JRC SCIENCE AND POLICY REPORTS

Financing building energy renovations

Current experiences & ways forward

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2014

Report EUR 26718 EN

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https://ec.europa.eu/jrc

JRC89892

EUR 26718 EN

ISBN 978-92-79-39129-3 (PDF)
ISBN 978-92-79-39130-9 (print)

ISSN 1831-9424 (online)
ISSN 1018-5593 (print)

doi: 10.2790/28141

Luxembourg: Publications Office of the European Union, 2014

Abstract

With the right set of policy tools, it is generally accepted that governments can play a crucial role in promoting energy efficiency and leveraging more investments in the building sector, especially in the existing stock. Indeed there is a wide range of policies at EU level which require Member States to set a number of regulatory, informative and economic measures with the aim to improve the energy performance of buildings. What is clear is that the existing policy mix needs to be reviewed as experience shows that actual energy efficiency investments in this segment of the building stock neither meet the scale nor the quality aligned with its overall potential. For now, economic instruments appear to dominate the policy framework for existing buildings, while the need for more market action and enhanced private sector involvement is increasingly highlighted as this offers the only sustainable route for scaling up existing efforts. This report deals with the importance of existing economic instruments in leveraging energy efficiency investments in buildings, examines their effectiveness in delivering energy savings as well as relation with other policy types. Based on experiences drawn from current practices, it increases our understanding of the type, scope and mix of economic instruments best suited to tackle demand-side energy use in existing buildings. The report also identifies innovative financing mechanisms and proposes other measures beyond current practices, which can further stimulate the market and offer more scalable solutions.

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Introduction

Background

The energy saving potential of the building sector in the EU has enjoyed increasing attention in recent years. This is because buildings are responsible for 40% of total energy consumption and their modernisation is considered to be pivotal in our shift towards a low carbon economy (European Commission, 2011). Modernising the building sector is also attached to a number of important benefits for many actors in society. It results in reduced energy bills, increased disposable income and improved indoor comfort levels for households. For firms, greater energy efficiency translates to increased productivity and competitiveness, while for governments more jobs, lower public expenditures and higher energy supply security stemming from these investments are all highly sought-after goals especially in current economic circumstances (Ryan & Campbell, 2012).

Realising the potential associated with the building sector requires addressing both new and existing buildings. With estimates showing that an approximate 75% of the current EU building stock will be still standing in 2050[1], existing buildings are at the forefront of the challenge (Urge-Vorsatz, et al., 2012). The ageing part of the stock, which was not built with energy efficiency in mind, aggravates the energy performance of the building sector as a whole. Although this theoretically offers an opportunity to incorporate energy saving measures, actual energy renovations taking place today neither meet the scale nor the quality aligned with their overall potential. Many barriers do not allow navigating through these suboptimal trends. Split incentives and inadequate information about costs and benefits are major obstacles, while high upfront costs, lack of access to finance and scarcity of private capital emphasise the need for more policy and market action (**Table 1**). From a financier's perspective, energy efficiency projects entail high transaction costs and are perceived to be risky due to the difficulty of predicting accurately energy cost savings. Sufficient experience with underwriting energy efficiency loans and standardised evaluation methods for measuring and verifying energy savings is still lacking. The lack of secondary markets to provide exit opportunities for investors, or further liquidity to the investments is another important barrier.

[1] New constructions roughly add 1% to the existing stock every year

Table 1 - Barriers to energy efficiency (Source: IEA (2010))

Market	• Market organisation and price distortions prevent customers from appraising the true value of energy efficiency. • Split incentive problems created when investors cannot capture the benefits of improved efficiency (IEA 2007a). • Transaction costs (project development costs are high relative to energy savings).
Financial	• Up-front costs and dispersed benefits discourage investors • Perception of EE investments as complicated and risky, with high transaction costs • Lack of awareness of financial benefits on the part of financial institutions.
Information and awareness	• Lack of sufficient information and understanding, on the part of consumers, to make • rational consumption and investment decisions.
Regulatory and institutional	• Energy tariffs that discourage EE investment (such as declining block prices). • Incentive structures encourage energy providers to sell energy rather than invest in cost-effective energy efficiency. • Institutional bias towards supply-side investments.
Technical	• Lack of affordable energy efficiency technologies suitable to local conditions. • Insufficient capacity to identify, develop, implement and maintain EE investments.

With the right set of policy tools, it is generally accepted that governments can play a crucial role in promoting energy efficiency and leveraging more investments in the building sector, especially in the existing stock. Indeed there is a wide range of policies at EU level which require Member States to set a number of regulatory, informative and economic measures with the aim to improve the energy performance of buildings (see page 6). While existing buildings are not yet at the receiving end of an aspiring goal in line with their potential[2], renovation roadmaps expected to transform the policy ground in that clear, long-term strategies[3] are to be set which can address the challenges associated with them. What is clear is that the existing policy mix needs to be reviewed as experience shows that energy efficiency investments in this segment of the building stock are insufficient. For now, economic instruments appear to dominate the policy framework for existing buildings, as they are particularly important for tackling risks associated with lengthy payback periods and activating the market for energy renovations. At the same time, the need for more market action and enhanced private sector involvement is increasingly highlighted as this offers the only sustainable route for scaling up existing efforts.

This report has a two-fold scope. It first deals with the importance of existing government-supported economic instruments in leveraging energy efficiency investments in buildings, investigates their effectiveness in delivering energy savings as well as relation with other policy types. Based on the experiences examined, it increases our understanding of the type, scope and mix of economic instruments currently used to tackle demand-side energy use in existing buildings. Secondly, it identifies innovative financing mechanisms and proposes other measures beyond what is currently practiced, which can further stimulate the market and offer more scalable solutions.

[2] For example, new buildings will be 'nearly-zero' energy status by 2020

[3] Article 4, Directive 2012/27/EU (Energy Efficiency Directive)

Aim & Objectives

The work first focuses on government-supported economic instruments which directly catalyse energy efficiency investments in existing buildings. The aim is to draw lessons from current experiences, improve our knowledge in how these instruments are designed and implemented as well as identify their impact and how they can be more effective in the future. In summary, the objectives of the work are:

- Review current national economic instruments targeting the renovation of their building stock
- Examine how they are used across different Member States and analyse them based on their main design elements, implementation approaches, impact indicators and evaluation.
- Discuss success elements and identify how these measures can be more effective in supporting renovations

Secondly, various new solutions (financial mechanisms, policy measures and regulations) which could help the mobilisation of investment in existing buildings are identified.

Layout of report

The structure of this report is as follows. Chapter 1 offers an overview of EU28 economic instruments and their key features. Chapter 2 deals with each type of instrument in detail, drawing key elements for each phase of their policy cycle and providing observations and conclusions. Innovative measures going beyond what is currently in place are proposed in Chapter 3 and conclusions are drawn in Chapter 4. The questionnaire is summarised in Annex I and an overview table of all identified instruments is presented in Annex II.

THE EU Policy framework for existing buildings

A number of European directives require Member States to set up policy tools and measures addressing the existing building stock.

The Energy Performance of Buildings Directive (2002/91/EC) has been the main policy driver for reducing energy use for heating, cooling, ventilation, hot water and lighting in buildings. The directive requires the application of a methodological framework for calculating the energy performance of buildings. It has allowed Member States to set minimum energy performance requirements for both new and existing buildings and request the upgrade of existing buildings to meet the minimum energy performance levels upon "major renovations". As part of this directive, Member States have also implemented certification systems which inform the potential buyer or tenant about the energy class of their building and provide recommendations for a cost optimal improvement of its energy performance. With a recast in 2010, the revised Directive (2010/31/EU) introduced a harmonised calculation methodology to increase the stringency of MS minimum energy performance requirements and push them towards a cost-optimal level.

The Energy Services Directive (2006/32/EC), replaced by the Energy Efficiency Directive in 2012 (2012/27/EU) also includes a number of measures targeting energy efficiency improvements in buildings. These include establishing long-term strategies for the renovation of national building stocks as well as undertaking renovation of 3% of the total floor area of all central government-owned public buildings annually from 2014 onwards. Energy efficiency obligations are another important tool which leverages investments from companies in the energy sector. Energy providers are requested to reduce energy use among their customers by the equivalent of 1.5% of final energy consumption per year. Member States are obliged to adopt an indicative national energy efficiency target in 2020, where significant savings are expected to accrue from the building sector. Promotion of the energy services market through the provision of model contracts, exchange of best practice and guidelines, in particular for the public sector, are also included. These along with other measures stipulated by the main elements of the directive, should be reported in the National Energy Efficiency Action Plans and are expected to have a significant impact on the energy efficiency of existing buildings.

With a focus on the building electricity, heating and hot water consumption, the Directives 2009/125/EC and 2010/10/30 address mandatory minimum energy efficiency and labelling requirements for energy-related products. The European Directive (2009/125/EC) establishes a framework for setting eco-design requirements for energy-related products aiming to increase their energy performance throughout their life time, while the Energy Labelling Directive (2010/10/30) sets out energy labelling requirements which can help consumers choose and industry to develop more energy-efficient products.

Methodology

Scope

The first part of the work had a scope of examining current economic instruments that target existing buildings in the year 2013. We focused on on-going instruments in the year 2013, which were either open for applications or at the stage of implementation. The instruments covered were largely organised at a national level; exceptions include Austria and Belgium where regional programmes were important. The types of instruments considered are listed in Table 2. These are divided in financial instruments such as loans, grants and subsidies, fiscal instruments such as tax credits or VAT reductions and market-based instruments such as energy saving obligations or white certificates.

We focused on programmes that provided financing only for direct interventions in buildings. We therefore excluded any programmes that were R&D oriented or solely had an advisory or informational role (e.g. a grant scheme for energy audits). In addition, the instruments considered were programmes designed to primarily yield energy savings in the concerned buildings. In other words, general renovation programmes which were directed at general restoration and maintenance with no particular focus on energy efficiency were excluded. Excluded examples that we came across in the literature were the Italian tax deduction for general renovation, Swedish tax rebate scheme ROT-avdrag[4] and Luxembourgish national fund for public building renovations.

Table 2 - Types of conventional instruments considered herein

FINANCIAL INSTRUMENTS	FISCAL INSTRUMENTS	MARKET-BASED INSTRUMENTS
Loans; Grants and subsidies;	Income tax credit or deduction; Accelerated depreciation; VAT reduction; Property taxation; Tax rebates	Energy saving obligations; White certificates;

The next step was to define what constitutes an "energy renovation". To do so, one should first consider what types of intervention actions fall under the term “renovation” and how energy efficiency measures fit into these actions. Renovation is an umbrella term which normally describes a variety of interventions in a building: from modernization, retrofit, restoration and rehabilitation to simple maintenance, repairs and routine upgrades. An energy renovation is often “behind the scenes” of many of these actions, with each action delivering different level of energy savings. For example, an upgrade of a gas boiler in a house will be of lesser importance compared to the insulation of its façade, roof and external walls; the latter offering the opportunity to significantly reduce energy losses from its building envelope, thus improving considerably the energy performance of the house.

While there is no clear definition of an energy renovation in the literature, one may describe it in terms of intervention measures installed or targeted energy performance improvement. A number of attempts have been made to relate the renovation depth/ambition with relative energy savings or absolute energy consumption levels. For example, the Buildings Performance Institute Europe has considered for its

[4] http://www.rotavdrag.se/About.asp

modelling purposes that minor renovations correspond to 0-30% of final energy savings, moderate 30-60%, deep 60-90%, while nZEB renovations represent savings beyond 90% (BPIE, 2011). In a cross-regional review, the Global Buildings Performance Network has concluded that deep renovation can be linked with improvements of at least 75% and/or have a primary energy consumption after renovation of less than 60 kWh/m^2 per year (Shnapp, Sitjà, & Laustsen, 2013). This mostly focuses on heating, cooling, ventilation and hot water end uses. As these are not universally accepted terms, herein we related energy renovations with the type of intervention measures taking place in the concerned building. These can be classified in the categories presented in Table 3, which also lists examples of individual measures in each category. It should be noted that instruments that solely cover renewable electricity generation systems do not fall under this definition, as energy efficiency improvements are the primary purpose of these renovations.

Table 3 – Categorisation and examples of intervention measures in an energy renovation

Building envelope	Insulation of external walls, roofs, lofts, floors; replacement of windows, doors; draught proofing; installation of solar shading systems; employment of natural ventilation techniques, passive solar heating or cooling techniques
Building technical systems	Replacement of inefficient boilers with condensing gas boilers; improvement of mechanical ventilation, air-conditioning, lighting, auxiliary systems; installation of heat recovery system; improvement of emission/distribution systems of technical systems (e.g. pipework insulation); installation of building controls; installation of micro cogeneration systems;
Renewable heat generation systems	Biomass boilers; thermal solar systems; ground, water, air source heat pumps
Renewable electricity generation systems	Photovoltaic systems, micro wind generation systems, micro-hydro systems
Connection to district heating	Upgrades or new connection to a district heating network
Other energy-related measures	Appliances

Adopted from various sources, e.g. Fernández Bonita (2013), CIBSE (2012)

Research approach & data collection

The analysis of the economic instruments was structured along each phase of their policy cycle: (1) design, (2) implementation (3) impact and evaluation. These phases typically form part of a natural review process by the end of which lessons learned are drawn and changes are incorporated in a planned redesign phase, thus allowing for constant programme improvements during its lifetime.

From a policy **design** perspective, the following elements have been examined:

- Motivation, objectives, timelines and targets set;
- Recipients & main stakeholders involved; targeted building segments;
- Financial architecture and intervention measure design;
- Interaction with other policy instruments.

From an **implementation** point of view, the following information was tracked:

- Main financing sources and their contribution to the disbursed budget;
- Yearly budget allocation;
- Intermediaries and implementing agents involved;
- Flow of disbursed finance from the source to the intermediary and sector
- Volume of investment;

- Outreach strategies.

For **impact and evaluation**, this information was surveyed:
- participation in the programme;
- impact assessment;
- methods used to measure energy savings;
- planned improvements.

A comprehensive questionnaire was designed to collect information for each financial instrument currently in place in EU28 targeting energy saving renovations. The questionnaire followed the typical structure of policy cycle (Figure 1).

The detailed questions included in each part are enlisted in Annex I. The questionnaire was completed by national experts working in the relevant ministries or agencies in each Member State, often being directly involved in the design and implementation of the instruments. The full list of our partners can be found in the Acknowledgement section. The data collected was complemented by a desk research.

The full list of programmes that fall under the scope defined above can be found in the table of Annex II. A coding system has been used – made up of the country ISO-code and a number – to enable easier identification of each programme in the main body of the report. Each programme is referred to with a code; the full information of which can be retrieved in Annex II.

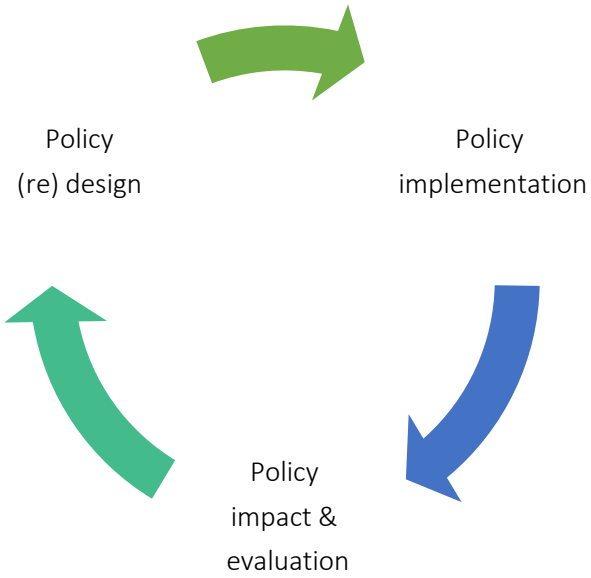
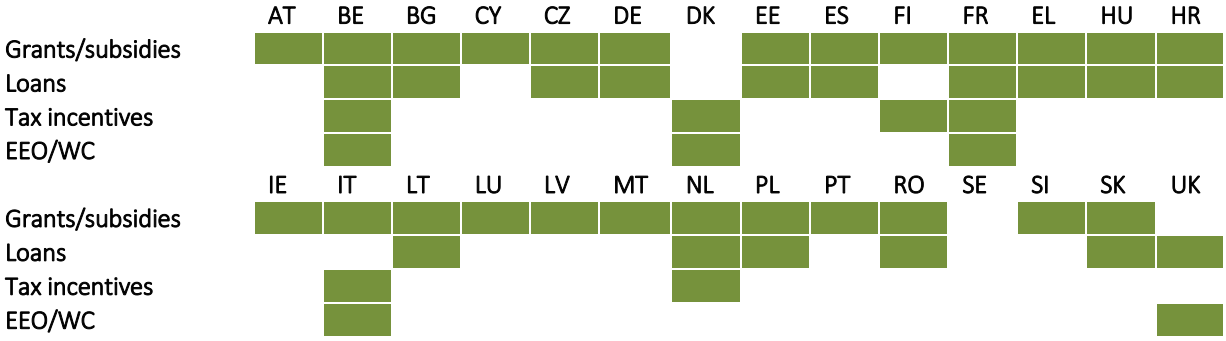


Figure 1 - Three-phase cycle of a policy instrument

Chapter 1 – An EU wide overview of current public economic instruments

Many countries choose to deploy a combination of different economic instruments, each tailored to address different barriers, specific segments and recipient groups within the building sector. **Table 4** provides an EU28 overview of the economic instrument types on energy efficiency investments in existing buildings operating in the year 2013. It is not possible to derive a clear pattern as a fixed combination of instruments cannot be singled as the best solution across all Member States. For example, France had all types of instruments in place, while Germany has had a long successful tradition with grants and loans through its KfW scheme. Sweden's policy measures on energy renovations in 2013 included no financial/economic incentives; these had rather a regulatory or informational nature. Many of the instruments examined herein were designed to work together with other economic instruments or be part of a policy package.

Table 4 – Main EU28 economic instruments in 2013 targeting energy renovations



Shaded cells indicate that the economic instruments types operational in 2013 in each Member State

Most of the economic instruments targeted the residential sector, however some instruments concerned commercial buildings or public buildings or a combination of different building types (see **Figure 2**). Our analysis confirms previous findings regarding the mix of economic instruments used to-date (BPIE (2012), Hilke & Ryan (2012)). That is, financial support is predominantly offered in the form of grants/subsidies, followed by loans and tax incentives. Energy efficiency obligations and white certificates are set up in a handful of Member States, but this is likely to change with the implementation of the Energy Efficiency Directive (2012/27/EU) and introduction of article 7 on energy efficiency obligations. The renovation strategies (article 4 of Directive 2012/27/EU), are also likely to change the policy scene of existing buildings but the reported plans are not due at the time of writing of this report and an analysis of their expected impact is not thus possible.

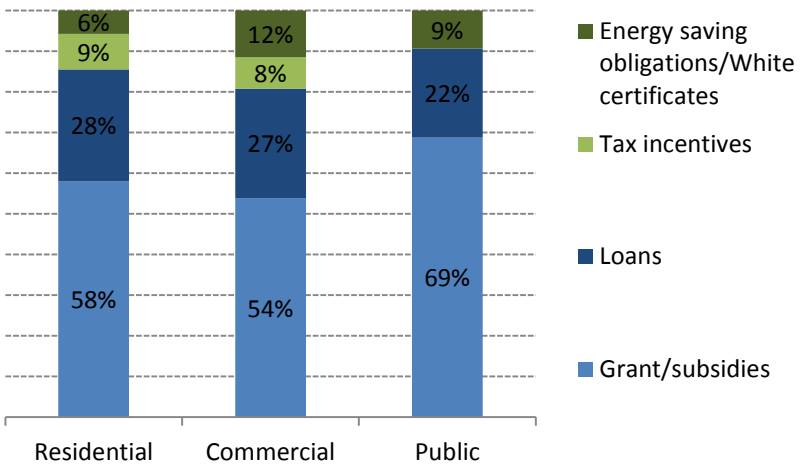


Figure 2 – Share (as a % of all instruments) of EU28 economic instruments by instrument type for residential, commercial and public buildings

A large range of groups were targeted by current instruments (**Figure 3**), reflecting the long complex chain of actors involved in the building sector. These ranged from households, housing associations to public authorities, commercial companies, ESCOs and many others. Tenants also formed part of the target group in certain programmes[5], however the success in terms of engaging tenants in energy efficiency investments is not clear.

