ENTRA NZE

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Overview and assessment of new and innovative integrated policy sets that aim at the nZEB standard

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ENTRANZE Project

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NATIONAL CONSUMER RESEARCH CENTRE	**NCRC**	National Consumer Research Centre
Fraunhofer ISI	**Fraunhofer**	Fraunhofer Society for the advancement of applied research
CENER	**CENER**	National Renewable Energy Centre
POLITECNICO DI MILANO	**eERG**	end use Efficiency Research Group, Politecnico di Milano
Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology	**Oeko**	Öko-Institut
SOFENA	**SOFENA**	Sofia Energy Agency
BPIE	**BPIE**	Buildings Performance Institute Europe
Enerdata	**Enerdata**	Enerdata
SEVEn	**SEVEn**	SEVEn, The Energy Efficiency Center

The ENTRANZE project

The objective of the ENTRANZE project is to actively support policy making by providing the required data, analysis and guidelines to achieve a fast and strong penetration of nZEB and RES-H/C within the existing national building stocks. The project intends to connect building experts from European research and academia to national decision makers and key stakeholders with a view to build ambitious, but reality proof, policies and roadmaps.

The core part of the project is the dialogue with policy makers and experts and will focus on nine countries, covering >60% of the EU-27 building stock. Data, scenarios and recommendations will also be provided for EU-27 (+ Croatia and Serbia).

This report provides an overview of different instrument options targeting at modernisation measures in the building sector. A focus of the report is laid on instruments that aim to trigger ambitious refurbishment measures in the building stock (deep renovation) and thus to converge to the nearly zero energy standard as introduced by the EPBD recast.

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Executive Summary

In many countries transforming the building sector is one of the key elements for moving the energy system towards low carbon. Very long reinvestment cycles, large capital intensity and a rather heterogeneous ownership structure make this transformation a challenge for governments to identify policy paths that comply with the long-term targets.

This report provides a comprehensive list of different instrument options all of which are targeting at modernisation measures in the building sector thus addressing the multiple and often target-group specific barriers in the built environment. Instruments are covered that either target insulation measures at the building envelope (e.g. insulation of the outer walls or the roof, replacement of the windows, installation of insulated window frames) or aim at increasing the efficiency or reducing the carbon-intensity of the active heating and cooling systems in a building. A focus of the report is laid on instruments that aim at triggering ambitious refurbishment measures in the building stock (deep renovation) thus converging to the nearly zero energy standard as introduced by the EPBD recast.

The instruments introduced in the report need to be regarded as generic concepts. We describe the principle architecture for the different approaches, in addition major advantages and drawbacks are briefly discussed. It should be considered that both, pros and cons might differ from country to country depending on the national context the instrument might operate in. Implementing one of these instruments in one of the target countries would also require an adaption of the detailed instrument design to the specific national context of that country. The detailed “fine-tuning” has to take into account several factors such as the market maturity of different technologies, the stimulation and assurance of ambitious technological standards and the potentially limited availability of specific resources (e.g. renewable energy sources) for heating and cooling purposes.

In regard to the important role of the building sector for achieving ambitious climate targets it is necessary to elaborate clearly defined long-term plans/strategies setting final goals and interim milestones to be reached by subsequent policies. Here especially the long reinvestment cycles in the building sector need to be taken into account when designing instruments addressing the refurbishment of buildings: Energy standards should be set to comply with the long-term targets and policies should be that ambitious as to stimulate a sufficient number of refurbishment projects.

The report covers a broad spectrum of different environmental economic approaches ranging from regulatory measures to “soft” policy instruments. A certain priority was given to innovative measures, for instance instruments that are independent from public budgets by mobilising alternative funding sources. The aim is to broaden the sometimes narrow discussion about instrument approaches in the building sector which often is restricted to governmental grant or soft loan schemes.

Instrument type		Main characteristic	Examples
Regulatory instruments		Command and control type regulations, works with orders and/or bans	– Building codes – Refurbishment obligations – RES-H obligations
Economic Instruments	Grants and prefential loans	Different ways of financing the programs	– Financed through state budget – Financed through state-like budget – Financed through surcharge on energy or climate taxes – Financed through levy on buildings
	Tax incentives	Positive or negative incentives (add. fiscal burden)	– Tax incentives for investors o Tax deductions o Tax credits o Reduced VAT – Property tax (bonus/malus) – Property purchase tax (bonus/malus)
	Energy tariffs	Tariff structure that is incentivising the reduction of energy consumption	– Progressive energy tariffs
	Instruments strengthening support and financing activities within the market	Financial support or finance provided by market actors -> state budget independent support	– Energy saving obligation – Quota system for RES-H – Bonus/Premium scheme – Contracting type of instruments – Bank obligation to grant interest reduced loans
Capacity building, qualification and quality assurance		Assure quality -> keep confidence high; targets at sufficient number of skilled manpower along whole value chain	– Professional training/ Vocational education – Branded quality standards – Qualified building specific refurbishment plans
Information, motivation, advice		Motivate home owners to invest in modernisation measures; allow home owners to do informed decisions	– Energy performance certificates – Combining financial support with mandatory advice – Competence centres for energetic building refurbishment
Market transformation (supply side) measures		Shape the market for new technologies by “working” with the supply side	– R&D support – Technology procurement – Premiums for providers of efficient technologies – Organising competitions or tenders between technology providers – Creating networks – Labelling, testing and certification
Target-group specific approaches	Owner associations	Targets the heterogeneous barriers in multi-family houses	– Mandatory renovation funds – Governmental debt guarantees – Professional housing companies/property managers
	Rental homes	Split incentive problem	– Toleration rules – Cost allocation rules – Rent reduction claims
	Low-income owners	Financing barrier	– Public debt guarantees – Grants for low income owners
	Public buildings	Exemplary role, poor state of public finance	– Committed renovation rate – Development of refurbishment strategies

The group of economic instruments aims at incentivising the investment in efficiency measures or a changed (more energy efficient) user behaviour. For all economic approaches two elements need to be distinguished, the revenue perspective and the support (expenditure) perspective:

- The revenue perspective mainly addresses the question how the financing of the support scheme is organised; in other words who finally is providing the financial resources that are required for the economic incentives given to those who are supposed to invest in refurbishment measures.
- The support perspective deals with the question how the support is organised; here especially the specific support conditions and support eligibility are key design parameters.

Most instruments combine both elements which means that financial incentives are offered to investors to take efficiency measures while support is financed through the state-budget or other non-fiscal means (such as levies, surcharges on the energy prices etc.). Resulting from the two perspectives two different steering mechanisms need to be distinguished. One effect is directly linked to the support side: By providing an attractive support framework building owners should be incentivised to take appropriate efficiency measures. The other steering effect is resulting from how the financing of the support side is organised. For several instrument options the financial burden is either borne by the building owners or by the residents. This additional financial burden is corresponding to an incentive to lower this burden while the level of impact is depending on the elasticity how the different actor groups will react on such price signals.

Since several barriers inhibit the energy saving potentials in the building sector at the same time, a single instrument will not be enough to stimulate modernisation measures to the necessary extent. In addition barriers can be rather target-group specific. In general it is difficult to design an isolated instrument that addresses several barriers simultaneously. In fact a bundle of instruments is required to properly address the most relevant barriers at the same time, which would be necessary to intensify investments in modernisation measure. In other words, target specific barrier bundles call for target specific instrument bundles (policy packages).

For the combination of different instruments into a policy package the following considerations should be taken into account:

- Instruments should be designed as to address the main barriers that hamper investments in the efficiency of buildings. In addition the policy package should include elements that target the needs of the major target groups. The instruments in the policy package should reflect the market maturity of the different technologies.
- If a certain barrier (e.g. a financial barrier) is addressed by two or more instruments at the same time, this should be adequately justified (e.g. by the fact, that the instruments offer different accesses to financial support which might aim at

different target groups). It should be avoided that instruments are simply redundant (which might only lead to higher administrative costs).

- In general administrative costs of a policy package should be kept as low as possible. This includes the transaction costs for the state but also all other system participants. For that reason it should be assessed to which extent synergies could be exploited when administering several instruments at the same time.
- In order to increase public acceptance from the communicative perspective the policy package should be kept as simple as possible. The main elements of a package should be easy to communicate.

1. Introduction

In many countries transforming the building sector is one of the key elements for moving the energy system towards low carbon. Very long reinvestment cycles, large capital intensity and a rather heterogeneous ownership structure make this transformation a challenge for governments to identify policy paths that comply with the long-term targets.

With the EPBD recast the European Commission has established the nearly zero energy standard (nZEB) as core standard in the building sector. The Directive calls on Member States to develop national strategies how to transform the building sector towards the nZEB standard. These strategies need to be supported by respective policies. In this regard Member States have to gradually align their technical standards and support policies with this standard.

This report provides an overview of different policy options that aim at the nZEB standard. The report introduces a wide range of different generic policy instruments that aim at mobilising more activity in the building sector towards the nZEB standard. A focus of the report is laid on instruments that aim at triggering ambitious refurbishment measures in the building stock (deep renovation) including insulation measures at the building envelope as well as measures to improve the efficiency of the heating and cooling technologies. In addition a certain focus is laid on innovative policy measures going beyond “simple” state financed grant programs.

Since several barriers inhibit the energy saving potentials in the building sector at the same time, a single instrument will not be enough to stimulate refurbishment measures to the necessary extent. A bundle of measures – in the report we call them policy bundles or policy sets – will be required to appropriately address the often target group specific barriers. The policy sector faces the challenge to identify suitable instrument combinations that either oblige or incentivise building owners to intensify their investments in refurbishment measures in view of two dimensions: increasing the refurbishment rate as well as tightening the refurbishment standard that a refurbishment measure will strive for.

1.1 Aim of the report

The report is aiming at providing a comprehensive list of different instrument options that are all targetting refurbishment measures in the building sector. This includes instruments that are addressing the efficiency standard of a building as whole but also rather specific instruments, e.g. affecting only specific technologies such as renewable heating or cooling technologies (RES-H and RES-C). A focus of the report is laid on instruments that aim at triggering ambitious refurbishment measures in the building stock (deep renovation) by thus converging to the nearly zero energy standard as introduced by the EPBD recast. Priority will be given to innovative measures, for instance to instruments that are independent from public budgets by mobilising alternative funding sources. The aim is to broaden the sometimes narrow discussion about instrument

approaches in the building sector which is often restricted to governmental grant or soft loan schemes.

Figure 1 is illustrating the role of the report in the context of the Entranze project. The instrument options will serve as some kind of toolbox for the subsequent modelling work. Drawing on the instrument list for each of the nine target countries of the project a handful of different country specific policy sets will be defined. The design of the policy sets will be jointly developed, discussed and fixed with the policy groups. The different instrument sets will then be subject to comprehensive modelling work (WP4). The outcome of the model runs and scenarios will help policy makers to learn and understand the quantitative impact of different policy instruments in the diffusion process of e.g. different technologies and the building-related energy demand in view of the specific national context.

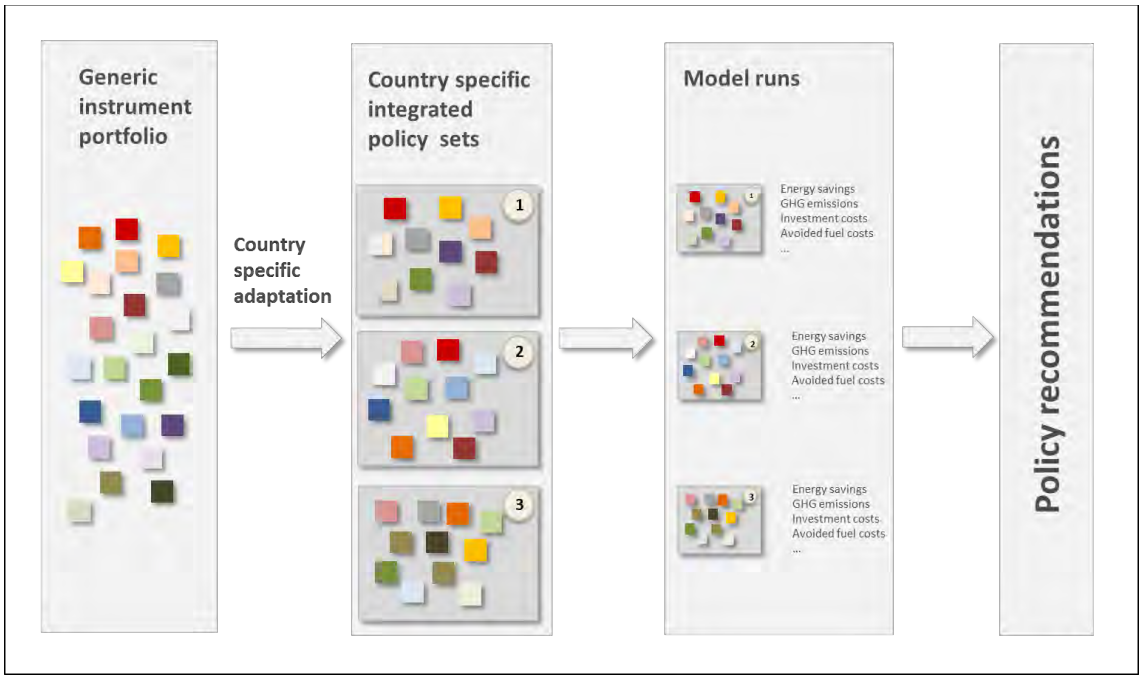

Figure 1: Role of the report in the Entranze project

1.2 Structure of the report

The report is structured in six sections. Following the introduction section 2 gives a brief overview of the policy requirements deriving from the relevant European Directives that need to be considered when developing the future policy mix for the building sector. The most relevant directives comprise the recast of the Energy Performance of

Buildings Directive (2002/91/EC)[1], the Renewable Energy Directive (2009/28/EC)[2] and the new Efficiency Directive (2012/27/EU)[3]. Apart from transposing European legislation policy instruments should in particular be designed as to properly address existing (often target group specific) barriers in order to be effective and efficient from the environmental economic perspective. Accordingly in section 3 we summarise the main barriers that currently hamper the modernisation of the building stock and identify some policy implications. The building sector is determined by rather long reinvestment cycles (e.g. as far as the building envelope is concerned). Therefore In section 4 we elaborate a bit on the long-term perspective and how it should be taken into account in order to avoid lock-in effects that are not compatible with the long-term visions for the sector. Section 5 constitutes the main body of the report. It describes a set of various policy instruments from different policy categories (e.g. regulatory instruments, economic instruments, information instrument etc.). Apart from the instrument architecture some generic advantages and disadvantages are provided for each of the listed approaches. In section 6 we briefly elaborate on the need of integrated policy packages and how these could be developed from the list of instruments.

1.3 Scope of the analysis

The focus of the report lies on instruments that aim at mobilising modernising measures in the existing building stock. In this respect instruments are covered that either target insulation measures at the building envelope (e.g. insulation of the outer walls or the roof, replacement of the windows, installation of insulated window frames) or aim at increasing the efficiency or reducing the carbon-intensity of the active heating and cooling systems in a building.[4] Apart from using more efficient conversion technologies and reducing the heat losses in the distribution system of a building or a heating grid the latter is also particularly addressing the enhanced use of renewable sources for thermal supply purposes.

Most instruments can be applied in both building segments, the residential and non-residential building sector.[5] In both segments buildings involve similar structural ele-

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recasting Directive 2002/91/EC on the energy performance of buildings).

[2] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[3] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

[4] With regard to technologies Entranze is focussing on technologies delivering space heating, hot water and space cooling (incl. RES-H/C). Lighting will be addressed only to a minor extent.

