minor for fuels used in buildings

4 Theoretical appraisal of policy mixes

Policy mixes are assessed at one moment in time rather than in sequence. Within the market transformation theory framework discussed in the literature review, this work focuses on information and incentives measures. R&D measures are largely missing from MS' policy mixes chosen for compliance with the Article 7 because a) they cannot deliver significant savings within the timescales required (2014-2020) and b) it is hard to quantify the energy savings from R&D measures. Standards only play a minor role for Article 7 because they are deemed non-additional if already required under existing EU legislation. It follows that MS are effectively left with information and incentives measures. The former are hard to evaluate so the latter are the most significant policy instruments in the context of Article 7.

4.1 Methodology

To present a systematic assessment of the interactions between the eleven policy types identified, it has been necessary to simplify the analysis in two key ways:

1. Combinations of two policy types only are considered.
2. Their interactions are analysed in terms of the net effect on energy savings.

Even just looking at pair-wise combinations, there are 55 policy combinations to consider. If all possible combinations of three policy types were considered, this would result in 160 combinations - too large a number to usefully report on. Given that in the real world, multiple policies are often combined, reporting on the rules used to judge the effect of combinations is more useful than analysing all possible combinations.

The criterion combinations are being judged against is 'effectiveness', i.e. how much energy is saved in combination compared with the original individual policy goals. This was chosen as a main criterion for the analysis in ENSPOL Work Package 5 after consultations with the European Commission and DG Energy. The reason excluding other criteria such as cost effectiveness was that the latter is being underreported in most MS and interpreted differently in the multitude of policies and MS. The literature review also suggests this may be the only assessment criterion for which there is much evidence.

Following Boonekamp (2006), the effects on energy savings of combined measures can be:

1. Savings from combination of instrument 1, instrument 2 and instrument n < savings from all instruments individually (overlap)

2. Savings from combination of instrument 1, instrument 2 and instrument n > savings from both instruments individually (complementary)
3. Savings from combination of instrument 1, instrument 2 and instrument n = savings from both instruments individually (neutral)

In this analysis the policy instruments are assumed target the same sector and technologies at the same time (i.e. we assumed direct interactions as per Boonekamp's (2006) classification).

Using empirical evidence (alone) to measure the effectiveness of policy mixes is generally understood to be very problematic, given the lack of sufficiently good monitoring and evaluation of individual policies. Thus, these analyses have been made with reference to the literature, and using expert judgement from across the ENSPOL team, which includes experts from various EU MS with experience on energy efficiency policy mixes.[2]

The literature (including Kosonen and Nicodeme 2009, Lee and Yik 2004, Sorrell et al. 2003, Gunningham and Sinclair 1999) suggests that combinations of policies fulfilling the same function (for the same technology and target group) are more likely to be counter-productive (overlapping) than combinations which accomplish different functions. This is the approach followed here; policy types within the same policy class are generally assumed to overlap, with minor exceptions.

4.2 Results

4.2.1 Energy or CO_2 taxes

Energy or CO_2 taxes increase the cost of (carbon-based) energy and, as a result, energy efficiency should be more favoured in any decision affected by economic considerations (unless price elasticity is zero which is unlikely in most cases) (Kosonen and Nicodeme 2009, Lee and Yik 2004). Generally, energy and CO_2 taxes are compatible with all other instruments as they increase the incentives for people and organisations to use financial incentives and

[2] The outcomes of the matrix are in principle similar to findings of other studies and tools, such as the ECPI tool, with documentation on Oikonomou et al 2012, Oikonomou et al 2011, Oikonomou et al 2010, Flamos et al 2014, Grafakos et al 2010, Grafakos et al 2010.

implement regulations to reduce their energy consumption, and to adopt more efficient technologies.

Unless the tax is very high it is unlikely to stimulate significant investments in energy efficiency on its own (Sorrell et al. 2003). Taxation measures can benefit from other policy measures that support energy efficiency improvements more explicitly. In theory, the revenues from taxation can also be hypothecated and made available for energy efficiency. However, in practice this is an exception as hypothecation is not particularly popular amongst fiscal policy makers.

Interactions: universally complementary

4.2.2 Purchase subsidies

EEOs are classed as a 'purchase subsidy' because this is how they appear to beneficiaries perspective when installing measures. As the total savings are capped as part of Energy Efficiency Obligations, additional financial incentives do not increase the savings beyond what would be delivered by the obligations on their own.

Combining purchase subsidies (EEOs, grants, tax rebates) with providing access to capital measures (loans, on-bill finance) for the same technologies is likely to deliver less savings compared to the sum of savings when those measures are used on their own. The reason for this is the same beneficiary can be over-paid for the same savings.

The authors are not aware of any examples where both Energy Efficiency Obligations and regulations are combined with and voluntary agreements and applied to the same target sector at the same time - they are usually understood as alternative means of reaching the same goal. If combined and targeting the same sector and technologies the interaction effect would be counterproductive because regulations usually set a minimum standard for energy performance and introducing voluntary agreements aiming at similar levels of performance would not generate any additional energy savings (Oikonomou et al. 2009). The same is the case for Energy Efficiency Obligations which set a target of the amount of energy savings to be achieved – voluntary agreements targeting the same sector are unlikely to deliver additional savings beyond the targets.

However, if used in sequence (voluntary agreements followed by regulations in case specific targets have not been reached) or to target different energy performance levels of the same technology (regulations setting the floor and voluntary agreements aiming for

improvements beyond compliance) their combination can be complementary (Gunningham and Sinclair 1999).

Interactions: overlap with polices in same class and access to capital policies, neutral or complementary with other policies

4.2.3 Access to capital

Loans and on-bill finance both offer access to capital. They are alternatives and would overlap if used together. In interaction with other policy instruments, they are judged to operate in same way. They would overlap with purchase subsidies – as the recipient would be given two forms of financial assistance, where one should be sufficient. They would interact positively with information measures

Interactions: overlap with polices in same class and purchase subsidy policy, neutral or complementary with other policies

4.2.4 Information and feedback

These instruments are judged to be complementary with all other instruments and with instruments in the same class. This is because they influence decision-making in a different way from other instruments, using social, psychological or behavioural economics mechanisms, rather than economic influences. In practice, a wide range of different policies fall into this broad category:

- Information campaigns – in which general information about energy efficiency technologies and techniques is made available, for example through mass advertising or on the web:
- Education – in which broader information about energy, how it is used and other potentially influential material (e.g. costs and impacts) is provided and discussed.
- Advice – in which personalised information, specific to the individual and their housing, is given to members of the general public, either by an expert (face-to-face or by telephone) or increasingly using web-based tools.
- Feedback - in which information and/or advice is provided based on, or in conjunction with, data about individual energy use and how it compares with some norm, e.g. the average in the area.

- Engagement – in which there is an attempt to engage individuals in changing their attitudes and/or behaviour to energy use issues, for example through community based projects and campaigns.

In general, it is found that those approaches with greater personal relevance have the most impact.

All of these "information-based instruments" have the aim of removing barriers to energy efficiency action. Coupled with all other policy instruments they have reinforcing effects as they help facilitate effective implementation of all other instruments. Information-based instruments on their own are usually not adequate for achieving significant impacts but combined with other policy instruments they are synergetic (Sorrell et al. 2003).

Interactions: universally complementary, including with policies in the same class

4.2.5 Minimum standards

If regulation and financial incentives (grants, loans, on-bill financing) are combined there is a risk of diminishing effects because the financial incentives are potentially used to fund investments which are required by law and would happen even in absence of those incentives (Sorrell et al. 2003). Therefore, financial incentives need to focus on energy performance levels beyond minimum standards in order to achieve additional savings.

There may be circumstances where combining financial incentives with regulations are sensible even if the combination does not result in further energy savings. For example, financial incentives can be used deliberately to help low income households to comply with regulations. In this case the policy mix addresses multiple policy goals (energy efficiency and avoiding regressive effects). If used in sequence, financial incentives can be used to support 'early action' in advance of regulation.

Interactions: overlap with polices in same class and between voluntary agreements and EEO, neutral or complementary with other policies

4.2.6 Underpinning measurement standards

Without standards and norms for measuring the efficiency of products, homes, insulation materials etc. most policy instruments would not be able to function. They are therefore not so much complementary as much as foundational for all policy instruments. Standards and norms help ensure that the quality of technologies adopted is high, increase transparency

and reliability, and reduce information asymmetries, which in turn reduces transaction cost (Lee and Yik 2004).

Interactions: universally complementary

4.3 Summary of policy interaction effects

The matrix below is based on the analysis above and has been tested with a panel of energy efficiency policy experts. It provides a high-level overview of the potential interaction effects discussed above. This matrix is in line with similar efforts carried out, for instance for the formulation of the Energy and Climate Policy Interactions Tool (Grafakos et al. 2010, Oikonomou et al. 2010, Oikonomou et al. 2012).

Table 2: Interaction effects of energy efficiency policy instruments

	energy or CO2 taxes	grants	loans	on-bill finance	tax rebates	Regulations	voluntary agreements	standards and norms	energy labelling schemes	information, advice, billing feedback, smart metering
Energy Efficiency Obligations	+	-	-	-	-	0	-	+	+	+
energy or CO2 taxes		+	+	+	+	+	+	+	+	+
Grants			-	-	-	0	0	+	+	+
loans				-	-	0	0	+	+	+
on-bill finance					-	0	0	+	+	+
tax rebates						0	0	+	+	+
Regulations							-	+	+	+
voluntary agreements								+	+	+
standards and norms									+	+
energy labelling schemes										+

+: complementary (savings from combination of policy A and policy B > than sum of savings policy A and policy B)

0: neutral (savings from combination of policy A and policy B > than sum of savings policy A and policy B)

-: overlapping (savings from combination of policy A and policy B < than sum of savings policy A and policy B)

The table shows that all policy instrument types have positive interaction effects with some other policy instruments. It also shows that standards and norms, energy labelling schemes and information measures have a reinforcing impact on all other policy measures. Combinations of policy instruments providing financial incentives are more problematic and the expected effects are diminishing.

Our analysis does not suggest that specific policy instrument types are always preferable to others and/or always effective. The setting of an instrument and the interaction effects depend heavily on the context and calibration which is different in each country. However, the discussion of interaction effects above illustrates what kind of effects can be expected in theory and need to be considered when designing policy mixes for energy efficiency.

In many cases policy instruments address multiple goals and are used to mitigate unintended effects of another policy instrument (for example financial instruments can be used to support low-income households to comply with building minimum standards). In other words, it may be legitimate to combine policy instrument types even if the overall effect on energy savings is diminishing. Hence the goal is not to always avoid such combinations where the overall effect is diminishing but to assess in which circumstances interaction between to policy instruments is acceptable or unacceptable (Sorrell et al. 2003).

This section was a theoretical discussion of potential interaction effects. The report now presents the empirical evidence on which type of policy mixes are used and which segments specific policy instruments target. In the discussion chapter the empirical analysis is compared to the theoretical appraisal of policy interaction.