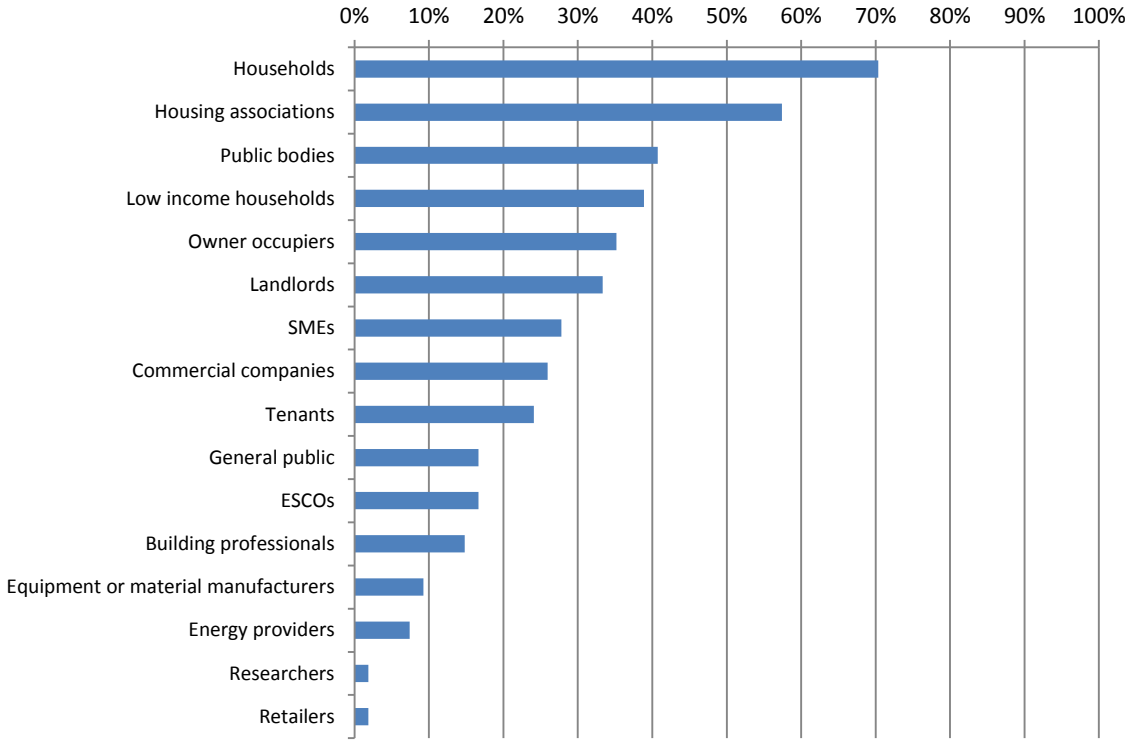


Figure 3 - Groups targeted by economic instruments (*values indicate % of instruments targeting each group*)

[5] Examples of these programmes include $BE_{BRU}02$, $BE_{VLG}01$, $BE_{VLG}02$, FR01, FR04 and UK01

The intervention measures supported by the examined economic instruments concerned all building elements and intervention types (**Figure 4**). The most common measures included upgrade of boilers, installation of insulation and replacements of windows. In certain cases, energy efficiency measures were combined with non-energy related interventions such as general maintenance work, plumbing works and structural construction repairs.

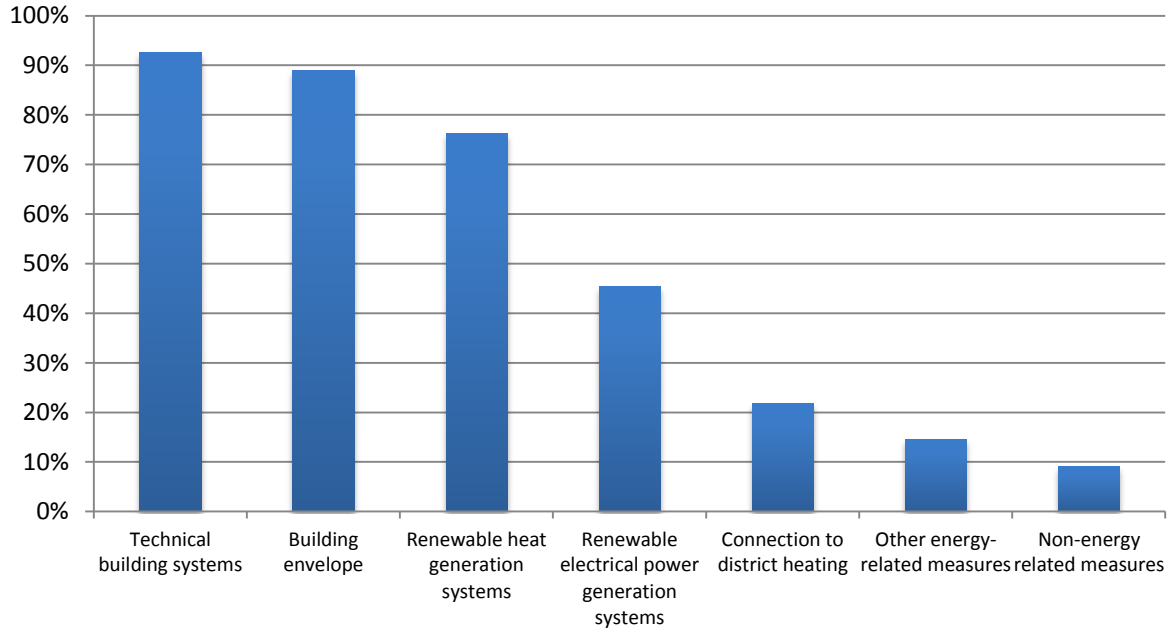


Figure 4 - Types of eligible intervention measures offered by the EU28 economic instruments (*values indicate % of instruments targeting each measure type*)

Motivation, targets and timelines

Recognising the multiple benefits of energy efficiency is a pre-requisite for developing ambitious policy instruments and leveraging considerable investments in the building sector. An assessment of the extent at which different policy drivers provide a motivation for developing financial instruments in EU28 (**Figure 5**) revealed that not all benefits stemming from energy efficiency investments were equally appreciated or recognised at the political level. Energy saving policy, followed by climate policy formed the most common drivers which can be justified by the buildings' position as the biggest energy consuming sector. Other key policy drivers (e.g. boost of construction industry, employment effect, reduction in dependency on international energy imports and fuel poverty alleviation) were important but at a lesser extent. The trends depicted in **Figure 5** can be partly explained by the challenge of quantifying some of the co-benefits[6] of energy efficiency, thereby aggravating the lack of awareness within governments, banks and other key stakeholders. This challenge often leads to underestimation of the cost-effectiveness of economic instruments at societal level. The lack of consideration of these benefits is also reinforced by the fact that their impact is merely concentrated on achieved energy savings and rarely do they extend to general macroeconomic effects (see page 24Error! Reference source not found.).

[6] Co-benefits refer to benefits other than energy or CO_2 savings (Copenhagen Economics, 2012)

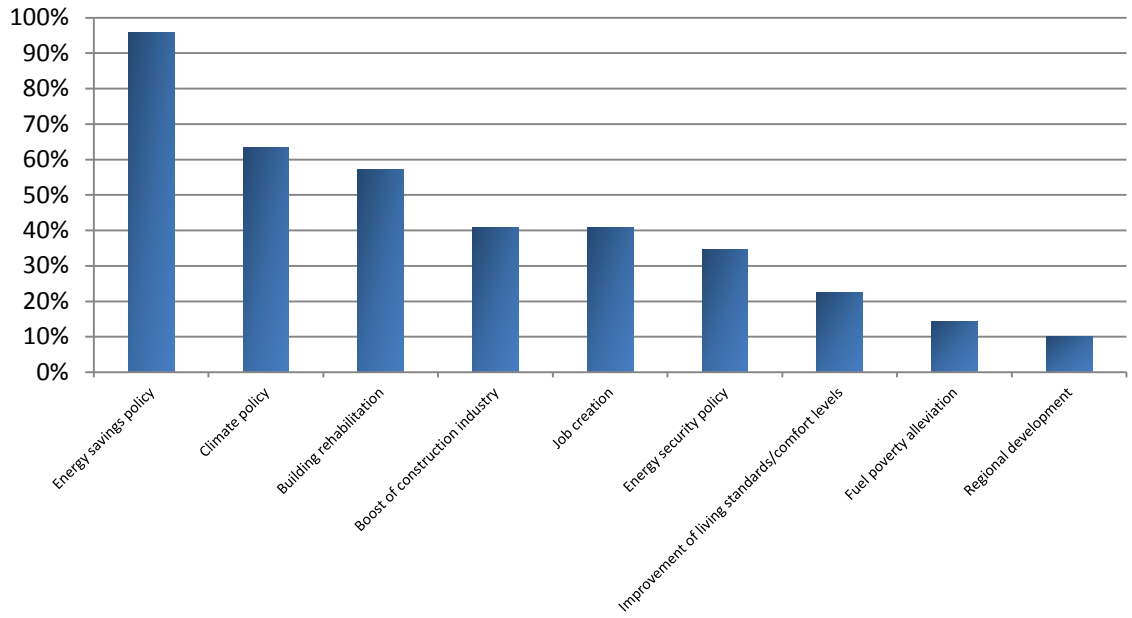


Figure 5 - Policy drivers behind the development of economic instruments targeting energy saving renovations across the EU

Policy instruments attached to an overall target can lead to comprehensive and effective strategies and ultimately measurable and transparent results. The target can be set at the time the policy instrument is introduced and may be readjusted as the instrument matures. This differs from the energy efficiency requirements which may be set for the interventions (e.g. a jump in energy class, maximum energy demand – see section Depth of renovations targeted on page 20). A substantial share of the examined economic instruments (**Figure 6**), however, was found to be affiliated with no particular target. In certain cases, the target was set for the overall policy package instead of individual instruments. If a target was set for individual measures, the target related to energy savings usually expressed as a certain amount of energy savings achieved per year. This was often coupled with a CO_2 savings target as the instrument also typically contributed towards a climate policy. Other indicators used include number of buildings to be renovated or number of awarded applications, which offer simplicity as they are easy to track. None of the current instruments set an energy or CO_2 savings target per building. In other words, a certain depth of renovation to be achieved per building was not fixed as a goal by any programmes.

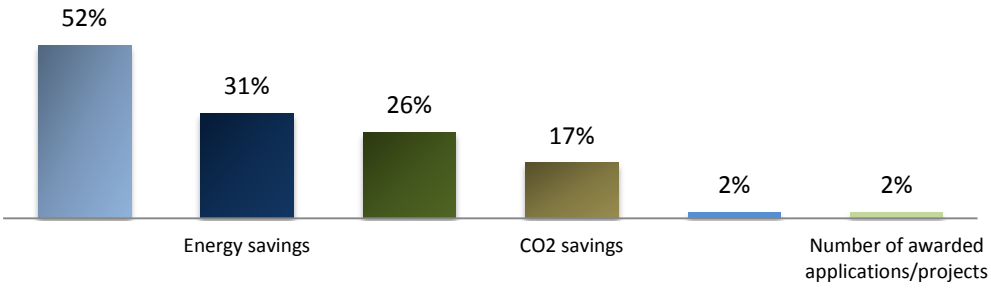


Figure 6 - Type of target chosen for on-going economic instruments

Together with a target, a clear and long term timeline can provide continuity and assurance within the market which is necessary for many actors in the supply chain in

order to plan and realise investments. Out of the reported data, a substantial share of the examined instruments were planned to end before 2015, which emphasises the difficulty of maintaining sufficient budgetary resources in publically funded economic instruments. These instruments were predominantly grants followed by tax incentives. Only a very small share of the examind instruments had a longer term span up to 2020 or beyond, while others were found to be linked with an unlimited or undefined timeline (**Figure 7**). It was also reported that certain programmes were forced to end before their planned end year due to applications exceeding the expected numbers or due to the threat posed by the current financial crisis. The latter was confirmed by several responses which identified the hard economic conditions as an additional risk on public funding continuity.

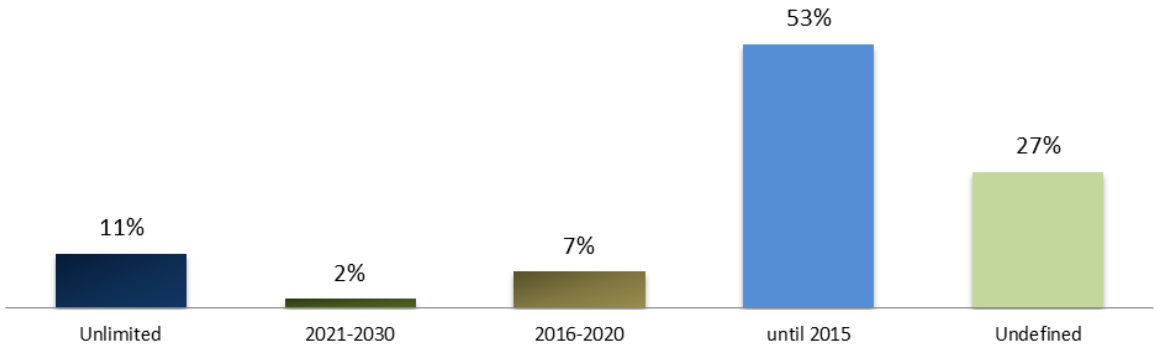


Figure 7 – Foreseen end year of current economic instruments (*values indicate % of instruments ending in each period*)

Interaction with other policy instruments

Economic instruments as part of a well-designed package can be more effective in addressing the various barriers hindering energy efficiency than standalone measures. Around 60% of current economic instruments were reported to be part of a "policy package", whereby the instruments were stated to be simply complementary with other policy tools or part of the National Energy Efficiency Plan. Other instruments were reported to be part of a general energy strategy/plan or a political agreement. Examples of identified long-term energy strategies concerning the building sector are shown in **Table 5**. Some of them have a general scope, where the building sector is one of the many sectors tackled (e.g. Germany and Austria), and others have a specific focus on the building sector (e.g. Belgium). The target is either expressed as a relative reduction of energy or GHG emissions, or the achievement of certain actions as in the case of Flanders and Styria. Based on the examples shown, it can be noted that economic instruments form the main policy tool for existing buildings, while for new buildings the main vehicle is regulations (energy building codes). The need to better define the concept of a policy package is, nonetheless, underlined by the fact that a common understanding of what constitutes a policy package and what it must entail seems to be lacking.

Table 5 - Examples of long-term energy strategies covering the building sector

Strategy	Sector(s) covered	Target for buildings	Policy instruments for the building sector

Energy strategy 2025 of Styria, Austria (Das Land Steiermark, 2010)	Buildings; Industry; Energy; Transport	High efficiency buildings (mandatory nearly zero energy buildings)	Building renovation campaign, Energy building codes for new buildings; Energy saving campaign for households etc.
Energy renovation programme 2020 in Flanders, Belgium[7]	Buildings (residential)	Energy efficient homes by 2020: 1. all roofs insulated; 2. all single glazed windows replaced; 3. outdated boilers eliminated	Energy building codes for new buildings; Premiums and tax credits for energy-saving investments
Energy strategy in sustainable construction in Brussels, Belgium (Dockx, 2013)	Buildings	GHG reduction of 30% by 2025	Energy grants; Exemplary buildings subsidies; Brussels Green Loan; Energy building codes;
Energy Concept 2050 (BMWi & BMU, 2010)	Buildings; Industry; Energy; Transport	80 % reduction in primary energy demand by 2050	Energy Saving Ordinance, KfW programmes

While the concept of policy package is not new, a comprehensive analysis on the optimal mixture of policies and measures together with their interaction is still work in progress (Thomas et al 2013). Economic instruments may interact with building codes, information tools or other economic and regulatory instruments running in parallel. Synergies can be created but there is a risk of different policy instruments undermining the objectives and credibility of each other if the interaction is not well designed (Sorrell, 2003). While the interaction can occur in different stages of the policy cycle, observations could only be drawn for interactions at the design level herein due to insufficient national analysis of the energy saving effect of one measure on another one. Design interactions were found to occur mostly with Energy Performance Certificates (EPCs), which are used to determine the energy efficiency criteria of the planned intervention work. In these cases, the beneficiary can receive financial support only if certain energy label requirements are met, thus ensuring that the most efficient buildings or equipment are supported. In other cases, energy labelling requirements may also apply to pre-renovation conditions ensuring buildings of worst energy performance are tackled first. It is also observed that the EPC scheme is also used as a tool for compliance check, whereby an EPC certifier carries out a check before and/or after the intervention. Economic instruments have also been found to be linked with energy building codes, where incentives are awarded to projects which achieve energy performance levels beyond current building code levels. With increasing number of instruments and measures as part of the implementation of an array of different EU directives, it is imperative to examine the interaction between various policy measures (Boonekamp, 2005, Eichhammer & Schlomann, 2012, Thomas et al., 2013). It should be also stressed that the effective implementation and enforcement of regulations, information tools and building codes is a pre-requisite for their successful synergy with economic instruments.

[7] http://www.energiesparen.be/2020/acties

Depth of renovations targeted

The extent at which various instruments support comprehensive, deep renovations is often a point of debate among policymakers. Although the data provided were limited, the relative energy savings achieved per building indicated a depth of renovation corresponding to the range of 10-70%, with a median of 35%. These figures largely reflect minor or moderate depths of renovation (see section Methodology Scope, page 11), while few programmes seem to support deeper renovations. Policymakers are often faced by the dilemma whether maximising overall energy savings shall be reached through a large-scale implementation of shallow interventions or deep renovations yielding significant energy savings per building but deployed at a smaller scale. Government-supported programmes can generally play a useful role in promoting deep renovations and sending market signals for such investments in the field.

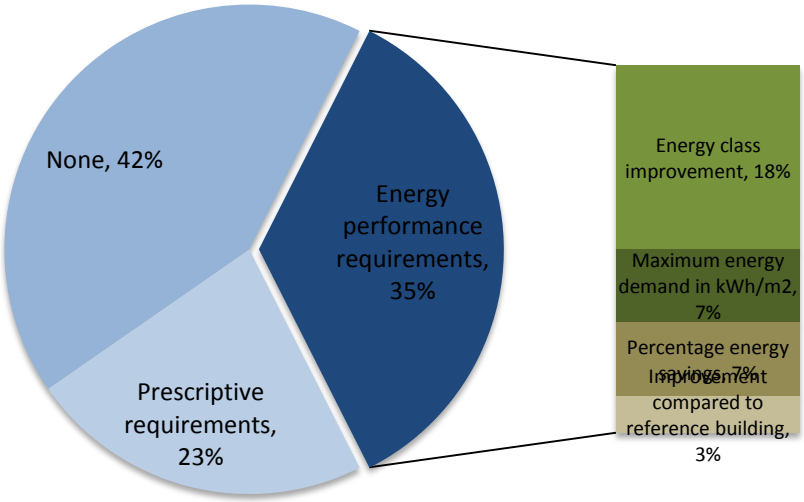
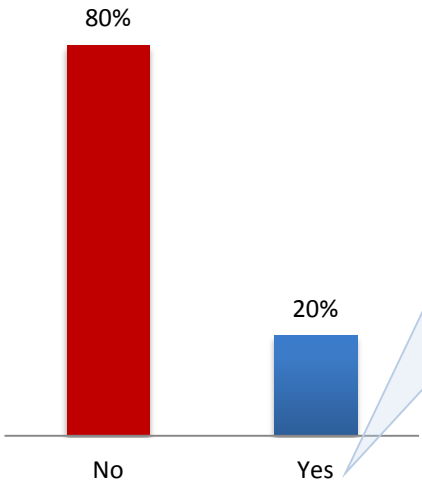


Figure 8 - Energy related criteria attached to current economic schemes in EU28

The fact that current practices provide limited support for deep renovations can also be reinforced by three general observations. Firstly, financial support is generally given for individual or multiple measures without the consideration of these measures being part of a comprehensive package of measures tackling the energy performance of the building as a whole. This was indeed confirmed by many responses provided. A second observation is that the majority of the instruments are either attached to no energy requirements or are linked to prescriptive requirements for individual building elements (**Figure 8**). An analysis of the eligibility criteria set by each instrument in terms of energy-related requirements indicates that these are linked mostly to an energy class improvement, followed by a percentage energy savings, a maximum energy demand or an improvement compared to a reference building. Although some of these cases may not exploit the full potential of the concerned building (e.g. if the requested improvement is a jump of only 1 energy class on the EPC scale), they are a step forward in the sense that they consider the building as a whole. One of the most successful programme supporting deep renovations is the KfW CO_2 energy-efficient renovation programme which offers loans for renovations achieving various "KfW Efficiency House" levels; the most ambitious one being the KfW Efficiency House 55 representing 55% of the maximum primary energy requirement set for a new building. Other examples include the Brussels Green loan 0% ($BE_{BRU}01$) which supports "low energy",

"very low energy" and "passive" renovation and Upper Austria housing subsidy (AT01) which requires at least a 50% improvement. Lastly, performance-linked investment subsidies, which can encourage households, businesses and public authorities to opt for deeper renovations, are currently a limited feature of the examined economic instruments (**Figure 9**). The share of instruments whereby the financial support is enhanced with the ambition levels of the intervention is currently one to five; examples of such instruments are shown in **Figure 9**.