[5] But also “mixed building” entailing dwellings and e.g. offices.

ments (e.g. outer walls, roof, windows) even though differing in size, stability and quality (for instance in terms of persistence and thermal insulation). Heating technologies are also quite the same. However non-residential buildings often have different use patterns that can significantly influence the economics of refurbishment measures. Other features that distinguish the non-residential sector from the residential one can be rather different internal heat loads; furthermore in some buildings the possibility to connect the heating/cooling system for space heating and domestic warm water supply to other active heat systems - e.g. resulting from thermal or other processes of the company holding the building (e.g. where waste heat from an industrial process is used for heating a factory building). In the best case the heating and hot water demand can be covered by waste heat that otherwise would be dissipated.

Moreover many non-residential buildings differ in the ownership structure and thus in the process how decisions on investment measures (such as refurbishment measures) are taken. Decisions often are based on other criteria or at least differently weighted criteria than in the residential sector. Building owners in the non-residential sector often have a better idea of the economics of renovation measures but expect much shorter refinancing periods than domestic home owners. This often limits the scope of such investments as many companies would not accept amortisation periods of 15 years or even more. Support instruments need to consider these differences. Nevertheless instrument types similar to the residential building sector could be applied, however differently designed as to reflect the different needs in the non-residential sector.

There are a couple of cross-sectoral instruments that also affect the building sector (at least to a certain extent). For instance such instruments include the Emissions Trading Scheme (ETS), energy/CO_2-taxes or public procurement. Fossil electricity generation in power plants larger than 20 MW thermal capacity is covered by the ETS thus affecting electric heat generation. Energy taxes on e.g. fossil fuels have an impact on the fuel price and thus the economics of fossil fuelled heating technologies. In order to strengthen the refurbishment activity in the building sector one might adapt these instruments. An often discussed example would be the extension of the ETS on sectors currently not covered by the system. However, such an extension would require respective changes in the European legislation regulating the ETS. Since our project is focussing on national policy approaches only, cross-sectoral instruments will be covered by the analysis for which the major design can be chosen by national governments. For instance this applies to the energy tax that is regulated on the EU level by the Directive (2003/96/EC)[6], while leaving some flexibility to the Member States in defining core parameters in order to adjust the tax to their specific policy targets. In contrast the ETS is a European instrument for which Member States also need to implement national regulations. However, the flexibility in adjusting the rules is rather low

[6] Council Directive 2003/96/EC of 27 October 2003 restructuring the community framework for the taxation of energy products and electricity.

since the instrument implies a European (carbon) market. For that reason an extension of the ETS towards the building sector would require European legislation and will not be dealt with in our project.

A policy framework aiming at mobilising financing for modernisation measures might imply policy approaches that have a clear social policy focus. Some of the proposed instruments may lead to an additional material or financial burden to certain actor groups. Instruments might involve an additional levy on the building owner or a surcharge on the energy prices that need to be paid by all energy consumers. In each of the affected groups there might be representatives that will not be in an economic position to cover the extra costs calling for balancing measures or any form of compensation. Balancing measures are indeed important elements for any policy approach that tries to mobilise comprehensive activity. However, since the need for such measures may be different from country to country and must be well adapted to existing transfer payments in the national social systems, such balancing measures will not be covered by our report.

The same applies to policies with a rather local component. Due to internal migration in a country there may be regions where it is not clear whether a certain building will have a future on the local or regional building market. For instance migration from remote rural areas to cities could reduce the demand for living space in rural areas while putting pressure on the building markets in the city centres. Under such circumstances it would be counter-productive to incentivise the modernisation of buildings in remote rural areas as this might imply stranded investments. The policy framework for modernising the existing building stock should properly take into account such developments. Since these effects might differ comprehensively between countries we did not consider them in our instrument list.

Finally, continuous monitoring and evaluation are key to understand the effectiveness and efficiency of different policy approaches and to provide evidence for potential instruments design adjustments to improve their impact (IEA, 2012a). For that reason every policy instrument should include monitoring elements from the date of implementation. We do not explicitly cover monitoring since it does not directly influence the impact of a policy.

Final note: The generic terms “energy refurbishment” and “energy modernisation” are used in the report to refer to different types of measures that aim at reducing the non-renewable primary energy consumption of a building including thermal insulation measures at the building envelope as well as measures related to the heating and cooling systems including the use of renewable energies. Both terms are used as synonyms.

2. European policy requirements

The building sector is addressed by several European directives that need to be taken into account when designing future policy sets for the building sector. The most relevant regulations are the

- Energy Performance of Buildings Directive (EPBD, 2002/91/EC) and the EPBD recast (2010/31/EC),
- Renewable Energy Directive (RED, 2009/28/EC)
- Energy Service Directive (ESD, 2006/32/EC) and the new Energy Efficiency Directive (EED, 2012/27/EU)
- Ecodesign Directive (2005/32/EC) and it's recast (2009/125/EC)
- Energy Labelling Directive (1992/75/EWG) and it's recast (2010/30/EU)

For the listed Directives Table 1 provides an overview of the most relevant rules and requirements as far as the building sector is concerned.

Table 1: Overview of European legislation addressing the building sector

Directive	Regulations for the built environment
EPBD	• requires Member States to develop and apply a methodological framework for calculating the energy performance of buildings. This calculation method shall consider thermal building characteristics as well as the technological equipment for the thermal supply • obliges Member States to take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set, applied and met with a view to achieving cost-optimal levels; this regulation applies to all new buildings and existing buildings that undergo major renovation • requires Member States to take measures that aim at optimising the performance, installation, appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing buildings • obliges Member States to ensure that all new buildings to be nZEB by the end of 2020, and all new public buildings to reach this standard two years earlier; in addition Member States shall draw up national plans reporting on their plans for increasing the number of nZEB, definition of nZEB, policies/measures in order to stimulate the transformation of buildings that are refurbished into nZEB, interim steps towards nZEB, implementation of Article 13(4) (see below) • requires Member States to ensure that all accessible parts of the heating and air-conditioning systems are regularly inspected and that heating installations older than 15 years are assessed with re-

	spect to their energy performance • obliges Member States to implement EPC schemes according to a number of minimum requirements (especially as regards content, display and disclosure, reliability, validity, quality) defined by the Directive • requires Member States to implement appropriate instruments (incl. financial support) to ensure the transition of the building sector to a nearly zero-energy standard
RED	• obliges Member States to set up sector specific targets for renewable heating and cooling and to track progress through periodical NREAPs • requires Member States to adopt support policies for RES-H at least for new buildings and existing buildings that are subject to a major renovation • requires MSs to take measures to overcome/eliminate market and administrative barriers for RES • defines technology specific restrictions (in view of target accounting) for heat pumps and bioliquids • requires Member States to ensure that new public buildings, and existing public buildings that are subject to major renovation, at national, regional and local level fulfil an exemplary role in the context of the use of RES-H
ESD	• requires Member States to adopt an overall national indicative energy savings target of 9% until 2016[7] and to periodically report the progress and measures undertaken through NEEAPs
EED	• obliges Member States to establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private • requires Member States to ensure a refurbishment rate of 3% per year related to the total floor area of all heated and/or cooled buildings (> 500 m^2) owned and occupied by their central governments (applying the standards set by the EBPD recast) • requires Member States to establish energy efficiency obligation schemes for energy suppliers of grid operators (commonly known as White Certificate Schemes) or alternative measures with equivalent effect aiming at providing efficiency measures that achieve energy savings of 1,5% per year in average

[7] Although the ESD has been replaced by the EED this 9% target still needs to be met by the Member States.

	• obligates Member States to promote the availability of independent high quality energy audits to all final customers • requires Member States to encourage public bodies to follow the exemplary role of their central governments to purchase only products, services and buildings with high energy-efficiency performance • obliges Member States to develop programmes to raise awareness among households about the benefits of energy audits and energy management systems through appropriate advice services • calls on Member States to ensure that final customers for electricity, natural gas, district heating, district cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use
Ecodesign	• sets minimum efficiency standards for energy related technologies and materials used in the building sector (e.g. boilers, hot water generators, pumps, ventilation, etc.)
Energy Labelling	• requires Member States to establish labelling schemes for energy related technologies and materials and in this regard to include a number of technologies used in the building sector

The RED is the first strong legislative measure for the support of RES-H in Europe. Firstly, it includes renewable heating and cooling in the determination of the overall renewable target; secondly it requires Member States to set indicative (non-binding) targets on how the RES-H/C share related to the total gross final consumption of energy for heating and cooling should develop until 2020; and finally it defines an explicit obligation for the use of RES-H in new and refurbished buildings. Art. 13(4) specifies:

> *"By 31 December 2014, Member States shall, in their building regulations and codes or by other means with equivalent effect, where appropriate, require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation."*

With regard to modernisation measures in the building stock Art. 13(4) distinguishes between two different segments

a) new buildings and existing buildings that are subject to a major renovation for which the Art 13(4) requirement is obligatory;

b) existing buildings that are renovated, however in a way that the modernisation measures do not qualify for the definition of "major renovation"; here Art 13(4) does not apply.

Art 13(4) leaves room for legal interpretation. The regulation implies to oblige Member States to adopt use obligations as the favoured RES-H support instrument. However,

the insertion “where appropriate” could be interpreted in a way, that alternative policy measures other than a use obligation could be also eligible as far as it is assured that they lead to an equivalent effect (in terms installing RES-H). In the Entranze project we follow this interpretation assuming that any RES-H policy measure would be acceptable under Art 13(4) that has a considerable positive impact on the number of installed RES-H devices for heating and domestic hot water generation in the building sector.

EBPD, RED and EED emphasise the important role of public buildings by setting specific targets or requirements for this building segment. While some of the regulations address all public buildings at the national, regional and local level, the requirement of the EED to achieve a 3% refurbishment rate per year applies to those public buildings only that are owned and occupied by their central governments.

A detailed overview of the current policy mix especially in the nine target countries of the project is provided by Deliverable D5.1/2 (Atanasiu et al., 2013). This report comprises dedicated factsheets for each target country, presenting national and regional policies, energy standards in the building sector (e.g. building codes requirements), updates on the implementation status of EPCs, nearly zero energy buildings, cost-optimality, as well as financial support programmes for new low energy buildings/passive houses and building retrofits.

3. Barriers and policy implications

Energy refurbishment measures in the building sector are impeded by a magnitude of barriers that should be considered thoroughly when developing policies targeting at the modernisation of the buildings sector. We define barriers as factors that hamper investments in energy saving measures which would in principle be profitable for the investor provided a profitability calculation such as a life cycle cost or net present value assessment is applied. Barriers can be of very different nature including financial factors (e.g. access to/cost of capital), information deficits, psychosocial factors such as preferences and attitudes, administrative, legal and technical barriers.

Generally different target groups have different barriers. In addition energy saving potentials often are not hampered by only one barrier but rather by a bundle of different barriers. For instance in the case of the owners of single-family houses such barrier bundles could include financial factors (e.g. unwillingness to incur debts), informative aspects (e.g. mistrust of information, lack of knowledge about refurbishment options) and preferences different from energy saving measures (e.g. the preference to renovate the bathrooms of a building instead of insulating the roof). Since policy intervention should be designed as to overcome the barriers as effective and efficient as possible, policy bundles involving different instruments need to be developed. Instruments implemented isolated (without being embedded in a full bundle of different instruments) might not deliver the expected outcome in terms of refurbishment activity.

Furthermore building owners base their decisions on modernisation measures on various factors that differ between ownership groups and might vary between countries. Obviously decision criteria and barriers have a strong causal relationship. However, both elements are important to a) know how building owners would react on different policy instruments or instrument bundles or vice versa b) how policy tools should be designed as to target-oriented address the needs of those who take decision on refurbishment measures.

Deliverable D2.4 (Heiskanen et al., 2012) of the ENTRANZE project provides a comprehensive overview of barriers and decision criteria of different ownership groups. D2.4 entails three important elements

a) a classification of the relevant stakeholders with regards to investment decision making and use behaviour;

b) the identification of the stakeholder-specific barriers to the application of energy efficient technologies and

c) the identification of the stakeholder-specific criteria within investment decision making (decision criteria).

The analysis in D2.4 covers the nine target countries of the project (Austria, Bulgaria, Czech Republic, Finland, France, Germany, Italy, Romania and Spain). These countries represent a large variety with regard to the characteristics of the building sector

including building classes, energy standards, ownership typology, barriers and decision criteria. With the selection of the target countries some main characteristics of the European building sector are covered.

In this section the main barriers for the most relevant ownership types are briefly summarised (more detailed tables illustrating the most critical barriers depending on different ownership conditions as identified in D2.4 can be found in the Annex of the report). In this context it must be noted that the significance of a barrier might vary between countries depending on factors such as the general financial situation in a country or the social, cultural, legal and infrastructural context.

3.1 Owner-occupied single-family homes

For this owner type financial barriers are dominant. The barriers include high initial investment costs for refurbishment measures at the building structure or for improving or replacing the heating and cooling system as well as the access to capital or the cost of capital. The latter is especially problematic in the case of low-income households owning a dwelling. Another barrier is the generally long payback times for the respective investments. It has to be considered that usually the payback time increases with the level of ambition of the refurbishment measure. Long payback times are particularly problematic for elderly people who amongst other reasons often refuse to take refurbishment measures as they are unlikely to benefit from the energy savings over the lifetime of such measures. Often home owners are unwilling to incur debts. This has two consequences: a) in cases where building owners lack sufficient financial savings to cover the investment, modernisation measures are hampered even if they were very profitable for the home-owner (corresponding to rather short pay-back times); b) policy intervention via soft loan programs will fail to be successful since they conflict with the specific barrier to take a loan at all.

Further critical barriers involve high information search costs while information often is perceived to be conflicting possibly leading to mistrust. The importance of the financial barriers as well as the existing information deficit implies the need to combine financial instruments (such as grant programs) with (mandatory) advice schemes.

3.2 Owner-occupied multi-family buildings

For this type of ownership group, important financial barriers entail the high initial costs and long payback periods. Another financial barrier (not highlighted in the table) is the fact that in several countries all dwelling owners of a multi-family building must mortgage their apartment when taking a collective loan for the investment in a refurbishment measure. Apart from the financial barriers, special attention must be paid to the problem of taking decisions about refurbishment measures collectively. Here different regulations apply in the target countries. Legally, in some countries a simple minority is sufficient to take such decisions. Other countries require a 75% majority. In addition different types of ownership can occur. Whereas in most target countries condominium

ownership[8] is dominant, Austria for instance has a unitary system which refers to an undivided apartment building of which owners own shares (Lujanen, 2009).

But even a 50% majority often turns out to be difficult to achieve considering the different nature of owners in such buildings (including persons in rather different living phases and conditions such as families with small children, elderly people etc. corresponding to diverging interests). Therefore, special instruments addressing the decision process and rules as well as involving housing companies, property managers etc. should build the key elements of a policy package. In addition, special financial tools should be considered that are a) tailored to properly address the different financial situations and needs of the dwelling owners as well as b) improve the procedures to get a collective loan.

3.3 Rental buildings

The tenure sector covers rental buildings that are owned by private or social companies. Although professional landlords in general have more skills in assessing properly the economic conditions of refurbishment measures, financial barriers do still apply. In this case the dominant hurdles are mainly the long payback times and in some countries the access to and cost of capital. Furthermore the landlord-tenant dilemma needs to be taken into account: it is mainly critical in those common cases where the landlord decides on and initially pays for the refurbishment while the tenants pays the energy bill (thus benefiting from any energy saving resulting from a refurbishment). Here regulations need to be implemented which distribute costs and benefits between landlord and tenant in a fair way. Of course this provokes the question about how a fair distribution mechanism could look like. Fair could mean that following a refurbishment measure the lump sum rent including heating will not increase. Fair could also mean that in case of a profitable measure that pays off shortly, the tenant is benefitting from lower costs (in form of a lower rent). More complicated is the case where investments in ambitious deep renovations (e.g. a passive house renovation) will have extremely long payback times: net costs need to be distributed and it must be discussed whether and to which extent tenants should also contribute to them.