5 Appraisal of existing policy mixes for energy efficiency

This section is structured as follows: First, the methodology is described. Second, an overview is provided of the most common policy measures by sector. Third, the combinations of policy instruments in the same sub-sector are analysed. Fourth, the technology cost and complexity segments particular policy instrument types focus on are analysed. Finally, the report assesses whether certain policy instruments are used for replacing existing technology or supporting new technologies and whether they provide general support of energy efficiency or target specific technologies.

5.1 Methodology

Data on policy mixes in selected EU MS was obtained from national experts working within the ENSPOL project. The MS analysed were Austria, Belgium, Bulgaria, Denmark, Estonia, France, Germany, Greece, Italy, Netherlands, Poland, Spain, Sweden and the United Kingdom. For the 10 most important energy efficiency policy instruments (in terms of expected energy savings provided in the Article 7 notifications on the European Commission's website) each MS expert provided information on:

- **Type of policy measure**: using the categories listed above.
- **Sector**: With regard to buildings, we differentiated between residential and service sector (including public), new or existing buildings, appliances, heating cooling, and ventilation measures.
- **Technology focus**: This element focuses on whether or not the policy instrument supports specific technologies (e.g. energy efficient windows) or energy efficiency improvements more broadly (e.g. grants for whole house retrofits only specifying the level of energy performance required).
- **New versus existing technology**: Distinguishing between new or replacement/upgrade of existing technologies.
- **Cost of supported technology**: Cost includes all cost involved (capital cost and ongoing cost if applicable) regardless of how the cost may be shared across different actors. The cost categories are relative and refer to how a specific energy efficiency technology / measure relates to other energy efficiency technologies / measures.

- **Complexity of supported technology**: The complexity of the technology / measure supported (not the policy measure supporting it).

Data collection was completed using a matrix with drop-down menus to ensure a consistent approach.

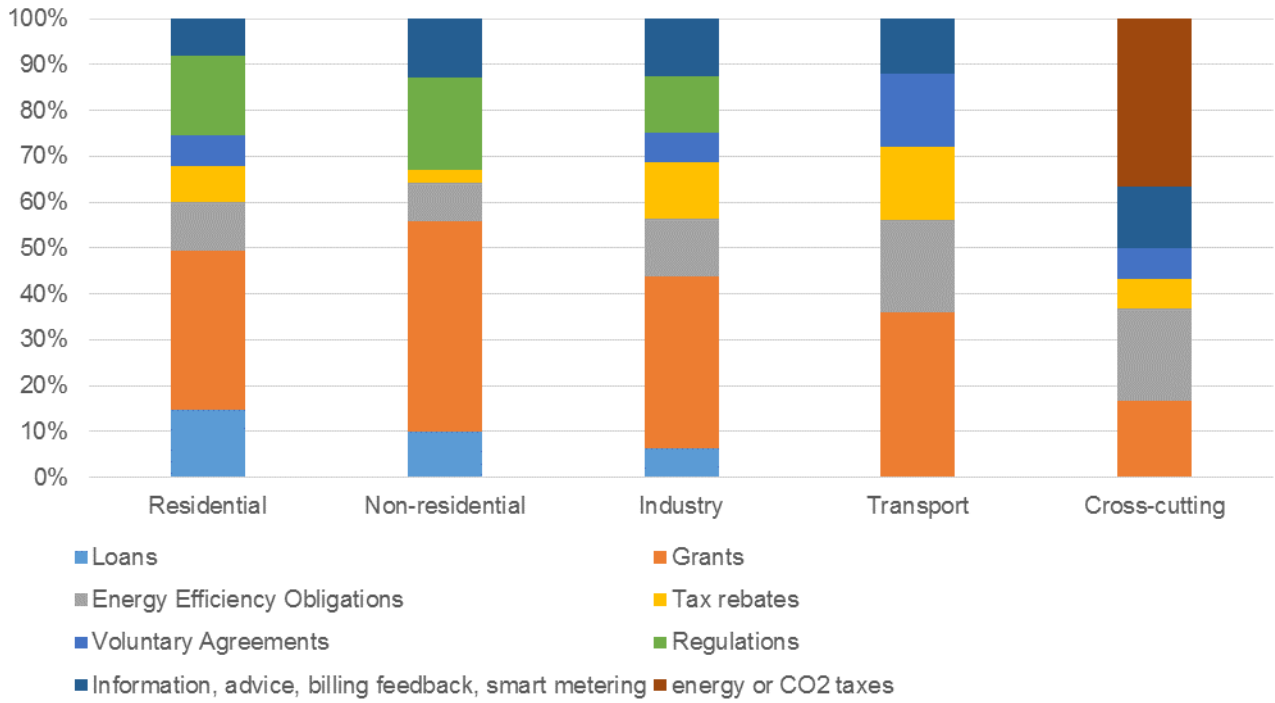
Policies adopted by MS to meet their Article 7 commitments, cannot be those which are already required by other EU regulations, so standards and norms, energy labels and regulations will be under-represented compared with their presence in national policy mixes.

5.2 Policy mix by sector

Below the policy mix is described by sector regarding the frequency of policy instrument types. A high frequency does not, however, automatically translate into a large amount of energy savings delivered. Analysis by Rosenow et al. (2015) provides an assessment of the contribution from different instrument types to the overall energy savings. In this report the focus is not on the amount of savings but on the commonality of particular measures.

Figure 2 provides an overview of the most commonly used policy instrument types for the purpose of complying with Article 7 of the Energy Efficiency Directive across the 12 MS analysed. In the residential sector by far the most frequently used instrument is grants (33%) followed by regulations (17%), loans (16%) and energy efficiency obligations (11%). The non-residential sector is very similar with the main exception that no voluntary agreements were included in the sample. In the industry sector grants play a less important role (although still being the most frequently used instrument) and the number of instrument types is more evenly distributed. In transport regulations and loans are not used by the MS analysed for the purpose of complying with Article 7 of the Energy Efficiency Directive. Not surprisingly, the cross-cutting category consists primarily of energy and CO_2 taxes and energy efficiency obligations which often target a wide range of sectors.

Figure 2: Policy mix by sector and instrument type across cases



5.3 Combinations of policy instruments

In the next step of the analysis the report discusses policy instrument combinations. Interaction of policy instruments only happens in each sub-sector (e.g. retrofits of existing residential buildings). Therefore, an analysis of the frequency of policy instrument combinations in each subsector was carried out. For presentation purposes the results are presented across all sectors in Table 3 below. The numbers represent the number of combinations within one country and in the same subsector. Except for Denmark which reports only EEOs in its Article 7 notification for all other MS policy instrument combinations were identified.

The analysis across all sectors shows that:

- **Grants**: There is a high frequency of grants combined with other policy instrument types. This is the result of the large number of grants in place in the MS investigated.
- **Information measures**: Those are combined with almost all other measures.
- **Taxation**: Taxation measures are not combined with many other measures primarily because it is not used as much as other policy instrument types for compliance with Article 7.

- **Standard and norms**: Standards and norms are almost non-existent which is not surprising given that many of them are driven by EU level requirements and cannot be counted as part of Article 7 due to the lack of additionality.

Table 3: Combinations of policy instruments across all sectors (only if in the same sub-sector)

	energy or CO_2 taxes	grants	loans	tax rebates	regulations	voluntary agreements	information, advice, billing feedback, smart metering
Energy Efficiency Obligations	2	7	2	1	1		3
energy or CO_2 taxes		1		1		2	2
grants			4	8	10	3	4
loans				2	4	1	2
tax rebates					2	5	
regulations						3	6
voluntary agreements							2

5.4 Technology cost and complexity segments

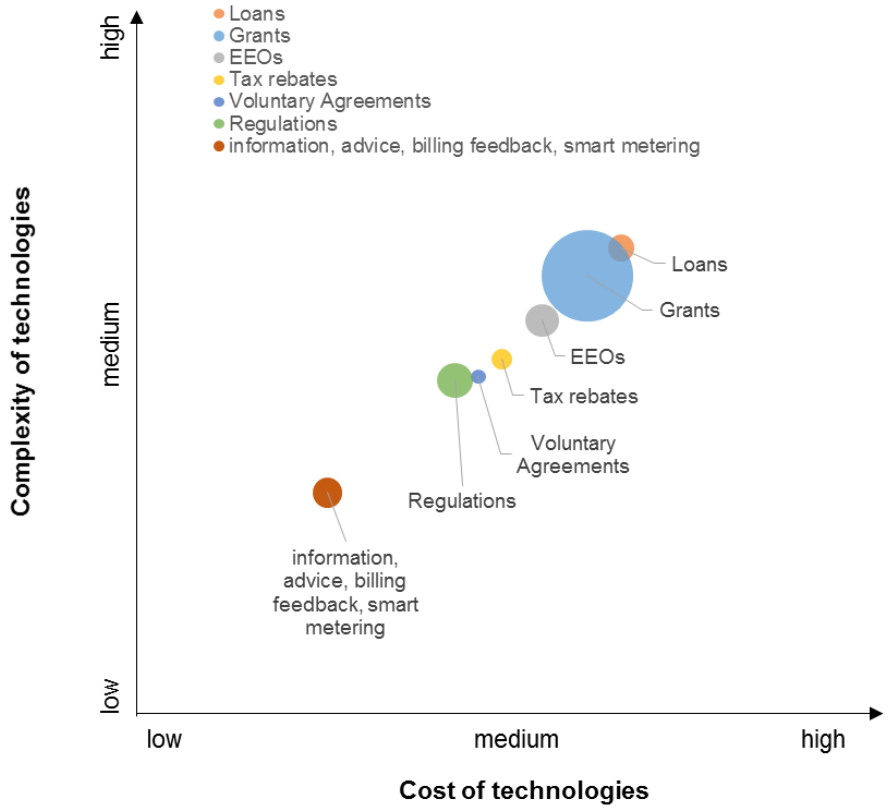
Based on the data provided by the experts on the complexity and cost of the technologies supported by the policy instruments the focus of different instrument types can be compared. The results of this analysis by sector is presented below. The position on the charts shows for which cost and complexity segment a policy instrument type is primarily used based on the sample of the 14 MS analysed. The diameter of the bubbles indicates the frequency the policy instrument was used across the sample.

5.4.1 All sectors

The analysis shows that loans focus on the most complex and costly technologies which is in line with the evidence on loans being able to achieve higher leverage effects than direct subsidies of energy efficiency measures. Loans are closely followed by grants and EEOs which are firmly targeting technologies of medium complexity and cost. Tax rebates appear to focus on low to medium cost measures which is in line with the evidence from other tax rebate programmes in the world. Voluntary agreements and agreements target a similar cost and complexity segment with regulations supporting slightly cheaper and less complex measures. As expected, information, advice, billing feedback and smart metering are located within the low cost and low complexity category. However, this policy instrument indirectly also helps facilitate the implementation of the other policy instruments that are focused on more costly and complex technologies.

None of the instruments targets highly complex and capital intensive technologies which indicates that further policy development is required in order to achieve deeper energy efficiency improvements.