Examples	
AT02	The subsidy rate increases with the ambition grade of construction norms
BE$_{BRU}$02	The premium increase from 70-110 €/m² for low energy renovation to 130-170€/m² for passive renovation
DE01	5%-15% debt relief for loans depending on efficiency; 10-20 % grant intensity depending on efficiency
EE02	25% grant intensity for energy label D; 40% for energy label "C"
LT01	Three levels of subsidy rates (15,30,50%) depending on energy performance achieved
NL02	The maximum amount for the green mortgage increases if the energy label jump is larger

Figure 9 - Correlation between financial support offered and energy performance of intervention work (Yes: more financial support is given if more ambitious measures are chosen, no: financial support is not linked with energy performance)

From source to destination: the flow of finance

To date, there has been no collective evaluation on the amount of money disbursed by economic instruments for energy renovation projects. The main obstacle is that finance related to these investments is not systematically and comprehensively tracked. The European Investment Bank has provided a rough estimate of €15-20 billion for energy efficiency investments in 2010, a significant part of which comes from public funds[8]. An attempt to track the disbursed budget for the examined instruments within the scope of this report is presented in **Figure 10**, which illustrates the average yearly disbursed budget of economic instruments running in the year 2013. It is estimated that around € 9 billion are collectively spent on average by these programmes[9] every year, which leads to investments of at least €24 billion. Building industry research, however, suggests that € 65 billion in buildings retrofits per year are necessary, which implies

[8] EIB(2012), Energy Efficiency Investments by Public Banks: EIB experience and strategic view, EIB estimation from several external studies, Presentation 11.01.2013.

[9] The disbursed budget data represent gross costs without taking into account the economic effects of the generated energy savings, such as reduction in unemployment or energy imports. For tax instruments, these reflect the reduced government income due to lowered collected tax. The budget source for white certificate/EEO schemes is included in the category "other" as the costs of these instruments are usually reflected in the energy tariffs to the final consumers.

that current efforts made by these instruments are not adequate to meet our long-term goals (EIB, 2013).

The funding sources can be distinguished into national/regional budgets, EU funds, revenues from emission allowance auctioning, international financial institutions and private investment funds. **National or regional budgets** constitute the largest source of funding to-date, representing **90%** of the total budget disbursed (**Figure 10a**). They can originate from different streams, such as regular budget allocations, earmarked public revenues from environmental/energy related taxes and other charges (Hilke & Ryan, 2012). EU funding is the second most important source, whereby the European Structural and Cohesion funds (Cohesion policy) have allocated a budget of € 5.5 billion for energy efficiency projects in different sectors including buildings in the period 2007-2013[10] (European Commission, 2013). Relevant examples within the scope of this research – partly or fully supported by EU funds – include the Lithuanian building modernisation programme, the Bulgarian Operational Programme "Regional Development", the Greek Energy efficiency of residential buildings programme and the Kredex Fund in Estonia. **Revenues from emission allowance auctioning** are particularly important for the so-called Green investment schemes (GISs) in Central and Eastern European countries. Money from trades of surplus AAUs in these countries are funnelled into energy efficiency programs which incentivize customers to engage in activities that reduce GHG emissions. Countries with GISs devoted to building energy efficiency include Czech Republic, Latvia, Hungary, Poland and Estonia[11]. **International financial Institutions** have also been active with energy efficiency lending activities for many years, but form a smaller funding source, as shown in **Figure 10a**. Examples include the European Bank for Reconstruction and Development (EBRD) which has provided loans and equity for several energy efficiency projects in the EU, amounting to €1.8 billion since 2002. The European Investment Bank (EIB) also provides support through traditional lending facilities while it is involved in several initiatives together with the European Commission such as EEEF, JESSICA, ELENA and EPEC (Kovacheva, 2013). Another active IFI is the Council of Europe Development Bank (CEB) which has approved a total of €1.9 billion for energy efficiency since 2002 (European Commission, 2013). **Private investment funds** are currently a very limited source of funding and this highlights the need to increase private involvement in energy efficiency investments.

Public and private intermediaries play an important role in channeling funds from different sources to their destination. In addition to gathering and distributing funds to the target groups, they may also provide additional finance. The intermediaries, responsible for the implementation of the examined economic instruments according to the size of their managed budget are shown in **Figure 10b**. Governments (e.g. ministries) form the largest intermediary, with a nearly €20 billion euro budget spent for ongoing instruments. Energy efficiency agencies represent the second biggest intermediary and their popularity can be explained by the fact that they bring

[10] For the period of 2014-2020, the money allocated for energy efficiency in these funds is expected to more than double with funding opportunities for energy renovations in public and private housing. Other sources of EU funding include the European Energy Efficiency Fund (EEE-F), the European Local Energy Assistance (ELENA) Facility under the Intelligent Energy Europe and combined EU grants with IFI funding under the PHARE instrument

[11] Czech and Latvian programmes were out of scope of this research as they ended before 2013. However, the Czech Republic is in the process of establishing a New Green Savings scheme to be implemented in 2014.

specialised expertise together with assistance in policy design, implementation, monitoring and evaluation. Examples of energy efficiency agencies that administer funds for energy renovations include the Portuguese Energy Agency (ADENE), Flemish Energy Agency (VEA), Spanish Institute for Energy Diversification and Saving (IDEA) and Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA). Funds dedicated specifically for energy efficiency, were also identified: examples include the Belgian Fund for the Reduction of the Global Cost of Energy, Bulgarian Energy Efficiency and Renewable Sources Fund (EERSF), Croatian Environmental protection and Energy Efficiency Fund, the Romanian Energy Efficiency Fund and Polish National Fund for Environmental protection and Water Management. Some of them, such as the Estonian Kredex Fund, are set as revolving funds and are therefore self-sustained. With a mandate to deliver social goals, public banks, set up and largely owned by governments, can act as intermediaries but they may provide funds either through general public budget or procured funds from the private financial markets (Hilke & Ryan, 2012). The German Kreditanstalt für Wiederaufbau (KfW) is the main public bank identified here and is actively involved in energy renovation projects. Other banks include the Polish Bank Gospodarstwa Krajowego (BGK), French Caisse des dépôts et consignations (CDC), Italian Cassa Depositi e Prestiti and Hungarian development bank (Hudson, Schopp, & Neuhoff, 2013).

A new EIB initiative named DEEP Green is planned to provide debt for energy efficiency projects and aims at developing a suite of new financial products for four key groups of players in the EE market: banks, public sector, ESCOs and utilities. DEEP Green targets aggregation and de-risking of energy efficiency (EE) projects and is expected to increase debt financing availability for EE projects by further developing EIB and commercial bank lending activity to EE.

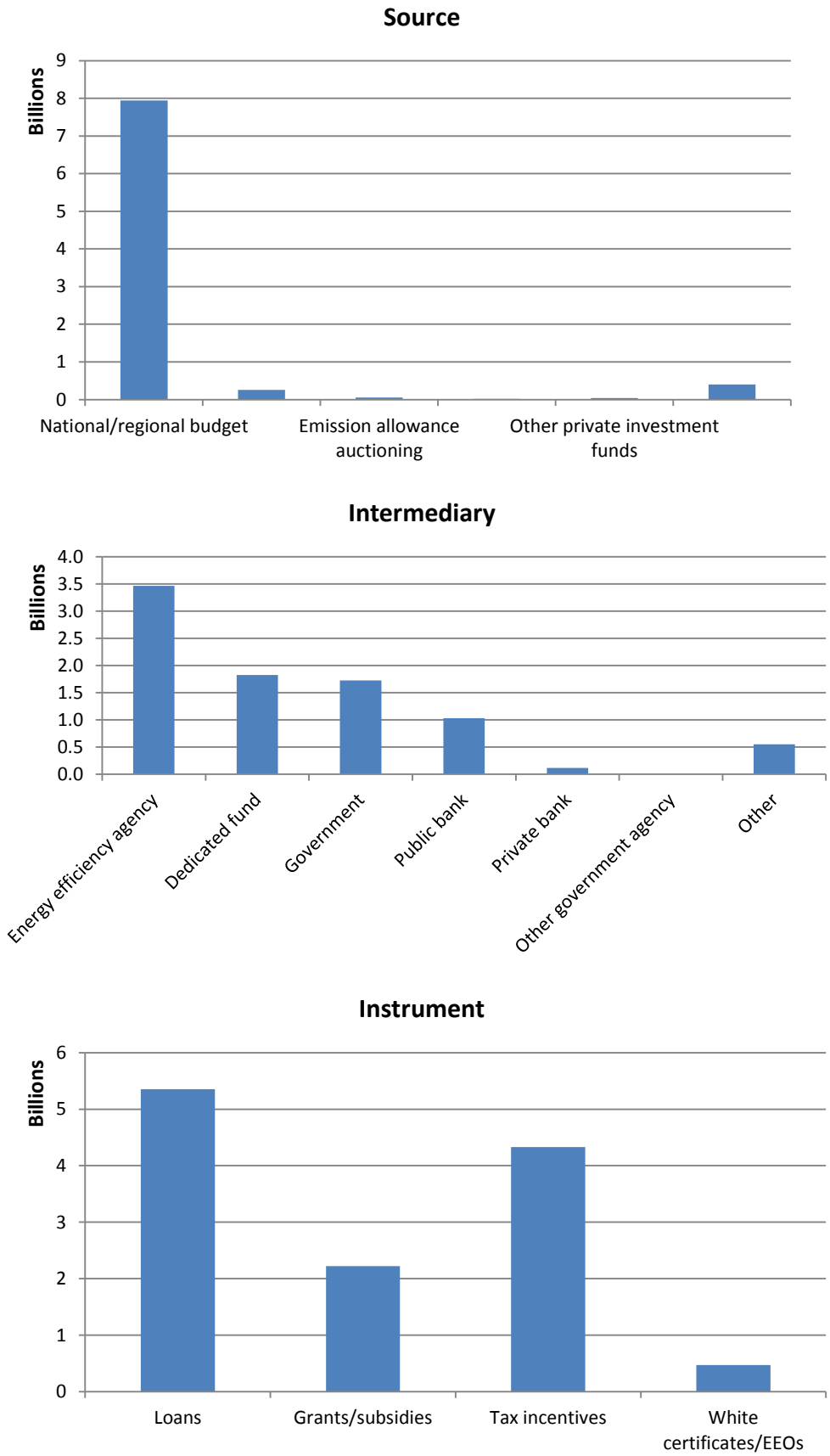


Figure 10 – Average yearly disbursed budget of examined economic instruments by (a) source, (b) responsible intermediary and (c) instrument type

Measuring the impact

Measuring the policy impact is critical for evaluating the effectiveness of policies at different levels. Although some general statements can be made about the characteristics of the various policy instruments, knowledge about the effectiveness of policy instruments is generally limited. The reasons are two-fold. Firstly, studies of the effectiveness and cost-effectiveness of policies that focus on end-use energy efficiency are generally limited. Our analysis shows that around 33% of the studied instruments have not had any assessment carried out, while systematic ex post evaluation seem to be of lower priority among policy makers (**Figure 11**). Without a comprehensive impact analysis, it is difficult to assess factors of success and failure which can subsequently allow conclusions on their impact to be drawn.

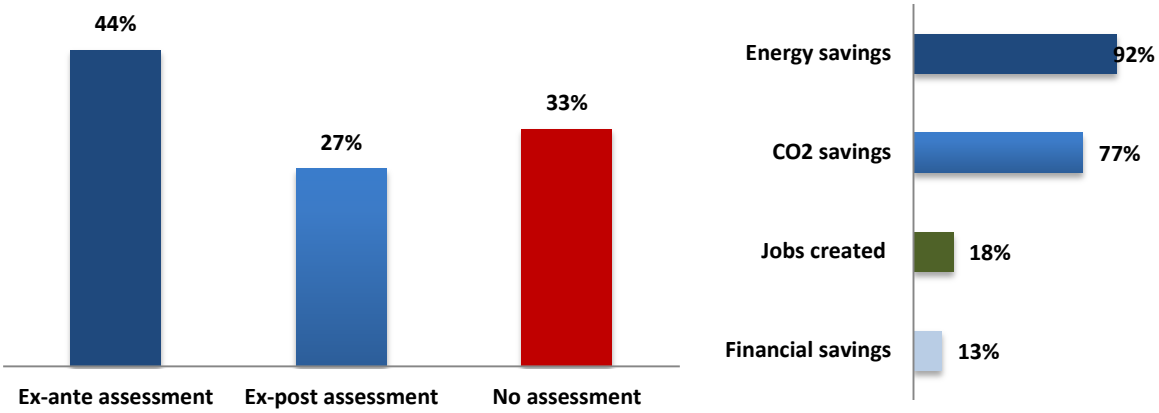


Figure 11 – Analysis of assessment undertaken for examined instruments including the main indicators used to evaluate the instrument impact

Secondly, a comparison between different policies is not straightforward. Overlapping between one or more policy instruments will inherently add complexity at calculating and attributing energy savings to each instrument. Moreover, if the intended impacts of two or more instruments are not coordinated (e.g. if they are not part of the same policy package) the challenge becomes bigger. Different methodologies, baselines and indicators used mean that results are not directly comparable. For example, some policies choose to measure their impact in terms of final energy savings achieved, others in terms of primary energy savings or CO_2 savings. In certain cases simple indicators such as number of enrolled buildings or number of sales of certain equipment or technologies are used but cannot be directly translated to savings. Although information was collected for a small share of instruments, various methodologies are deployed to calculate energy savings, ranging from direct measurements, software simulations to building stock modelling, econometric modelling and others **(Figure 12)**.

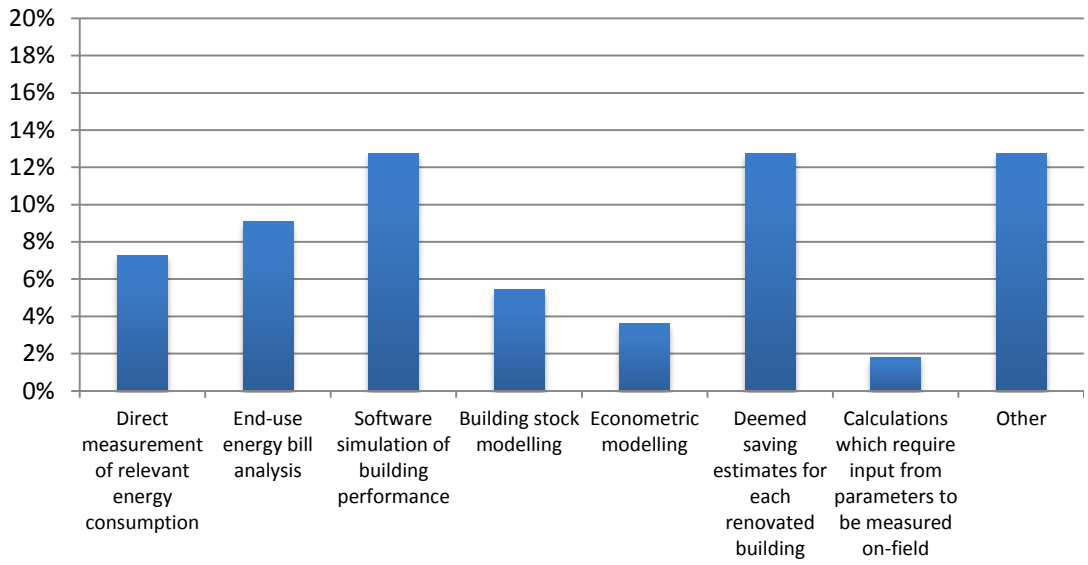


Figure 12 - Share of instruments using a range of different evaluation methods for energy savings calculations

The lack of detailed data collection and analysis for various programmes does not only prevent adequate evaluation of these programmes in terms of their effectiveness, but also reinforce the barrier of missing or asymmetric information faced by the market for energy efficiency, ultimately affecting the demand for energy efficiency by property owners and occupiers. More detailed data should be tracked on participation rates, types of renovation made, energy savings, methodology used to calculate energy savings, government costs, breakdown of government costs, volume of investments made, employment effects. In case of loan programmes, financial performance of EE loans including factors that lead to defaults are also important.

Table 6 - Employment effects of some instruments across the EU

Employment effects	
BG01	2000-8000 employees per year (ex-ante)
ES01	1700 jobs per year (ex-ante)
FR04	52 800 jobs created per year (ex-post)
EL01	5050 jobs per year (ex-ante)
UK01	38 000-60 000 jobs in the insulation sector by 2015 (ex-ante)

Chapter 2 – Economic instruments in detail

Grants/subsidies

Grants and subsidies are generally applied when governments consider that the optimal level of energy efficient investments cannot be fully supported by the market alone. They can partly help overcome the upfront cost barrier as they directly fill an immediate financial gap and thus enable a temporary shift in the market. As explained below, direct investment subsidies rely on limited resources and can neither offer a sustainable solution nor support massive market uptake programs.

Design considerations

From the examined grant/subsidy schemes, it can be deducted that over 70% of them are directed towards residential buildings, 45% public buildings and 26% commercial[12]. The target groups are mainly households, housing associations, public authorities, while most supported measures include building envelope improvements, technical building systems and installation of renewable heat generation systems.
An overview of the financial support offered by various grant schemes across Europe is shown in **Table 7**. These mainly serve as direct investment subsidies[13]. The project investment size supported varies greatly from a few thousand to over €1 million, reflecting the varying nature and scope of the eligible projects. The support may cover the entire renovation costs including acquisition of material/equipment, advice, certification and installation. The financial support provided can be expressed as a percentage of the total investment– with reported grant intensities in the range of 15%-100% of total costs – or as a subsidy expressed as €/m^2. Any remaining costs are either self-financed or covered by a loan.
In summary, it can be deduced that the grant intensity may vary with the following parameters:

- energy performance improvement
- household income
- target group
- intervention measure
- innovativeness of technology

An interesting design element is observed in the evaluation process of the Portuguese Energy Efficiency Fund whereby more points are awarded for applications planning to deploy measures beyond those supported by the call. In this way, while financial support is provided only for two types of measures in total, the scheme indirectly encourages beneficiaries to engage in more energy efficiency activities.

Table 7 - Examples of financial support provided by grant schemes across the EU

AT01	The subsidy varies depending on the region and the energy performance achieved after the renovation. Some regions use a step-based and others a point-based system to evaluate the subsidy

[12] Please note that some programmes support more than one segments of the building stock

[13] An exception is the Belgian scheme ($BE_{BRU}04$) which subsidises the salary of the energy manager instead of directly supporting the investment itself.

	to be granted.
AT02	For residential buildings: € 5000 + bonus for insulation material derived from renewable resources. For commercial buildings: 30 % of the investment costs (maximum €1.5 M per project). For public buildings of municipalities: 18 % of the investment costs + requirement of additional 12 % of the regions (Länder).
$BE_{BRU}03$	A €100/m^2 subsidy, which is distributed between the designer (€10/ m^2) and the building owner (€90/m^2).
$BE_{BRU}04$	A share of the salary of the energy manager is subsidised - 100%, 75%, 50% depending on the sector. This is negotiated with the participants for each project (local communities, schools, hospitals, social housing).
BG01	A subsidy of up to 20% of total cost of renovation including the package of technical services (technical inspection, energy performance certificate and consulting).
BG04	70% of project value is subsidised for residential buildings; 100% for municipal and state buildings.
CY01	Subsidy can cover 30 to 55% of the total investment cost.
DE01	A 10-25% subsidy for investments ranging from € 5,000 - 18,750 per residential unit, depending on energy efficiency ambition level of the renovation work.
EE02	The subsidy rate is 25% for energy label "D" or 40% for energy label "C". A 60% grant is given for solar domestic hot water production and 70% for PV panels or windmill for electricity production. The grant allocation ranges from €1000 - €30,000.
EE03	A grant equivalent to 15%, 25% and 35% of the total project cost depending on the level of integration in the reconstruction is available. There is no maximum amount of support.
EL02	A 70% subsidy is given covering costs of technology, materials, installation costs and energy certification. The maximum amount of support is defined according to the municipality's population. A legislative regulatory is prepared to increase the level of subsidy form 70% to 100%.
FI01	The grant intensity shall not exceed 25% of the expenditure approved by the municipality. The amount does not exceed the maximum limit of €200,000.
FI03	Grant intensity for conventional technology is 20%; grant intensity for new technology is 25-35% .
FR06	A grant of €1350 is available for medium and low income households, which is independent on the actual amount spent.
HU08	A 30 - 75% (depending on supported activities/target groups) for investments ranging from 1 to 500 million HUF per application.
HU10	A 40 - 60% (depending on supported activities/target groups) for investments ranging from 1 to 500 million HUF per application.
IE01	The average grant amounts 30% of total works. Grant levels were reduced since the scheme started as market competition provided lower prices for most works.
IT03	A grant of 40% of the total investments is provided with monthly instalments for 2 to 5 years depending on intervention type.
LV01	A maximum grant intensity of 50 % of total eligible project costs is available (or 60% if at least 10 % of apartment owners of the multi-apartment residential building have been granted the status of disadvantaged person), with a maximum cap of LVL 35 (€54) per m^2.
PL01	Grant intensity within the range of 30-100% is available for various eligible interventions.
PT01	A maximum of €1500 or 50% of eligible expenses submitted for thermal solar systems case; and €1250 or 50% of eligible expenses for window replacement.
RO01	An 80% subsidy is provided (50% from state and 30% local budgets). The remaining 20% of the total rehabilitation work costs is divided among all owners, each having a share, depending on each owner`s undivided share.
SI01	Grant intensity up to 90% (mainly in range 60%-90%) is available.
SI02	Grant intensity is on average 17%, and varies depending on subsidised measures and equipment criteria.