3.4 Public building sector

Critical barriers in the public building sector relate to public budgeting practises. Often the public sector has different budget lines distinguishing between investment and operation costs. Solving this problem would require cross-financing between different budget items which is not quite common in many countries. Another significant problem is the high initial cost for refurbishment measures. Many communities are heavily in-

[8] Owners own their own dwelling while common parts of the building (e.g. the outer wall, the roof, the garden) are jointly owned. Together they build some form of homeowner association that is the legal entity that takes decisions about the commonly owned parts (this including refurbishment measures).

debted which limits their scope of action for investing in measures to improve their infrastructure.

3.5 Cross-cutting barriers

Other cross-cutting barriers include (while their significance varies between countries)

- the poor state of public finance: In most European countries public authorities on the national, regional and local level are in a precarious financial situation and have to reduce their budgets. It thus hampers them to refurbish the public infrastructure; while public support programs do not receive the funding that would be required to sufficiently mobilise the private sector to take refurbishment measures that would be necessary in number and level of ambition to reach the climate targets (see section 4).
- the often low reliability and continuity of public support programs: The overview of barriers illustrates that financial barriers are dominant for many of the owner types. Most countries address financial barriers by financial support programs providing grants, soft loans etc. (BPIE, 2012). However, in most cases support funds available are rather limited. Due to the financial crisis and debt limits it can further be expected that these funds will continue to be under-financed regarding the financial needs. The experience on public support funds showed another problem: Funding conditions tend to change frequently, funds happen to be exhausted for certain periods. Both developments compromise investment and planning security which are key drivers for both, building owners to take decisions on modernisation measures and companies that operate on the refurbishment market.
- the high cost of capital: In many countries building owners are unable to finance energy refurbishment measures from their own (surplus) savings but have to take a loan. In some countries banks are not eager to offer such loans or are not skilled enough to differentiate between refurbishment projects that would be bankable and those that would not. Often interest rates are rather high and increase the cost of capital. Furthermore some homeowners are not at all bankable, e.g. due to their age or the lack of securities that can be provided. Many of these barriers concern the question of risk allocation. From the bank perspective the risk of non-payment of a loan materialises either in high interest rates, short repayment periods or in the worst case in rejecting the loan. Here instruments partly transferring the risk from the bank to other institutions (e.g. by socialising the risk) could help to bring down capital costs.
- the low value of some buildings (e.g. due to poor structural conditions): This might lead to the conclusion that several buildings are not worth to be refurbished but should rather be replaced by a new efficient building. Since such low quality buildings often are inhabited by the poorest this calls for social strategies to offer alternative living space in case such buildings are replaced. The value of buildings can

also be so low that property-owners are unlikely to receive market based finance to invest in refurbishment measures.

- the uncertainty of the long-term value of a property: Migration within a country or between different countries can influence the building sector in a sense that in some regions the long-term value of a property is not ensured. For instance in Germany due to migration from the eastern to the western part of the country and due to migration from rural areas to the urban centres some regions now have a large building surplus. This brings a lot of insecurity in the housing market and especially in the rental sector since rents are decreasing, and landlords cannot be sure whether they will have tenants and thus have rent revenues to pay off a refurbishment investment.
- the sometimes poor quality of refurbishment measures: In many countries the quality of modernisation measures was identified as a common problem, however the severity varies by countries. Poor quality might derive from inadequately qualified workforce lacking the competence to properly conduct such measures, or from do-it-yourself type of renovations carried out by the homeowners themselves. Lacking measures to substantially improve the renovation competence, the problem will even increase as soon as more ambitious refurbishment levels need to be met. Particularly in the case of deep renovations special attention has to be paid to a sound installation of the different components as well as coordination between the different structural elements (e.g. wall – window, roof – wall).
- the often low level of information and awareness concerning economic benefits from refurbishment measures, benefits with regard to comfort, the availability of support schemes; furthermore the lack of technical/administrative advice (e.g. due to the absence of energy agencies on the local, regional or even national level).
- the sometimes complex and complicated administrative procedures (multi-stakeholders decision chain) for undertaking refurbishment measures or for applying for support.
- in many countries the lack of a coagulated market for building refurbishment projects beining able to offer complex/holistic solutions leading to nZEB levels.

4. Taking the long-term perspective into account

The building sector is characterised by rather long reinvestment cycles for the structural components of a building. For instance, in Germany it is assumed that the exterior wall is comprehensively rehabilitated after 50 years only, the roof after 40 years and the windows every 25 years on average (e.g. (Diefenbach et al., 2005). EN 15459 specifies the lifetime of many of the components of the heating systems in the range of 15-25 years. Commission Regulation 244/2012[9] recommends Member States to use a calculation period of 30 years for residential and public buildings, and a calculation period of 20 years for commercial, non-residential buildings for calculating cost-optimal levels of minimum energy performance requirements for buildings.

Considering the long replacement cycles, an outer wall or roof that will be insulated in the coming years might not be touched again until 2050. Thus these components will to a major extent determine the GHG emissions base in 2050. In other words, the modernisation standards that will be met in the coming years will determine the long-term emission level in 2050 to a certain degree. Therefore the necessary level of ambition in terms of rehabilitation standards must be anticipated when taking any measures directed at current building stock.

Conclusions:

In view of the ambitious targets it is necessary to elaborate clearly defined long-term plans/strategies setting final goals and interim milestones to be reached by subsequent policies. With regard to policy the ambitious long-term energy standard targets that need to be met as well as the long reinvestment cycles need to be taken into account when designing instruments addressing the refurbishment of buildings. Regarding the policy path this has a couple of implications:

- Energy standards should be set as to comply with the long-term targets. In those cases where only one component is refurbished at a time (step-by-step refurbishment), the building owner should be obliged to (or at least be incentivised to) ensure that all single refurbishment steps are compatible with a refurbishment strategy aimed at the long-term target. This mainly applies to the long-living components such as the outer wall and the roof. Policy makers should bear in mind that if such a strategy[10] fails it might mean that until 2050 a component needs to be refurbished again (out of the regular reinvestment cycle) in order to reach long-term compatibility. This could lead to higher costs than for only one but ambitious modernisation.

[9] Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

[10] This could e.g. be justified by counting on the mid-term availability of better and/or cheaper insulation materials or more efficient retrofit measures (e.g. pre-fabricated insulation panels).

Climate protection long-term scenarios for Germany

In recent years a couple of long-term scenarios have been developed for Germany trying to model the transformation of the different demand sectors as well as the transformation sector until 2050. Some of the scenarios underlie the normative target to reduce GHG emissions until 2050 by 80-90% (especially Prognos and Öko-Institut, 2010; Prognos et al., 2010; Diefenbach et al., 2013). The ambitious scenarios conclude that the building sector plays a key role to achieve the GHG reduction target. In addition it is assumed that it is necessary that nearly every single building (residential and non-residential) needs to be modernised by the mid of the century.

For instance, in the official energy scenarios for the German government (Prognos et al., 2010), the specific average space heating demand of residential buildings related to the living space amounts to between 33 and 40 kWh/(m^2*a) by 2050. The target level corresponds to an energy standard that lies under the current minimum standard for new buildings which lies in the range of 70 kWh/m^2*a. The average values entail all new residential buildings built by 2050, all residential buildings for which energy refurbishment measures have been implemented by 2050 and all residential buildings which have not been refurbished by this time.

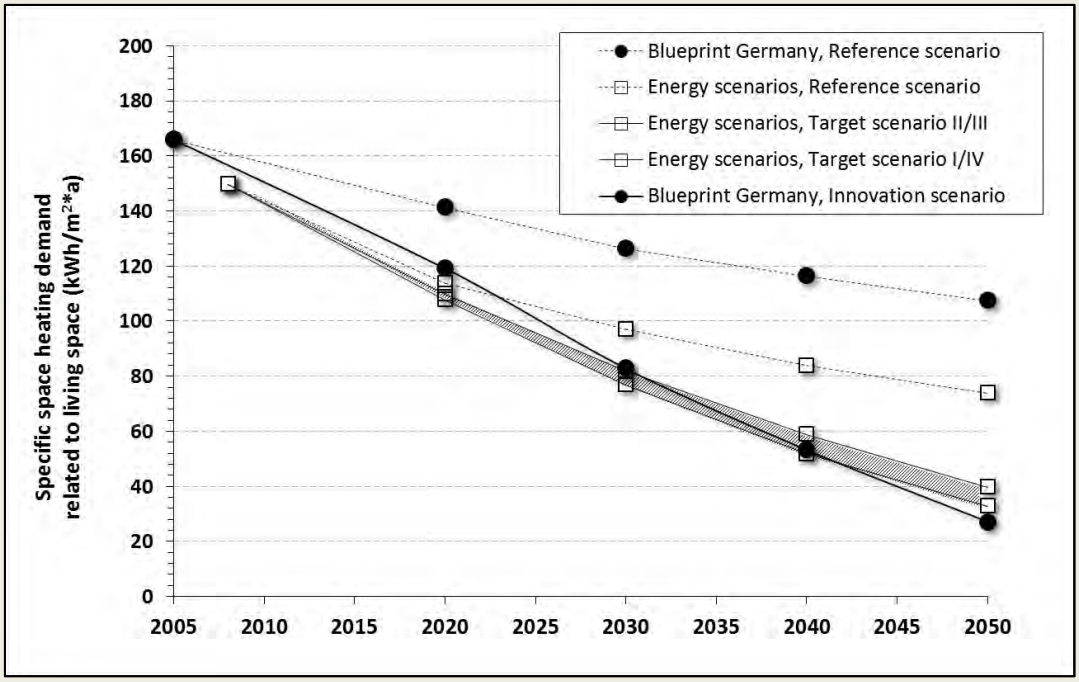

Figure 2: Development of space heating demand related to living space

Source: Bürger/Klinski 2013

- Policies should be ambitious, yet realistic and based on market specificities in order to stimulate a sufficient number of refurbishment projects (refurbishment rate)

- In the long-term the justification of certain flexibilities might need to be verified. This mainly applies to the flexibility between thermal insulation requirements for buildings and supply technologies, as laid down in the building codes in many Member States. Often building codes allow home owners to compensate a lower insulation standard of the building envelope by the use of renewable energies for the thermal energy supply. From the short-term perspective this flexibility is likely to increase the cost efficiency of such standards. However, in the long-term limited renewable potentials and the inter-sectoral competition between the electricity, heat and transport sector for those potentials might limit this flexibility. At least for those countries with limited renewable potentials the long-term impact of such flexibilities should be thoroughly assessed.
- Finally first quantitative model-based cross-sectoral investigations of the long-term interaction between the electricity and the heating and cooling sector predict an increasing integration of those two sectors (e.g. Eichhammer et al., 2012; Henning and Palzer, 2012). Further investigations and scenarios should be performed in order to learn more about potential implications and to identify robust transformation paths that could already be induced today.

5. Building sector specific instruments

5.1 Preliminary remarks

In this section we discuss a considerable number of different political instruments that aim at incentivising investments in the building sector towards the nearly zero energy standard. The main focus of the instruments is set on ambitious refurbishment measures in the building stock (deep renovation). The instruments cover both, modernisation measures on the structure of a building (envelope) and the supply technology (mainly heating, warm water, cooling) including the intensified use of renewable energy sources. A special focus will be laid on innovative measures, for instance instruments that are independent from public budgets by mobilising alternative funding sources.

For the most part, instruments are discussed that target the investment side in the building sector addressing those who take decisions on modernisation measures or are involved to a certain extent. Barriers in the value chain other than on the investment side, e.g. addressing manufacturers, craftsmen, installers, planners, architects, technology provider are dealt with as well, however in less detail.

For several instruments major advantages and drawbacks are briefly discussed. They derive from assessing the different instruments against a set of qualitative criteria (see section 5.2). However it should be considered that both, pros and cons might differ from country to country depending on the national context the instrument will operate in (IEA, 2007a; Heiskanen et al., 2010). For instance, in a Member State there might be a general political trend towards regulatory measures: this could imply that such instruments are assumed to be more appropriate than market oriented approaches. Or a Member State has a track record with financial support programs; this could be a good starting point for developing comparable programs for the building sector. Since the framework conditions as well as the cultural, social and legal context differ largely in the EU-27, the presented assessment can only provide some overall indications on the general appropriateness of the instruments.

The discussion of advantages and disadvantages is based on existing knowledge. Pros and cons of different types and classes of support instruments targetting energetic modernisation measures in the building sector have been subject to several studies and publications. For our purpose the sources listed in Table 2 were used.

The instruments introduced in the following chapters should be regarded as generic concepts. For the different approaches we describe the principle architecture. To implement one of these instruments in one of the target countries, the detailed instrument design needs to be adapted to the specific national context of that country. The detailed “fine-tuning” would have to take into account several factors such as:

- the market maturity of different technologies: different stages of market maturity could determine how the average building owner might recognise and accept the respective technologies (for instance if technologies are rather new or per-

ceived as innovative, just some pioneer users might be willing to take the risk to decide on such an investment). Heiskanen et al. 2013 highlight the different levels of market maturity for various nZEB and RES-H/C technologies. Provided that a country has defined the political goal to broaden the scope of technical solutions towards the nZEB standard, the political framework needs to offer support which is reflecting the market maturity of these technologies. Consequently instruments need to be adapted to the specific needs of the different technology options.

- the further development and assurance of ambitious technological standards: In some countries financial support instruments turned out to become the key driver for the development of ambitious technical solutions. For instance, in Germany eligibility to the main grant and soft loan programs in the building sector is depending on the efficiency standard that will be achieved by a new building or renovation measure. The better the standard - the higher the support. Different efficiency levels (e.g. Efficiency House 55, 70, 85[11]) all being better than the minimum requirements set by the building code have been defined by the KfW (KfW Bankengruppe), the promotional bank that is administering the programs. Since several years these standards have been established as the core standards in particular in the new built market. In Austria the "Wohnbauförderung", the main support program in the building sector, managed to stimulate a rather similar development (even though it had originally been introduced for reasons other than stimulating energy efficiency). For that reason and apart from the aim to mobilise investments in the efficiency of buildings, support instruments should also be regarded as a potential driver for technology development.
- the availability of resources: The nZEB standard implies the thermal renovation of the building envelope as well as an increased use of renewables for heating, cooling and hot water supply. Already today different renewable resources have quite different roles in the building sector of different countries. Enlarging the RES-H/C market will intensify these distributional effects. Solar thermal might take a bigger role in the southern European countries, biomass is more likely to be relevant in countries with large biomass potentials while the regional role of geothermal energy depends on the availability of respective resources. In view of these differences national policy instruments should take into account the distribution and availability of resources. Particularly in the case of biomass it should be thoroughly investigated to which extent a long-term strategy to import biomass on a large scale is feasible (taking into account the long-term demand for biomass in the exporting country).

[11] Efficiency House 55/70/85 means that the primary energy demand of a building must not exceed 55%/70%/85% of the maximum value as being defined by the building code.