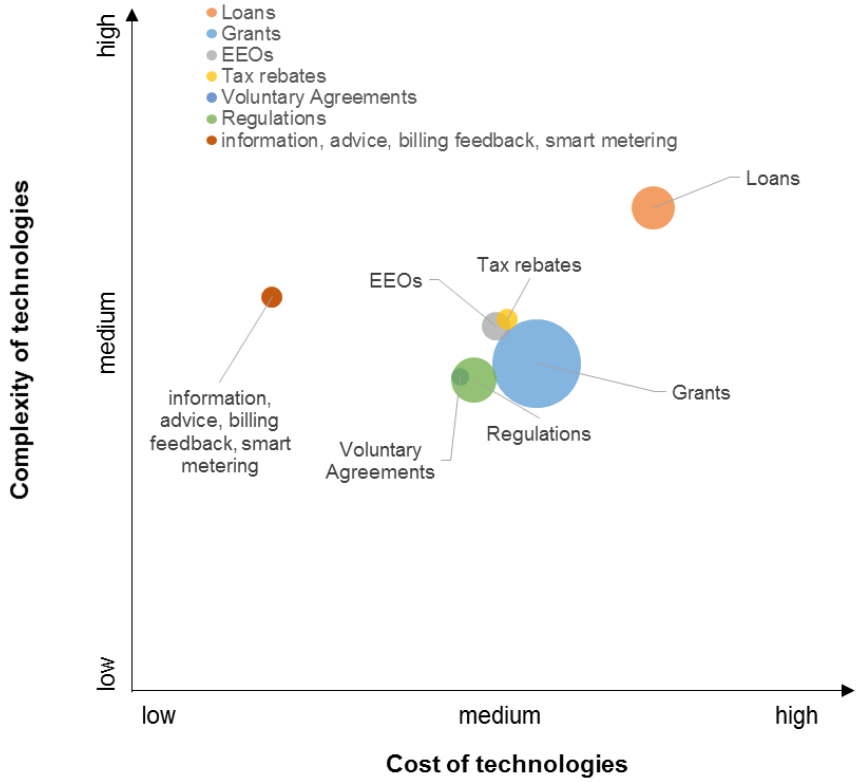
Figure 3: Technology cost and complexity by policy instrument type for all sectors



5.4.2 Residential sector

Most policy instruments in the residential sector focus on the medium cost and medium complexity segment. As expected, loans clearly target the higher cost and complexity measures. There are no other policy instrument types supporting technologies with a higher than medium complexity and cost with most instruments being located in the medium cost and complexity category. Surprisingly, information measures target low cost but medium complexity measures, partly due to the inclusion of smart meters in this policy instrument category which are more complex than other information measures.

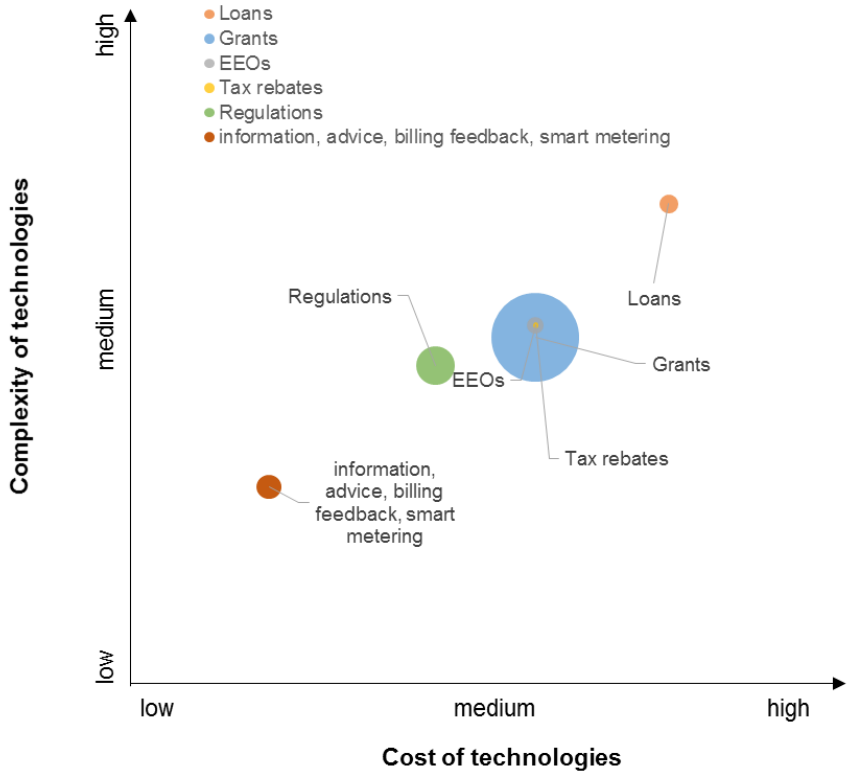
Figure 4: Technology cost and complexity by policy instrument type for the residential sector



5.4.3 Non-residential sector

The focus of the policy instruments used in the non-residential sector is very similar to the residential sector in that most policy instruments focus on the medium cost and complexity segment. However, loans are used to target more complex and costly technologies compared to the residential sector.

Figure 5: Technology cost and complexity by policy instrument type for the non-residential sector

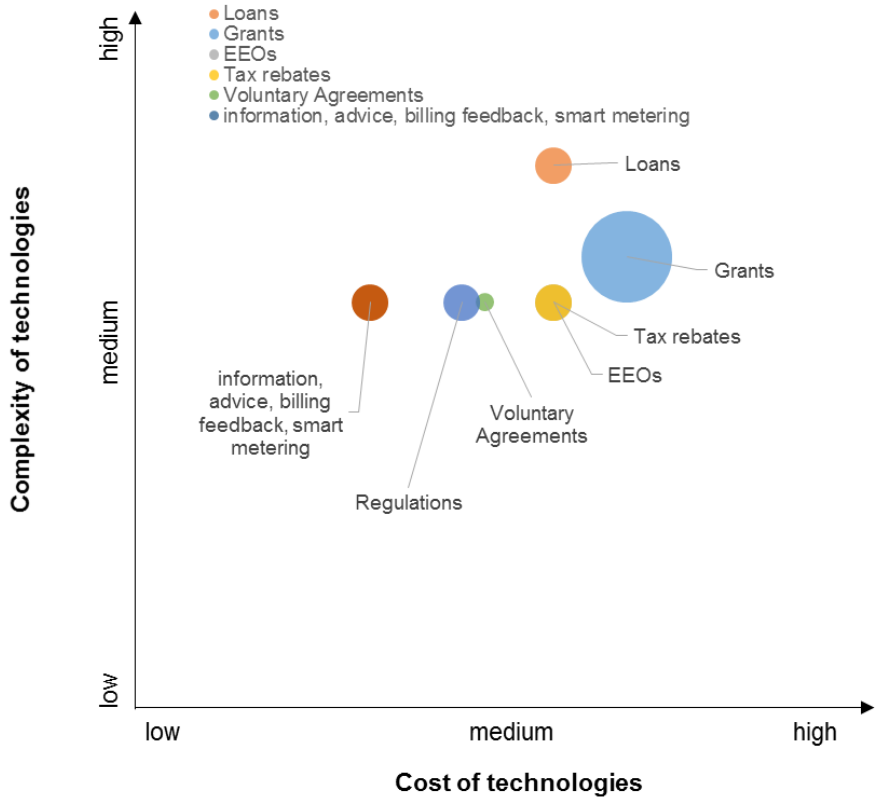


5.4.4 Industry sector

The number of policy instruments used in the industry sector is significantly smaller than in the buildings sector (about 1/3). Overall, policy instruments used in the industry sector focus on more complex and capital intensive technologies compared to the other sectors. This is in line with expectations as the industry sector is inherently more complex regarding energy efficiency improvements, both in terms of the number of potential measures which can be in the thousands as well as the complexity of the technologies itself. Many energy efficiency improvements are bespoke to a particular sub-sector and cannot be standardised easily as is the case in the buildings sector.

Industry is the only sector where loans are not used for the most expensive measures. Voluntary agreements target more costly measures than regulation which is expected as regulation defines the floor whereas voluntary agreements go beyond compliance.

Figure 6: Technology cost and complexity by policy instrument type for the industry sector

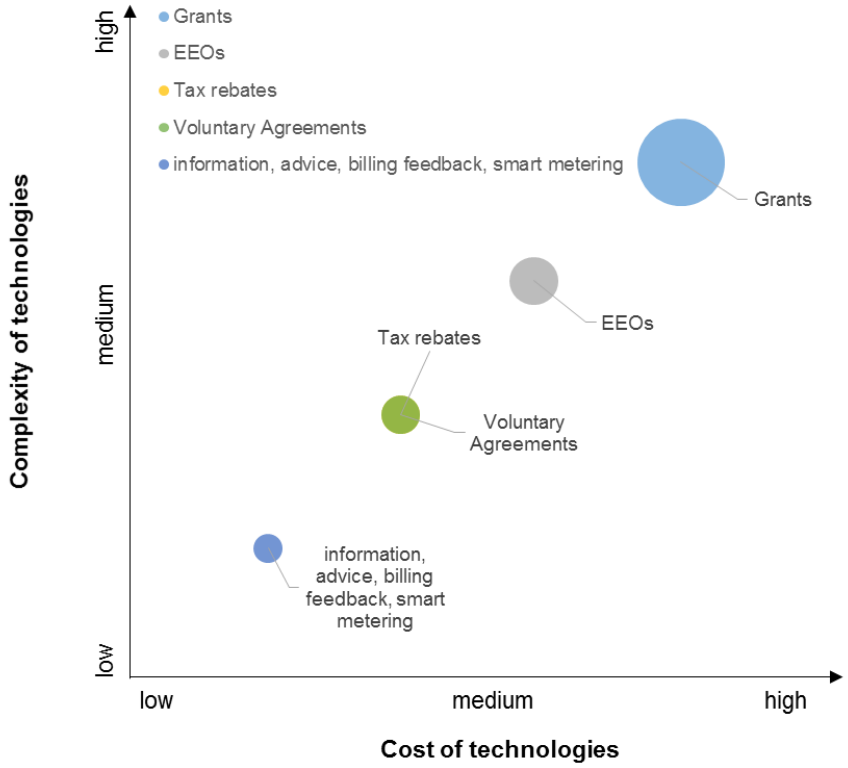


5.4.5 Transport sector

The transport sector can be characterised by a relatively small number of policy instruments and also policy instrument types (there are no loans and energy taxes). The order of policy instruments does not diverge from the patterns observed across the other sectors with increasing complexity and cost from information measures to grants.

The previously noticed correlation between cost and complexity is most profound in the transport sector with a clear linear correlation.

Figure 7: Technology cost and complexity by policy instrument type for the transport sector



5.5 Aim of policy instrument types

The figure below shows whether policy instrument types focus on:

a) support of specific technologies; or
b) general support of energy efficiency.

All measures focus on the technology deployment stage (Article 7 requires savings and R&D measures cannot be used for this purpose).