Implementation

Governments form the main implementing bodies of grant schemes with dedicated funds being the second most common body followed by energy efficiency or other

government agencies (**Figure 13**). As expected, the funding mostly originates from national and regional budgets where at least half of the grant schemes are wholly supported by national/regional sources (**Figure 14**). Other sources of funding include EU funds and sale of assigned AAU units.

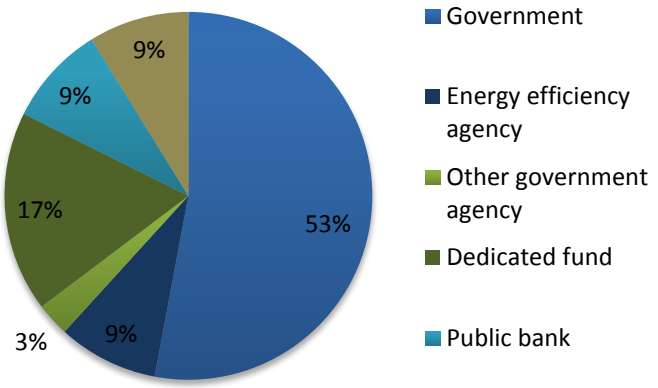


Figure 13 - Intermediary bodies responsible for the implementation of grant/schemes

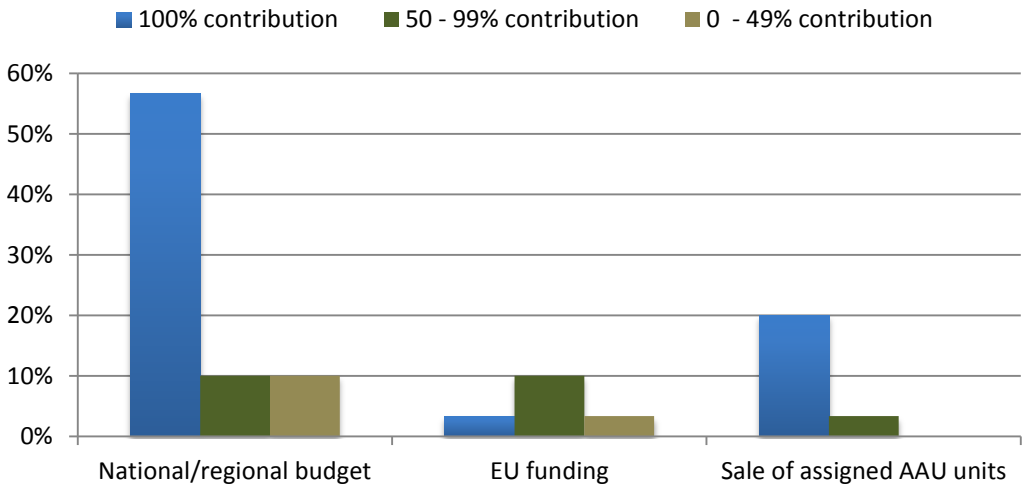


Figure 14 - Composition of grant schemes (as a % of all grant schemes) by funding source and their relevant contribution

Impact and evaluation

It is difficult to review the effectiveness of grant instruments without a proper assessment. From **Table 8**, it is clear that many of the reported programmes lack an ex-ante or ex-post assessment, while in some cases neither an ex-ante nor ex-post assessment has been carried out. Due to the absence of target setting and/or regular monitoring, it is not possible to deduct how the actual participation compares against the expected outcome. It can be however observed that even the most prominent instruments cannot offer a real widespread implementation. For example, the Austrian programme in the years of 2009-2011, resulted in interventions of residential buildings in the order of 200,000 dwellings, corresponding to around 1.6% of annual renovation rate of their residential building stock. With 3 million enrolled dwellings in the period 2006-2012, it can be deducted that an about 1% of the German residential stock was

tackled by the German KfW programme[14]. Other schemes have been found to have a much smaller effect.

Subsidies schemes often attract recipients who would have carried out the investments even without the incentive, the so-called free riders. A more careful design of grant schemes can reduce the effects of free ridership. For example, the eligible interventions can be restricted to renovations leading to state-of-art energy performance requirements or the scheme could be open only for a specific target group, e.g. low income households and small and medium enterprises. Indeed, some of the current schemes adopted this approach, examples are shown in **Table 7.**

Table 8 - Impact indicators of grant schemes in Europe

CODE	QUANTITATIVE TARGET	PARTICIPATION INDICATOR	TOTAL INVESTMENT	EX-ANTE ANALYSIS	EX-POST ANALYSIS
AT01		216,264 dwellings (2009-11)			CO_2 savings: 279kt/a (2011)
AT02		12,848 projects (2012)	€517 M in 2012		
$BE_{BRU}02$			€80,503,600 in 2012; €93,981,400 in 2013		Energy savings: 244 GWh/a Financial savings: €22 million/a (2004-2011)
$BE_{BRU}03$		193 buildings of 521,836 m^2 (5 project calls)	€677,006,888 for 5 project calls		
$BE_{BRU}04$		1380 buildings of 4,500,000 m^2 out of which 313 priority buildings improved (9 year period)			Energy savings: 141215 GWh/a CO_2 savings: 0.031 Mt/a Financial savings: €4.25 million/a Employment: 34 jobs/a (2006-2013)
BG01	105,000 dwellings for the period 2005-2015; 579,676 renovated dwellings for the period 2008-2020;			Employment: 2000-8000 jobs (2006-2013)	
BG04	180 renovated multi-family buildings for a period of 3 years	1 093 dwellings (2007-12) 83 public buildings (2012)	Approx. €26 million for 2012-2015	Energy savings: 21.5 GWh/year CO_2 savings: 0,015 Mt/year (2012-2015)	
CY01					
DE01*		3 million dwellings	€135 billion for 2006-2012		CO_2 savings: 6.5 Mt/a (2006-2012)
EE02		68 buildings of 14,262 m^2 (2012)	€9,891,766 for 2012-2013		
EE03		10,877 dwellings of 734,330m^2 (2010-12)	€34,700,000 for 2010-2013		CO_2 savings: 0,21t CO2e emission factor/MWh
EL02	9.957,57 kWh/m2 per year		€49,487,228 for 2009-2015	Energy savings: 28.92 GWh/year CO_2 savings: 0.0087	

[14] This however also takes into account new construction

				Mt/year	
FR06	No official target, but 90,000 dwellings could be renovated				
HR01			Approx. €82 million since 2004		
HU01		1129 projects; 65,360 dwellings		Energy savings: 146 GWh/a CO_2 savings: 60,40 Kt/a	
HU02		1042 projects; 1,662 dwellings		Energy savings: 20.3 GWh/a CO_2 savings: 4.3 Kt/a	
HU03		386 projects; 432 dwellings		Energy savings: 10.1 GWh/a CO_2 savings: 2.1 Kt/a	
HU04		3517 projects; 3559 dwellings		Energy savings: 11.8 GWh/a CO_2 savings: 3.6 k t/a	
HU05		415 projects; 418 dwellings		CO_2 savings: 2.5 Kt/a	
HU06		718 projects; 35,765 dwellings		Energy savings: 116.8 GWh/a	
HU07		1423 projects; 96,820 dwellings		Energy savings: 150 Gwh/a	
HU08				Energy savings: 697,37 GWh/a CO_2 savings: 166 Kt/a	Energy savings: 56 GWh/a CO_2 savings: 16,109.15 t/a
HU10				Energy savings: 117 Gwh/a CO_2 savings: 38 Kt/a	Energy savings: 5.4 GWh/a CO2 savings: 2166.03 t/a
IE01		10,877 applications or renovated floor area of 377,188m^2 for 2009-2013	Approx. €441 million for 2009-2013		
IE02					
IT03				Energy savings: 2-2,5 Mtoe Financial savings: €30-35/saved MWh (2013-2020)	
LV01		7560 dwellings with floor area of 493,050m^2	€40,704,715 for 2009-2013		Energy savings: 130 GWh/a
PL01	Energy management in public buildings part 1: 124 921 Mg CO2/a part 2: 112 780 Mg CO2/a	1,541 buildings for 2010-2013	Approx. €357.4 million for 2010-2013	Energy savings: 527 GWh/a CO_2 savings: 201 065 Mt/a (March 2010 - September 2013)	
PL02		27,546 projects (1999-2012)	Approx. PLN 8,481.27 mln for 1999-2012		
PT01	Overall 1467 buildings to be renovated for a budget of €2 million	1422 buildings (2012-2013)	€3,867,838 for 2 years		
SI01		126,000 m^2 (2011-2013)	Approx. €16.7 million for 2011-2013	Energy savings: 9,7 GWh/a CO_2 savings: 0,3	

				Mt/a (2014-2034)	
SI02		43,776 projects (2008-2012)	Approx. €342.5 million for 2008-2012		Energy savings: 324 GWh/a CO_2 savings: 0,05 Mt/year (2013-2023)

Footnotes

*Together with grant scheme

Loans

Debt financing in the form of loans can be a more sustainable means of financing in comparison to grant or subsidy schemes. They provide liquidity and direct access to capital which can be more relevant for energy efficiency measures attached to high upfront costs, especially in deep renovation projects. Private debt finance supporting energy renovations is limited as financial institutions are typically unfamiliar with these investments and perceive energy efficiency loans as high risk investments. High transaction costs for relatively small projects and failure to offer financing for terms long enough to support deeper measures are all factors hindering market uptake. To address some of these issues, international financing institutions and national governments have intervened with the aim to provide subsidies in public-private partnerships so that financial institutions can offer customers loans with attractive terms.

Design considerations

A comparative analysis of different loan schemes currently used in Europe in terms of loan cap, equity contribution, interest rates, and maturity terms is provided in **Table 10**. While attractive loan terms are not the only pre-requisite for success, reducing the cost of loans to final recipients can theoretically incite a larger number of applicants.
The recipient of the loans are typically the building owner – owner occupiers or landlords of residential, public or commercial buildings – while a few programmes are also open to the occupants. For example, low income tenants may also apply for the Brussels green loan scheme ($BE_{BRU}01$) given that they have the approval by their landlord. In Flanders ($BE_{VLG}02$), the "most vulnerable persons" can obtain assistance by a local subsidiary (called "Local Entity") in choosing measures, carrying out the work and making payments. In practice these tenants are long-term tenants and the landlords can accept an engagement of co-financing or lower the loan or guarantee a minimum duration of rental contract. The tenant stays responsible for repayments of the loans. The UK's Green deal deploys the most innovative approach whereby the loan is not attached to the property rather than the building owner. When the original owner or tenant leaves the property, the loan continues to be paid by the next occupant. It can be useful for building owners who cannot or do not want to increase their debt. Such innovative practices are described in more detail in Chapter 3 - Innovative instruments and mechanisms
The examples shown in **Table 10** depict the various approaches adopted to offer preferential terms in order to make the product more attractive to customers. Low interest rates are common feature of most of these loan schemes. In certain cases, zero interest rate loans are available such as in Belgium, Croatia and France which are usually directed towards the most vulnerable groups such as low income households. This is primarily due to the government mandate and resources that enable the institutions in charge to offer these attractive terms. In case of France, the cost difference between the normal- and zero-rate loans is paid by the government through a tax credit scheme offered to participating banks. Incentive payments in order to offset some of the project cost are also a common practice, as shown in **Table 10**. For example, incentive payment of 20-35% with a cap of 9,000€ is offered by the Bulgarian (BG03). Some programmes also offer additional tax benefits to participants; for example

the Greek programme allows for a reduction in payable tax, which can reach €300 for energy efficiency expenditures of up to €3000. In other occasions, the costs of audits or energy performance certificates are covered by the programme, thus subsidising the associated transaction costs.

Guaranteeing loans or pre-funding reserves (funds set aside to cover defaults) enable lenders to both offer loans to a wider (more risky) group of borrowers, and also to offer lower interest rates because of security provided by the guarantee. Such groups could be ESCOs with business in energy efficiency. As ESCOs need to raise debt to fund their performance contracts or have a line of financing ready and fill it in with projects, support available in the form of guarantees can control their risk with delayed payments or defaults from clients. An example is the Bulgarian Energy Efficiency and Renewable Sources Fund (BG03) which provides ESCO portfolio guarantee, and thereby undertakes some of the risk of the ESCO associated with disruptions in the flow of receivables of the ESCO. Other examples of guarantees provided include the Estonian Renovation loan for apartment buildings (EE01), Spanish Aid Program for the Energy Rehabilitation of Existing Buildings (ES01) and Romanian programme on the thermal rehabilitation of residential buildings, (RO02).

In terms of repayment mechanism, most loan schemes are based on a standard monthly loan repayment bill. However, there is growing interest in attaching repayments for energy efficiency loans on the utility bill (i.e. on-bill financing). The only European scheme which currently applies the mechanism of on-bill financing is the UK Green Deal. The Green Deal scheme makes a link between loan repayment and energy savings, with the condition that savings must exceed loan repayment amount. As the scheme is very new (its implementation started in 2013), but concerns however have been raised due its high interest rate and its potential impact on primarily low cost measures (see Chapter 3, page 52). Ireland is also in the process of establishing a new scheme which incorporates the on-bill financing concept.

A summary of key design options for energy efficiency loans is shown in **Table 9**. An option for stretched underwriting criteria can be for lenders to consider energy savings on the income side when they are evaluating a borrower's credit using a debt-to-income ratio.

Table 9 – Summary of key design options for energy efficiency loans

FINANCING MECHANISM	COLLECTION MECHANISM	ENHANCEMENT	SECURITY
Person loan	Amortised payment bill	Reduced interest rate	Unsecured
Mortgage	Lease payment	Stretched underwriting criteria	
Credit line	On utility bill	Guarantees	Lien on real estate
Lease	On property tax bill (PACE)	Tax incentives	Lien on other property
Performance contract	Performance contract bills	Subsidised transaction costs	Disconnection from non-payment

Source: Adapted from Fuller (2009)

Table 10 - Key terms of national loans financing energy efficiency improvements in existing buildings

	INTEREST RATE	LOAN AMOUNT (€)	EQUITY CONTRIBUTION (%)	MATURITY	LOAN SECURITY	GOVERNMENT GUARANTEE	BUNDLED GRANT OR SUBSIDY
$BE_{BRU}01$	0%	500-20000	0%	Up to 7 years		Yes	No
$BE_{VLG}02$	0-2%*	10,000	0%	5 years			Can be combined with grants
BG02	At least 7.90%	Circa 50,000	0%	10 years	Life insurance; Cash		Incentive payment of 20-35% with a cap of 9,000€
BG03	4.5-9%		10-25%	5 years	ERSF requires standard loan collateral: mortgage, pledge on movable property, claims on accounts and commercial contracts, financial risk insurance, bank guarantees, etc. The form of collateral and its size are defined according to the financial standing of the respective borrower. Currently EERSF does not apply future savings as collateral for loans to ESCO companies, because of difficulties with the repayment of the loans of such contracts in the past 2-3 years.	Partial - 80% on a "pari passu" basis or 50% on a first-loss basis after the bank-creditor; ESCO portfolio guarantee; Residential portfolio guarantee	
DE01	1-1.6%	150/m2	0%	30 years			A subsidy of up to 17.5% can be combined with the loan depending on efficiency level achieved
EE01	3.5 – 4.0%	min €6400	15%	20 years		Guarantee of 75% of the loan amount	15% self-financing can be covered Kredex reconstruction grant
ES01	Interest rate Euribor + 0.0%	max €9000?	?	12 years		Guarantee or surety contract amounting to 20% of the loan amount	30% grant for envelope measures;

FR02	0%	max €30,000		10 years	The lender is entitled to require the borrower to take out invalidity and death insurance. It may also require security for the loan, the cost of which is borne by the borrower.		
EL01	0% for up to 85% of investment	max €15,000	0	Up to 6 years		No guarantee required	Grant of up to 70%; can be combined with tax incentives;
HR01	0%			5 years			Grant of up to 40%; 2 year grace period
LT01	3%		0%	20 years?			15-25% subsidy if class D renovation is achieved
NL02	Favourable rate	max €100,000					
PL02				10 years			20% grant for loan amount (equivalent to no more than 16% of investment cost)
RO02	Subsidised interest rate	€1,850 per unit for multi-family housing, €7400 for single family	10%	5 years		Loan is 100% guaranteed by the National Credit Guarantee Fund for Small and Medium Enterprises (FNGCIMM)	A 30% grant of investment costs may be possible
SK02		€20,000-€2,500,000					A 7.5-15% grant of the loan amount and free technical assistance
UK01	7.50%	Expected 10,000 GBP but no official cap	0%	25 years			

* Interest-free loans are provided only for vulnerable groups. The interest rate is subsidised by the Flemish government

Implementation

The main actors involved in the implementation of loan programmes are governments, international institutions or public banks which typically establish public-private partnerships in order to incite customers to adhere to a particular scheme. By establishing a concurrent collaboration between public and private sector, joined resources can be raised which enables a market transformation while public aid is still on-going is present. Public-private partnerships tend to be sustainable since they tend to foster a genuine market transformation. Although they do not offer much flexibility in the targets on which they apply, they allow much flexibility in the tools to be applied by the private sector. An overview of the main intermediary actors is presented in **Table 11**. A notable example is the KfW soft loan scheme whereby public funding

decreases the cost of loans, which are then distributed by private banks. The German public bank KfW has had a long tradition in subsidising housing renovation and finances itself at low rates on the capital markets thanks to its AAA rating and the guarantee of the Federal State. KfW receives a subsidy from the government to lower the interest rate at which it lends to the commercial banks, which can thus propose loans to homeowners under market rates.

Table 11 - Intermediary actors involved in energy efficiency loans

CODE	MAIN ACTOR	SECONDARY ACTOR(S)
$BE_{VLG}02$	Fund To Reduce the Global Costs of Energy	Local authority
BG02	EBRD (International financial institution)	Procredit Bank; Raiffeisen Bank; DSK Bank; CIBANK; Piraeus Bank; United Bulgarian Bank
BG03	EERSF has the capacity of a lending institution, a credit gurantee facility and consulting centre. The principle of its management is a public-private partnership.	
DE01	German government-owned financial institution, KfW	Retail banks
EE01	KredEx is a state-owned credit and export guarantee fund, which has received loans from the Council of Europe Development Bank (CEB), guaranteed by the Estonian State, and also receives funding from ERDF together with income from the sale of AAUs under the Kyoto protocol.	Swedbank, SED
EL01	Hellenic Fund for Entrepreneurship and Development (ETEAN SA)	Alpha Bank, EFG Eurobank, Piraeus Bank, National Bank of Greece
ES01	Institute for the Diversification and Energy Saving (IDEA)	-
FR02	Society of Management of Funds for Guarantee of home purchasing (SGTGAS)	Banques Mutualistes, Coopératives "Etablis sements spécialisés"
PL02	State owned bank, Bank Gospodarstwa Krajowego (BGK), provides 20% grants for the loan amount borrowed by clients from its participating banks	Various Banks collaborating with BGK state bank
RO02	National Credit Guarantee Fund for Small and Medium Enterprises (FNGCIMM)	CEC BANK SA and BCR
SK02	Slovak Energy Efficiency and Renewable Energy Finance Facility - SLOVSEFF	Ceskoslovenska obchodna banka, Slovenska sporitelna, Tatra banka, UniCredit Bank Slovakia, Vseobecna uverova banka

Impact and evaluation

An overview of the impact of the loan schemes identified is presented in **Table 12**, which provides information on the target set prior the implementation, the participation indicator (e.g. volume of loans issued), the average loan size and assessment results. Some loans resulted in investments which mostly focused on energy efficiency measures, while others supported both energy efficiency as well as renewable energy measures (e.g. $BE_{VLG}02$). The average loan size varied from €1.5 thousand in case of Bulgaria to €2 million in the Netherlands through its Green Funds scheme. This is because projects vary greatly in scope and ambition; the loans may finance individual measures in small residential units or comprehensive renovation of building complexes. Low participation rates in most programmes are observed despite the attractive terms of these loans. For example, in case of the Brussels Green loan 0% ($BE_{BRU}01$), the target of 500 loans granted per year was partially met as only 466 loans were issued in the period 2008 - June 2013 (indicating a rough 20% target achievement). The reasons behind the low participation should be further investigated.