Table 2: Literature review for instrument assessment

Literature review	
Fiscal instruments	BPIE, 2012; Eichhammer et al., 2012; Rezessy and Bertoldi, 2010; IEA, 2012a
Budget independent support for building refurbishment measures	Bürger and Klinski, 2013b; Rosenow et al., 2013
Support instruments for RES-H	IEA, 2007b, 2012b; Bürger et al., 2008, 2011; IPCC, 2011; Seefeldt et al., 2011; Connor et al., 2012; Steinbach et al., 2013
Energy Saving obligations	Capozza, 2006; Lees, 2007; Oikonomou and Mundaca, 2008; Bertoldi et al., 2010; Swedish Energy Agency, 2011; Giraudet et al., 2011; Bürger, 2012; Ecofys, 2012; Rosenow, 2012; Schlomann et al., 2012; Staniaszek and Lees, 2012
Instruments in the rental sector	Klinski, 2009; Tigchelaar et al., 2011
Housing associations	Lujanen, 2009; Bürger et al., 2012
Market transformation	Nilsson, 2003; McCormick and Neij, 2009; IEA, 2012a; Killip, 2012

5.2 Qualitative assessment criteria applied

Policy instruments can generally be assessed against quantitative and qualitative criteria. In the case of building refurbishment policies, quantitative criteria involve e.g. the induced energy and GHG savings, the development of the market penetration of different technologies, the overall costs of a support scheme, detailed cost parameters such as transaction costs as well as macro and micro economic benefits. In the Entranze project these quantitative figures will be derived from modelling the impact of different policy sets. Besides the quantitative criteria there are a number of qualitative criteria that should also be taken into account when decisions are made on the implementation of a single instrument or bundle of instruments. Qualitative criteria do not deliver “hard figures”; they generally lead to some form of semi-quantitative results, such as assessing an instrument against an evaluation scale reaching from “very suitable” to “unsuitable” or an ordinal scale from 1 to 10. Lacking quantitative models qualitative assessment generally is based on system knowledge and experience.

In the previous section we pointed out, that in view of the variety of different national contexts in the EU-27 it is not feasible to evaluate the suitability of an instrument in an absolute and exclusive way. Rather, the evaluation strongly depends on the context in which the instrument is supposed to operate. Some indications on the suitability and the functionality can be provided though. For this purpose the criteria listed in Table 3

was applied. They should be thoroughly looked at once more as soon as the instruments are assessed for a specific country. Then it must be investigated how and to which extent the specific national context might influence the outcome of the assessment. It could definitely happen that from the perspective of the qualitative criteria a specific instrument might look very appropriate for country A while the national context of country B might lead to a negative evaluation.

Table 3: Selection of qualitative assessment criteria

Criteria	Key questions
Target achievement	To which extent is an instrument appropriate to achieve a quantifiable target (e.g. renovation rate, annual final/primary energy savings, GHG reduction)?
Target compatibility	Can the instrument be designed as to incorporate incentives to steer investments into deep renovation measures that are compatible with the long-term needs (see section 4)?
Type and strength of steering effects	Which steering effects are applied (e.g. steering effect through putting a financial burden or substantive duty on e.g. the building owners or energy consumers; steering effect through the support regime) and how strong are they? Who is targeted by the instrument?
Investment and planning security	Is the instrument assuring stable conditions (e.g. support conditions) in order to allow investors to build their modernisation decisions on a reliable basis? Are the mid- to long-term support conditions predictable? How resistant is the architecture of the instrument against potential impacts (e.g. from the executive authorities) that could undermine investment and planning security? Is support granted ex ante (e.g. at the time of financing a refurbishment measure) or ex post (e.g. once the measure has been completed)?
Cost allocation	In case of financial support programs, who is finally providing the counter-financing (e.g. tax payer, energy consumers, building owners)? How does this relate to important environmental economic principles such as the polluters pays principle or generally the ability-to-pay principle? Does the instrument allow for avoiding asymmetric allocation burdens (e.g. allocating all costs to e.g. private households due to their generally low price elasticity of demand)?
Suitability for overcoming target-group-specific barriers	Is an instrument suited to properly address the diverse target-group-specific barriers facing the energy refurbishment of buildings? Is an instrument suited to be implemented as flanking measure specifically addressing a certain target group?

Administrative burden	What kind of administrative burden does an instrument incur for the authorities? Which minimum administrative tasks are assumed necessary to keep the level of compliance high? Are there possibilities for achieving synergies (with other instruments) as regards administrative tasks that can be used to decrease the administrative burden at the authorities' side? Which administrative burden does an instrument incur for all other market participants (incl. building owners)?
Triggering of dynamic efficiency	To which extent can an instrument be designed to stimulate innovation and to incentivise technology development and diversification?
Acceptance	How will an instrument be perceived by the different actor groups involved (especially representatives from the policy sector, building owners, tenants, fuel suppliers and associations, representatives from the finance sector, intermediaries, installers, planners, architects etc.)?

Source: Bürger/Klinski 2013 and Bürger/Varga 2009

5.3 Regulatory instruments

Regulatory instruments are "command and control" type regulations that a government adopts in order to achieve certain policy objectives. Different from economic instruments that aim at achieving a policy target by setting respective price signals, regulatory instruments work with orders and bans. Figure 3 illustrates the regulatory instruments that will be further investigated.

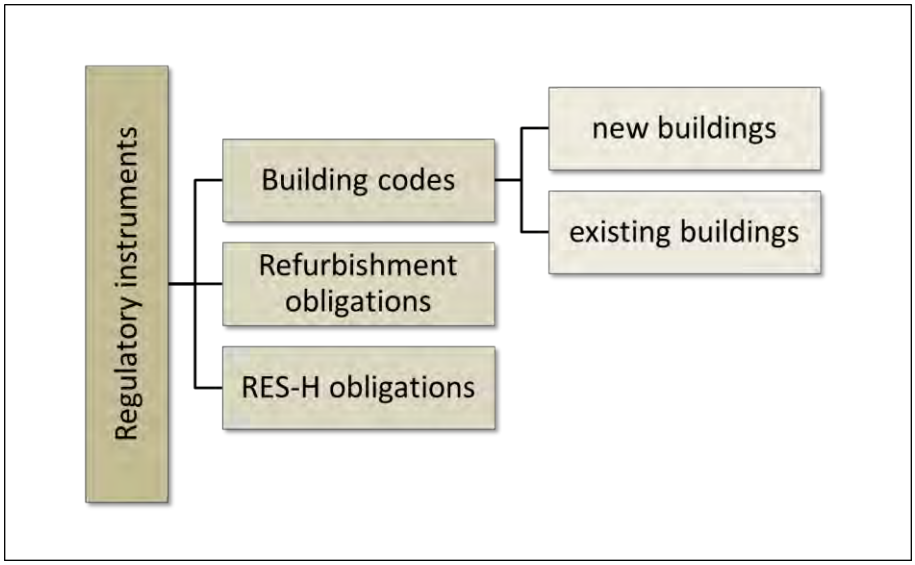

Figure 3: Overview of regulatory instruments

Building codes	
Description	Tightening the minimum modernisation standards in the case of a building refurbishment. According to the EPBD these standards need to apply to those buildings that are subject to a major renovation at a minimum; however they could also be extended to the modernisation of single components (e.g. parts of the outer wall, windows, roof). Here it needs to be defined which renovation measures lead to the requirement to meet the code. In principle and where justified, the level of minimum requirements could be differentiated between residential and non-residential buildings.
Discussion	In the case of renovations, minimum standards are generally conditional which means that they apply only if a renovation measure is conducted. For instance if the plaster of an outer wall is repaired the conditional requirement could apply to insulate the wall as well. Where no renovation takes place no standard needs to be met. Thus, from the perspective of the isolated instrument, imposing or tightening such standards can have two effects; either an increase of the energy savings through more ambitious standards or a decrease of such savings due to a dropping refurbishment rate (which might be a result of home owners postponing renovation measures in order to avoid the burden of the tightened modernisation standard, e.g. because they simply might not be able to afford the necessary investment costs for ensuring compliance). Moreover for the effectiveness of building codes it is necessary to ensure compliance by means of appropriate measures (e.g. via spot checks, effective sanctioning). Especially in the building stock where refurbishment measures often are not subject to any form of licensing by or notification to the authorities these are key measures. However, enforcement measures come along with a considerable administrative burden. In the tenant sector sanctions based on tenancy law could also be considered (e.g. the right of the tenants to reduce the rent in the case of a home owner failing to comply with certain standards or obligations, see section 5.8.2).
Examples	An detailed overview of building code requirements for new and existing buildings is provided by Deliverable D5.1/5.2 (Atanasiu et al., 2013).

Refurbishment obligations	
Description	Imposing a legal obligation to take a certain refurbishment or retrofitting measure while different situations may trigger the measures; triggers could be that a component has reached a particular age, that the building as a whole, a specific building component or element of the thermal supply systems does not meet a legally fixed minimum standard (which could e.g. be a minimum efficiency standard in the case of a whole building or a boiler or a maximum U-value that must not be exceeded) or the change of ownership of a building. Additional design parameters of the instrument involve the development of the trigger or the minimum standards over the time (e.g. the U-value or efficiency

	level that trigger the obligation) but also potential compensatory measures, e.g. the possibility to pay a compensation charge in order to avoid the refurbishment obligation.
Discussion	In principle refurbishment obligations are highly effective in terms of achieving a specific target (e.g. a specific refurbishment rate). However, any form of refurbishment obligation interacts with principle ownership rights that are generally protected by the Member States' constitutions. The "harder" the obligation (especially in terms of the financial impact on the obliged home owner) the more extensive is the intervention with these ownership rights. There are at least four options to alleviate the effective burden from such regulations: • the creation of exemption rules for cases of hardship; • the introduction of the optional payment of a compensatory fee (which of course could also impose a high financial burden depending on the level of the fee); • the establishment of sufficiently long periods in which building owners would have to comply with the requirements (which would allow them to identify the cost-optimal point in time to conduct the measure, e.g. by synchronising the measure with the renovation cycles of the building components); • the establishment of a support program to which house-owners would have access when conducting measures that are triggered by the obligation (while the support program could partly be fed by the compensatory fee). If the obligation is linked to the efficiency standard of the whole building, another drawback is the necessity to classify all buildings according to their status quo efficiency. This would require collecting a set of data on each existing building. Whereas the huge burden associated with this initial classification could be alleviated by grouping buildings into typical efficiency categories according to building type and age[12], there would be a trade-off with regard to the accuracy of the scheme. Similar to building codes, enforcement would go along with a considerable administrative burden.

[12] Such classification has for instance been developed within the IEE Tabula project (http://www.building-typology.eu/).

Example	Some countries have adopted modest refurbishment requirements. For instance in Germany building owners must ensure that heat distribution and hot water pipes as well as fittings that are not situated in heated spaces are insulated; or that non-insulated top floor ceilings of heated spaces will be insulated. However we are not aware of any country that has implemented wide ranging unconditional refurbishment obligations especially affecting the larger structural elements of a building such as the outer wall or the roof.

Use obligations for RES-H	
Description	Implementing a legal obligation on building owners to utilise renewable energy sources for heating (and cooling) purposes to a defined extent: The obligation could arise in connection with the installation of a new heating system. The obligation could be limited to new buildings or extended to the building stock (where it could be triggered by e.g. the replacement of the existing heating system or the vintage of vital components (e.g. the boiler) of the system). A levelled playing field for the different renewable heating technologies could be achieved by setting different minimum shares for different technologies (e.g. 15% for solar thermal, 50% for heat pumps etc.) as well as technology specific minimum requirements (such as a quality label for solar collectors or a minimum COP in the case of heat pumps). Another option to introduce a high level of flexibility would be to define alternative measures (e.g. achieving a certain minimum insulation standard, the connection to an efficient district heating network etc.) that would also qualify for compliance. A variant of this instrument is the compulsory connection to a district heating network.
Discussion	Similar to the refurbishment obligation the RES-H obligation interferes with ownership rights; though due to generally lower investment costs to a lesser extent. The effect could be alleviated by imposing exemptions in hardship cases or by the introduction of compensatory measures such as the option to pay a substitute fee instead of installing a RES-H device. A main advantage of a RES-H use obligation is its rather simple structure. Several Member States (e.g. Germany, Spain, Portugal) have already implemented such an obligation and are providing experience other countries can draw upon. However a use obligation lacks incentives to install RES-H devices where it is deemed most profitable as all buildings are subject to the same obligation irrespective the suitability of a site. In addition it lacks incentives to install larger devices than required under the obligation. This might lead to a lower economic efficiency compared to other support approaches. Moreover obligations require a sound control system in order to ensure a high compliance rate.
Example	Explicit use obligations for RES-H are applied in Spain, Portugal and Germany. In some countries use obligations are implemented on the regional level; in some cases they are integral part of the building code.

5.4 Economic instruments

Economic instruments are approaches that use economic parameters (e.g. taxes, price, grants) to provide incentives for building owners or others to invest in efficiency measures in order to reduce the negative environmental externalities deriving from the thermal energy consumption. In this section we introduce instruments of rather different nature including fiscal and non-fiscal approaches. The section is subdivided in grants, tax incentives and financial incentives that are processed exclusively between private entities within the market.

For all instruments two elements need to be distinguished, the revenue perspective and the support (expenditure) perspective:

- Revenue perspective: This refers mainly to the question how the financing of the support scheme is organised; in other words who finally is providing the financial resources that are required for the economic incentives given to those who are supposed to invest in refurbishment measures.
- Support (expenditure) perspective: This deals with the question how the support is organised; here especially the specific support conditions and support eligibility are key design parameters.

Most instruments combine both elements which means that financial incentives are offered to investors to take efficiency measures while support is financed through the state-budget or other non-fiscal means (such as levies, surcharges on the energy prices etc.). Often there are different alternatives to combine the two perspectives. For instance a typical grant scheme can be combined with several options of counter-financing, e.g. by using financing from the state-budget, by revenues from ETS (which would constitute a state-like budget) or by an efficiency levy on buildings. In our categorisation these different options would be classified as grants. Other instruments cover only one of the two elements. For instance this applies to tax based instruments where a certain tax scheme is designed or changed in a way as to provide incentives to invest in efficiency measures. For instance the property tax could be modified as to reflect the current efficiency standard of a building; the better the standard the lower the tax rate. The tiered tax rate would provide an incentive, especially in the case of buildings showing very bad efficiency indicators as the building owner could substantially reduce the tax burden by improving the efficiency level by taking appropriate modernisation measures.

Economic instruments aim at incentivising the investment in efficiency measures or a changed (more energy-efficient) user behaviour. Here two different steering mechanisms need to be distinguished. One effect is directly linked to the support side. By providing an attractive support framework building owners should be incentivised to take appropriate efficiency measures. The other steering effect results from how the financing of the support side is organised. For several instrument options the financial burden is either borne by the building owners or the residents. This additional financial

burden is corresponding to an incentive to lower this burden while the level of impact is depending on the elasticity how the different actor groups will react on such price signals.

5.4.1 Grants and preferential loans

For grants and/or preferential loan schemes different alternatives of counter financing can be used (see Figure 4), involving

- state budget or state-like budget (e.g. financed through the ETS);
- a surcharge on the energy or climate taxes;
- a levy on buildings.