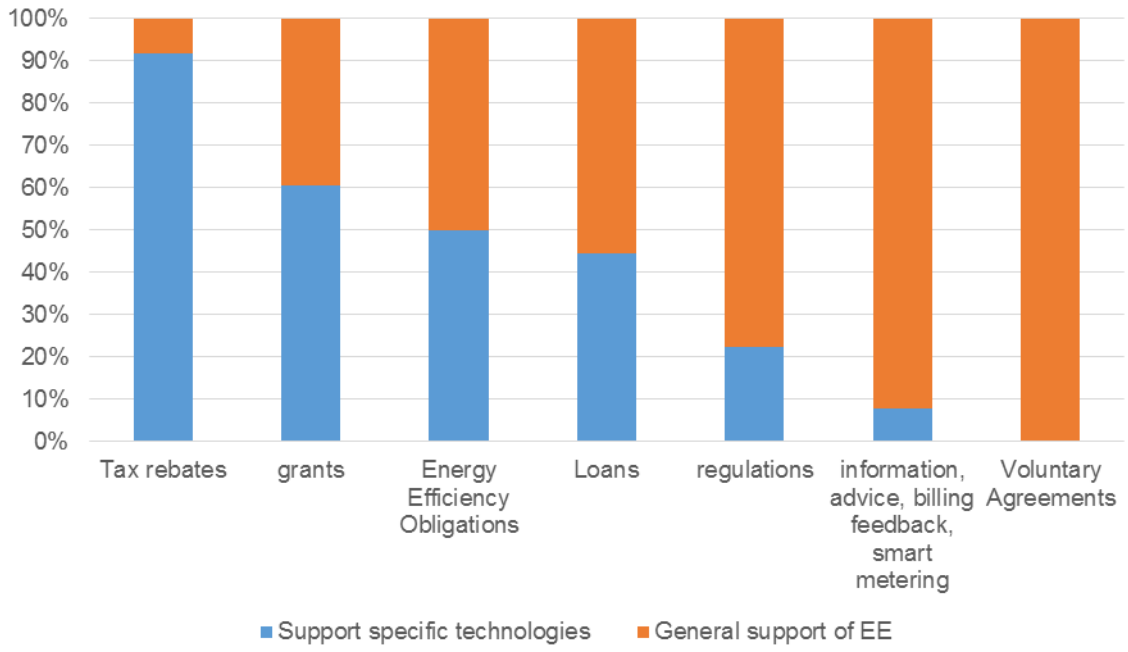
Tax rebates almost exclusively support specific technologies. This is largely resulting from the nature of the policy instrument because tax rebates are usually provided when purchasing specific energy efficiency technologies.

Grants, EEOs, and loans provide both support of specific technologies but also general support of energy efficiency. For example, grants for building renovations may either specify which types of measures can be financed or set a minimum energy performance to be achieved in kWh/m^2.

Regulations usually set a certain energy performance requirement without specifying the technologies that can be used to achieve this (a good example are building codes).

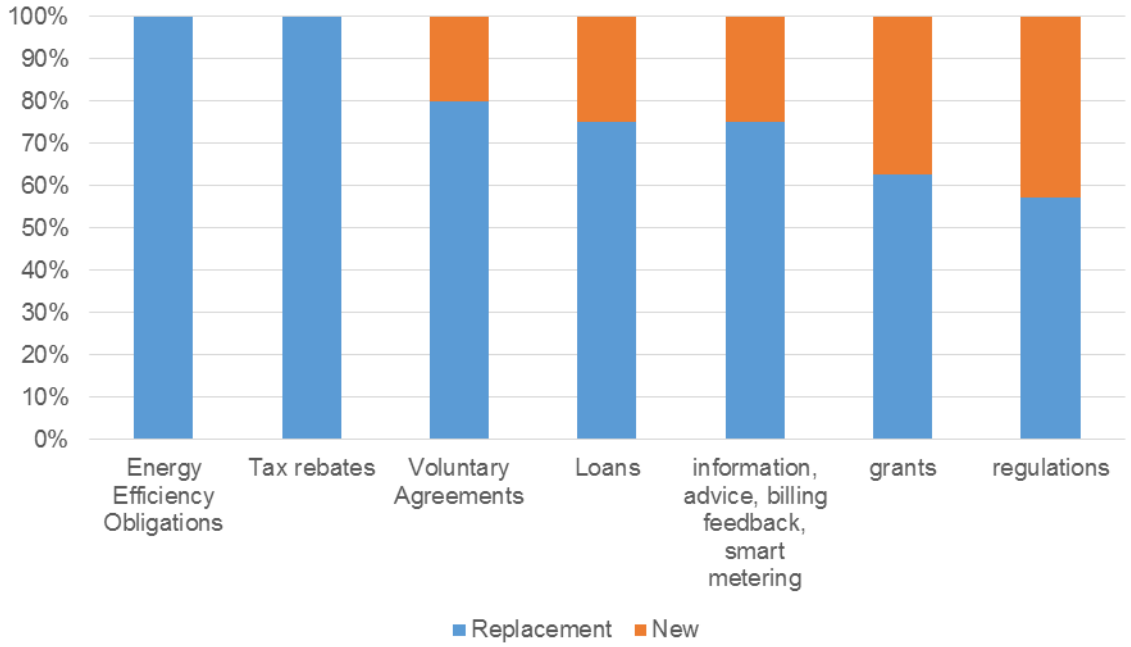
Information and voluntary agreements provide support of general energy efficiency improvements. Voluntary agreements often set an energy efficiency target to be achieved by the participants but do not require specific technologies to be used. Information measures usually provide information on a wide range of energy efficiency improvements.

Figure 8: Degree of specific technology support of different policy instrument types



The vast majority of policy instruments incentivise the replacement of existing (inefficient) technologies with grants and regulations providing more support of new technologies (for example new energy efficiency buildings).

Figure 9: Share of support for replacing existing and implementing new technologies of different policy instrument types



6 Discussion and conclusions

There is history of interest in policy mixes. One tradition, which emerges from economic theory, has developed the concept of 'optimality'. However, this has been difficult to operationalise, apart from for very specific policy mixes (e.g. interactions between fiscal and monetary policy). A number of broader approaches based on concepts including 'appropriateness', 'consistency', 'coherence', and 'compatibility / incompatibility' have been developed. This report continues in that tradition, and has developed definitions for three possible interactions between policies: complementary, neutral, overlapping. These have been used to look at all possible two-way interactions between policy instruments.

The criterion combinations are judged against is 'effectiveness', i.e. how much energy is saved in combination compared with the original individual policy goals. Using empirical evidence (alone) to measure the effectiveness of policy mixes is generally understood to be very problematic, given the lack of sufficiently good monitoring and evaluation of individual policies. It is particularly difficult in this case, as policy mixes are considered which may have only recently been put into place, to meet Article 7 requirements. Thus, the analyses have been made with reference to the literature, and using expert judgement from across the ENSPOL team.

This analysis suggests that some policy instruments only interact with others in a positive way – which means their inclusion within a policy mix should always be encouraged, in terms of effectiveness. The universally complementary policies, with the exception of taxation, are in many cases already in place at an EU level for energy-using products, buildings and building components. This includes energy labelling schemes, a requirement to introduce smart meters, and test standards and procedures (which may be international, rather than just EU-level). Their usefulness has been recognized by policy makers. The policies which tend to be neutral in their interactions, regulations and voluntary agreements, also have a strong place in EU as well as national level policy. Where these policies are missing for sectors or sub-sectors, their introduction should be considered.

While theoretical analysis suggests carbon or energy taxation would be complementary with all other policy types, countries take very different views on taxation of energy of different types and across different sectors (Eurostat 2015). Some countries have high rates of taxation, while others are as low as EU legislation allows. Theoretically useful policies can be politically unacceptable (e.g. the history of public opposition to household energy taxation in the UK (Dresner, Jackson et al 2006)), or not fit with other policy goals. This illustrates one weakness of this method, which is that it can only consider the effect of a policy mix on a

single goal (effectiveness), whereas policy is usually required to deliver multiple goals simultaneously.

In terms of managing the risk of counter-productive policy mixes, there is a relatively small number of policy instruments which can deliver less than the sum of their parts when in combination. Where these combinations appear in national policy mixes, this points to potential problems.

Using the theoretical approach here, it is difficult to explicitly analyse combinations of more than two policy types for all combinations given the way in which the numbers escalate for combinations of three or more. However, there are ways to usefully expand the analysis. Firstly, using the policy class concept, the analysis could extend to a mix of four or five policy instruments, provided they originate from just two policy classes. Alternatively, expanding on the empirical analysis in Table 2, key combinations of more than two policies could be identified, and theoretical insights brought to bear on these mixes. The focus could be on mixes at risk of overlap, to help identify risks of under-achieving savings targets.

This analysis is systematic, and the reasons for the judgements of the effects of different policy instrument interactions have been clearly explained. Given the many simplifications which had to be made to carry out this analysis, particularly the need to look at one success criterion only, and to disregard many important contextual factors, it would be wrong to over-claim its potential usefulness to policy makers. However, it does offer a very clear way of thinking about policy combinations, identifies areas of potential under-performance, and highlights policy instruments which can always make a positive contribution to a policy mix.

Following the analysis of policy instrument combinations, empirical data explored policy mixes from 14 MS. This has been presented descriptively and has been used to reflect on how reality matches the policy combinations the analysis suggests should pursued by governments most interested in effectiveness.

Sectoral policy instrument combinations have been illustrated using colour coded tables. These enable the most and least popular combinations to be more easily identified, which is helpful given the complexity of the data.

The technology cost and complexity of individual policy instruments, by sector, have been illustrated using a graph which includes information about the number of examples which make up each data point. Separating the analysis by residential, non-residential, industrial and transport sectors highlighted the popularity of different policy types in these sectors.

Grants are the most popular instrument in all sectors, and on average used for measures of medium complexity, supporting medium-cost technologies in the residential and non-residential sectors and medium- to high-cost technologies in the industrial and transport sectors. Grants are a long-established policy mechanism, with a strong record of success, and good methods in place to monitor and evaluate the savings they can deliver. Thus, though moderately expensive, their popularity is easy to understand.

The empirical analysis shows that nation states rely strongly on policies in purchase subsidy and access to capital classes to deliver their Article 7 commitments. This is in part a reflection of the rules surrounding Article 7 (as explained earlier). Given that theory tells us these combinations are at risk of overlapping, a more detailed examination of policy mix design could be helpful to nation states in enabling them to deliver their targets. With the exception of Denmark, all have chosen a policy mix, and it would be essential to understand the extent to which their policy mixes are designed to meet multiple goals.

As noted in section 5.3.1, none of the instruments targets highly complex and capital intensive technologies. This may be partly a function of the focus on existing market measures (rather than innovative technologies or technology combinations) which characterises Article 7 policies. However, it also indicates a possible policy gap, whereby the next set of mass market efficient measures are not being sufficiently supported.

Notably, there are also few policies characterised as being low cost - in fact, only information, advice and related policies are classified in this way. There are relatively few of these policies in place. This may be a function of the difficulty of verifying and accounting for savings from such policies, leading to their exclusion from Article 7 national submissions.