Table 12 - Overview of impact of loan schemes across Europe

	TARGET SET	PARTICIPA-TION INDICATOR	TOTAL INVEST-MENT	AVERAGE INVEST. PER LOAN	INVEST. BREAKDOWN BY MEASURE	EX-ANTE ASSESSMENT	EX-POST ASSESSMENT
$BE_{BRU}01$	500 loans granted/ annum	466 loans / 466 housings (2008-June 2013)	€4,524,848	€9,710	BE: 85% TS: 15%	No assessment	No assessment
$BE_{VLG}02$	100 dwellings per annum and "local entity"	12646 dwellings (2006-June 2013)	€130,092,546	€10,287	BE: 58%, TS: 17% RE_{he}: 3% RE_{el}: 21%	No assessment	No assessment
BG02		53,835 projects (2006-2013)	€82,966,251	€1,541	BE:46% TS: 6% RE_{he}: 47% RE_{el}: 0.1%	Results not disclosed	ES: 206,928 GWh/a (electric. equ.) CS: 0,297 Mt CO_2/a (2006-2013)
BG03		192 projects (160 loans, 32 guarantees) (2005-2013)	€44,840,000	€242,378		Results not disclosed	ES: 75,923 GWh/a CS: 0.065 $MtCO_2$ /a (2005-2011)
DE01*		3,000,000 dwellings (both new or existing) (2006-2012)	€135,000,000,000	€45,000	-	No assessment	CS: 6.9 $MtCO_2$/a (2006-2012)
EE01		552 loans/projects/dwellings (2009-2013)	€72,000,486	€130,436	-	No assessment	No assessment
EL01	Energy savings: 500 GWh/a, buildings to be renovated: 50.000 CO_2 reduction: 0.44 $MtCO_2$/a	14,830 loans/building(2011-2013)	€421,220,882	€28,403	-	ES: 500 GWh/a CS: 0,440 $MtCO_2$/a J: 5050 jobs (2011-2015)	No assessment
ES01	Savings of at least 70.000 GWh/a					ES: 86.000 GWh/a CS: 9,6$MtCO_2$/a J: 1700	

FR02		225,000 loans		€ 17,180 (2012)			
HR01		306 projects (2004-2013)	€82,000,000	€267,974		No assessment	No assessment
LT01		37 buildings (2012)				ES: 8571 GWh/a CS: 1932 $MtCO_2$/a (2010-2011)	No assessment
NL02		546 green certificates including new houses (1995-2009)	€1,078,000,000	€1,974,358.97			
PL02		27546 projects (1999-2012)	€2,026,000,000	€73,550	-	No assessment	No assessment
UK01		481 measures	No data available		BE: 33% TS: 52% RE_{el}: 16%	17.08 TWh per year in 2020 1.8 $MtCO_2$/a 38,000-60,000 jobs by 2015 together with ECO policy (Jan-Oct 2013)	No assessment

Footnotes
*Together with grant scheme
Legend
BE: Building envelope; TS: Technical systems; RE_{he}: Renewable heat generation systems ; RE_{el}: Renewable electricity generation systems
ES: Energy savings; CS: CO_2 savings; J: Employment effect

Tax incentives

Tax incentives are considered a popular instrument due to the fact that they can be less costly than subsidies or grants. They may work well alongside a taxation scheme, whereby the tax loss attributed to the tax incentive scheme is offset by revenues from taxation for energy intensive industries, and their performance is correlated with the rate of tax collection. They can take various forms, such as tax exemptions, income tax or VAT reduction. Tax schemes directed towards energy renovations of buildings are currently favoured in Belgium, Denmark, Netherlands, France, Italy and Greece. These are discussed in the following sections.

Design considerations

Tax incentives reduce the tax paid by consumers or companies that undertake energy efficiency investments. These can take the form of accelerated depreciation for commercial companies, income tax credits or deductions for households or companies and VAT reduction for consumers. An overview of different tax incentive schemes and their main design characteristics in Europe is presented in **Table 13**. Income tax credits or deductions form the most common type of instrument. The schemes are often designed with a specific technology focus, which mean that they are designed to stimulate investments in specific technologies/measures rather than set overall energy performance criteria. Eligible measures cover all intervention types: building envelope improvements, building technical systems, connection to district heating, renewable heat and electricity generation systems.

The target groups (usually households or commercial companies) are typically allowed to declare tax benefits for one or more measures mostly based on their own choices or needs. Exceptions include the Italian tax scheme (IT02) which offers the option of a comprehensive retrofit package in addition to their list of individual measures. The package requires a minimum 20% primary energy demand reduction for heating compared to current building code levels. The Dutch scheme (NL01) also provides the option of a package alongside single measures. Lastly, the Greek Energy efficiency household programme (EL01)[15], which is a programme that combines different types of instruments, requires an upgrade by at least one energy class in the energy performance certification scheme or, alternatively, a reduction of primary energy demand of at least 30% compared to a reference building.

Tax schemes can have a positive impact on new, innovative technologies. By allowing for frequent updates of the eligible measure list, the schemes can facilitate the market introduction phase of new technologies if new inventions are considered in the list. An example is the Dutch Energy Allowance investment scheme which offers innovators a stimulus to develop new technologies that have a better energy efficiency performance than reference technologies. These investors can propose their new inventions to be added in the Energy List, which in turn would likely increase sales and profitability of these new investments in the future (Ruijs & Vollebergh, 2013).

[15] The scheme is a combination of three types of instruments: loan, grant and tax incentive

Table 13 - Examples of tax schemes with their main characteristics across Europe

	TYPE	ELIGIBLE INTERVENTIONS	FINANCIAL SUPPORT
DK01	Income tax deduction	Roof replacement and insulation, replacement of windows, insulation of external walls, repair or replacement of gas fired boilers and heating systems, replacement or repair of heating devices, installation or replacement of heating control systems, solar thermal panels, heat pumps, PV panels, small wind turbines, other non-energy related measures	Cap is DKK 15,000 per year including VAT for labor, service and maintenance of residence. This saves approximately DKK 5,000 in taxes (around 1/3 of the total costs). Maximum cap is DKK 30,000 per household.
EL01	Income tax credit (in combination with loan and grant)	Heat insulation, replacement of doors/windows; installation of a new, or replacement of the existing, burner and/or boiler system with a new (central or independent) diesel or gas system; installation of a new, or replacement of the existing, burner and/or boiler system with a biomass burner, solar-thermal systems; heat pumps	A reduction in payable tax, which can reach €300 for energy efficiency expenditures of up to €3,000. Tax deductions do not apply to funds received by a citizen in the form of a grant
FR01	Income tax credit	Insulation of walls, windows and doors; Condensing boilers; micro-cogeneration boilers; wood-burning appliance; heat pumps; solar thermal panels; PV panels; Wind and hydropower appliances; Connection equipment to a DH system mainly alimented by renewables or cogeneration systems; realization of an energy performance diagnosis	The level of support ranges from 10-32% depending on measure. The cap amounts to € 8,000 for a single person; € 16,000 for a couple (with additional €400 per dependant) and € 8,000 per dwelling unit for a landlord (max 3 units). This can be declared over a period of 5 consecutive years.
FR04	VAT reduction	Building envelope improvements, technical building systems, renewable heat generation systems, renewable electrical power generation systems	For the year 2013, the reduced VAT was 7% instead of 19.6%. In 2014, the new reduced VAT should be 5% instead of 20% (new VAT rate too).
FR05	Property taxation	This exemption from property tax is available for measures which are eligible for FR01	If chosen to be implemented by local authorities, the property tax exemption can be either 50% or 100% for spending over 10 000€ during the year previous to the first year of exemption, or over 15 000€ during the 3 years previous to the 1st year of exemption. The exemption works for up to 5 years.
IT02	Income tax credit	Insulation of walls and roofs; replacement of windows and shutters, gas condensation boilers; solar thermal panels, biomass boilers, heat pumps	From June 2013, the tax credit is equivalent to 65% of the total expenditure (increased from 55% in previous year). For interventions made in 2007 the deduction was reimbursed over a period of 3 years; in 2008 from 3 to 10 years; in 2009 over 5 years; from 2011 over 10 years. Max credit per project amounts to €100,000
NL01	Income tax deduction	Building envelope; technical building systems; renewable heat generation systems; renewable electrical power generation systems; connection to district heating; other energy-related measures	This tax relief gives a direct financial advantage to Dutch companies and entrepreneurs investing in energy-saving equipment and sustainable energy. They can deduct a 41.5% of the investment cost from their pre-tax profit, so they will pay less income tax or corporate taxes.

Implementation

The tax incentive schemes are all implemented by governments (ministries) and their agencies, e.g. the Italian energy agency is in charge of the Italian tax credit scheme. The budget associated with these schemes reflects the tax loss, i.e. the reduced government income due to lowered collected tax. As explained below, these should be considered in conjunction with new tax revenues as a direct impact of the scheme.

Impact and evaluation

None of the tax incentive schemes are attached with a specific target, so it is not possible to comment how successful they are in terms of responsiveness from the target group and ratio of desired over actual number of energy efficiency investments. The Dutch EIA scheme (NL01) has had around 10,000 applications per year instead of the expected 3,000 in its early years of implementation (Ruijs & Vollebergh, 2013). Since then, the numbers of applications and tax expenditures of the scheme have mostly been on a rising trend. The general popularity of tax incentive schemes is also reflected by the Italian and French schemes which appear to attract a large number of participants as shown in **Table 14**.

A varying picture in terms of achieved leverage factors is observed. In Italy, a fiscal support of about 8.5 billion in the period of 2007-2011 for the tax incentive programme has yielded investments equivalent to 15.5 billion in the same period, which results in €2 of investment triggered by each €1 of fiscal support. This compares moderately to the Dutch scheme, which reported €1.3 billion of investments and total tax benefit for its recipients of €94 million in 2012 (Agentschap NL, 2013). Although this figure includes all concerned sectors, it yields a much higher leverage ratio.

For the schemes which offer "packaged" interventions, evaluation shows that the uptake of this type of interventions have a low uptake. For the Dutch scheme, comprehensive retrofits accounted for 3% of the total claims. In addition, the share of comprehensive retrofits the Italian scheme was only 3% of the total investment and 2% of the total claims in 2009 (Neuhoff, et al., 2012). Possible explanations include lack of information or certified advisors, lack of financial incentives to pursue more ambitious measures and complexity in implementation. The single measures with the highest uptakes for the Italian scheme included window replacement, replacement of heating systems and thermal solar installations. For the Dutch scheme, popular invententions were energy efficient heating or air-exchange systems, ligthing and thermal insulation.

Tax schemes have generally a positive impact in reducing the incidence of undeclared work in the construction sector. By encouraging participants to deduct costs through the tax system, an incentive is given for participants to receive services from workers in the legal sphere. This has been the case in Italy where tax income from installation companies has increased significantly due to the introduction of the tax scheme. The scheme has acted as a stimulus to employment in a labour-intensive sector in a time of global economic crisis. In Finland, a tax credit for domestic help for services including home repairs has resulted in a reduction of the proportion of undeclared work from about 60% to 25% of the household services[16]. The French reduced VAT scheme on works in residential buildings (FR) is considered to be a profitable measure, where earnings due to decrease of the number of unemployment benefit, more taxes due to the job creation are generally greater than the direct loss of VAT[17].

A general drawback of tax incentive schemes is the difficulty to prevent free-riders from benefiting from the scheme. In an ex-post evaluation for the Dutch scheme for the period 2000-2005, a range of free ridership rates was estimated to be 26-68% depending on technology with the average rate

[16] Source: http://www.eurofound.europa.eu/areas/labourmarket/tackling/cases/fi004.htm (accessed January 2014)

[17] It is estimated that the direct loss due to this scheme were equivalent to 2.350 billion dollars, while earnings corresponded to 2.855 billion dollars (Source: MURE database)

being 47% (Aalbers, et al., 2007). No estimates on free riders have been found in other ex-post evaluations.

There is limited data about the cost efficiency of these tax schemes. A general observation is that tax incentive schemes are inherently less cost effective compared to instruments such as white certificate or energy saving obligation schemes. For example, the total costs (public and private) of the Italian scheme was estimated to be 13 euro cents/kWh of saved energy, in comparison to 4 euro cents/kWh associated with the Italian White Certificate scheme (Mebane & Piccinno, 2012). This is due to the fact that the former is designed to support high cost measures with sufficient savings while the latter is optimised to deliver the most energy savings with the least amount of investment. The Dutch scheme is estimated to cost €4-7 per tonne of CO_2 avoided.

Table 14 - Impact of tax schemes across Europe

	PARTICIPATION INDICATOR	TOTAL INVESTMENT	TAX EXPENDITURE	EX-ANTE ASSESSMENT	EX-POST ASSESSMENT
DK01	829,720 persons in period 2011-12			No assessment	No assessment
EL01*	14,830 applications in period 2011-13	421 million (2011-13)		Energy savings: 500 GWh/a CO_2 savings: 0.44 kt/a Employment: 5050 jobs (2011-2015)	No assessment
FR01	1,364,000 households in year 2010	11 billion (2010)	12.8 billion euros (2005-2011)	Energy savings: 6630 GWh/a (2010)	No assessment
FR04	6,000,000 dwellings in year 2010	38.5 billion (2010)		No assessment	Financial savings: €0.5 billion** Employment: 52,800 jobs/a
FR05	-	-		No assessment	No assessment
IT02	1,250,000 dwellings in period 2007-11	15.5 billion (2007-11)	Circa 8.5 billion (2007-11)	Energy savings: 11,630 GWh/a (2011-2020)	Energy savings: 7700 GWh/a CO_2 savings: 1650 kt/a (2007-2011)
NL01	15,000 applications per year	1 billion per year***	94 million (2013)	No assessment	CO_2 savings: 765 Kt/a (2012)

* In conjunction with other instruments

**Due to unemployment

*** Across different sectors including energy, agricultural. In 2012, built environment investments amounted € 598 million (equivalent to 7451 requests)

Energy efficiency obligations and white certificates

Energy efficiency obligations (EEOs) or tradable white certificates placed on different energy market actors have been used for years in Denmark, Flanders, France, Italy, and United Kingdom. The principle behind the obligations is that energy companies are required to prove that they have undertaken activities that promote or fund energy efficiency improvements in the premises of end use customers. Italy and France have energy savings obligations in combination with tradable white certificates (WCs), meaning that accredited parties (not just the obliged energy providers) can earn WCs which can be subsequently traded. Obligations or projects can be traded without formal certification in the UK and Denmark (Bertoldi & Rezessy, 2009).

The obligations may be applicable for a number of different sectors and the main differences among the current European schemes are provided in **Table 15.** It should be noted that the Flemish scheme no longer operates as a traditional energy efficiency obligation scheme. Instead, since 2012, the scheme has switched to an "action obligation", which means that a target for certain energy or CO_2 savings is not set, but a series of actions are foreseen instead. France plans to have a third period power from 1 January 2015 to 31 December 2017 with an energy savings target of 220 TWh (cumac) per year, almost doubling the ambition compared to the previous period.

The importance of these schemes in delivering energy efficiency improvements in the building sector is examined in the subsequent sections.

Table 15 - An overview of current EEO schemes in EU28

	ITALY	DENMARK	UK	FRANCE	FLANDERS (BE)
STARTING YEAR	Since 2005	Since 1995	Since 1994	Since 2006	Since 2003
CURRENT TARGET	7.6 Mtoe of cumulative primary energy savings in 2016	, 10.7 PJ of final energy per year for 2013-2014	(1) 278MtCO2 of carbon savings (2) £4.2bn cost savings on energy bills for Jan 2013-June 2015	The second period is now extended until December 31, 2014	For 2012 onwards, no official targets are set per obligatory action*
HISTORI-CAL TARGETS	- **2005-2009:** 6.5 Mtoe of primary energy savings	- **2010-2012:** 6.1 PJ per year - **2006-2009:** 2.95 PJ per year - **1995-2006**: no target. The scheme was primarily an information/advice/audit scheme without the possibility to finance or implement energy saving investments	- **2009-2012:** 9.25 MtCO2 of carbon savings CESP*** - **2008- 2012:** 293 MtCO2 of carbon savings CERT** - **2005-2008:** 130TWh - **2002-2005:** 62TWh - **2000-2002:** 4981 GWh (electricity); 6144 GWh (gas) - **1998-2000:** 2713 GWh (electricity) - **1994-1998:** 6103 GWh (electricity)	- **2011-2013:** 345 TWh added and discounted - **2009-2010:** transitional period - **2006-2009** 54 TWh (cumac)	- **2003-2007:** 1-2.2% reduction of electricity supplied for low voltage clients, 1% for high voltage clients - **2008-2009:** 2% residential clients: 1.5% non-residential clients - **2010-2011:** 3.5% for all clients for DSOs with more than 2500 customers; 2.5% for all clients for DSOs with less than 2500 customers
OBLIGED PARTIES	Electricity and natural gas distribution operators	Electricity, natural gas and district heating distribution operators	Electricity and natural gas suppliers	Electricity, gas, LPG, heating and cooling suppliers	Electricity distribution operators
CERTIFI-CATE TRADING	Yes; 1WC=1 toe of energy savings with average value of €100.	No	No, but trading between suppliers is possible	Yes; 1 WC = 1 kWh (cumac)	No
SECTORS	All	Residential; Commercial; Public; Industry; transmission, solar power and conversion	Residential	Residential, Commercial; Public; Industry; Transport; Agriculture	Residential and non-energy intensive industry; commercial; public
ENFORCE-MENT	Financial penalties for non-			Financial penalty (2 c€ /missing WC)	Fines (not to be incorporated in tariff):

	compliance with target; no unitary penalty defined ex-ante; grace period of 1 year for 60% compliance; otherwise the penalty does not cancel the obligation				if RUE evaluation reports not on time, €1000 per day; if obligatory actions are not executed, €1000-1% of turnover; if RUE evaluation report does not comply with regulation, reminder + €1000 per day

Sources: JRC survey, Suna & Haas (2012), Rosenow, Platt, & Flanagan (2013), Bertoldi & Rezessy (2009)
Footnotes:
*Before 2012, the programme used to be a "savings obligation" while now it's an "action obligation"
** CERT: Carbon emissions reduction target
*** CESP: Community Energy Savings Programme

Design elements

The main design elements of Energy Efficiency Obligation and White Certificate Schemes are provided in **Table 16**. The schemes target all segments of the building sector (residential, commercial, public) except the UK scheme which focuses on residential buildings only.
Eligible intervention measures for the building sector, examples of which are shown in Table 16, fall in all main categories: building envelope, technical building systems, renewable heat and electricity generation systems. The list of eligible measures is usually defined in advance by the monitoring and verifying authorities. In Denmark, the obliged parties are given great freedom as to what intervention measures can be used. In the UK, Ofgem publishes a list of measures under each subcategory of the ECO scheme; the focus of its new ECO scheme being on high-cost insulation measures. The Flemish scheme also provides discount coupons for appliances (washing machine or refrigerator), subsidised energy scans, investment support for companies after performing an energy audit, while the Italian scheme does no longer finance low cost measures, such as CFLs, domestic electrical appliances, flow-rate shower heads, water saving kits and aerators for taps in the building sector.
As the examined schemes are based on a horizontal approach, the possibility to bundle measures together in a holistic approach is not feasible. Subsequently, no energy efficiency criteria are set as a whole for the intervention measures, although prescriptive criteria may apply in certain cases. The exception is the Flemish scheme which sets a global energy performance indicator but this is only applied for new housing. This premium increases as higher energy performance level is reached. "Protected customers" under the Flemish scheme get higher premiums, e.g. a 50% higher premium for this segment of customers is available for renovation measures in residential buildings. In the Italian scheme, package measures are mainly implemented in the industry sector by energy providers, whereby the methodology used for the measurement of the achieved energy savings must also be provided by the customer.