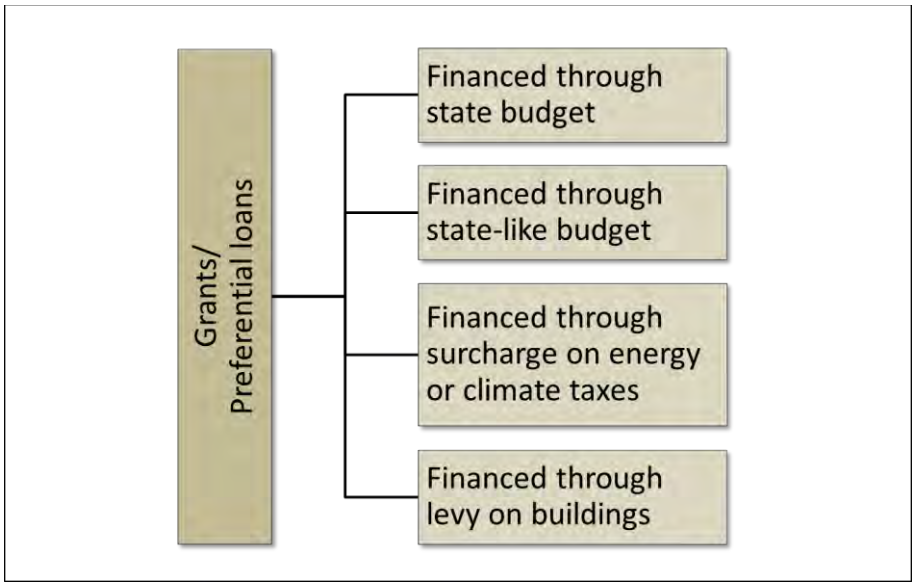

Figure 4: Design options for grants / preferential loans

Whereas differing in financing sources the support conditions could be alike or even identical in all cases. In practical terms this means that one and the same grant or preferential loan program could be financed through different sources. Also a combination of different financing sources is conceivable.

Grants/Preferential loans, counter-financed through the state budget	
Description	Establishing a financial support programme which is financed through the state budget: Support could be provided by grants and/or preferential loans (where the support results from the difference between the market interest rate and the applied rate); sometimes combined with a repayment bonus. The grants usually cover a certain share of the total investment in a modernisation measure. Grant programmes could support a holistic approach looking at the building as a whole (including the envelope and the supply technology) but could also support single measures (e.g. the insulation or replacement of single components). In order to incentivise investors to decide on deep retrofit measures (instead of "just" striving for minimum standards) the support rates could be tiered according to different efficiency levels: the better the efficiency level the higher the support. Moreover additional requirements could be implemented to qualify for support. Especially this could include measures to ensure quality, e.g. the need to provide an independent proof that a measure has been implemented as intended.
Discussion	In some Member States financial support schemes have proven to be quite effective (e.g. Germany, Austria). Program administration is straight forward, public perception is generally high. However, in many Member States the available support funds are not at all sufficient to stimulate an adequate number of modernisation measures or deep retrofits as required by the long-term climate targets (see above). It can further be assumed that in times of debt-ridden public budgets available funds will continue to be limited for the coming years. However, it can also happen that available budgets are not used because of a lack of promotions or due to complex administrative procedures. The dependence on public budgets often leads to frequent changes in the support conditions, e.g. the support levels of the programs or the conditions to get access. This can even include the temporary suspension of support funds (e.g. when at the end of a year the available funds are exhausted). This causes uncertainty in the market, potentially stop- and-go developments and might have a negative impact on the readiness of companies to invest in innovations. Building owners on the other side are often left in uncertainty about the support they can expect when investing in the energy efficiency of their building. In the worst case it may happen that an investment has been done (in expectation of a financial support), and the support is refused because the efficiency measure has been completed (whereas in some programs completion is a precondition to receive support). Summing up, state-budget financing of support programs might undermine the aim of having a support scheme that provides a high level of investment and planning security. The problem of uncertainty due to fluctuating support conditions could be partly eliminated by introducing a legal entitlement to support. Under such a regulation building owners would have a legal right to have access to the support fund (and to specific minimum funding conditions such as the minimum support volume). However, such an entitlement would shift the risk back to the state

	since the required total funding volume would then be determined by the amount of claims: If more investors would claim support, more financial resources would be required and would have to be provided by the government.
Example	An overview of state financed grant programs is provided by (BPIE, 2012; Atanasiu et al., 2013).

Grants/Preferential loans, counter-financed through state-like budget	
Description	Similar instrument as above, however financing is provided by a state-like budget that is fed by specifically dedicated revenues, e.g. revenues from the carbon market such as the income from auctioning CO_2 allowances under the ETS as required by the revised ETS Directive (2009/29/EC)[13].
Discussion	Similar evaluation as instrument with financing through the state budget; however investment and planning security could in principle be higher since it could be regulated that the budget of this fund will not be negotiated every year (as it would be the case in the event of financing from the state-budget which is subject to annual budget negotiations). On the other hand, if financing comes from ETS auctioning the revenues would be highly dependent on the development of the CO_2 price, thus again compromising planning security.
Example	In Germany the central support program for energy modernisation measures in existing buildings is partly financed by a fund called Energy and Climate Fund (EKF). The EKF is largely financed through the ETS revenues. For the original budget of the EKF a CO_2 price of 17 EUR/t was assumed. Due to the - at the moment - extremely lower CO_2 prices the government now has to compensate for missing incomes in order to ensure that the support programs financed through this fund can continue. In the Czech Republic the Green Savings Program which constitutes one of the important grant programs for supporting refurbishment measures in the residential sector is financed by the revenues from the trade with Kyoto AAUs (Assigned Amount Unit).

[13] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

Grants/Preferential loans, counter-financed through a surcharge on energy or climate taxes	
Description	Similar instrument as above, however counter-financed by a supplement on existing energy or climate taxes on those non-renewable energy carriers that are used in the building sector for the thermal energy supply (including electricity for heating and cooling purposes provided that the tax administration allows for separating the electricity use for heating and cooling purposes from other electricity consumption). The level of the surcharge can be determined in accordance with the required fund volume for the support program. It should be noted that legally taxes must not be raised for a specific purpose. Countries are not allowed to e.g. raise a tax on the energy consumption of buildings in order to finance a support program while creating a legal link between the tax and the program. However the link can be virtual: The taxes could be raised and contribute to the overall tax revenue of a country while a legislative decision is taken to finance a support program along with the expected tax revenues from the surcharge on the energy or climate tax.
Discussion	Similar evaluation as instrument with financing through the state budget; the main difference to above design options is that the financing of the whole support scheme is allocated to the energy users who pay the energy tax. Whereas in the case of owner-occupied dwellings owner and user are the same person, in the rental housing sector owner and user of a building are separate individuals. Imposing the financing burden on the tenants and provided the tenant has to pay the energy tax (e.g. directly to the energy supplier or indirectly through the heat bill from the landlord) this instrument is addressing an actor group that indeed can reduce the energy consumption through a changed user behaviour, however only to a limited extend. A much greater impact on the dwelling's energy consumption has the thermal standard of the building structure as well as the efficiency of the heat supply system. It is fairly common that tenants do not have any influence on decisions on building retrofits. This means that the direct steering effect from the additional financial tax burden on the tenant will be rather low.
Example	-----

Grants/Preferential loans, counter-financed through a levy on buildings	
Description	Similar instrument as above, however the support program is financed through a new levy on buildings. The levy could have the effect of a building tax (if e.g. the level of the levy would be determined according to the size of a building). Preferably it would be determined by the energy quality (energy standard) of a building: The worse the energy standard the higher the levy. The level of the climate levy could be derived on the basis of different rationales, e.g. the • required support volume;

	• calculated "value" of the CO_2 savings achieved through the energy refurbishment of an average building to a desired standard; • investment costs that would arise if a set of modernisation measures would be taken to "improve" the building according to the desired energy standards (here only the energy related investment costs should be accounted).
Discussion	Similar evaluation as an instrument with financing through the state budget; the main difference to the above design option is the budget-independent nature of the financing source: Financing of the whole support scheme is allocated to the building owners, disregarding whether they live in the building or have let it to others. This allocation mechanism means that the financial burden is put on those who in principle have the power to decide whether, which kind of, and when a refurbishment measure on the building is taken. Furthermore the regulation imposes an incentive to avoid paying the level by improving the energy standard of a building (direct steering effect). A drawback of the instrument is the administrative burden. Similar to the refurbishment obligation it is necessary to classify all existing buildings according to their current energy standard. Only such a classification would allow for the determination of the building-specific levy. In addition the revenues from the levy and the financial claims towards the support program need to be balanced. This would be necessary to ensure that the revenues from the levy cover the support needs over the time. If e.g. in year 1 building owners would apply for more support than is covered by the levy, the levy either would have to be increased in the following years or the support conditions (e.g. level of support) were worsened. Both would compromise the planning security of the whole scheme. An alternative could be that the government agrees to compensate for potential shortfalls of the support fund. Finally the levy needs to be assessed against social criteria. "Poor" building owners often lack finance for modernising their building. Thus the share of non-refurbished buildings is higher in the group of "poor" building owners which would by a climate levy for buildings then have to bear a considerable part of the levy costs.
Example	-----

5.4.2 Tax incentives

Tax incentives can involve positive incentives in the form of e.g. tax credits or tax reductions but could also provide disincentives (negative incentives) by putting a fiscal burden on the party that is supposed to take the decision in favour of a refurbishment measure.

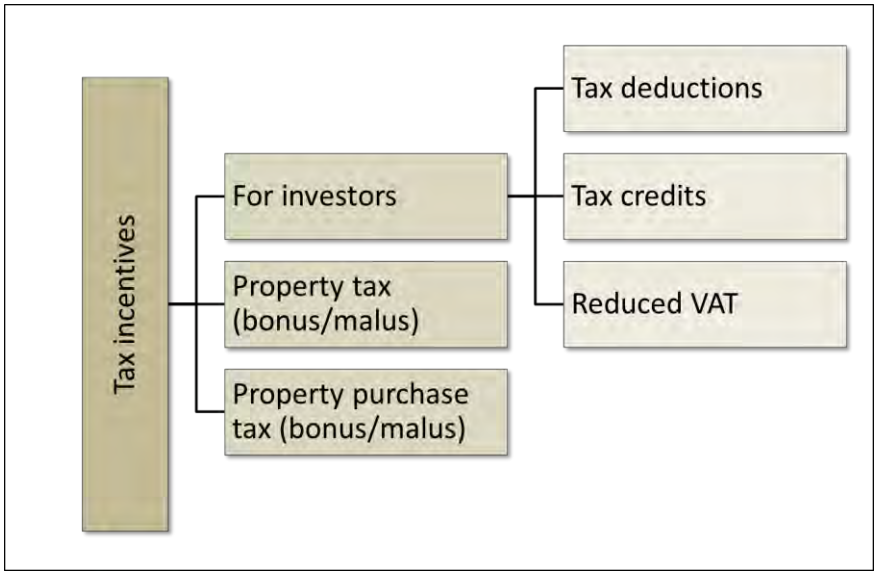

Figure 5: Design options for tax incentives

Tax incentives for investors	
Description	Direct positive tax incentives for refurbishment measures could be of different nature. Financial incentives could be granted through • tax deductions that reduce the taxable income of the building owners who makes an investment in a refurbishment measure; • tax credits that directly reduce the building owner's tax liability; • reduced tax rates (e.g. VAT rates) building owners incur when purchasing refurbishment equipment (e.g. insulation material) and efficient heating and cooling technologies.
Discussion	The different options of providing a tax incentive differ in the way they incentivise refurbishment measures. The value of a tax deduction depends on the taxpayer's marginal tax rate, which rises with the income. The higher the income the higher the support equivalent of a deduction. Therefore it could be argued that incentivising refurbishment measures through tax deductions would lead to an unbalanced and somewhat unfair support effect as prosperous building owners would receive more support than buildings owners with a lower income (who might be even more depending on receiving any form of support). In contrast tax credits directly reduce the tax liability of a person. For that reason they have the same value for all tax payers disregarding the level of taxable income. From the perspective of an investor tax credits are rather similar to a "normal" financial grant. Provided that tax credits are not paid out (which means that in absence of a taxable income no credit is provided) both support options are restricted to those building owners that have a positive tax liability. This might for instance be problematic for older people with an often rather low tax burden or when

	they even do not pay any taxes at all. All three options are counter financed through the state budget as they lower the tax revenue of the state. Although they are rather popular in the society they need to be thoroughly assessed in particular in times of tight public budgets. Providing that the support conditions (e.g. the amount of a tax credit) are stable and transparent, tax incentives can offer high planning and investment security. However, in the case of tax deductions the planning security might be lower if the deduction was stretched over several years while the development of the income is not predictable. Another advantage of tax incentives are rather low transaction costs as the administration could closely be linked to existing tax procedures.
Example	In Italy building owners who invest in refurbishment measures can claim tax deductions for 55% of the incurred investment costs (http://efficienzaenergetica.acs.enea.it/ and IEA 2012a). The deduction applies to the personal or corporate income tax and must be spread over 10 years. Eligible measures are refurbishment activities at existing buildings, the installation of solar thermal collectors, the replacement of central heating systems and (for year 2012) the replacement of traditional water heaters.

Property tax (bonus/malus like system)	
Description	Many countries raise taxes on property. Generally tax levels depend on the property size, the larger the site the larger the tax rate (Eurostat, 2012). An option would be to tier the tax level according to the energy standard of the building which underlies the tax. This would set an economic incentive for building owners to invest in refurbishment measures in order to reduce the tax burden. The tax levels could be adjusted as to become revenue-neutral which would imply raising current tax levels for buildings with a low energy standard and reducing the tax for buildings which are in a good energetic shape. As an alternative the taxes could be increased (while introducing the efficiency tiers) in order to generate additional income for sourcing a support fund.
Discussion	The instrument would be very similar to a levy on buildings that is depending on the energy standard of the house (see above). In principle both instruments could be designed as to be identical. However it must be taken into account at which political/administrative level the tax is raised. For instance in Germany and in France the competence to fix the property tax lies within the competence of the municipalities which also receive the tax revenues. Here a coordinated approach would be necessary in order to introduce such a system in the whole country, in particular when part of the tax revenues are scheduled to feed a public support program on the national level. Another drawback occurs through the administrative burden. The procedure of raising the tax could be well integrated in existing taxing procedures and would not imply any major burden. However, similar to the efficiency levy described above, it would be necessary

	to classify all buildings according to their status quo energy standard. This would be a prerequisite to be able to fix a building's individual tax level in a legally reliable way.
Example	-----

Property purchase tax	
Description	Many countries raise taxes when a property is changing ownership (property purchase tax, Eurostat 2012). Generally the tax level is depending to the value of the property. Similar to the property tax this purchase or transfer tax could be modified as to reflect the energy standard of the property that is changing ownership from owner A to owner B. Well refurbished buildings with a good energy standard would be charged less than buildings with a low standard. This would incentivise modernisation measures in order to reduce the tax burden. Since the purchase tax is paid by the new owner it is mainly the new owner of a property who is interested in improving the energy standard. However refurbishment measures can generally only start when the property has changed ownership (and the tax already has been paid). For that reason it could be regulated that for a certain period the new owner may claim back part of the purchase tax when he can prove that refurbishment measures have been carried out within a period of e.g. two years after ownership has been transferred. Similar to the property tax the property purchase tax could be reformed as to be revenue neutral or to create additional finance for a support program.
Discussion	The property purchase tax is raised at a time that often constitutes a window of opportunity for refurbishment measures. Change of ownership often involves a change of occupancy. While the new occupant might carry out some renovation measures anyway this is a good occasion to add measures to improve the energy standard of the building. In particular this is the case for single-family houses where no major collective decision process has to be triggered. Similar to the property tax it needs to be considered whether this tax is charged by the state or by the regions.
Example	-----

Another financing option with a fiscal component is to combine a public loan with the property tax scheme. Under the property tax approach the public institution that is administering the property tax offers loans to home owners which are willing to refurbish their buildings to a certain efficiency standard. The loan is paid back by a surcharge on the property tax. Loan security could be provided by placing an (additional) lien on the property for which the loan is given. If a building ownership changes before the end of the loan term, the loan remains with the property and has to be accepted by the new owner. 17 American states have or are actively considering the adoption of such pro-

grams (called Property Assessed Clean Energy (PACE) Programs; Rezessy and Bertoldi, 2010).