Concluding remarks

This report has contributed to knowledge on the role of the policy mix within innovation studies and the energy efficiency literature. Whilst the theoretical conceptualisation of the policy mix has recently advanced there are still few empirical studies accessing policy mixes

within specific policy domains. This report fills that gap for energy efficiency policy in buildings. Developing a method based on the literature, combined with expert judgement, 55 different combinations of policy instrument types have been assessed for their effectiveness. Combinations which deliver more, less and the same as the sum of individual policies have been identified. This analysis was based on the concept of effectiveness, which is of key importance in policy making. However, theoretical analysis necessarily has to simplify reality, and is unable to incorporate the full complexity of multiple goals and contextual factors which affect national policy mixes.

In addition, empirical data has been gathered and used to describe and analyse the policy mixes in 14 EU MS. Reflections on how reality matches the policy combinations theoretical analysis suggests were presented. The current buildings energy efficiency policy mixes are dominated by combinations of purchasing subsidies providing a financial incentive to end-users to adopt more energy efficient technologies. Theoretical analysis suggests that combining such instruments focusing on the same segment is likely to deliver less savings than using them individually - an area possibly requiring further investigation.

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8 Appendix - Country profiles

8.1 Austria

8.1.1 Policy mix for delivering Article 7 of the EED

Austria has adopted regulations and grants covering almost all sectors and sub-sectors. Through the Austrian Refurbishment subsidy scheme grants are provided to residential building retrofits. The energy-intensive industry sector is targeted by the Domestic Environmental Support Scheme (UFI) which covers the transport sector as well. Regarding EEOs there is no restriction regarding the eligible sectors. Any energy efficiency measures that that reduce final energy consumption at final customers are eligible. One requirement is that for each obligated party 40% of yearly savings have to be achieved with measures at households. The remaining 60% of savings can be achieved in any end use sector (households, services, industry, transport, agriculture). Beside the UFI another policy instrument is related to transport, namely the federal highway toll for multi-track motor vehicles, which forms part of Austria's policies to shift from road to other modes of transport and reduce CO_2.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 4: Policy mix and sectoral focus in Austria

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Energy Efficiency Obligations	1											
Regulations		1	1	1	1	1	1					
Energy or CO_2 taxes	1										1	
Grants	1	1	1		1	1	1	1	1	1	1	
All	3	2	2	1	2	2	2	1	1	1	2	

8.1.2 Policy instrument combinations

The measures can be characterized by significant variety regarding the targeted end use sectors. One measure will be implemented in the residential sector, another one in the commercial and tertiary sector and the third one in the transport area. Some measures have a horizontal impact across sectors, as for example the energy taxes.

As mentioned above, grants and regulations cover almost all sectors and sub-sectors and function in combination to each other. In some sectors these two instruments are combined with one of the following instruments:

- EEOs and/or
- energy or CO2 taxes

Some of the grants cannot be combined as they exclude each other.

8.1.3 Focus of different policy instrument types

Most of Austria's policy instruments support high and medium cost technologies with mostly medium complexity. For some measures the technology as well as the costs of the supported technology cannot be defined.

There are no significant differences amongst the policy instruments in terms of the cost and complexity of technologies supported. The existing policy mix mainly supports replacement and/or upgrade of existing technology but some policy instruments (grants) also support new technologies.

The table below lists the relevant policy instrument types and their respective focus in terms of technologies, their cost and complexity.

Table 5: Focus of policy instruments in Austria

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Energy Efficiency Obligations	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	medium-low	medium-low
Regulations	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable
Grants	yes, specific technologies supported	supports new technology and replacement and/or upgrade of existing technology	high-medium-low	medium
Energy or CO2 taxes	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable

8.2 Belgium

8.2.1 Policy mix for delivering Article 7 of the EED

The Belgian NEEAP consists of three regional action plans for Flanders, Wallonia and the Region of Brussels. The table below gives a summary for the three regions together, none of the regions opted for an EEO. Having voluntary agreements with the energy-intensive industry and giving financial incentives to promote energy efficiency in the built environment (renovation market) is the common focus within the three regions. Because the industrial sectors are limited in the region of Brussels, the target sector in the Brussels' NEEAP is the built environment. To complement these grants, Brussels also submitted measures such as energy advice (Energy House), obligation to perform energy audits in companies having an environmental permit, and obligations to inspect periodically gas or fuel oil boilers. Although the measures cover almost all sectors, the transport sector is missing in the three action plans because the impact of instruments is difficult to measure.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 6: Policy mix and sectoral focus in Belgium (Sum of Flanders, Wallonia and Brussels)

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Energy Efficiency Obligations		1											
Regulations		5			4					1			
Tax rebates													
Information, advice, billing feedback, smart metering													
Voluntary Agreements									4				
Loans		1			2					1			
Grants		2	1		1	1							
Energy labelling scheme													
All		9	1		7	1			4	2			

8.2.2 Policy instrument combinations

A combination of policy instruments in a sector is only submitted in the region of Brussels in frame of the NEAAPs Art. 7. For the built environment (residential & services sector), the measures of grants, regulation, information & advice are combined in this region. Wallonia also attributes some savings to loans in the residential sector, besides the important measure of grants, and to premiums, besides voluntary agreements, in industry. Actually, Flanders as well as Wallonia combine policy instruments within the different sectors, but these regions limited the combinations in the context of Article 7.

8.2.3 Focus of different policy instrument types

The table below lists the 2 most important measures (i.e. savings by 2020) for each of the three regions. For each measure, the policy instrument type and their respective focus in terms of technologies, their cost and complexity is listed.

Belgium's policy instruments support a mixture of low to high cost technologies with low to medium complexity. The technologies implemented in the built environment are considered to have a higher cost compared to their expected savings (long payback time). The existing policy mix mainly supports replacement and/or upgrade of existing technologies. All policy instruments provide support for multiple energy efficiency technologies (from insulation to heat pumps).

Table 7: Focus of policy instruments in Belgium (6 main measures in terms of expected savings by 2020: 2 per region).

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Standards and norms	no, general support of energy efficiency improvements	not applicable	low	Low
Grants	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	high and medium	medium
Voluntary agreements	no, general support of energy efficiency improvements	not applicable	low	Low
Grants	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	high and medium	medium

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Voluntary agreements	no, general support of energy efficiency improvements	not applicable	low	low
Grants	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	high and medium	medium

8.3 Bulgaria

8.3.1 Policy mix for delivering Article 7 of the EED

Bulgaria is in the process of development of EEOs that will cover all sectors and sub-sectors. It is expected EEOs to be focused on insulation, windows replacement of existing residential, public, commercial and industrial buildings as well on heating systems. Although the Bulgarian government declares no alternative measures will be applied, support to different sectors and measures is provided. Through the Renovation of Bulgarian Homes Programme (structural funding) grants are provided to residential multi-family buildings retrofits. In addition, a national programme provides support to energy renovations of multi-family residential buildings. Loans are available for individual houses and apartments through the Residential Energy Efficiency Credit (REECL) Facility. Public sector buildings are supported through structural funding for municipalities and governmental organizations. The Green Economy Programme provides support to commercial and industrial small and medium size enterprises for EE measures implementation. A limited number of measures (energy-efficient vehicles, low-resistance tyres for passenger, fuel additives) are envisaged to be supported after EEOs are adopted. The following table provides a summary of the policy instruments and their sectoral focus.

Table 8: Policy mix and sectoral focus in Bulgaria (indicative)

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Loans		1		1	1		1	1	1	1		
Grants		1		1	1							
Energy Efficiency Obligations		1		1	1		1	1	1	1	1	1
Tax rebates												
Voluntary Agreements												
Regulations			1	1	1	1		1		1		
Information, advice, billing feedback, smart metering		1	1	1	1	1	1	1	1	1		
Energy or CO2 taxes												
Energy labelling scheme												
All		4	2	5	5	2	3	4	3	4	1	1

8.3.2 Policy instrument combinations

It is expected that the new regulations to cover almost all sectors and sub-sectors. In different sub-sectors, regulations will be combined with the following instrument types:

- EEOs;
- grants; and
- loans.

8.3.3 Focus of different policy instrument types

It is expected that Bulgarian policy instruments will continue to support low and medium cost technologies with mostly low complexity. The policy instruments provide support to replacement and/or upgrade of existing technologies. Most policy instruments provide support for specific technologies such as building insulation and windows replacement. It is expected also that the new EEOs will support heating systems renovation measures and limited new technologies.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 9: Focus of policy instruments in Bulgaria

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Energy Efficiency Obligations	specific technologies will be supported	supports replacement and/or upgrade of existing technology	low	low
Regulations	support to sector specific technologies and energy efficiency improvements	supports replacement and/or upgrade of existing technology	low-medium	low-medium
Information, advice, billing feedback, smart metering	support to sector specific technologies and energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low	low
Loans	general support of energy efficiency improvements, specific technologies supported	supports replacement and/or upgrade of existing technology	medium	low
Grants	general support of energy efficiency improvements, specific technologies supported	supports replacement and/or upgrade of existing technology	medium	low

8.4 Denmark

8.4.1 Policy mix for delivering Article 7 of the EED

Denmark is using only one policy instrument to deliver on Article 7 of the EED, namely an EEO. There is a variety of other policies that is not part of article 7 notification but it falls outside of the ENSPOL project to cover these in the analysis.

8.4.2 Policy instrument combinations

Obligated parties can use all methods/measures they can think of to meet their target. This means that when the policy instrument is translated into practice by operators/subcontractors to obligated parties savings can realised through advice, subsidies, loans, marketing campaigns (if the effect can be documented), feedback from smart metering data (if it exceeds minimums requirements in the EED) etc. or a combination of the above. It is up to the market forces to find the optimal mix.

8.4.3 Focus of different policy instrument types

Almost all technologies are supported. The basic rational behind the EEO in Denmark is that by using the market forces and a benchmarking system of the DSOs cost of the policy instrument (the EEO) will be minimised.

It is natural to assume that projects with low cost of the instrument will be projects that also have short payback periods from the point of view of end users (the majority of project cost are carried by end users and not the policy instrument).

However, it should not be neglected that what is considered an acceptable payback period varies greatly between industries and households. This means that the cost of supported technologies in the residential sector can be much higher than the industry sector yet the cost of the policy instrument is more or less equal across sectors thanks to the benchmarking system.

There is no clear evidence that practical implementation of the EEO means that savings are realised mainly for low cost technologies in the residential sector (technical installation e.g. boilers) rather than high cost (the building envelope).

8.5 Estonia

8.5.1 Policy mix for delivering Article 7 of the EED

The Estonian NEEAP foresees the combination of two types of alternative policy measures to achieve the targets set by the EED: energy and CO_2 taxes and financing schemes (mainly renovation of street lighting, energy and resource efficiency of companies and reconstruction of apartment buildings).

To cover the part that falls short of the target (7140 GWh for the entire obligation period), the following options considered:

- Implementation of additional financing schemes;
- modification of energy and CO2 taxes; and
- introduction of EEOs.

In March 2015, general elections in Estonia were held, and although important changes as far as the energy saving targets are not expected, nothing about the potential combination of measures to achieve the national energy saving targets has been made public yet.

The following table provides a summary of the existing policy instruments and their sectoral focus.