Table 16 - Main design elements of EEOs and WCs with respect to the building sector

	IT01	DK02	UK02	FR03	$BE_{VLG}02$
ELIGIBLE INTERVENTION MEASURES IN BUILDING SECTOR	Examples: double glazing windows; Insulation of walls and roofs, - gas water heaters, gas-fired central heating boilers; external air	Flexible; examples include: Insulation, replacement of windows, doors and skylight, gas boiler, lighting, heat pumps, PVs*	Solid wall and hard-to-treat cavity wall insulation, window glazing, boiler replacement, heat pumps, biomass boilers, PVs, micro	Insulation; glazing; condensing boilers;	Insulation, high performance glazing, lighting, condensing boilers, heat pumps, thermal solar panels

	conditioners, thermal solar systems, small cogeneration systems		wind, micro hydro, micro combined heat and power		
ENERGY PERFORMANCE CRITERIA	None	None	None		Prescriptive criteria (e.g. U values)
INCENTIVE CHARACTERISTICS	Subsidies or rebates are offered (e.g. for appliances)	Grants (e.g. end user presents a project before it starts and an energy company buys the right to report the project by providing a grant)	Subsidies are provided to consumers (100% for low income households, 50% for "able-to-pay" households)	Soft loans, rebates The % cost covered by the certificates varies from one measure to another, depending on the potential energy savings rather than measure cost.	The support is provided in the form of "premiums", offered upon submission of invoice proof. Premiums vary depending on measure (e.g. insulation premium is €3-8/m^2)
COST RECOVERY MECHANISM	Electricity and natural gas tariffs; €/toe saved, updated annually (maximum level so far 100 €/toe)	100% tariffs	Tariffs	Tariffs	Tariffs with the exception of certain costs reimbursed by the Flemish government such as residential premiums, residential energy scans and residential social roof insulation projects.
THIRD PARTY INVOLVEMENT		A service company in the same group (e.g. a private engineering company or an installer) carries out the work – the obliged bodies are not allowed		Local and regional authorities – public housings and the ANAH (national agency of housing)	

* To be excluded from 1 April 2013 onwards

Implementation

Obliged parties exercise the right to reduce the energy consumption outside their control of the DSO[18] area or cover other energy carriers. To deliver their obligations, they mainly establish contracts with third parties within the energy efficiency market such as an insulation company, retailer of appliances, manufacturers and heating installers. As explained above the Flemish scheme was altered to an "obligatory action" scheme in 2012 due to the challenge of setting an ambitious but realistic target. Before 2012, the scheme experienced a high administrative burden as there was a continuous need to discuss the level of savings of each action.

Implementing an obligation on energy suppliers has the advantage of not placing a burden on the national budget as the obliged bodies can recover their costs via the consumers' energy bills (**Table 16**). As funding is not dependent on public expenditure, the schemes are not affected by any budget cuts. The only exception is the Flemish scheme, where a share of the costs is borne by the Flemish government. The general principle is that all costs of the Flemish obligations are incorporated in the electricity distribution tariffs, with the exception of costs reimbursed by the Flemish government for residential premiums, residential energy scans and residential social roof insulation

[18] Distribution system operators

projects. In Denmark the average cost to save a unit of energy was 0.45 euro cents/kWh over the period 2006-09. This included the consumer costs, administrative costs for the Danish Energy Agency as well as cost for administration and quality assurance costs for the DSOs.
Our data show that around 1.5 billion euros are disbursed on a yearly basis by energy companies in these countries to implement energy efficiency measures.

Impact and evaluation

An analysis of the impact of the schemes in terms of savings, measures installed etc. is presented in Figure 15 -Figure 16 and Table 17 - Savings, costs and cost effectiveness of various EEO/WC schemesTable 17 Table 18.
The UK scheme is used as the main policy for reducing fuel poverty, primarily focusing on high cost measures such as solid wall insulation and hard-to-treat cavity wall insulation. In the year 2013, a total of 447,583 individual households have had measures installed. Only 5% of the ECO measures however represented solid wall insulation, while cavity wall insulation measures amounted to 32% and loft insulation measures to 24.5%. The remaining 37.6% concerned boiler installations and other measures.
While the UK scheme has a strong interest on mitigating fuel poverty in the residential sector, the Danish EEO mainly focused on realising the energy saving target at minimum costs, regardless of sector and energy form. For the Danish scheme, it was found that while energy savings in the public and business sector have a high net impact, some subsidies given under the EEO are inappropriately high. The net impact in the residential sector was found to be very low (Bundgaard, et al., 2013). In a sample of 56 projects, approximately a quarter of the reported projects had a payback of 1 year. The scheme is not economically profitable in terms of promoting energy savings in households. The socio-economic costs of the scheme in the context of households are three times greater than the value of the realized savings. However, it is generally recognised that it is a challenge to find economic ways to reduce energy consumption in existing buildings.
The Italian white certificates are a very important scheme in terms of delivering energy savings, however their main focus is on industry. As of 31 December 2011, it was estimated that only around 10% of energy savings (equivalent to 1109 GWh/a) accrued to buildings. In terms of energy savings within the building sector, the first implementation period primarily focused on the distribution of CFLs and low flow-rate shower heads (**Figure 16**, **Table 18**). This was criticized by many stakeholders as the majority of investments stemmed from short-term measures which were not specifically addressed to the large energy providers, the real target of the mechanism.
The average renovation depth per building achieved by the intervention measures was reported to be 10-20% in the case of Denmark and 20-30% for Flanders.

Table 17 - Savings, costs and cost effectiveness of various EEO/WC schemes

	IT01	DK02	UK02	FR03	$BE_{VLG}02$
ENERGY, CARBON AND FINANCIAL SAVINGS	**Ex-ante:** 5 Mtoe of net energy savings for 2011-2020 €10-15 of financial savings for each saved MWh of final energy **Ex-post:**		**Ex-ante:** 27.7 Mt of CO_2 savings and €4.9bn of financial savings (Jan 2013 - Mar 2015)	**Ex-post:** 5800 GWh/year of energy savings and 1.45 Mtons of CO2 savings for July 2006- Dec 2011	No assessment has been carried out

	26,781 GWh/year of net energy savings for 2005-2011				
AVERAGE SCHEME COST PER YEAR	€90 million per year	An estimated 400 million DKK per year 20	*Previous schemes*: £10 billion since 1994	€200 million per year	€25.8 million per year
COST EFFECTIVENESS	0,10 c€/kWh 3.8 c€/kWh (annual savings, 2006)	0.38DKK/kWh	0.8 c€/kWh (2004, lifetime)		4.8 c€/kWh (2005, annual savings)

Sources: JRC survey, World Energy Council (2008)and other sources

Table 18 - Measures implemented as part of the Italian and UK schemes in the building sector

	IT01	UK02
Building envelope	1,204,012 m^2 for heating insulation 183,968 m^2 double glazing windows	172,162 cavity wall insulation measures; 129,540 loft Insulation measures; 27,518 solid wall insulation measures; 1,768 other insulation measures, 255 window glazing measures
Building technical systems	322,234 gas-fired central heating boilers; 2,370 gas water heaters; 239,171 kWf from external air conditioners;	167,297 boilers
Renewable heat generation systems	737,332 solar panels	-
Renewable electricity generation systems	1,792 photovoltaic systems	-
Other energy-related measures	75million CFLs; 1.1million domestic electrical appliances; about 26million low flow-rate shower heads; about 57million aerators for taps	-
Time period	2005-June 2012	Jan-Dec 2013

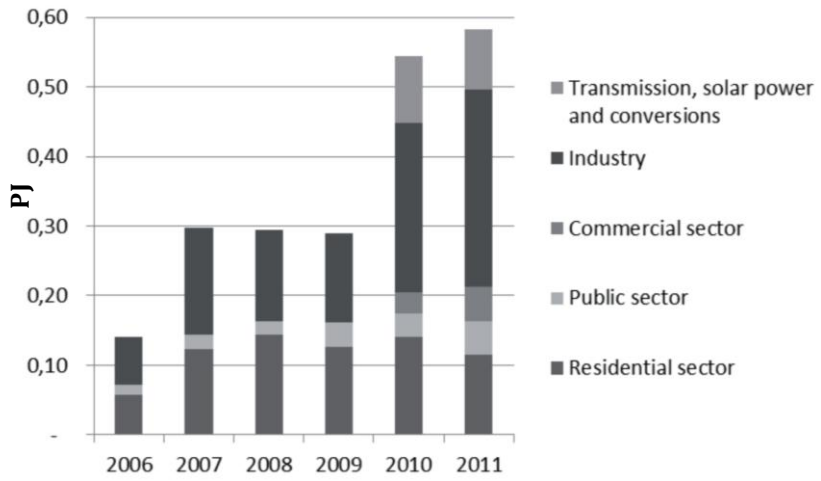


Figure 15 - Reported savings in the Danish EEO 2006–2011 distributed on sectors (Source: Bundgaard, et al. (2013))

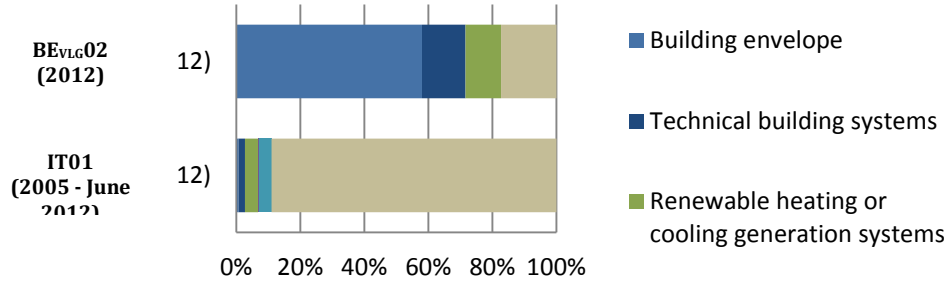


Figure 16 - Breakdown of disbursed budget spent by the Italian and Belgian schemes by intervention measure type in the building sector

Chapter 3 - Innovative instruments and mechanisms

It is generally recognised that current financial incentive schemes cannot result in widespread adoption of energy efficiency investments and scaling up investments is necessary in order to meet the energy saving potential of the existing stock. The following findings can be summarised from our research:

- Public subsidies provided by governments can create economic stimulus towards energy renovation projects however they are unlikely to form a major driver for large-scale investments, especially in cases of limited fiscal budgets. These, however, form the most popular instrument type provided in Europe to-date.

- Current budget sizes disbursed by the examined instruments are small compared to investment needs reported in the literature. Our research shows that on average €8 billion is disbursed per year which mainly originates from public sources. This results in investments of at least €24 billion, and this is not sufficient to meet the EU targets.

- The market for energy efficiency is complex and many actors such as multi-family building owners, tenants, small businesses or other actors who may not be eligible for credit are not always served by current mechanisms. With a few exceptions, accessible finance to everyone is generally missing.

- While grants and subsidies can provide additional incentives, it can be difficult to structure attractive loan terms for deep renovations due to long payback periods. Conventional mortgage underwriting processes by commercial banks do not take into consideration energy efficiency parameters and energy costs, and therefore treat unfavourably renovations which yield higher energy savings.

- The difficulty of forecasting exact savings leads to uncertainty over return which can act as hurdle for diversifying existing capital sources and attracting private interest.

In this chapter we examine various new solutions which could help the mobilisation of investment in existing buildings. These are categorised into (a) financial mechanisms and (b) alternative policy measures and regulations.

New financing mechanisms

Various mechanisms can be used to provide finance for energy efficiency investments (**Figure 17**), which can originate from either private or public funds. Conventional mechanisms include debt, private equity, project and leasing financing. Below, we concentrate some of the most promising mechanisms in terms of new ideas on how to overcome some of the key barriers associated with energy efficiency finance. For example, these may be based on funding structures permitting a loan to be repaid from energy savings and thus eliminating the need for upfront capital. They can take the form of energy performance contracting, property assessment clean energy and on-bill finance. As debt financing typically needs to be compatible with restrictions associated with existing mortgages, energy mortgages can also offer an attractive option. These are also discussed in this section.

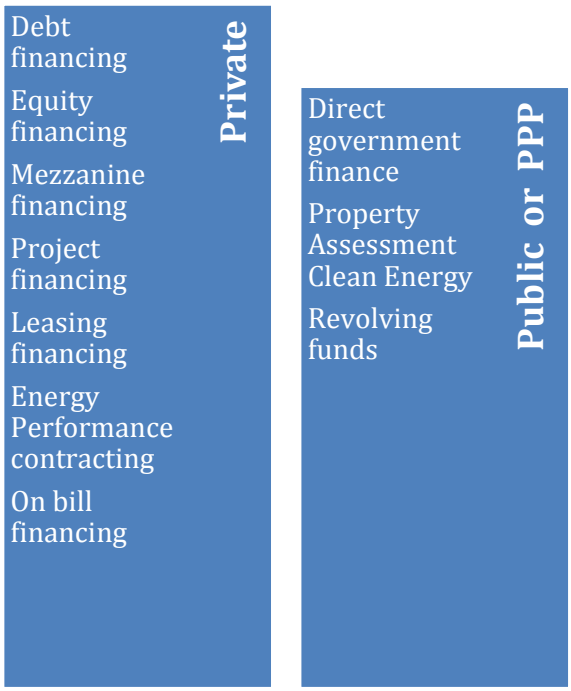


Figure 17 - Financing Mechanisms for Energy Efficiency Improvements in Buildings (Adapted from: He (2012))

On-bill finance

On-bill financing is a mechanism that reduces first-cost barriers by linking repayment of energy efficiency investments to the utility bill and thereby allowing customers to pay back part or all costs of energy efficiency investments over time. The funds can originate from utilities, the state or third parties. Energy savings which accrue from the installed measures can be large enough so that the total post-renovation utility bill does not exceed the pre-renovation bill. They can be particularly useful for small businesses with limited capital to spend as well multi-family or rented properties where split incentive deter such investments. On-bill finance programmes can be categorised into: (1) *on-bill loans* and (2) *on-bill tariffs*. The main difference between the two is that on-bill loans must be paid off in case of ownership transfer while on-bill tariffs assign the obligation to the property, thus allowing for a transfer of the repayments to the next tenant or buyer.

Utility on-bill financing programmes have been used in the U.S. for many years. In 2011, 20 U.S. states implemented or were in the process of implementing utility on-bill financing programmes (Bell, Nadel, & Hayes, 2011). The capital in these cases can be usually raised through public benefit funds and utility funds, which can also be used to create loan loss reserves and guarantees to hedge against default risk. Alternatively, they can be used to buy down interest rates to make these programmes more attractive and minimise investor's risk by enhancing the credit quality of the financial product. Other capital sources may include bond issues, public loan funds, revenue from cap and trade programmes, banks, credit unions and capital markets (Bell, Nadel, & Hayes, 2011). They can be administrated by utilities although in certain cases other actors (such as government, energy agency, non-profit or service companies) can assume this responsibility. The US experience shows that while on-bill financing is associated with elements which overcome important barriers such as upfront cost and split incentives, issues such as the need to modify billing systems, role of utilities as financial

institutions, risks of no payment, handling transfer of property, diversifying sources of capital, non-utility and differing fuels need to be addressed.
It should be noted that on-bill tariff programmes are based on a similar concept with PAYS® model which was first developed by the Energy Efficiency Institute in 1999 in search of a market-based response at a time of diminishing national funding. The PAYS® model allows the tenants/owners to benefit from the savings of installed energy efficiency measures through a tariffed charge on their utility bill, but only for as long as they occupy the location where the measures are installed. The monthly charge needs to be lower than the measure's estimated savings and it remains on the bill for that location until all costs are recovered. In the U.S., the PAYS® model was first introduced as a pilot programme in New Hampshire while programmes in 5 states exist today (EEI, 2013). Some examples of such programmes are shown in **Table 19**.

Table 19 - Key features of PAYS® schemes in the United States

Name	Projects completed	Period	Investment size	Examples of measures
Public Service of New Hampshire	59 municipal projects	2009	$866,879 ($31,208 programme fees)	Street lighting, lighting upgrades, HVAC improvements
Midwest Energy How$mart® (Kansas)	858 locations (716 homeowners, 114 rental properties, 28 businesses)	2007-2012	$5,000,000	Heating systems, geothermal loop projects, air sealing and insulation
3 Hawaiian pilot programmes	513 applications	2007-2009	-	Solar water heaters
How$SmartKY™ (Kentucky)	90 customers	2012	$687,517	Insulation, duct/air sealing, heat pump upgrades

Source: EEI (2013)

In the European context, the first PAYS®-inspired scheme was implemented in the UK in 2013 with the introduction of the Green Deal, which enables owners and occupants to install energy efficiency improvements at no up-front cost using a similar concept, the so-called "Golden Rule". The Golden Rule simply states that the repayments must be less than the savings on the energy bill. The scheme however, has not yet performed as originally expected and only a small share of the total Green Deal assessments[19] undertaken have so far led to signed agreements. Much criticism has accrued since its inception with some of the main points of dispute outlined as follows:

- The 7-8% interest rate attached to the Green Deal loan is considered uncompetitive in comparison with general home improvement loans[20]. Despite the attractive Green deal elements of attaching the loan to the property and extending the loan terms for up to

[19] A Green deal assessment is an upfront survey carried out in a building with the aim to identify cost-effective EE measures and financial savings as well as outline payments and an advice report

[20] Loans for home improvements can be as low as 5% although in certain cases they can be much higher than 7% (Guertler, Royston, & Robson, 2013).

25 years, traditional commercial bank loans or re-financing existing mortgages offer cheaper forms of financing.

- The loan repayments are based on average estimated figures rather than figures tailored to the occupant's energy usage. While an updated version of the RdSAP[21] tool is planned to be used (incorporating occupancy-related "in-use" factors), there is no guarantee that the estimated bill savings and thus monthly loan repayments are less than real savings (Ingram & Jenkins, 2013).
- The trustworthiness of energy companies is generally low among consumers. One survey found that half of all consumers do not trust their energy supplier (Opinium, 2011).
- Vacant periods of Green Deal properties are also of concern. This was confirmed in a survey carried out among building owners, which found that the majority of respondents were concerned that they would be responsible for making repayments during void periods or if tenants defaulted. They also viewed the attachment of loan to the property as a disincentive likely to make a property less attractive to prospective tenants or buyers (Eadson, Gilbertson, & Walshaw, 2013)

In Ireland, the new scheme Better Energy Finance – expected to roll out in 2014 – is an initiative of the Irish government and industry actors, which is based on the idea of a market-based PAYS® residential retrofit scheme. The scheme is expected to apply the lessons learned so far from the experience with similar programmes.

Property Assessed Clean Energy financing

Property Assessed Clean Energy (PACE) is a means of financing energy renovations through the use of specific bonds offered by municipal governments to investors. The governments use the funds raised by these bonds to loan money towards energy renovations in residential or commercial buildings. The loans are repaid over the assigned term – typically 15 or 20 years – via an annual assessment on their property tax bill. The long repayment term attached to PACE programmes allows for investments with long payback times to be considered in the renovation. This additional tax assessment is placed on the property rather the property owner which means that PACE assessments are also transferable. In other words, it is possible to recoup the investment upon sale thereby reducing the concern about investment recovery during sale transactions. PACE programmes are secured by a senior lien on the owner's property, which avoids repayment security to be attached to the borrower's creditworthiness and is therefore more attractive to financiers.

[21] RdSAP stands for Reduced Data Standard Assessment Procedure is a steady state model used to assess and compare the energy and environmental performance of dwellings

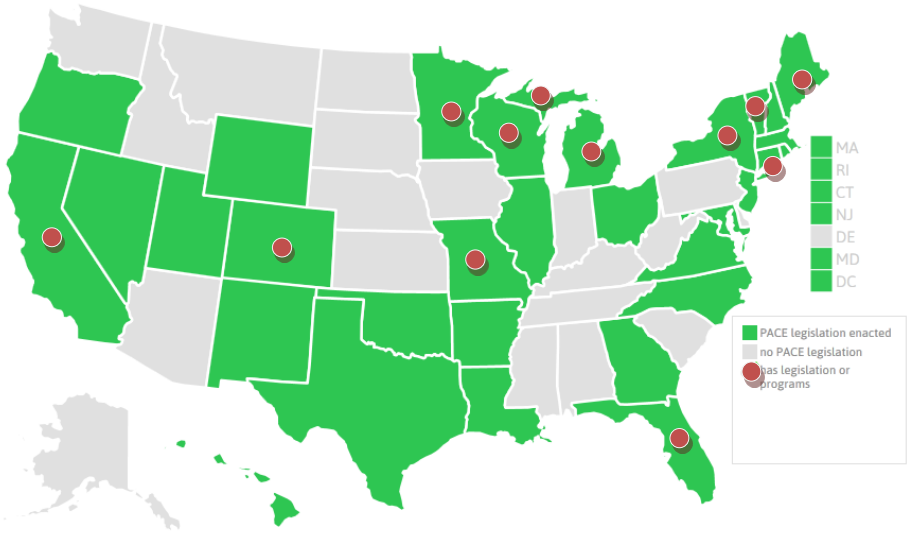


Figure 18 - PACE legislations and programmes in the US (Source: www.pacenow.org)

PACE programmes are mainly implemented in the United States with a reported $150 million in federal grant funds initially allocated (LBLN, 2011). Currently, there are 31 US states with PACE enabling legislation, 12 with active programmes and others in the process of programme development (**Figure 18**). It should be noted that PACE programmes were suspended in 2010 due to the fact that U.S. mortgage authorities Freddie Mac and Fannie Mae refused to finance mortgages with PACE liens. This occurred because PACE loans are generally assigned first lien status; that is, in cases of default, they are paid off to the municipality before the main mortgage is paid to the lender (Bird & Hernàdez, 2013).