5.4.3 Energy tariffs

Energy tariffs could be set as to incentivise the reduction of energy consumption either by investing in refurbishment measures or by changing the consumption behaviour. The idea of progressive energy tariffs is to establish a tariff that is depending on the actual consumption, e.g. by increasing the specific costs of energy (e.g. ct/kWh) with rising consumption. In practical terms this would mean that increasing consumption by e.g. 10% would result in additional energy costs that would exceed 10%. The idea behind progressive tariffs is to provide incentives to lower consumption. As with energy tariffs in general the impact of such a tariff in the form of reduced consumption would depend on the price elasticity of those who pay the tariff. Whereas for the building sector progressive tariffs might be appropriate for grid based energy sources (especially gas and electricity) they might be difficult to be implemented in the case of heating oil (here the annual consumption would have to be calculated).

Example: Some form of a “progressive energy tariffs” was developed in France. In 2012 the French government developed an innovative approach for household electric and gas tariffs that should have affected the electricity and gas tariffs from 2015 onwards. The instrument, called Bonus/Malus, was designed to impose a reward/penalty system to energy consumption in private households. Households with excessive consumption would be penalised by a larger tariff while consumers with low consumption would pay a lower rate.

A "benchmark volume" of electricity and gas would be assigned to each household category (based on several parameters such as average size, heating fuel and geographical location to take account of heating needs). This amount represents the first quartile of consumption in France. The proposal foresaw that for each dwelling and for each type of fuel, three levels of consumption would have applied: 1) consumption below the benchmark (bonus (i.e. discount): up to 5 EUR/MWh in 2015 increased to 30 EUR/MWh in 2017); 2) consumption between 100% and 300% of the benchmark (malus (i.e. tax): up to 3 EUR/MWh in 2015 to 9 EUR/MWh in 2017); 3) 300% above the benchmark (malus: up to 20 EUR/MWh in 2015 to 60 EUR/MWh in 2017). To alleviate the financial burden for poor households, it was intended that a certain number of low-income households should receive government support.[14] However, in April 2013,

[14] France to launch Bonus-Malus scheme for energy use; ENDS Europe DAILY, Wednesday 13 March 2013

the French Constitutional Council struck down the new law which now must be revised (e.g. by extending it to the service sector).[15]

5.4.4 Non-fiscal instruments strengthening support and financing activities within the market

In this category of instruments financial support is provided by (in general private) actors that operate in the market. That could be e.g. energy suppliers or grid operators. An essential element of these approaches is the budget-independent nature of the financing source. While the government defines the rules including the obligation of different parties to take a certain role in processing the scheme, passing costs or even delivering energy savings the relevant financing relationships are generally organised between private entities.

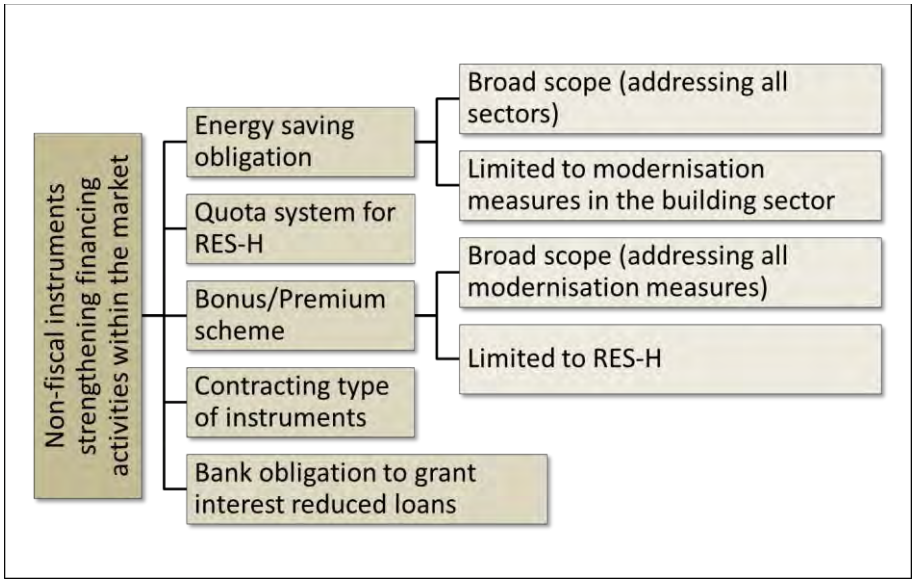

Figure 6: Non-fiscal instruments strengthening support and financing activities within the market

Energy saving obligation (limited to modernisation measures in the building sector)	
Description	An energy saving obligation (often referred to as White Certificate Scheme) is a typical quantity based approach. Energy suppliers or grid operators are obliged to achieve a legally set minimum level of energy savings per obligation period (as required by the Efficiency Directive, see above). Whereas energy saving

[15] The judges of the Council ruled the bill unconstitutional, citing that it did not uphold the country's principle of equality.

	obligations usually have a broader scope addressing saving potentials in different sectors (households, industry, service, transport, transformation), such schemes could also be limited to measures in the building sector. However, such limitation in scope should be adequately reflected by the group on which the obligation is placed. For measures in the building sector this would either be the fossil fuel or district heating suppliers or the operators of the gas and heating grids. A handful of Member States have already implemented energy saving obligation schemes. Apart from the target level, the compliance period, the sectoral coverage of eligible projects and the selection of the obligated party saving obligations differ in many other design parameters such as the reference of the savings target (e.g. final energy, primary energy, CO_2), the baselines against savings are calculated, the procedures how savings are determined (deeming vs. measuring), the selection of the accounting period (e.g. lifetime savings, discounted vs undiscounted), flexibility measures such as banking and buy-out and the question whether non-obliged parties are also eligible to deliver savings and participate in the system. Some countries (France and Italy) have set up certificate systems (White Certificates) in order to facilitate a certificate trade. In other countries (especially United Kingdom, Denmark) only bilateral trade or exchange of target contributions are allowed.
Discussion	The theoretical background of the market oriented instrument is to exploit saving potentials at the lowest costs possible. Following a quantity based approach it is more or less ensured that the politically set saving target will be achieved. However it must be kept in mind, that energy saving obligations as implemented in most countries with such a scheme and as foreseen by the Efficiency Directive generally do not automatically lead to an absolute reduction of energy consumption but might “only” attenuate its increase. Another advantage lies in the fact that the obliged companies have a strong incentive to deliver their savings at the lowest costs possible. Since the delivery costs will be passed on to the customers these costs constitute a competitive factor. Thus costs are aimed to be kept low. Thus there is a chance, that obliged companies start to develop new innovative (target group specific) saving programs that allow them to achieve the required savings as cheap as possible. One of the main drawbacks of the regulation is the comparatively low investment and planning security. Obliged companies may have met their target well ahead of the end of the compliance period. This is linked to the risk of funds being exhausted at the end of the obligation period which could result in house-owners no longer receiving any support for a certain period. In addition energy saving obligations can increase complexity and might confuse investors. Depending on the market structure of a country the scheme could involve several hundred obliged companies. This would result in a comparable large number of support programs possibly differing in scope and conditions. Fluctuating certificate prices can also hamper planning security.

	Furthermore energy saving obligations tend to trigger the exploitation of low-hanging fruits if not particularly designed for ambitious saving measures (such as deep renovations). Like surcharges on the energy tax the system costs are finally borne by the consumer since the obliged companies will pass these costs on via the energy prices or the grid charges. Thus in the tenant sector the support costs will be covered by a group which is not in charge of decisions on larger modernisation measures in the building envelope or the supply technology. In addition there is the risk of an unbalanced cost burden: If no specific allocation rules are established, it can be expected that the costs are primarily passed on to the customers with the lowest price elasticity of demand, generally households and small-sized enterprises. Finally the transaction costs must not be neglected, especially in countries where a multitude of companies would be obliged.
Example	In Europe energy saving obligations have been implemented in Denmark, France, Italy and the UK (see above). In the former CERT scheme of the UK the eligibility of measures was restricted to the household sector, thus a large part of overall savings were delivered by refurbishment measures at residential buildings.

Quota system for RES-H	
Description	Legal obligation of an actor group (e.g. all companies that supply fuel for heating purposes in the building sector as well as all commercial heat suppliers) to purchase or sell a specified amount of renewable heat or renewable heat products (such as wood pellets, biogas etc.). The obligation can be a fixed amount of RES-H or it can be a specified percentage (e.g. 15%) of all the energy supplied by the obliged utility in a fixed period. This fraction can either be fixed or increased over time. Flexibility could be introduced by implementing a scheme of tradable certificates that would allow obliged companies to exceed their quota and sell the surplus renewable heat via certificates to companies that fall short of the quota. Certificates are issued to RES-H generators per unit (e.g. 1 MWh) of renewable heat that is eligible to the scheme. Obliged companies demonstrate compliance by submitting an amount of certificates that corresponds to their individual obligation. In order to create a levelled playing field for the different RES-H technologies that reflect different levels of technical and commercial maturity technology, specific weighing factors could be introduced (e.g. counting heat from solar collectors by a factor x higher than e.g. heat from a heat pump). Sanctions need to be implemented to ensure compliance. Alternatively a buy-out price could be set that would constitute the upper price limit of the whole system. Other important design parameters are the length of the compliance period and flexibility measures such as banking certificates from one to the next compliance period. For the selection on which companies the obligation is put synergies could be exploited with the administration of the energy tax. For each obliged company it

	has to be quantified and fixed which RES-H volume the company needs to deliver (e.g. in form of RES-H certificates) in order to be compliant. The basis of this volume - which generally is the volume of conventional fuels or heat - should in most countries be subject to the energy tax. Thus the relevant data is already collected by the tax authorities and could be used for the purpose of the quota scheme.
Discussion	Being a quantity-based approach and similar to the energy saving obligation the outlined quota system for RES-H is aiming at creating a market on which the required amount of RES-H will be delivered at lowest costs possible. Obliged companies compete to find the cheapest RES-H sources and RES-H generators will try to deliver RES-H at lowest possible costs in order to fall under the quota. Although such a quota scheme would address the heating sector as a whole it might have a significant impact on the building sector. However, while yet there is no experience with existing RES-H quota systems there is a body of evidence from the RES-E sector that this theoretical advantage cannot be observed in practice (e.g. Ragwitz et al., 2005, 2007). Another drawback of the system is the risk of price fluctuations on the certificate market. Since the price level of the certificates determines the level of support, fluctuating prices can undermine planning and investment security which is a key condition for small scale investors and especially SMUs that generate and install the respective RES-H systems. Furthermore there is evidence from the RES-E sector that quota schemes tend to increase the costs for capital for potential RES-H investors due to risk premiums (mainly reflecting volume risks regarding selling all certificates and price risks regarding the certificate price development). Being implemented without weighing factors the scheme would compromise the concept of dynamic efficiency. A pure mechanism without weighing technologies according to their level of competiveness would tend to mainly support the cheapest RES-H technologies. Less competitive technologies may be left stranded as there would be no real incentive to use them. Several technologies would fail to develop further though it can be expected that they will be needed in the long-term (e.g. in order to achieve more ambitious targets while the cheap technologies might already be fully exploited at that time).
Example	-----

Bonus/Premium scheme	
Description	Bonus or premium type of support schemes (often also referred to as Energy Efficiency Feed-in Tariffs) are price based approaches. Investors in energy efficiency measures and/or RES-H are granted a legal entitlement to a bonus payment depending on the saving achieved or the amount of RES-H delivered. The architecture of the approach could be limited to saving measures and/or RES-H installations in the building sector. Similar to the Renewable Heat In-

	centive in the UK (Department of Energy and Climate Change (DECC), 2011a) the bonus could be claimed from the state and be paid from the state budget. Such a case is quite similar to a typical grant that is paid from the state budget (see above). For an alternative the bonus could be paid by the suppliers of fossil fuels that are used for heating purposes in the building sector, or by electricity suppliers as far as electricity is concerned that is used for heating and cooling and by the suppliers of district heating. Another option would be to oblige the grid operators (gas, heat, electricity) to pay the boni. The system costs that incur to the obliged companies will be passed on to the customers via the energy bill or the grid charges. Design parameters of bonus schemes entail the bonus level (depending on e.g. the energy saving achieved through a modernisation measure or the RES-H technology used), the baseline against which the savings are calculated, the payment procedure (e.g. one-off payment vs. annual payments over the lifetime of the measure) and the procedure how savings and/or RES-H generation are determined (deeming vs. measuring).
Discussion	Bonus-types of instruments have a very high investment and planning security. Investors in saving measures and/or RES-H installations know what kind of support they can expect under which conditions. And they have a legal entitlement to this support leading to stable and reliable market conditions. Another advantage of the system that is counter-financed by the energy suppliers or grid operators and finally by the consumers, lies in its budget-independent nature of its financing source (see above). One of the challenging design questions concerns how the financial flows are organised between the investors and the companies who are obliged to pay the bonus. Here it has to be considered that in many Member States several million building owners – that in principle all would be potential beneficiaries within the scheme – would face several hundred energy suppliers obliged to pay the bonus. In addition refurbishment measures and/or RES-H installations need to be approved in order to qualify for the bonus.[16] Governmental or private administration agencies that aggregate claims and payments would have to be established in order to cope with the complexity of the system.[17] Furthermore the support costs would finally be paid by the energy users. As a consequence in the tenant sector the costs would be borne by those who do not have the decision power in favour of investments in the structural building efficiency but could only react by changing their user behaviour.

[16] A bonus system solely for RES-H might be less complex as at least for small installations determination of the eligible RES-H volume (which is the basis for the bonus payments) could be based on few standard plant parameters and simple calculation models (and not necessarily on measurements).

[17] In Germany the involvement of a government agency may be considered un-constitutional, greater leeway might be provided under the constitutions of other countries (Bürger et al., 2008).

Example	We are not aware of any country which has implemented a bonus or premium type of system in which the bonus is paid by the fossil fuel suppliers. In the RHI in the UK the bonus is paid from the state budget.

Contracting type of instruments	
Description	Improving the national framework conditions for the creation of or strengthening the contracting market for energy saving measures in general (including ESCOs and Energy Performance Contracting) with a special focus on modernisation measures in the building stock. On such a market contractors finance the refurbishment measure and get re-paid by the energy cost savings (pay-as-you-save). From the perspective of the home owner the measures are cost neutral or in the case of very profitable measures even beneficial (when the cost benefit is shared by the contractor and home owner). Options for the government to support the establishment of such systems would for instance include elements of risk management (e.g. to carry the risk against payment defaults) which is important in view of the rather long repayment periods.[18] In addition the government could establish clear rules how contracting projects should be dealt with in the case of a transfer of ownership. Furthermore, in emerging contracting markets the government could provide capital for contractors which they need to be able to pre-finance the refurbishment measures.
Discussion	Contracting addresses the barrier that many building owners have problems in raising the capital for refurbishment measures and/or are not willing to incur debts. This hampers efficiency investments even if in principle they would pay back after a reasonable period of time. Contracting types of instruments operate in the market. If the framework conditions are set appropriately it can be expected that a market dynamic will emerge and the rate of refurbishment measures will rise. The instrument addresses the important barrier that many building owners are not willing to incur debts. The main disadvantage of the system is that an isolated implementation without a combination with other funding programs does not sufficiently address very ambitious energy standards as required by the long-term targets (see above). Contractors rather have a strong incentive to concentrate on those measures with rather short repayment periods (low hanging fruits). In this regard is it not assured whether such single measures are compatible with a holistic target-oriented refurbishment strategy for a building.

[18] For refurbishment measures it must also be considered that such investments are rather specific. Other than with a transferable device such as a CHP plant once an insulation has been fixed to a certain building it cannot easily be removed and transferred to another building. Thus it loses its initial market value and the investor is depending on the building owner or user to repay the investment over a rather long time (Langniss and Praetorius, 2006).