Table 10: Policy mix and sectoral focus in Estonia

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour	public (not buildings)
Loans		1		1	1			1					
Grants									1	1			1
Energy or CO2 taxes	4												
All	4	1		1	1			1	1	1			1

8.5.2 Policy instrument combinations

In Estonia, most of the potential energy savings are expected to be obtained through energy or CO2 taxes and financing schemes (grants and loans). Combinations of policy instruments can happen between these two kinds of policy instruments.

8.5.3 Focus of different policy instrument types

The policy mix chosen by Estonia is formed by energy and CO2 taxes and financing schemes. Whereas the first group of measures supports any energy efficiency improvement, the second one focuses on supporting specific technologies that increase the energy and resource efficiency of companies across sectors and the improvement of the energy performance of the existing building stock.

The cost of the technology supported by the financing schemes can be ranked as medium and high whereas the range of the complexity of the technology includes low to high complexities.

Table 11: Focus of policy instruments in Estonia

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Loans	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	high and medium	high and medium
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	high and medium	medium and low
Energy or CO2 taxes	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable

8.6 France

8.6.1 Policy mix for delivering Article 7 of the EED

Within the framework of Article7, France notified a series of measures, the weighting of which may change, in particular in the light of their effectiveness, to reach its annual target of 1.092Mtoe of energy savings.

In addition to France's EEO, which should cover 314 out of the 355TWh to be saved over the 2014-2020 period (88.5% of the obligation), the following measures will be implemented:

- **budgetary and fiscal measures**: continuation of tax credit and of the interest-free eco-loans, and gradual increase in the domestic consumption duty based on CO_2 content;
- **financial measures:** setting up of a guarantee fund for energy renovation;
- **informative measures** aiming at encouraging energy refurbishment projects: launching of energy renovation "passports", which should trigger more energy renovations thanks to a better understanding of buildings consumption and energy saving potentials.
- **other measures**: such as the creation of a load management bonus for operators.

France has also adopted many measures (thermal regulations, voluntary agreement in the transport sector, green loans for energy efficiency measures in the industry, measures for information, advice, billing feedback, smart metering, etc.) that were not notified as part of the mix to reach Article 7 target but that will contribute to reducing its energy consumption.

Even though the French EEO targets all energy consuming sectors (residential, commercial and public buildings, public lighting, industry, transport and agriculture), it still remains mainly focused on buildings, and especially on residential buildings. This is also true for the rest of the energy efficiency policy mix: the tax credit, the interest-free eco loan, the guarantee fund for energy renovation and the energy renovation passports solely target residential building retrofits.

Green loans are available for enterprises, from both the tertiary and industrial sector, wishing to invest in energy efficient equipment. A voluntary agreement also started in 2013 for tertiary enterprises.

Transport related policies include among others ADEME's car ranking, a bonus/penalty system based on CO_2 content for the sale of new cars, a voluntary agreement for passenger and freight carriers, etc.

Finally, the increase in the domestic consumption duty based on CO_2 content will impact all sectors.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 12: Policy mix and sectoral focus in France

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Loans		1		1				1	1	1		
Grants												
Energy Efficiency Obligations	1											
Tax rebates		1		1								
Voluntary Agreements					1						1	1
Regulations		1	1	1	1	1	1	1				
Information, advice, billing feedback, smart metering	1											
Energy or CO2 taxes	1											
Energy labelling scheme		1	1	1	1	1	1	1			1	
All	3	4	2	4	3	2	2	2	1	1	2	1

8.6.2 Policy instrument combinations

As mentioned above, regulations, EEOs, CO_2 tax and information cover almost all sectors and sub-sectors. In different sub-sectors, these instruments are combined with some of the following instrument types:

- loans;

- tax rebates;
- voluntary agreements; and
- energy labelling scheme.

The sub-sector residential – existing buildings is targeted by every instrument types, except for voluntary agreements.

8.6.3 Focus of different policy instrument types

French policy instruments support a broad range of technologies, with costs and complexity covering low, medium and high complexities.

In the case of the French EEO, most standardized operations have a low level of complexity, but measures in the building sector remain quite expensive (this is true for all financial and fiscal measures targeting the residential sector) while those in the industrial sector are usually low cost (short payback periods).

Specific actions are more complex, either because they concern an innovative technology or because they are implemented in very large building/plants.

The existing policy mix mainly supports replacement and/or upgrade of existing technology but some policy instruments (for instance specific actions within the EEO) also support new technologies. Most policy instruments provide support for specific technologies such as building insulation or thermal system for example but there are also multiple instruments in place which provide more general support for energy efficiency improvements.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 13: Focus of policy instruments in France

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Energy Efficiency Obligations	yes, specific technologies supported	depending on the type of action (standardized or specific)	All	All

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Regulations	depending on sector, specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low-medium	Medium
Information, advice, billing feedback, smart metering	depending on sector, specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	Low-medium	Medium
Loans	depending on sector, specific technologies supported or general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	Medium-high	Medium
Tax rebates	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	Medium-high	Medium
Energy or CO2 taxes	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	medium	Medium
Energy labelling schemes	yes, specific technologies supported	supports new technology	medium	Medium

8.7 Germany

8.7.1 Policy mix for delivering Article 7 of the EED

Financial measures are dominant in Germany, especially in the residential sector but they also play an important role in the industrial and tertiary sector. The focus lies on grants which cover almost all sectors and sub-sectors. Furthermore, Germany has adopted

regulations and information, advice, billing feedback and smart metering. Germany has not adopted an EEO scheme so far. The energy-intensive industry sector is targeted by the "Combined Heat and Power Act". With regards to energy efficiency, the building sector is regarded as key to greater energy efficiency. Within the 10 most important measures for Article 7 compliance there is no transport related policy instrument. Energy labels are thought as a complementary instrument for minimum energy efficiency requirements, but they are not mentioned in the summary below since they are not among the 10 most important measures.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 14: Policy mix and sectoral focus in Germany

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Grants	1	1	1	1	1	1	1	1	1	1		
Regulations			1	1	1	1						
All	2	1	2	2	2	2	1	1	1	1	1	

8.7.2 Policy instrument combinations

The present mix of instruments is mainly based on regulatory and state-financed financial policy measures covering almost all sectors and sub-sectors. Germany aims at a mixture of policy instruments providing the required long-term stability to investors in energy efficiency investments.

8.7.3 Focus of different policy instrument types

Germany's policy instruments support low, medium and high cost technologies with low, medium and partly high complexity. The existing policy mix supports replacement and/or upgrade of existing technology as well as the support new technologies. Some of the policy instruments provide support for specific technologies such as building insulation or heating system for example. Nevertheless there are multiple instruments in place which provide more general support for energy efficiency technologies.

Especially the Combined Heat and Power Act as well as the National Climate Protection Initiative are in the rather medium to high-cost category. The other legislative measures and some additional financial measure are categorized as medium to low.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 15: Focus of policy instruments in Germany

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Regulations	yes, specific technologies supported	supports new technology	medium - low	medium - low
Information, advice, billing feedback, smart metering	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable
Grants	depending on sector specific technologies supported and general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	high – medium-low	high – medium-low

8.8 Greece

8.8.1 Policy mix for delivering Article 7 of the EED

Eighteen policy measures were specified within the framework of Article 7. The majority of them provide financial support and incentives, while other measures include training and educational activities, standards and norms, and legislative and institutional regulations.

Ten of the specified measures make an essential contribution to the achievement of the target, as they correspond to 88.4% of the foreseen target. The majority of these measures promote interventions in residential and tertiary sectors emphasizing on public buildings, while one is a cross-cutting measure and another is a transport-related policy instrument. Specifically, the "Energy saving at home" measure increases the energy efficiency in the

residential sector, while the same target has been established by the regulatory measure for the offsetting of fines for arbitrary houses with energy efficiency measures. Various other measures focus on interventions in buildings, such as the measure for the energy upgrading of residential buildings, the measure for the energy upgrading of commercial buildings, the measure for the energy upgrading of existing commercial buildings through Energy Service Companies and the support of energy managers in public buildings. Moreover, educational and training activities for employees of the tertiary sector will be organised, while the implementation of energy management systems based on ISO 50001 in government and public sector bodies will be initiated. Finally, the installation of electronic and intelligent metering of electricity is a cross-cutting measure, while the only transport related policy instrument is the extension of the Athens Metro.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 16: Policy mix and sectoral focus in Greece

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Grants	1	2		2	2		2	2				1
Regulations		1		1								
Information, advice, billing feedback, smart metering					2		2	2				
Standards and norm					1		1	1				
All	1	3		3	5		5	5				1

8.8.2 Policy instrument combinations

Behavioural measures (information measures) can be combined with a grant scheme under the prerequisite that the potential double counting will be avoided during the calculation of the triggered energy savings.

8.8.3 Focus of different policy instrument types

Almost all of the existing and planned policy instruments support low and medium cost technologies with mostly low to medium complexity. There is the exemption of the extension of the Athens metro, which is a measure focusing on high cost and high complexity. There are no significant differences among the policy instruments in terms of the cost and complexities of technologies supported.

The existing policy mix mainly supports the replacement and/or upgrade of existing technology, while two measures also promote new technologies (measures for the installation of electronic and intelligent metering of electricity and the extension of the Athens Metro). Most policy instruments provide support for specific technologies in building envelope, but there are also multiple instruments in place which provide more general support for energy efficiency technologies.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 17: Focus of policy instruments in Greece

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Regulations	general support of energy efficiency improvements	support the replacement and/or upgrade of existing technology	low	low
Information, advice, billing feedback, smart metering	general support of energy efficiency improvements	support the replacement and/or upgrade of existing technology	low	low
Grants	depending on the measure it can be supported either generally energy efficiency improvements or specific technologies	depending on the measure it can be supported either the replacement and/or upgrade of existing technology or the installation of new technology	low to high depending on the measure	low to high depending on the measure

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Standards and norms	general support of energy efficiency improvements	support the replacement and/or upgrade of existing technology	low	low

8.9 Italy

8.9.1 Policy mix for delivering Article 7 of the EED

Italy has adopted a mix of regulations and information tools, covering almost all sectors and sub-sectors. Besides all residential consumers have smart meters and benefit from bills that give information about their monthly consumption (this aspect will be enhanced in the next month in accordance to the decree that transposes the 2012/27/EU directive). Most of the policy tools target existing residential buildings (both building fabric and heating system). Besides tax deductions and the heat account scheme, this sector is largely covered by the combination of standards, EPBD requirements and labelling, and regional and local policies. The industrial sector is covered by the EEO and in the last three-four years has become the main sector in terms of certified savings under the Italian EEO scheme. The transport sector benefits from the energy labelling scheme for vehicles and tires, some information campaigns, and the white certificate scheme.

EEOs, tax deductions, and heat account can be considered at least partially an incentive, since they provide money to the users or to intermediary parties – e.g. ESCOs, DSOs, consultants, etc. – (even if for white certificates, being an EEO scheme with a tradable market, there are no certainties about the amount of money that can be obtained by selling the certificates to obliged parties).