Despite this issue, there is still growing interest around the PACE mechanism. The California Statewide Communities Development Authority (CSCDA) has recently announced that a PACE programme (the so-called CaliforniaFIRST) will be launched in 17 California counties and 167 cities in the second half of 2014. Under this programme, homeowners in the targeted cities will be able to contract for energy and water efficiency projects and pay for the projects through a special tax assessment in their property tax bills over a period of up to 20 years. Key actions have also been taken in order to create a PACE mortgage loss reserve program which address concerns raised by mortgage providers. Administered by the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA), the loss reserve program will refund mortgage holders from losses associated with a PACE lien on the property.

Energy performance contracting (EPC)

An Energy Performance Contracting (EPC) is a contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement[22]. Under an EPC arrangement, an ESCO develops, installs maintains and monitors an energy efficiency project and uses the energy cost savings to repay upfront investment costs. EPCs

[22] Definition extracted from the Energy Service Directive (Directive 2006/32/EC)

are designed so that the value of the energy savings is split between the beneficiary (customer) and the ESCO throughout the contract term. Energy renovations under EPCs mainly take place in large public or commercial buildings. There are two types of contracting models:

- guaranteed savings model, whereby the ESCO guarantees the savings, but the building owner finances the investments;

- shared savings model, whereby the ESCO finances and guarantees the savings, and recoups most of the cost savings in order to repay the upfront costs.

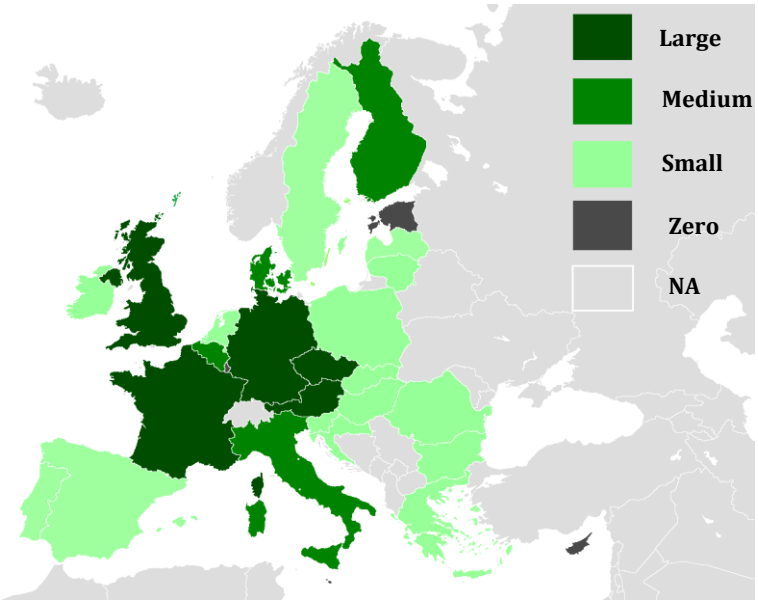


Figure 19 – The size of the ESCO market across the EU (Source: Bertoldi, Kiss, Panev, & Labanca (2014))

The guaranteed savings model currently forms the most commonly used model where customers either self-fund or use debt/lease financing to cover the upfront costs. In certain cases, government incentives (examples of which are described in the previous chapter) may be available. After the contract ends, payments to the ESCO cease and the customer maintains all savings. If, in the meantime, the guaranteed savings are not delivered, the ESCO will pay the difference between the guaranteed and actual energy savings. The intervention measures typically include energy management systems, HVAC or lighting replacements, while measures with higher payback time (e.g. solid wall insulation) or new technologies are rarely supported by EPCs. This is perceived as one of the main disadvantages of the ESCO model.

Figure 19 shows the size of the current market of ESCOs in EU Member States, as concluded by a study carried out by the Joint Research Centre of the European Commission (Bertoldi, Kiss, Panev, & Labanca, 2014). It is clear that the opportunity of market growth still exists in many EU countries, and political support, existence of market facilitators and project aggregation can play a role in stimulating this growth. These can help address some of the current weaknesses such as high transaction costs, large risk margins of ESCOs and focus on mainly low cost measures (Bullier & Milin, 2013). New market actors such as construction companies or utilities can also be important players in the EPC market for deep renovations. Overcoming legal barriers (e.g. rental laws) or providing public financial/fiscal incentives supporting ESCOs can also help accelerate the uptake of EPCs.

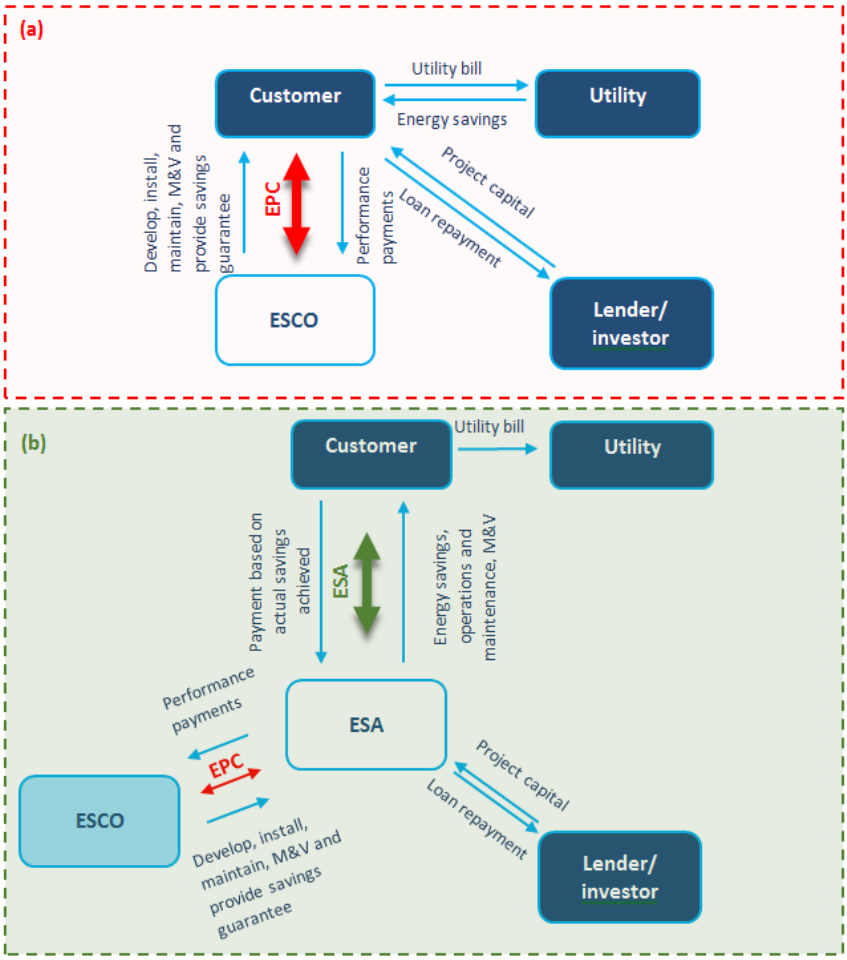


Figure 20 - Schematic diagram illustrating the underlying principles of (a) EPC and (b) ESA models

Energy Services Agreement (ESA)

An Energy Services Agreement (ESA) is a contract that packages energy efficiency measures as a service which building owners pay for through their actual energy savings without having to provide the upfront cost. It is analogous to power purchase agreements (PPAs) which have been utilized to finance solar power projects over the last years. The difference is that ESA payments are based on actual energy units saved rather than energy units generated.

Figure 20 depicts how the ESA model works and what the main similarities and differences are with the EPC model. In an ESA arrangement, a project developer arranges for the installation of energy efficiency measures by an ESCO and coordinates the capital investment in the project. The project developer then operates and maintains the energy efficiency measures during the term of the ESA, while the customer pays for the energy saved as a service. The advantage of ESAs is that they allow customers to finance these improvements "off-balance sheet" which can be useful for tax purposes or in cases where existing mortgage are attached to restrictive terms. The ESA is similar to the shared savings EPC model, in which an ESCO funds the energy efficiency project and the owner agrees to repay an agreed percentage of measured and verified savings.

Energy mortgages

Preferential loans for energy efficiency can also be delivered through mortgages; for example, preferential mortgage terms may be offered to efficient homes, or existing mortgages can be extended in order to finance efficiency improvements. Energy mortgages give the opportunity to obtain better borrowing terms, finance upgrades as part of a single mortgage, increase debt-to-income qualifying ratios and allow consumers to qualify for a larger loan amount. Energy mortgages can be differentiated into:

(1) Energy Efficient Mortgage (EEM), which is a mortgage that credits a home's energy efficiency in the mortgage itself and thereby increases the home buying power of consumers and capitalizes the energy savings in the appraisal.

(2) Energy Improvement Mortgages (EIMs), which are used to purchase or re-finance existing homes that will undergo energy efficiency upgrades. They allow borrowers to include the cost of energy-efficiency improvements to an existing home in the mortgage without increasing the down-payment by using the money saved in utility bills.

In the Netherlands, Triodos, a sustainable bank concerned with social and environmental impacts, has introduced sustainability aspects in its home mortgage underwriting process, and partly bases its mortgage interest rates on these criteria. The mortgage interest rate falls 0.1 percent for every increase in the energy efficiency label[23], while homes with an A++ label are allowed to have €8,000 more financing as compared to regular homes. In Germany, Bayerische Landesbank has incorporated the sustainability of (commercial) properties into its mortgage acceptance terms by offering more favourable financing terms if the bank's sustainability criteria are met. It offers support in the certification process of buildings through its subsidiary Bayern Facility Management. Bayerische has also created a service called LBImmoWert that helps to establish the value and risk effects of the sustainability (or lack thereof) of their clients' properties, and provides advice concerning building improvements that improve value and reduce risk in this regard (Eichholtz & Kok, 2013).

Alternative policy measures and regulations

Energy Efficiency Feed In Tariffs (EE FiTs)

Energy efficiency feed-in tariffs (EE FITs) represent a new instrument based on the principle of Feed in Tariffs for renewable energy (RE FITs), namely that the participant is rewarded for the operational performance of their investment rather than the investment itself. While the reward for RE FITs is in the form of a payment for energy they produce from renewable sources, EE FITs are rewarded for the energy savings delivered by energy efficiency investments[24]. Simply put, consumers under an EE FIT are encouraged to reduce their energy use through an additional financial incentive on top of the monetary savings from reduced energy bills. This additional financial

[23] That means if the G-rated building is renovated to class A, a reduction by 0.6% will apply to the mortgage rate

[24] Bertoldi et al. 2013 suggest that savings delivered through behavioural actions can also be awarded under the EE FIT

incentive is determined based on measured/delivered savings as it is based on the idea of offering a price subsidy for each unit of energy saved. It therefore connects the incentive with the actual performance of the investment.

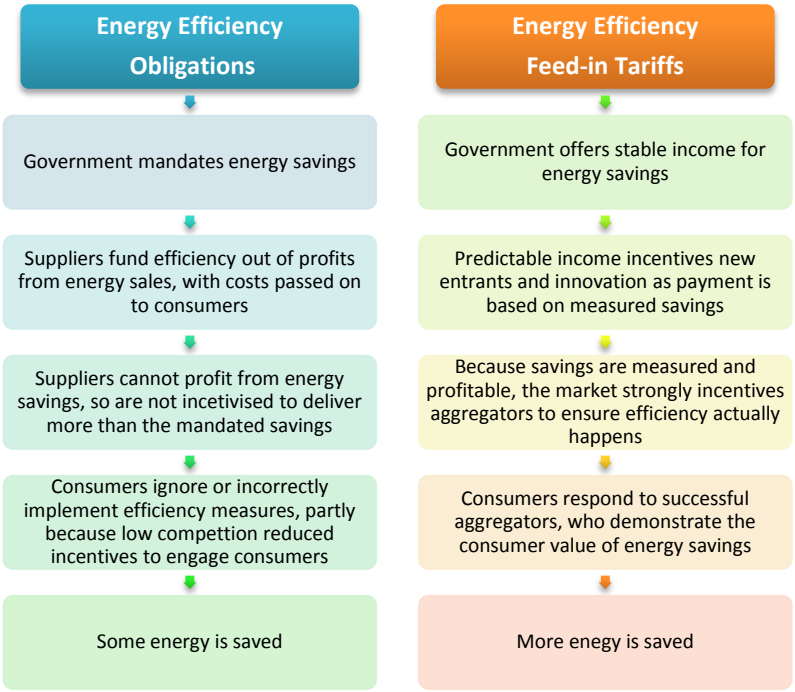


Figure 21 - Conceptual differences between Energy Efficiency Obligation and Feed-In Tariff schemes (Green Alliance, 2011)

As explained, EE FITs work differently in comparison to other economic instruments in that they focus on providing incentives based on the operational performance of the energy efficiency investment rather than the investment itself. EE FITs work in a reverse mechanism compared to EEO/WC (see **Figure 21**). In EE FIT, the exact price for a kWh of energy saved is indicated and the market is then allowed to determine the quantity of energy savings to be delivered (*price-based* mechanism). Conversely, the quantity of savings is established under the EEO, and the market then determines via the obliged energy companies the price of achieving them (*quantity-based* mechanism). Because EE FITs do not rely on energy companies, they would provide incentives for innovation in project delivery in a much wider range of actors including householders, community groups, local authorities and small businesses.

While the concept of EE FITs is relatively simple, there are policy design issues that need to be carefully considered. Among available literature sources, there seems to be consensus that, unlike RE FITs which aim to increase the amount of electricity produced by renewable energy sources and thereby focus on electricity, EE FIT should cover both electricity and gas (Eyre (2013), Neme & Cowart, (2012), Bertoldi, Rezessy, & Oikonomou (2013)). Agreement also exists regarding sectoral coverage; that is, all sectors (residential, commercial, public) can be targeted by potential EE FIT schemes. Neme & Cowart (2012) proposed that payments under an EE FIT should be allowed for verified savings arising from both individual projects as well as mass market programmes.

As EE FITs are a new concept, there are no practical examples from which experiences can be drawn and therefore many points for discussion. For example, setting the price of energy savings (€ per kWh) is a critical element of the design process. A fixed price system will generally favour cheap energy efficiency measures. Neme & Cowart (2012) propose price variations which can encourage more difficult or expensive savings to be realised. For example, rewards can increase with the depth of measures where deeper or more advance measures with low market penetration are offered a bonus. The price of energy savings is also suggested to vary depending on end use as well as different market segments (e.g. residential, low income households, small commercial customers). Debates on whether the reward should be based on monitored savings as well as what approach to be used for evaluation, measurement and verification need to be carefully examined. The number of years for which savings are to be paid is also important, where the savings produced over their entire lifetime should be ideally recognised. Finally, payment options can range from a full up-front payment immediately after the measures are installed to yearly payment according to each year's savings, where the form effectively works as an installation grant, while the latter as stream of annual payments.

Incremental property taxation

Property taxes are imposed in many EU Member States (**Figure 22**) which can be distinguished in recurrent taxes on immovable property and other taxes such as taxes imposed on purchase transactions. These taxes mostly depend on the real estate value of each building. A modification, however, could be introduced in order to incorporate the efficiency level of the building in the property tax paid by the owner. That is, efficiency tiers – e.g. based on building's EPC label – would be created which would link the property tax due to the building's energy performance. By doing so, an incentive is given to the property owners to invest in energy saving measures in energy-hungry buildings in order to reduce their tax burden. Bürger (2013) propose that the adjustment can be revenue-neutral – i.e. tax levels are increased for inefficient buildings and decreased for efficient ones– or revenue-generating where taxes are increased for inefficient buildings only. The generated revenue of the latter could feed a public support fund which would provide incentives to groups with low creditworthiness or limited capital to invest (e.g. low income households or SMEs). This efficiency adjustment could apply to both annual property taxes paid by the building owners and taxes paid in property purchases. In case of a property purchase, the new owner could be given a certain grace period (e.g. 2 years after the transaction) before the extra tax charge attached to the building's efficiency is due. This would give the opportunity to new owner to carry out renovation work and improve their building's energy label in the meantime.

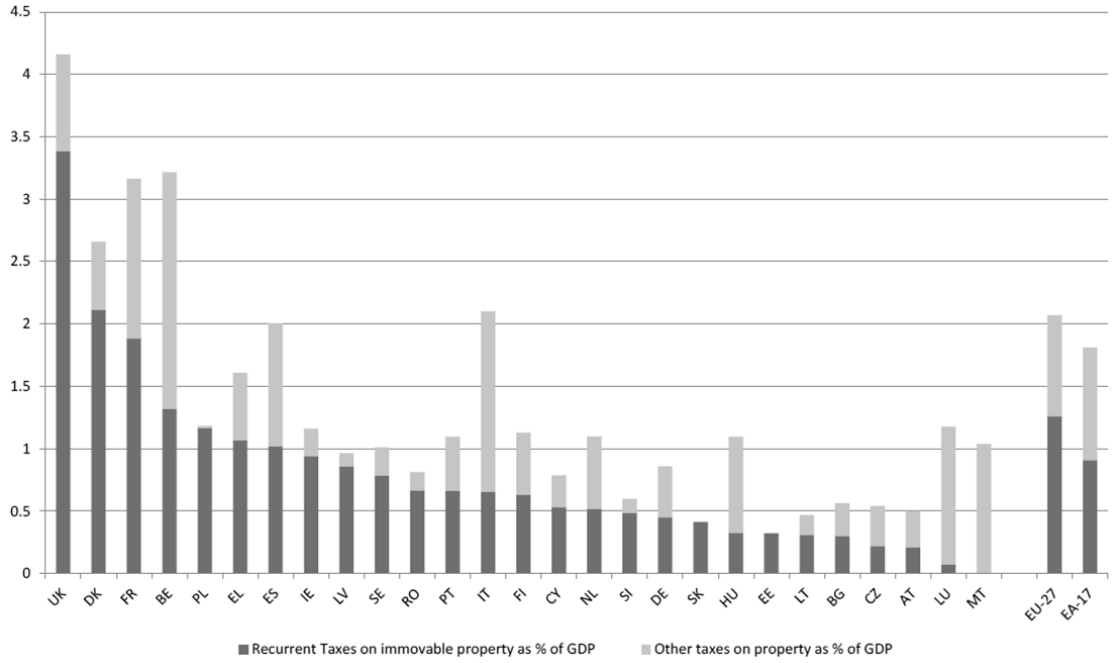


Figure 22 Composition of property taxes by EU Member State 2011, in % of GDP (Source: Eurostat (2013))

Other regulations, legislations and measures

Rented properties are usually less likely to undergo energy renovations due to the split incentives barrier between landlords and tenants. Some of these rented properties are inhabited by low-income households which may not afford to pay their utility bills and therefore under-heat their homes. **Minimum energy efficiency standards** in rented properties could ensure minimum comfort levels in low income housing as well as help address the misalignment of incentives in the building sector in general. The latter can occur through the combination of these minimum standard regulations and appropriate financing mechanisms, specifically designed to overcome split incentives. Such a legislative measure was created in 2011 in the UK under which all buildings with an energy performance certificate (EPC) level F or below will not be let out after 2018. The legislation also foresees that tenants and councils will have the right to demand improvements from 2016 onwards. In the Netherlands, an energy index of 1.25 as an average target (label B) for social housing has been set for 2020. This would mean that energy use in the social rented sector would fall by 33% by 2020 compared with 2008. The goal for private rented dwellings is that 80% of the stock should have an energy label C or higher in 2020 (Meijer, Visscher, Nieboer, & Kroese, 2012).