	Furthermore target compliance cannot be assured because the effectiveness of the instrument is depending on the willingness of the market to mobilise refurbishment measures to the desired extent. Finally, depending on the mechanism how and where the risk is allocated (e.g. whether it has to be factored in by the contractors), financing conditions might be worse than those under state-financed grant programs.
Example	An overview of the ESCO market status including contracting activities is provided by JRC (2010). A rather innovative example of such a system has recently been introduced in the UK. Under the Green Deal so called Green Deal providers offer refurbishment measures. Measures are accepted as long as they fulfil a "Golden Rule": Only those measures qualify under the system that allow for re-financing by the energy cost savings within a pre-defined period. The innovative element of the Green Deal is the fact that the Green Deal loan is attached to the building (technically to the electricity meter), and not to the building owner. The loan is repaid via a surcharge on the electricity bill (on-bill repayment) which involves the electricity suppliers that transfer the payments to the Green Deal provider. Since the loan is on the property itself, the new owner or tenant "inherits" the cost burden in case of ownership transfer or change of tenant (Department of Energy and Climate Change (DECC), 2011b).

Bank obligation to grant Interest reduced loans	
Description	Banks will be obliged by law to offer interest-reduced loans for refurbishment measures. For instance the interest rate could be e.g. 2% (in absolute terms) or 30% (in relative terms) lower than the average loan for measures in the built environment. Since banks will not automatically be willing to promote these soft loans, regulations should be implemented to ensure that a minimum number of loans are granted. This could either be a quota (e.g. the financial volume of interest reduced loans in relation to the total credit volume of a bank for loans in the built environment) or the obligation to pay some form of compensation fee in case a bank falls short of a certain minimum level. In the latter case the fee could finance a public fund that could be used to e.g. provide financial support for deep renovation measures. Provided that the instrument will mobilise additional refurbishment activity the banks would increase their overall credit volume (by granting more loans than before) and thus their turnover. However the specific bank profit would decrease due to the reduced interest rate. It can be expected that the bank will refinance the gap in the interest rate between the market rate and the "supported" rate by increasing the rates for other loans in the building sector (e.g. for newly built houses). Accordingly, some other customer groups of a bank would compensate for the supported loans.
Discussion	The instrument would allocate at least a part of the responsibility to provide cheaper finance for refurbishment measures in the bank sector. The administrative burden would be rather low since the instrument could be integrated in

	the existing bank procedures of giving loans for investments in the built environment. However the instrument might not be appropriate to stimulate deep renovation measures. Here the incentive from a soft loan alone might not be sufficient enough. The instrument also does not address the barrier that several building owners are not willing to incur debts. Finally the appropriateness of the instrument might be especially high in periods with generally high interest rates.
Example	-----

5.5 Capacity building, qualification and quality assurance

Badly performed refurbishment measures hamper the achievement of the expected energy savings and are thus having a negative impact on the economics of such projects. In addition this damages the confidence of home owners, which is a problem especially for those who are already hesitant to decide in favour of a building renovation. For that reason the deliverance of qualitatively sound refurbishment measures presents a key to keep the confidence high. It requires well skilled manpower in sufficient quantity. As regards skills policy makers need to consider that policies aiming at a significant growth in demand for refurbishment measures have to be flanked by qualification measures that ensure that simultaneously sufficient well skilled manpower is available. A problem remains when a lot of refurbishment works are performed autonomously by the home owners themselves. Here the influence of the government to intervene might be rather limited.

Training and capacity building is also required in the financial sector, to facilitate bank financing of refurbishment projects and to support the effective implementation of soft loan programs. For private and public banks that are not familiar with financing energy modernisation measures, capacity-building should be provided in advance of the introduction of any support program that aims at increasing the number of refurbishment projects.

Moreover, assessors need to be trained and certified to enable them to conduct building energy efficiency audits to a high standard in terms of accuracy. Audits need to provide accurate and credible results, especially when they are used as a basis for financial support or loan applications.

Apart from typical education and training measures such as

- the systematic integration of topics related to refurbishment measures in the curriculum of universities and professional training of architects, construction engineers, engineers for supply technologies, expert planners and other occupational categories with strong links to the renovation of buildings (such as plasterer, window fitters, roofers, heating installers);

- the further development of teaching modules and their integration in the vocational education of all building refurbishment related occupations requiring formal training;
- where appropriate: development of a trade-integrative occupation combining competences of all different trades that are relevant for major refurbishment projects

the following ideas could help to assure high quality standards.

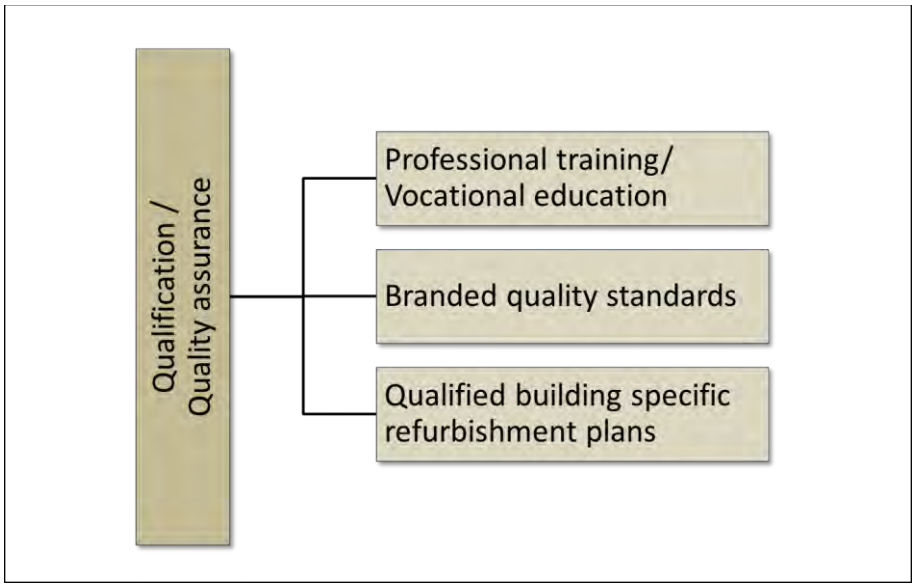

Figure 7: Instrument options to improve qualification and quality assurance

Branded quality standards	
Description	Establishment of a quality standard for refurbishment measures. The quality standard should cover the main structural elements (walls, roof, windows, technical systems) and lay a specific focus on the interface between them. Companies doing refurbishment measures (e.g. plasterer, roofer, window fitter, installers) can apply for accreditation against the standard. For accreditation it is required that representatives of the company undergo a training program and that they continuously attend training courses to keep the expertise alive and to learn about new technologies. The standard can be implemented on the national, regional or even local level. A logo or brand will be established that can be used by all accredited companies. The brand will be promoted by the public authorities as being a quality seal or label on the market, which home owners can rely upon. Accredited companies will be listed by the energy agencies which might be an additional incentive for companies to take the burden to get the seal. Public authorities

	will also work with the standard when refurbishing their own properties.
Discussion	Typical flanking measure that is mainly aiming at keeping the performance of refurbishment measures high. This has mainly two positive effects, a) to ensure that the calculated and expected energy savings of a refurbishment measure can be met and b) that the general reputation of the renovation market will not be damaged. Drawbacks derive from the administrative burden; respectively the corresponding costs to establish such a standard, as well as for promoting and administering it.
Example	Branded quality standards are mainly known on the local level. An example in this respect is the so-called "Stuttgarter Sanierungsstandard"[19]

Qualified building specific refurbishment plans	
Description	Introduction of a qualified long-term building specific refurbishment plan; this plan would outline a strategy how a building could be refurbished over a time to finally (in the long-term) achieve an energy standard that is compatible with the long-term goals. The strategy could either be a one-off deep renovation or a staged approach where measures are taken step by step e.g. according to the availability of finance. For the step-by-step approach the plan would outline different alternatives how to proceed. The plan would include both, refurbishment measures at the envelope as well as efficiency measures concerning the heating and/or cooling system, including the use of renewables.
Discussion	The plan would constitute a building-specific long-term roadmap. It would assist home owners to get an evaluation on the status quo of their buildings. More important, the plan would provide a guideline on how different refurbishment measures could be combined or consecutively conducted in a reasonable way. Furthermore, the plan supports the idea that staged refurbishment measures should be carried out to be compatible with the modernisation of adjacent components and in particular with the long-term goals. In this regard a refurbishment plan would inhibit that early refurbishment steps do not impede later ones. The plan could also benefit refurbishment contractors by allowing them to develop an ongoing relationship with their customers. Establishing a building specific refurbishment plan will require skilled resources that result in costs which generally will be higher than those for "normal" energy performance certificates. There may be public support for contracting such a plan, however in general a major part of the costs will need to be borne by the homeowners. Therefore the instrument would require to be promoted (e.g. by highlighting that the costs will pay off as soon as the first measure has been

[19] Stuttgarter Sanierungsstandard (http://www.ebz-stuttgart.de/unsere-leistungen/der-stuttgarter-sanierungsstandard.html, site available in German only)

	taken; moreover that the plan is illustrating a strategy how a certain energy standard can be reached at lowest possible costs avoiding lock-in effects that would correspond to economic disadvantages such as stranded costs resulting from measures that are not compatible with the long-term needs).
Example	As an element of the energy advice strategy the German government supports the development of qualified building specific refurbishment plans with 400-500 EUR per plan.[20]

On the European level the BUILD UP initiative (http://www.buildup.eu/) was established as an important information hub around EPBD topics. The initiative is collecting and disseminating activities and elaborated strategies for training and qualification of work-force in construction.

5.6 Information, motivation and advice

Programs that aim at informing and motivating building owners to invest in refurbish-ment measures are important flanking measures necessary to strengthen the impact in particular of financial support programs. Advice programs are necessary to enable building owners to make well informed decisions about which measures to go for. There are many different options of information, motivation and advice measures. They can be implemented on the national, regional or local level. In this section two options will be introduced.

[20] Richtlinie über die Förderung der Energieberatung in Wohngebäuden vor Ort – Vor-Ort-Beratung – vom 11. Juni 2012 (http://www.bafa.de/bafa/de/energie/energiesparberatung/vorschriften/vob_richtlinie_2012.pdf, support guidelines available in German only)

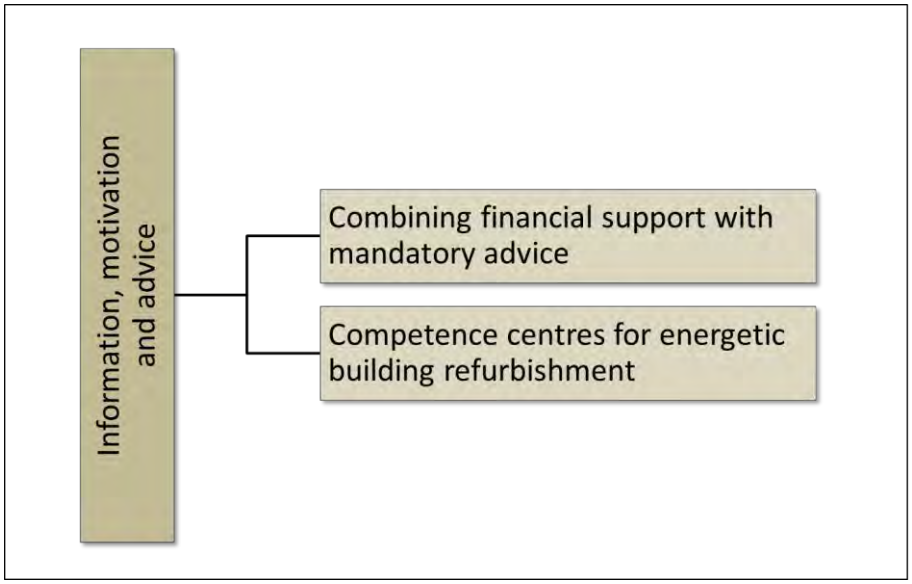

Figure 8: Information, motivation and advice measures

Combining financial support with mandatory advice	
Description	The eligibility to a financial support program could be linked to the requirement to get energy advice. The idea behind this combination is to ensure that a) building owners select reasonable refurbishment measures and b) to ensure high quality measures.
Discussion	Combing financial support with advice is especially important in the case of buildings that are refurbished step by step. In this case advice is necessary to ensure that the different measures are coordinated even if they are spread over a longer period (e.g. insulation of the roof in year 1, insulation of the outer wall in year 10). Furthermore in the case of deep renovations high quality is a key to ensure that the calculated savings can be achieved and no damage on the building (e.g. in form of moisture, mould) will occur. Also here linking support to advice should be a fundamental prerequisite.
Example	Within the German KfW support scheme investors have to provide evidence that in case of deep renovations planning work and supervision of the measure is carried out by an independent expert.

Competence centres for energetic building refurbishment	
Description	Establishment of local competence centres that are specialised in all topics concerning the energetic refurbishment of buildings. This would include technological measures, legal, economical and financing issues. The centre would provide an overview of support programs available for the specific refurbishment projects, in addition a positive list of local companies conducting such

	measures.
Discussion	The competence centres would ensure that the various stakeholders involved in refurbishment projects (e.g. investors, installers, refurbishment companies) would have one central contact and meeting point. The establishment of such centres could be supported by national, regional or local governments by a start-up funding. In the mid-term financing could come from those business sectors that benefit from increasing refurbishment activities.
Example	In many countries energy agencies take a rather similar role as described for the competence centres. However only few countries have a network of local energy agencies that operate all over the country. Often energy agencies cover a much broader spectrum of topics than just the refurbishment of the building stock.

5.7 Market transformation (supply side) measures

Instead of addressing the investor (demand side) market transformation measures try to shape the market or even create a market for new technologies by "working" with the supply side, especially with technology manufacturers, installers and craftsmen. The idea behind this kind of intervention is that markets can be shaped by policy so that desirable solutions appear.