The following table provides a summary of the policy instruments and their sectoral focus.

Table 18: Policy mix and sectoral focus in Italy

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
White certificates	1	1	1	1	1	1	1	1	1	1	1	
Tax deductions		1		1	1			1				
Heat account		1		1	1			1		2		
Others (information campaigns, smart metering, energy labelling, etc.)		1	1	1	1	1	1	1	1	1	1	
All	1	4	2	4	4	2	2	4	2	4	2	

8.9.2 Policy instrument combinations

Even if some sectors or subsectors are covered by more incentive schemes, only one of them is granted, so the choice depends on the characteristics of the energy efficiency projects and of the users. In particular, tax deductions are the more easy to obtain and valuable incentive, so it is usually the main choice, if available.

Loans and small grants, sometimes available on regional or local basis, can usually be combined with the national schemes.

8.9.3 Focus of different policy instrument types

The EEOs very flexible and covers a very broad range of technologies and solutions. The complexity and the investment cost of the energy efficiency projects can range from low to high (low-medium solutions are predominant if compared with the number of presented projects, whereas the medium-high range can be considered if the analysis is based on the

certified savings). The scheme covers both existing and new buildings or facilities, but the first option is by far the most common.

The other schemes are more focussed in terms of the covered technologies and deal mostly with existing buildings. The complexity of the considered technologies is usually low-medium, whereas the cost shows a broader range.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 19: Focus of policy instruments in Italy

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
White certificates	all technologies covered	all options available	from low to high	from low to high
Tax deductions	heating and cooling applications, thermal renewables, building envelope	mainly existing technologies	from low to high	mainly low-medium
Heat account	heating and cooling applications, thermal renewables, building envelope	mainly existing technologies	from low to high	mainly low-medium

8.10 Netherlands

8.10.1 Policy mix for delivering Article 7 of the EED

The Netherlands has a longstanding tradition of energy savings policies in the most economic sectors. For the scope of the Article 7 of the Energy Efficiency Directive, the Netherlands is taking into account and has reported to the EC 40 existing and planned policy instruments (including agreements, regulatory standards, fiscal incentives, direct subsidies and 'green' lending facilities) in several sectors (built environment, transport, agriculture/horticulture, industry and commercial). An overview of D 3.1 Alternative measures

under Article 7 of the EED these instruments can be found in the National Energy Efficiency Action Plan (2014) and the Article 7 notification to the EC. The sectors with most instruments are the built environment and transport, while other sectors, such as industry and agriculture generally have a lower number of policy instruments in place. Most savings due to these policies are expected in the built environment, industrial and commercial sectors.

Table 20 provides a summary of the most important Dutch policy instruments that are expected to generate savings, as listed in the 2014 NEEAP and the Article 7 notification to the EC and their (sub)sectoral focus. The instruments are grouped in several categories, e.g. loans, grants, tax rebates, regulations, voluntary agreements and others.

Table 20: Policy mix and sectoral focus in the Netherlands

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Loans		1			1							
Grants		1			1							
Tax rebates	2	1			1				2	2	5	
Voluntary agreements	1	3			1				1	1		
Regulations	2	1		1	2							
Information, advice, billing feedback, smart metering												1
Energy and CO_2 taxes	1								2			
Energy labelling schemes		1	1		1	1	1				1	
All	4	9	2	0	6	3	1	0	5	3	9	3

8.10.2 Policy instrument combinations

As can be derived from the table above, within each (sub)sector a given mix of instruments is used to trigger energy savings. Within the building sector, in addition to the EPBD requirements (translated in EPC labelling), the use of fiscal incentives is limited (primarily tax rebates on savings technologies –mainly insulation and small scale renewable energy-), while loans and grants provide more the financial basis for energy savings. On top of this, the use of voluntary agreements within this sector (and sub-sectors) appears to be more common (aside from cross-cutting instruments). Within the non-energy intensive industrial sector, the mix of instruments consists of voluntary agreements and fiscal measures (in addition to cross-cutting instruments). Within the transport sector the dominant instrument types are fiscal instruments, in combination with a labelling scheme and some voluntary agreements.

At the sectoral level it many cases a mix of three or more instruments in the area of energy savings is generally in effect, while at the sub-sectoral level the policy mixes generally comprise a lower number of energy savings instruments deployed.

8.10.3 Focus of different policy instrument types

Sectoral focus: The majority of policy instruments have been designed for specific purposes and in most cases can be linked a given set of (sub-)sectors and thus have a certain sectoral focus.

Technology focus: There are several instruments implemented in which only a predefined (or regularly updated) list of technologies / actions is considered eligible (prescribed in the Energy List of the EIA for instance or the List of Environmental Technologies in VAMIL/MIA). The technologies addressed in the built environment are mainly insulation and small scale RE, while there are provisions for updates in the existing Energy Lists. In the industrial sector, where bottom up evaluations per company or sector take place, there are lists of technologies (ranging from process efficiency to end-use savings), which have been tested and approved and serve as guidance for new companies (such as the MJA3 with sectoral specific or generic technologies, where their cost-effectiveness can be tested by potential users).

For tax rebate and subsidy schemes, such as the EIA, where the Energy List is regularly updated with new eligible technologies, the technology focus can be seen as a 'moving target' where certain actions are considered either as common practice or cost-effective according to some economic norms or technological standard.

Cost focus and complexity of technology/action: The majority of policy instruments are aiming for low to medium cost technologies, while in several sectors the more cost-effective measures are above the low hanging fruits and there is an increasing cost for such actions, especially in the built environment sector.

The following table lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 21: Focus of policy instruments in the Netherlands

Policy instrument type		Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Loans	Revolv. Fund for en. Saving	no, but targets built environment	supports replacement / upgrade and new technology	medium and low	medium and low
Grants	400 mln. EUR subsidy for Social Rent sector	no, but targets built environment	supports replacement / upgrade and new technology	medium and low	medium and low
	Sust mobility pilots	yes	supports replacement / upgrade and new technology	all	all
Energy Efficiency Obligations	N.A.	-	-	-	-
Tax rebates	EIA	yes, there is a technology list	supports replacement / upgrade and new technology	all, provided they meet norms	all, provided they meet norms
	VAMIL	yes	supports replacement / upgrade and new technology	all	all
	MIA	yes, there is a technology list	supports replacement / upgrade and new technology	all	all
	Green Projects Scheme	yes	supports replacement / upgrade and new technology	all	all

Policy instrument type		Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
	Red. VAT for insulation & renov.	Yes	Supports replacement / upgrade of existing technology	Medium and low	Medium and low
	Exemption motor vehicle tax	Yes	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Vehicle CO2-tax differentiation	Yes	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Company car - income tax differentiation	Yes	Supports replacement / upgrade and new technology	Medium and low	Medium and low
Voluntary Agreements	Long-term agreements	No	Supports replacement / upgrade and new technology	All	All
	Green Deals	No	Supports replacement / upgrade and new technology	All	All
	Block-by-block	No, but focus on building sector	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Acceleration (Stroomversn.)	No	Supports replacement / upgrade and new technology	High and medium	High and medium
	En. Sav. Agr. Social Rent sector	No	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Lean & Green logistics	No, but focus on transport	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Lean & Green pers.mobility	No, but focus on transport	Supports replacement / upgrade and new technology	Medium and low	Medium and low

Policy instrument type		Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Regulations	Tightening of EPC	No	Supports new technology (new builds)	Medium and low	Medium and low
	WWS	No	Supports replacement / upgrade and new technology	Medium and low	Medium and low
	Enforce env. Mgmt Act	No	Supports replacement / upgrade and new technology	Medium and low	Medium and low
Information, advice, billing feedback, smart metering	New driving	No	N.A. (behavioural)	Medium and low	Medium and low
Energy or CO2 taxes	Energy tax	No	Supports replacement / upgrade and new technology	All	All
Energy labelling scheme	Transport, appliances and buildings	No	Supports replacement / upgrade and new technology	All	All

8.11 Poland

8.11.1 Policy mix for delivering Article 7 of the EED

In Poland the whole system of legislation on energy efficiency, primary and secondary, has been built around the Energy Efficiency Act (2011)[3]. This act implements main provisions of the Energy Efficiency Directive (EED).

The obligation set in Article 7 of the EED is implemented by an obligatory scheme that bears all the fundamental features of EEOs as implemented in other countries. Poland has not notified any alternative measures. In this respect the EEO is a standalone measure and its

[3] Energy Efficiency Act of 15 April 2011.

performance is not directly linked to any other measure being in place. However, in practice its operation is supported by a number of programs which can be regarded as derivatives of the EEOs.

Although the energy efficiency fund has not officially been established, one can consider the separated fund operated by the National Fund for Environment Protection and Water Management (NFEP&WM) as an equivalent of such a fund. This conclusion is justified by the fact that compensation fees and penalties generated by the EEOs are allocated to the account, and then used for financing energy efficiency projects. Its financial resources enabled to launch several programs aiming at energy efficiency improvements in different sectors and exploiting numerous measures. They mostly include loans and grants. The most popular scheme is a NFEP&WM launched, managed and supervised program financed by commercial bank on preferred conditions due to the fund given public money support.

Basing on the fund there have been a number of programmes initiated by the NFEP&WM aiming at improving energy standards in building, private and public.

Some other programmes aimed to limit losses in energy intensive industry preceded by publicly supported energy audits were also carried out. Similar programmes addressed SMEs.

The most essential regulation applies to buildings. The main provision laying down requirements for energy efficiency of buildings are the Construction Law[4] and a following regulation, both provided regulatory arrangements for activities involving design, construction, maintenance and demolition of buildings. The new regulation[5] stemming from this act lays down new requirements regarding heat protection and energy efficiency of buildings and of technical systems using energy in buildings. Existing building codes and energy efficiency standards in buildings, as far as numerical values of obligatory energy efficiency technical parameters are concerned, are not demanding, and can be considered as lagging behind EU leaders.

Smart metering pilot programs are common, and launched by all main DSO in power system but they are predominantly considered as elements required by modern power system (Smart Grids), and in reality are only in second rank regarded as one of the energy efficiency measure on the demand side.

[4] Construction Law the Act of 7 July 1994.
[5] Regulation of the Minister of Transport and Maritime Economy of 5 July 2013, entered into force on 1 January 2014.

Concerning energy efficient oriented regulation created by the Energy Regulation Office, it can be assessed as rather neutral, not giving strong signals or tariff incentives towards energy efficiency increase, neither on the supply nor demand side.

Some generic public campaigns were initiated and carried out by the government but none of them directly addressed issues coupled with the art. 7 obligation. Introduction of the WCS had been not preceded by any information campaign and it took some time for the obliged parties to learn the meanders of the system ("learning by painful doing").

It is to note that the WCS includes transport fuel suppliers and the fund managed by the NFEP&WM scheme funds transport energy efficiency measures, schemes and programmes.

8.11.2 Policy instrument combinations

The existing policy instruments are very much EED article oriented e.g. each of the instrument is aimed to serve a specific article of the EED rather than play cross-cutting universal role. Only the WCS is classified as a cross-cutting instrument. Combined use of the instruments is possible where applicable except for mixing financing from different public sources.