Simplifying **rental and condominium laws** are also a pre-requisite for enabling energy renovations in rented properties or multi-family buildings. A study investigating the energy renovations in condominiums in different EU Member States revealed that complex decision making structures, which require majority decisions with minority rules in place in certain cases, form a major barrier (Matschoss, Heiskanen, Atanasiu, & Kranzl, 2013). An external, unbiased party to facilitate the renovation decision process and provide a step-by-step technical and organizational support process has been recommended. **Green or energy efficiency leasing**, can be an effective practice that addresses split incentive issues in rented buildings. A green lease is a lease between a landlord and tenant which provides obligations on both parties to reduce energy consumption and ensure the efficient operation of the building. They establish agreements which align financial- and energy-related incentives by distributing costs

and benefits in a fair manner. These are mostly appropriate in large commercial buildings. In residential buildings, a pilot German project which enables the incorporation of energy efficiency ratings in residential rent indexes could be a promising approach to address misalignment between tenants and landlords in private residential units.

Summary and conclusions

The landscape of government-supported instruments in 2013

Economic instruments, offering government-supported incentives towards energy renovations in buildings, have been adopted in all EU Member States[25]. These were active in the year 2013, where roughly half of them were expected to end before 2015 and the other half were associated with longer or undefined timelines. The financial support provided by the various identified instruments was predominantly offered in the form of grants/subsidies, loans or tax incentives. Grants and subsidies were simply used to reduce initial costs for material, equipment, installation, advice and certification. Public funds were also used to buy down interest rates and make loan financing for energy efficiency investments more attractive. Income tax credits and deductions for the acquisition of energy efficient products are also available in certain cases. Energy efficiency obligations (EEOs) and white certificates – placing mandatory energy targets on energy market actors – formed another important type of economic instrument in the building sector in certain Member States.

A large range of groups were targeted by the identified instruments reflecting the long chain of actors involved in the building sector and their diverse interests. The latter highlights the inherited complexity in the underlying financial arrangements of energy efficiency programmes. The intervention measures supported by these instruments were related to all building elements and intervention types, and mainly fell in the categories of building envelope, building technical systems and renewable heat generation systems. Only a third of the instruments required energy performance criteria to be met for the installed energy efficiency measures, such as a certain percentage of energy savings, an overall building energy class improvement or a maximum energy demand at the building level.

Sources of finance largely originated from national or regional budgets (90%), while remaining sources constituted of EU funds, revenues from selling AAUs, funds by IFIs and other sources. The short or uncertain life time of these instruments is reinforced by the fact that many of them were reported to be highly dependent on public funds. This is particularly true for grant/subsidy schemes, while it should be noted that energy efficiency obligations have the advantage of placing no burden on the national budget and are therefore independent of budgetary changes. They, however, require political support for their continuation. Current budget sizes disbursed by the examined instruments were estimated to be on average €8 billion per year. This results in investments of at least €24 billion, but is not sufficient to meet the EU targets.

From a policy perspective, a substantial share of the current instruments was found to be affiliated with no particular policy target. In terms of interaction with other policy measures, economic instruments were found to be linked with energy building codes – where incentives were awarded to projects achieving energy performance levels beyond current code levels – or with EPCs. The latter were used to either determine the energy efficiency criteria of the planned intervention work or as a tool for compliance check, whereby an EPC certifier carries out a check before and/or after the intervention. The need of a comprehensive definition of a policy package was highlighted by the

[25] With the exception of Sweden

diversity in responses on whether and how these economic instruments formed part of an overall policy package.
The lack of detailed data collection and analysis of impact of various programmes hinders the comprehensive evaluation of these programmes in terms of their effectiveness and cost-effectiveness. A third of these instruments were found to carry no impact assessment. For the remaining ones, energy or CO_2 savings were used as the main indicators for evaluating their impact. Macroeconomic or other benefits were rarely included which implies that these benefits are not fully appreciated at the political level. Missing or asymmetric information faced by the market for energy efficiency, can be partly addressed if the experience drawn by these instruments is better utilised and more detailed data are tracked and analysed.

Future considerations for emerging financial measures and other policy measures

Private investments in the building sector are critical for tapping into the considerable energy efficiency potential linked to the building sector. New or emerging financial models can negate long-standing barriers such as upfront costs or split incentives as well as address the current lack of scalability associated with conventional solutions. Other policy measures or legislations may be necessary to overcome shortcomings of existing measures.
Some of the main considerations around these mechanisms and measures have been examined in this work. On-bill financing is a mechanism that reduces first-cost barriers by linking repayment of energy efficiency investments to the utility bill. These can be tied to the property owner (on-bill loans) or the meter of the property (on-bill tariffs). The latter makes the obligation of repayment transferable to the next occupant or building owner. Some of the barriers related to on-bill programmes that need to be overcome include high administrative costs (due to the need for individual energy audits and new billing structures), allocation of risk in the event of default, transferability of obligations in the event of property sale in practice, and ways to ensure energy savings exceed loan or tariff payments.
The PACE model is another promising means of scaling up energy efficiency investments in the building sector, through the use of specific bonds offered by municipal governments and tax assessments against the properties benefitted by such improvements. They can be assigned to long terms of around 15-20 years, which are appropriate for energy efficiency measures with longer payback time. The assessment lien is an attractive element for investors and the option of repayment obligation is transferable to the next owner as in the case of on-bill tariffs. Legal complications related to the lien priority, however, need to be addressed.
While there is no yet experience with programmes based on the PACE mechanisms in Europe, EPC-related activity has been on a rising trend in many EU Member States in the last years. EPCs offer the option of performance guarantees which can reduce risks associated with complex projects. Key issues include high transaction costs and lack of deployment of new technologies while EPCs cannot offer a realistic framework for smaller projects. Moreover, customers bear the responsibility of securing the financing part in many cases. ESAs can offer an alternative solution by allowing customers to finance these improvements "off-balance sheet", while they pay only for actual savings realised.
Mortgage lending can play an important role in promoting energy efficiency by making it more mainstream and in addressing some of the problems associated with financing energy efficiency. As debt financing typically needs to be compatible with restrictions

associated with existing mortgage on the properties, energy efficiency can also offer an alternative option.

As the energy efficiency finance market grows, emerging concepts will evolve into more established schemes, while new ones may emerge. What is clear is that no single "silver bullet" for energy efficiency finance solutions exist due to complex nature of the sector. Together with the right policy set, successful energy efficiency finance structures can incentivise all the stakeholders involved, and balances the risks of implementing energy efficiency improvements with the resulting energy savings returns and benefits.

Annex I – Questionnaire

Part 1: General information

1. Please select the country in which the instrument is implemented
2. Instrument name in English
3. Relevant website of instrument
4. Instrument type
5. What are the building types covered by the instrument?
6. What is the current implementation status of the instrument?
7. Please indicate the implementation period of the instrument
8. At what level is the instrument implemented?
9. Please select the relevant target groups
10. Why was this type of instrument chosen over others? Please rank the following factors in terms of their importance
11. What was the policy driver behind the specific financial instrument?
12. Other general information (optional)

Part 2: Design

1. Under what categories do the intervention measures covered by the instrument fall?
2. Please provide more information on the intervention measures
3. What is the format in which the intervention measures are offered?
4. What is the level of direct (e.g. grant intensity) or indirect (e.g. tax relief) financial support provided and what is the expected contribution by the target group? What is the maximum amount of support that can be received? Please specify changes made since the beginning of the instrument and why.
5. If applicable, please indicate the repayment terms for the applicants along with the associated timeline
6. Does the level of the financial support described above increase with certain parameters (e.g. ambition of renovation depth or income of household)?
7. What criteria need to be fulfilled prior to intervention work?
8. What criteria need to be fulfilled after the intervention work?
9. Please describe how it is controlled that the pre and post renovation criteria are met
10. What is the average renovation depth per building achieved by the intervention measures of the instrument?
11. Please indicate the average yearly energy savings in kWh/m2 achieved per building
12. Is there an overall target set to be achieved by the instrument in a yearly or other basis (e.g. overall energy savings or number of buildings to be renovated)?
13. Is the instrument part of a policy package including other economic, regulatory and information instruments?
14. What communication channels are used to disseminate the existence of the instrument to the relevant target groups

Part 3: Budget and operation

1. Which body acts as intermediary (responsible for gathering and disbursing funds to the target group)?
2. What are the funding sources of the instrument? Please provide a percentage estimate of the contributing part of each of them
3. What is the total disbursed budget used to date? Please provide the budget disbursed only for building renovations projects (If it is not possible, please explain in the notes)
4. Is there available disaggregated data on the disbursed budget by year, building type, intervention measure?

5. If the answer of question 4 is 'yes' for option A, please provide the breakdown of the disbursed budget by year
6. If the answer of question 4 is 'yes' for option B, please provide the breakdown of the disbursed budget by intervention measure type
7. If the answer of question 4 is 'yes' for option C, please provide the breakdown of the disbursed budget by intervention measure type
8. Is the current financial instrument under threat because of budget/financial crisis?
9. Is there a specific strategy for using EU structural funds?
10. Are there plans to diversify funding sources in the future?

Part 4: Impact and evaluation

1. How many buildings have had intervention measures installed by the instrument to date?
2. Breakdown of enrolled buildings per year
3. What is the estimated total volume of investment originated by the instrument to date (including contributions by applicants)?
4. Has an impact assessment been carried out for the instrument?
5. Ex-ante impact assessment
6. Ex-post impact assessment
7. Is there a policy for regular monitoring and evaluation of the financial instrument?
8. Please describe the method used for verifying the energy savings
9. Which evaluation method is used to calculate energy savings?
10. Have any correction factors been applied in the evaluation of energy savings to account for any of the following effects?

Part 5: Success

1. How successful is the instrument perceived with respect to ...?
2. Main reasons behind success
3. Improvements and changes foreseen for the future
4. Please provide links of relevant reports, papers and research on the instrument

Annex II – Catalogue of identified programmes

Please note that the first two letters of each instrument code denotes the ISO-code of the country in which the instrument is implemented. For Belgium, the subscript next to the ISO-code denotes the relevant region.

CODE	INSTRUMENT	INSTRUMENT TYPE	BUILDING SECTOR
AT01	Housing Subsidy ("Wohnbauforderung")	Grant/Subsidy	Residential
AT02	Building Renovation Campaign ("Sanierungsoffensive")	Grant/Subsidy	Residential; Commercial ; Public
$BE_{BRU}01$	Green Loan At 0%	Loan; Grant/Subsidy; Guarantee Funds	Residential
$BE_{BRU}02$	Grants For Energy Efficiency In Buildings (Domestic, Tertiary, Industrial)	Grant/Subsidy	Residential; Commercial ; Public
$BE_{BRU}03$	The "Exemplary Buildings" Call For Projects	Grant/Subsidy	Residential; Commercial ; Public
$BE_{BRU}03$	Local Action Plan For Energy Management (PLAGE)	Grant/Subsidy	Public
$BE_{VLG}01$	Rue (Rational Use Of Energy) Obligations For Electricity Distribution System Operators	Grant/Subsidy	Residential; Commercial ; Public
$BE_{VLG}01$	Fund For The Reduction Of The Global Cost Of Energy (FRGE)	Loan; Supporting Policies For Escos	Residential
BG01	National Renovation Programme For Residential Buildings	Grant/Subsidy	Residential
BG02	Residential Energy Efficient Credit Line Facility (REECL)	Loan; Grant/Subsidy	Residential
BG03	Energy Efficiency And Renewable Sources Fund (EERSF)	Loan; Guarantee Funds; Supporting Policies For Escos	Residential; Commercial ; Public
BG04	Operational Programme "Regional Development"	Grant/Subsidy	Residential; Public
CY01	Support Scheme For The Promotion Of Renewable Energy And Energy Conservation	Grant/Subsidy	Residential; Commercial ; Public
CZ01	Green Investment Scheme In Czech Republic	Grant/Subsidy	Residential
CZ02	Operational Programme	Grant/Subsidy	Public
CZ03	National Environmental Fund	Grant/Subsidy	Public
CZ04	Panel Programme	Loan; Guarantees	Residential
DE01	CO_2 Efficient Buildings Program - Kfw Bank Renewable Energy Program For Buildings (BAFA)	Loan; Grant/Subsidy	Residential; Public
DK01	Income Tax Deduction Scheme ("Bolig Job Ordning")	Income Tax Deduction	Residential
DK02	The Danish Energy Saving Scheme	Energy Saving Obligations	Residential; Commercial ; Public
EE01	Renovation Loan For Apartment Buildings	Loan	Residential
EE02	GIS "Energy savings through refurbishments in detached houses and installation of micro renewable energy equipment in Estonia"	Grant/Subsidy	Residential
EE03	Energy savings through refurbishment of multi-apartment buildings in Estonia	Grant/Subsidy	Residential
ES01	Aid Program For The Energy Rehabilitation Of Existing Buildings	Loan; Grant/Subsidy	Residential; Commercial
FI01	Grants For Residential Buildings	Grant/Subsidy	Residential

FI02	Tax Deductions	Income Tax Deduction	Residential
FI03	Energy Audit Grants	Grant/Subsidy	Commercial ; Public
FR01	Sustainable Development Tax Credit	Income Tax Credit	Residential
FR02	Zero Rate Eco-Loans	Loan	Residential
FR03	Obligation Scheme (Energy Efficiency Certificates)	White Certificates	Residential; Commercial ; Public
FR04	Vat Reductions	Vat Reduction	Residential
FR05	Property Tax Exemption	Property Taxation	Residential
FR06	Grants For Medium And Low Income Households	Grant/Subsidy	Residential
EL01	Energy Efficiency At Household Buildings Programme ("Εξοικονόμηση κατ' οίκον ")	Loan; Grant/Subsidy; Income Tax Deduction	Residential
EL02	Energy Saving By Local Authorities ("ΕΞΟΙΚΟΝΟΜΩ")	Grant/Subsidy	Public
HR01	Environmental Protection And Energy Efficiency Fund	Loan; Grant/Subsidy	Residential; Commercial ; Public
HU01	GIS: Climate Friendly Homes - Reconstruction Program Of Panel Apartment Complexes / Pre-Fabricated Homes I. And Ii.	Grant/Subsidy	Residential; Public
HU02	GIS: Climate Friendly Homes - Energy Efficiency Program	Grant/Subsidy	Residential
HU03	USZT-GIS: "Home Reconstruction And New Homes" Program	Grant/Subsidy	Residential
HU04	USZT-GIS "Fostering The Use Of Renewable Energy Sources: Installation Of Solar Panels For Hot Water Preparation And Heating"	Grant/Subsidy	Residential
HU05	USZT Subprogram "Modernization Of Heating Systems"	Grant/Subsidy	Residential
HU06	Support Of Industrial Technology Built, Pre-Fabricated Apartment Houses' Energy Saving Renovation - Hungarian Budget 2008	Grant/Subsidy	Residential
HU07	Individual Measurement And Control In District Heating "OKO-Program"	Grant/Subsidy	Residential
HU08	Building Energy Developments And Street-Lighting Reconstratction (ECOP-5.3.0/A)	Grant/Subsidy	Commercial ; Public
HU09	Modernization Of District Heating Systems - Subsidy For Investment In Energy Modernisation Of DH Systems (ECOP-5.4.0)	Loan	Residential; Commercial ; Public
HU10	Building Energy Improvements Combined With Renewable Energy Utilization (ECOP-5.3.0/B)	Grant/Subsidy	Commercial ; Public
IE01	Better Energy Homes Scheme	Grant/Subsidy	Residential
IE02	Better Energy Workplaces	Grant/Subsidy	Commercial ; Public
IT01	White Certificates	White Certificates	Residential; Commercial ; Public
IT02	55% (65% From June 2013) Tax Credit For Energy Efficiency Improvement Measures In The Residential Sector	Income Tax Credit	Residential
IT03	Renewable Energy For Heating & Cooling Support Scheme	Grant/Subsidy	Residential; Commercial ; Public
LT01	Modernisation Of Multi-Dwelling Buildings	Loan; Grant/Subsidy	Residential
LU01	Subsidies For Residential Buildings	Grant/Subsidy	Rensidential
LV01	Existing Support Programs In EU 2007-2013 Planning Period - Improvement Of Heat Insulation Of Multi-Apartment	Grant/Subsidy	Residential

	Residential Buildings (3.4.4.1 Activity)		
LV02	Climate Change Financial Instrument	Grant/Subsidy	Commercial ; Public
NL01	Energy Investment Allowance	Income Tax Deduction	Commercial
NL02	Green Funds Scheme	Loan; Income Tax Deduction	Residential; Commercial ; Public
NL03	Vat Reductions For Building Renovations	Vat Reduction	Residential
NL04	More With Less	Grant/Subsidy	Residential
PL01	Green Investment Scheme In Poland	Grant/Subsidy	Public
PL02	Thermo-Refurbishment Fund	Loan; Grant/Subsidy	Residential; Commercial ; Public
PT01	Energy Efficiency Fund (EEF)	Grant/Subsidy	Residential
RO01	Programme On The Thermal Rehabilitation Of Housing Blocks	Grant/Subsidy	Residential
RO02	Programme On The Thermal Rehabilitation Of Residential Buildings	Loan; Guarantee	Residential
RO03	Regional Operational Programme	Grant/Subsidy	Residential
RO04	Rehabilitation Programme For Collective Residential Buildings	Grant/Subsidy	Residential
SI01	Energy Efficient Renovation Of Public Buildings - Education Buildings (Cohesion Funding)	Grant/Subsidy	Public
SI02	Subsidies For Citizens For New Res And EE Investments	Grant/Subsidy	Residential
SK01	State Fund For Housing Renovation	Loan; Grant/Subsidy; Income Tax Deduction	Residential
SK02	SLOVSEFF	Loan; Grant/Subsidy; Income Tax Deduction	Residential
SK03	EKO Fund	Grant/Subsidy	Residential
UK01	The Green Deal	Loan	Residential; Commercial ; Public
UK02	The Electricity And Gas (Energy Companies Obligation) Order 2012	Energy Saving Obligations	Residential

Annex III – Acknowledgements

This report was developed by the Joint Research Centre with the input of various people.
We would like to thank the following national partners for sharing their valuable knowledge with us and helping us develop an understanding of the situation in their respective country.

NATIONAL EXPERTS

AUSTRIA

Gottfried Lamers
Federal Ministry For Agriculture, Forestry, Environment And Water Management

Wolfgang Jilek
Government Of Styria

BELGIUM

Françoise Onclincx
Bruxelles Environnement (IBGE)

Tine Tanghe
Flemish Energy Agency

BULGARIA

Tsvetomira Kulevska
Sustainable Energy Development Agency

CROATIA

Vesna Bukarica
Environmental Protection And Energy Efficiency Fund

CYPRUS

Nicos Hadjinicolaou
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DENMARK

Danish Energy Agency

ESTONIA

Pille Arjakas
Ministry Of Economic Affairs And Communications

FRANCE

Elodie Trauchessec
ADEME

GREECE

Georgia Konstantinopoulou
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Maria Zarkadoula
Center For Renewable Energy Sources And Saving

GERMANY

German Energy Agency (DENA)

HUNGARY

Krisztina Ligetvári
Émi Non-Profit Limited Liability Company For Quality Control And Innovation In Building

IRELAND

Eamonn Confrey

Ministry For Energy

ITALY

Alessandro Federici
Italian National Agency For New Technologies, Energy And Sustainable Economic Development (ENEA)

LITHUANIA

State Enterprise Energy Agency

LATVIA

Inita Henilane
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NETHERLANDS (the)

Lucinda Maclagan
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POLAND

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Barbara Letachowicz
National Fund for Envtironmental Protection and Water Management

PORTUGAL

Rui Fragoso
Agência para Energia (ADENE)

ROMANIA

INCD URBAN-INCERC

SLOVENIA

Damir Staničić
Energy Efficiency Centre, Jozef Stefan Institute

Barbara Petelin Visočnik
Energy Efficiency Centre, Jozef Stefan Institute

SPAIN

Instituto para la Diversificación y Ahorro de la Energía (IDAE)

UNITED KINGDOM

Elizabeth Brunton
Department of Energy and Climate Change

Marcia Poletti
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We would like to thank the following experts for their time, contribution and insights to the work underpinning this report.
Christopher Lamport, Federal Ministry for Agriculture, Forestry, Environment and Water Management, Austria

Wilhelm Kuckshinrichs, Institute for Energy and Climate Research, Systems Analysis and Technology Evaluation (IEK-STE), Jülich, Germany

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European Commission
EUR 26718 EN – Joint Research Centre – Institute for Energy and Transport

Title: **Financing building energy renovations**

Author(s): Marina Economidou, Paolo Bertoldi

Luxembourg: Publications Office of the European Union

2014 – 77 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)
ISBN 978-92-79-39129-3 (PDF)
ISBN 978-92-79-39130-9 (print)

doi: 10.2790/28141

LD-NA-26718-EN-N

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doi: 10.2790/28141

ISBN 978-92-79-39129-3