It means that the eligible policy instrument combination is prohibited as far as public financing is considered, e.g. double public financing is forbidden. This comment mainly refers to those instruments involving investments in which there is a rule "only one public source of funding". For example, in all programs it is forbidden to receive join funding from NFEP&WM and any other domestic or international sources. It also applies for the WCS (EEO) projects and publicly funded grants or loans.

It can further be guessed that combination of soft measures, e.g. not involving investments, like billing feedback or public campaigns can be joined and applied in combination.

Table 22 provides a summary of the policy instruments and their sectoral focus in Poland.

Table 22: Policy mix and sectoral focus in Poland

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Energy Efficiency Obligations	1			1					1		1		
Regulations		1	1	1	1	1		1					1
Tax rebates													
Information, advice, billing feedback, smart metering		1	1	1	1	1		1	1	1	1		
Voluntary Agreements													
Loans	1	2	2	3	2	2		2	2	1	2		1
Grants												1	1
Energy labelling scheme		1	1				1	1				1	
All	2	5	5	6	4	4	1	5	4	2	4	2	3

8.11.3 Focus of different policy instrument types

The financial supporting schemes can be roughly divided into general category in which all possible technological improvements are eligible, and those were specific technologies are accepted, e.g. lighting systems, motor replacement, Smart Grid technologies. All such oriented schemes are manufacture neutral, providing guidance on technologies in a way not discredited any specific manufacture or service provider (public procurement rules are obligation).

The costs of new technologies lies in a wide range, from relatively low cost, e.g. some technical measures in building retrofit, replacement of lights, to highly costly, e.g. variable speed drive or replacement of transformers. Usually the costs of replacement or technological up-grade are limited by the maximum eligible public support unless the investor can cover higher costs himself.

Similar, complexity of the technologies can vary significantly. For example, those used in standard refurbishment of buildings are rather standard, involving well established market technologies, whereas changes in some industries enforced by the WCS obligation are untypical and complex, e.g. in steel industry or power systems.

Table 23 lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 23: Focus of policy instruments in Poland

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Energy Efficiency Obligations	specific technologies supported	supports replacement and/or upgrade of existing technology	high	high
Regulations	depending on sector specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low-medium	medium
Information, advice, billing feedback, smart metering	depending on sector specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low-high	low-high
Loans	general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	medium	medium
Grants	specific technologies supported	supports replacement and/or upgrade of existing technology	medium-high	medium-high
Energy labelling schemes	specific technologies supported	supports new technology	medium	medium

8.12 Spain

8.12.1 Policy mix for delivering Article 7 of the EED

Spain has mostly adopted financial/fiscal measures as well as a few informational and training measures. In combination with those measures the EEOs are implemented in different sectors, mostly focusing on transport, industry, buildings, public services and agriculture. Alternative measures' scope of application is also focused primarily on the transport sector (e.g. 4 financial schemes out of a total of 10 alternative measures proposed) while also targeting at the tertiary and services sector. Regarding the transport sector different types of measures are implemented with a basic focus to promote efficient vehicles through incentive programmes or efficient driving through training programmes for new divers, and also Urban Mobility Plan in general (and electric mobility projects).

Apart from the transport sector there are a few policy instruments related to other sectors as well. Indicatively, through the PAREER Program aid (grant) is provided to renovate existing residential buildings and hotels, in order to make them more energy efficient. In addition PIMA SOL is also implemented as a plan for promoting energy rehabilitation of hotel sector. The only cross-cutting related policy instruments is JESSICA – FIDAE which is an energy saving and diversification instrument Fund.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 24: Policy mix and sectoral focus in Spain

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour	agriculture - improvement of the
Loans		1								1				
Grants	1					1			1	2	4		1	
Energy Efficiency Obligations			1	1	1		1	1	1		1	1	1	1
Tax rebates														
Voluntary														

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour	agriculture - improvement of the
Agreements														
Regulations														
Information, advice, billing feedback, smart metering		1								1		2	1	
Energy or CO2 taxes									1					
Energy labelling scheme														
All	1	2	1	1	1	1	1	1	3	4	5	3	3	1

8.12.2 Policy instrument combinations

As mentioned above, information, training and basically financial measures cover almost all sectors and mainly transport. The different types of instruments implemented are the following ones:

- EEOs;
- Grants; and
- Loans.

The target sector of EEOs coincides with the scope of a number of alternative measures, since both EEOs and alternative measures mainly focused on the residential and transport sector. Regarding the residential sector financial and informational measures are mainly implemented on existing buildings, whereas EEOs refers to existing and new buildings. In the transport sector, a combination of financial measures mainly focused in electric vehicles and in urban mobility plan is prevalent. However the EEOs' scope is further differentiated, as obligations also provide financial support to agricultural sector and to public and business use buildings, covering also new buildings.

8.12.3 Focus of different policy instrument types

Most of the Spain's policy instruments support low and medium cost technologies with mostly medium and low complexity. There are no significant differences amongst the policy instruments in terms of their associated costs of support for eligible technologies as well as complexity in the implementation of technologies promoted.

The existing policy mix mainly supports new technologies (electric vehicles, renewable energy systems, energy management systems) but also supports the replacement and/or upgrade of existing technology interventions. Most policy instruments provide support for specific technologies such as electric vehicles for transport and building renovation for residential and hotel sector.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 25: Focus of policy instruments in Spain

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Tax rebates	no, general support of energy efficiency improvements	not applicable	high	low
Grants	yes, specific technologies supported	supports new technology	medium	high and medium
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	medium	medium
Loans	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	medium and low	medium and low
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	medium and low	medium

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Information, advice, billing feedback, smart metering	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	low	low
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	medium	medium
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	low	low
Information, advice, billing feedback, smart metering	no, general support of energy efficiency improvements		low	low
Energy Efficiency Obligations	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	all	all

8.13 Sweden

8.13.1 Policy mix for delivering Article 7 of the EED

The implementation of Article 7 of the EED that Sweden has designed consists of a combination of financial instruments, with a clear focus on energy and carbon dioxide taxes and targeted information initiatives to provide good conditions for achieving an improvement in energy efficiency that is effective under Swedish socio-economic terms.

These instruments complement each other and it is interaction of all of them that provides the energy savings required by the EED.

Table 26: Policy mix and sectoral focus in Sweden

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour	Public sector	Electricity
Grants		1									1		1	
Voluntary Agreements	1												2	
Information, advice, billing feedback, smart metering		1	1						1	1		1		
Energy or CO2 taxes	1													
Standards and norms														1
All	2	2	1						1	1	1	1	3	1

8.13.2 Policy instrument combinations

Within the Swedish policy mix, the combination of policy instruments is very common. Taxation is often complemented with information, advice, voluntary agreements or standard and norms. The drawback of this combinations is the impossibility to assess the cost-effectiveness of each measure individually.

8.13.3 Focus of different policy instrument types

The policy mix implemented by Sweden does not focus on any technology in particular. It was observed that some of the measures adopted by Sweden are especially useful for disseminating and raising awareness at a local level (municipalities, general public, companies). To foster their impact, some of the measures foresee not only financial support but also technical advice towards any technology that is able to increase the energy efficiency of any sector.

Defining the level of cost of the supported technology as well as its level of complexity is almost impossible since a technology in particular is not identified.

Table 27: Focus of policy instruments in Sweden

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Information, advice, billing feedback, smart metering	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable
Standards and norms	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable
Voluntary agreements	no, general support of energy efficiency improvements	not applicable	not applicable	not applicable
Energy or CO2 taxes	no, general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	not known	not known

8.14 United Kingdom

8.14.1 Policy mix for delivering Article 7 of the EED

The UK has adopted regulations and information, advice, billing feedback and smart metering covering almost all sectors and sub-sectors. 20 out of 27 sub-sectors targeted by the mix are within residential, commercial and public buildings. In addition to regulations and information, advice, billing feedback and smart metering the EEOs focus exclusively on existing residential buildings (both building fabric and heating system). Through the Scottish Home Energy Efficiency Programmes grants are provided to residential building retrofits. Loans are available for public sector buildings through the SALIX loan scheme, there is, however, no such scheme for commercial buildings at the moment. The energy-intensive industry sector is targeted by a carbon tax, the Climate Change Levy which works in conjunction with the Climate Change Agreements providing exemptions from the levy if industrial sub-sectors meet certain sectoral target for energy efficiency. The only transport

related policy instrument is an energy labelling scheme for vehicles, which forms part of the UK's low emissions vehicle policies.

The following table provides a summary of the policy instruments and their sectoral focus.

Table 28: Policy mix and sectoral focus in the United Kingdom

	cross-cutting	residential - existing buildings	residential - new buildings	residential - heating, cooling, ventilation	service (incl public) - existing buildings	service (incl public) - new buildings	service (incl public) - appliances	service (incl public) - heating, cooling, ventilation	industry - energy intensive	industry - non-energy intensive	transport - vehicles	transport - behaviour
Loans					1		1	1				
Grants		1										
Energy Efficiency Obligations		1		1								
Tax rebates												
Voluntary Agreements												
Regulations		1	1	1	2	2		2		2		
Information, advice, billing feedback, smart metering		1	1	1	1	1		1	1	1		
energy or CO2 taxes									2			
Energy labelling scheme											1	
All		4	2	3	4	3	1	4	3	3	1	

8.14.2 Policy instrument combinations

As mentioned above, regulations and information, advice, billing feedback and smart metering cover almost all sectors and sub-sectors. In different sub-sectors, these two instruments are combined with one of the following instrument types:

- EEOs;
- grants;
- loans; and
- energy and CO2 taxes.

The only combination of more than three instrument types is within the sub-sector residential – existing buildings where grants and EEOs are used in addition to the regulations and information instruments.

8.14.3 Focus of different policy instrument types

All of the UK's policy instruments support low and medium cost technologies with mostly medium complexity. There are no significant differences amongst the policy instruments in terms of the cost and complexity of technologies supported.

The existing policy mix mainly supports replacement and/or upgrade of existing technology but some policy instruments (regulations, information, advice, billing feedback, smart metering, and the energy labelling for vehicles) also support new technologies. Most policy instruments provide support for specific technologies such as building insulation for example but there are also multiple instruments in place which provide more general support for energy efficiency technologies.

The table below lists each policy instrument type and their respective focus in terms of technologies, their cost and complexity.

Table 29: Focus of policy instruments in the United Kingdom

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Energy Efficiency Obligations	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	low	low

Policy instrument type	Technology focus	New vs existing technology	Cost of supported technology	Complexity of supported technology
Regulations	depending on sector specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low-medium	medium
Information, advice, billing feedback, smart metering	depending on sector specific technologies supported and general support of energy efficiency improvements	supports new technology and replacement and/or upgrade of existing technology	low	medium
Loans	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	medium	medium
Grants	yes, specific technologies supported	supports replacement and/or upgrade of existing technology	low	low
Energy or CO2 taxes	no, general support of energy efficiency improvements	supports replacement and/or upgrade of existing technology	low	medium
Energy labelling schemes	yes, specific technologies supported	supports new technology	medium	medium