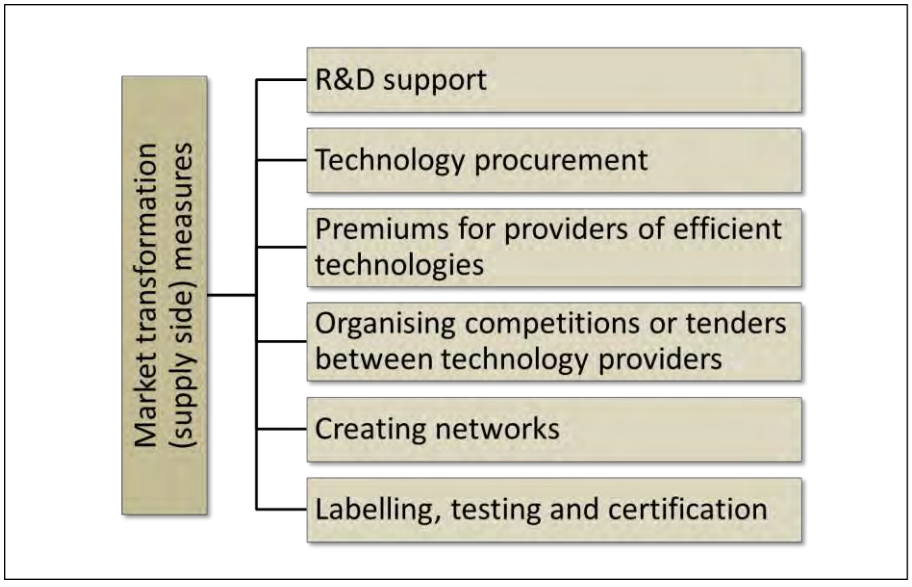

Figure 9: Market transformation (supply side) measures

Typical market transformation approaches include:

- R&D support: Public funding for research and development activities is a key to ensure innovation and technological improvement which are required to bring down costs of refurbishment measures. R&D activities should address both, incremental improvements in existing technologies and processes but also the development of new technologies, materials and processes. For instance, the latter includes new insulation materials (e.g. vacuum insulation panels, aerogel insulation, vacuum insulation glass), new technologies or concepts for "prefabricated" or "industrial" refurbishment measures.
- Technology procurement: Technology procurement can be a strong instrument for the introduction of new technologies into commercial use. Since the public sector holds considerable potential for refurbishment measures at the public building stock it can play an important role in shaping the efficiency market in terms of the technology portfolio and related costs. Coordinated and straight forward public procurement aggregating demand constitutes a significant purchasing power that can be used to catalyse the refurbishment market. Thus technology procurement can eliminate barriers to market entry and market expansion by encouraging innovation and the introduction of new, more energy-efficient technologies. The public sector can also play a leadership role in demonstrating the potential of energy efficiency to reduce energy consumption and in presenting new technologies and energy management (IEA, 2012a). For instance technology procurement has been used e.g. for low-energy windows in Sweden, and in general the Swedish Energy Agency has organized several technology procurement programmes e.g. for demand controlled ventilation etc. together with large building stock owners (Nilsson, 2003). This example highlights the importance of intermediaries in such programs. An intermediary such as a national energy agency could take the role of a facilitator, setting up procurement groups consisting of buyers (such as a group of housing companies) or potential buyers of a technology; in addition to assist the organisation of the procurement process.
- Approaching technology providers: While technology procurement is mainly aiming at creating and bundling demand for new technologies, policy measures could also directly intervene at the supply side. For instance, this could be done by paying premiums to technology providers for selling technologies that go beyond certain efficiency standards (e.g. insulation materials or window frames that exceed a certain conductivity); or alternatively by organising competitions or tenders between technology providers by offering an award to the company which develops or further develops a technology according to a defined efficiency standard, introduces it to the market and achieves a pre-defined sales volume.

- Creating networks: Another element within a strategy for stimulating market transformation would be to create new or strengthen existing networks within the market. This includes “horizontal” collaborations between technology manufacturers, handicraft chambers, ownership associations, energy agencies etc. but in particular vertical collaborations e.g. between technology providers, energy agencies and large property owners bringing together the supply side, typical facilitators and the demand side.

Finally, labelling, testing and certification would be some last steps in this kind of supply-active policy.

5.8 Selected target specific approaches

In the following sections a handful of rather target specific approaches will be introduced. The idea behind these approaches is to implement measures that address the often specific barriers of a certain target group (which might even only occur in the case of a certain target group).

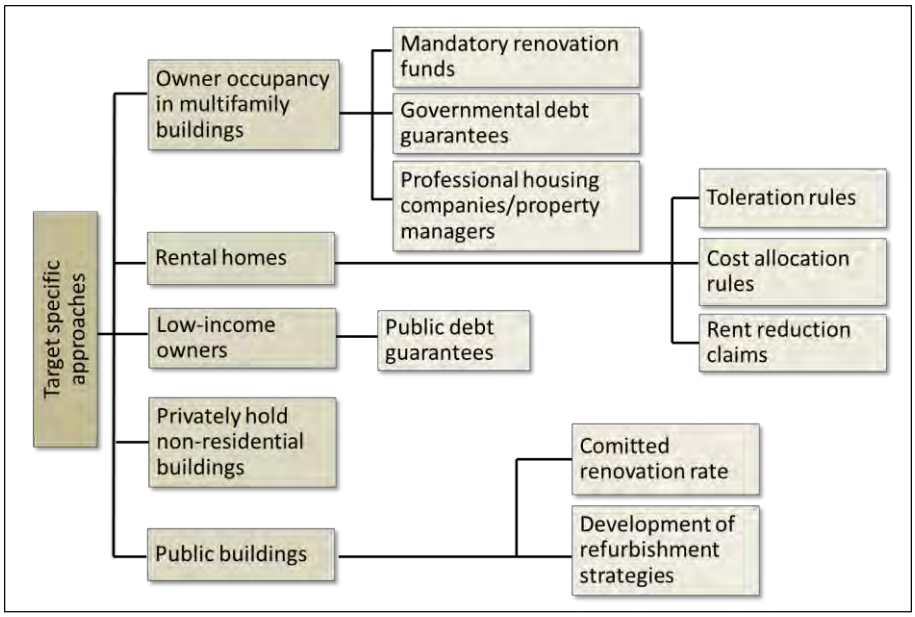

Figure 10: Selected target group specific instruments

5.8.1 For owner occupancy in multifamily buildings

Shared ownership in multi-family buildings often brings together home owners that differ in age, family context, economic background etc. As outlined in section 3 the heterogeneous ownership structure results in a cluster of rather specific barriers. This calls for target group specific instruments in order to exploit the saving potential in this par-

ticular segment of the building sector. Contracting could be one approach to overcome the barrier that some owners might not be able to provide sufficient financial contributions. There may be different organisational forms of homeownership and of the managing of the property, e.g. condominium and unitary ownership (see above). In addition various decision rules for modernisation measures may apply (e.g. in regard to the required majority and/or quorum). For that reason the below mentioned instrument options can only be regarded as first ideas on where political intervention could apply. In any case these instrument ideas need to be thoroughly assessed against the national legal framework and the regulations that apply to shared ownership already today.

Mandatory renovation funds	
Description	Many countries require homeowner associations to gradually build up a reserve funds for financing major repairs. The idea behind these regulations is that in case of shared ownership funds should be available at all times to ensure that a building can be maintained and finance be provided when a major repair has to be done (e.g. fixing the roof, repairing or even substituting a broken boiler). In general, the obligation to source the reserve fund does not cover renovation measures that mainly aim at improving the efficiency standard of a building. However, in principle the concept of reserve funds could also be extended to refurbishment measures. It could be regulated that additional funds need to be set aside in order to finance a modernisation measure at a later stage. At least for refurbishment measures that result from legal requirements (e.g. in countries that apply conditional refurbishment obligations for existing buildings) setting aside a reserve fund could be well justified as the fund would be used to fulfil an obligation that would in any case occur sooner or later.
Discussion	A reserve fund for refurbishment measures would improve the financial situation the measure would start from The fund would provide at least a certain share of the investment costs of a refurbishment measure lowering the barrier of how to finance such an investment. However it still requires a common decision of the owner association in favour of the refurbishing of a building. The drawback is that to implement such a fund would increase the running costs of those who live in the building.
Example	-----

Governmental debt guarantees	
Description	In countries with condominium ownership a multi-family building is considered as a set of several properties (each owner has his own dwelling, only the common areas are jointly owned). If a loan is needed e.g. for investing in a refurbishment measure all individual owners must usually mortgage their dwellings (whereas in the unitary model the building as a whole could be used as collat-

	eral of a loan). This turns out to be a major barrier due to the high administrative burden for mortgaging all apartments. Governmental debt guarantees could alleviate this burden. However, this would shift the risk from the home owners to the society. In order to incentivise ambitious refurbishment measures bank guarantees could be limited to measures that meet a certain minimum standard. Governmental bank guarantees could also be applied to reduce the risk of contractors or ESCOs that pre-finance a refurbishment measure and need to rely on the capability of an owner association to repay the measure over time.
Discussion	The instrument would address a major barrier for shared ownership in multi-family buildings. Apart from putting away the administrative burden of mortgaging, the dwellings owner associations might additionally benefit from lower interest rates (since the lender's risk is reduced because the government would satisfy the debts in case one of the home owners can't service the loan). In order to limit the risk of the state transparent rules must be established for the creditworthiness of each member of an ownership association.
Example	In Germany the regional government of Baden-Württemberg is providing loan guarantees when homeowner associations take a loan for modernisation measures at the state bank of Baden-Württemberg.

Professionalization of housing companies or property managers	
Description	Many multi-family buildings are managed by professional housing companies or by property managers. Often such companies have considerable influence on which investment decision is taken by an ownership association. However, many property managers lack competence regarding measures that go beyond typical maintenance and repair. For that reason programs could be implemented that specifically aim at strengthening the property managers' expertise in regard of refurbishment measures. The measure should also include training modules to improve the competence of property managers for moderating decision processes. In order to incentivise housing companies or property managers to join such courses a quality seal (e.g. "social-ecologic" housing company) could be introduced that could be used by the companies that get accredited for a certain training standard. Furthermore networks involving housing companies and local/regional energy agencies, ESCs etc. should be established.
Discussion	The instrument would address an important actor in the decision making process of many ownership associations. Furthermore a multiplying effect could be achieved since a well skilled housing company - provided more than one building is administered – would reach several owner associations at the same time.
Example	-----

5.8.2 For rental homes

In the rental housing sector, policy intervention should take into account the often rather divergent interests and perspectives of the landlords and the tenants. From the perspective of the building owner incentives should be improved to increase the willingness of landlords to invest in refurbishment measures. However, the problems of split incentives are key issues to be addressed: especially the regulations how tenants (provided they pay the energy costs and thus would benefit from reduced energy demand while the landlord takes the investment) could be involved to contribute to the investment costs. Furthermore landlord rights could be strengthened in terms of obliging tenants to tolerate a refurbishment measure. The same applies to the question to which extent tenants are permitted to reduce the rent provided a refurbishment activity compromises the living conditions (e.g. due to noise, dust etc.). From the tenant's perspective important issues are e.g. protection from high energy cost burdens (e.g. by allowing tenants to reduce the rent in case a mandatory refurbishment measure remains undone); in addition regulations to ensure that there are restrictions to which extent refurbishment costs may increase the rent.

The relationship between landlord and tenant is regulated by national tenant law in regard to refurbishment related issues such as toleration duties, cost shift options etc.. Regulations differ between countries and have to be evaluated in view of the structure (e.g. ownership structure and ownership models) of national building sectors. Due to different legal frameworks and the varying building sector characteristics it is rather challenging to elaborate on specific generic instruments. For that reason only some basic concepts are presented for discussing national policy options that aim at addressing the various barriers in the rental housing sector.

- Tolerating refurbishment measures: Some countries apply regulations to which extent and under which conditions tenants are obliged to tolerate refurbishment measures at the building they are living in. Here has to be distinguished between two different kinds of measures that differ in the impact on the tenant. In the majority of cases refurbishment measures are conducted that might disturb tenants through noise, dust etc. due to construction works leading to discomfort, but still allow them to stay in an apartment. However major building renovations such as many deep retrofits that involve the whole building structure, might only be implemented in a vacant building. This would imply re-locating the occupant for the period of the measure. It can impose a major barrier if the regulations are too restrictive to which extent tenants can refuse to tolerate refurbishment measures. In such cases changing the legislation to less restrictive regulations might be helpful in mobilising more modernisation activity.
- Cost allocation rules: The landlord-tenant dilemma occurs in the fairly common case in which the building owner decides on refurbishment measures while the tenant pays for energy costs thus benefitting from a better energy standard. In such cases in many countries a national tenant law regulates to which extent

and under which conditions the investment costs may be shifted to raise the rent. In case of refurbishment measures that amortise within a reasonable period a mechanism should be found that allows for distributing costs and benefits in a fair way between landlord and tenant. From the tenant's perspective it should at least be ensured that after the refurbishment is done, the total rent including heating costs should not be higher than before. For more demanding refurbishment standards with much longer amortisation periods it must be thoroughly decided to which extent tenants should contribute to the corresponding costs, e.g. whether cost neutrality related to the total rent including the heating costs should be the upper limit for the cost shift.

- Rent reduction claims: In several countries there is evidence that enforcement and compliance of building codes is not sufficiently undertaken. This is especially a problem where building codes oblige building owners of existing buildings to fulfil certain minimum requirements (e.g. major renovations or even conditional requirements in case only one building component is renovated). The reasons for this compliance deficit are manifold. Due to the ongoing liberalisation in the building sector public authorities simply do not have sufficient resources to ensure compliance though they are responsible for this task. Moreover many refurbishment measures do not require any form of announcement to the authorities. Therefore, authorities often lack an overview at which places in a community refurbishment is currently underway. From the perspective of tenants, refurbishment measures that are required by law but have failed to be carried out by the landlord, can incur high energy costs. In order to protect tenants from unjustified cost burdens, regulations could be thought of to allow tenants to reduce the rent if it can be proven that a refurbishment measure has not been conducted at all, or was not ambitious enough although it was required by the building code.
- Another option how to regulate cost allocation is following an idea outlined by (Tigchelaar et al., 2011). Apart from limiting the maximum-allowed cost shift in relation to the refurbishment costs[21] it could be regulated that the cost shift must not exceed a limit. That limit is legally fixed according to the efficiency standard reached or to the number of efficiency classes that are skipped by a measure. If for instance a building with G label would be modernised as to reach C, the maximum cost shift could be higher than a modernisation that ends only in F. Linking the maximum cost shift to the skipped efficiency classes could be justified by the energy cost savings for the tenant that are higher as more efficiency classes are skipped.

[21] For instance in Germany the landlord to allowed to shift maximum 11% of the eligible total modernisation costs into the rent.

5.8.3 For low-income owners

Amongst the nine target countries of the project, the share of low-income homeowners among all owner-occupants is above 15% in Romania, Bulgaria, Spain and Italy. This is most problematic as these countries have a rather large ownership rate.[22]

Public debt guarantees	
Description	Governmental guarantees e.g. to private banks would reduce the risk faced by private banks thus lowering the cost of capital; in addition governmental guarantees might allow low income owners (that otherwise might not be eligible for a bank loan) to take a loan for refurbishment measures at all; the loan risk can be taken over fully or partially by government; different options exist to share the risk between the government and the private banks (IEA, 2011).
Discussion	The instrument would enable low income owners to finance refurbishment measures. This might have an absolute positive impact in countries with a considerable rate of building owners with low income (see section 3.1). Though the question remains whether low income owners would at all be willing to incur a debt for such measures. This might be the case if the investment costs can be re-paid by the energy cost savings resulting from a refurbishment measure. However it is more than doubtful in case of very ambitious refurbishment measures where this rule does not apply. From the perspective of the state the instrument implies that part of the financing risk is allocated to the state budget. However real costs do only occur in case of financing difficulties or complete payment defaults.
Example	-----

Another option would be grant programs particularly targeting low-income building owners. For instance in New Zealand the program “Warm up New Zealand: Heat Smart” provides grants for insulating existing buildings and replacing inefficient heating systems. Low-income homeowners or landlords with low-income tenants can recover 60% of the costs for insulation works through grants (IEA, 2012a). In this respect grants for low income house owners could be part of the instrument mix addressing fuel poverty, as it allows low-income households to invest in energy efficiency in order to counter rising energy prices.

[22] Eurostat 2012, (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Housing_statistics/de#Datenquellen_und_Datenverf.C3.BCgbarkeit)

5.8.4 For public buildings

The European legislator intended a leading role for public buildings. This was "translated" in tangible requirements, namely the obligation of Member States to annually renovate at least 3% of the buildings occupied by their central governments. However governmental buildings constitute only a rather small share of all public buildings. For instance in Germany buildings used by the central government sum up for only around 1% of the overall effective area (Bürger and Steinbach, 2010). For that reason additional instruments should be taken into consideration in order to allow the public sector to really fulfil its exemplary role.

Extending the 3% renovation rate to all public buildings	
Description	As foreseen by the original Commission proposal for the EED (2012/27/EU) from June 2011[23] national, regional and local governments could extend the obligation to reach an annual 3% refurbishment rate to all public buildings. The commitment would have to be backed by respective budget allocations in the national, regional and/or local public budgets. Besides the refurbishment rate public bodies could give an additional commitment to reach the nZEB standard for a certain share of all refurbished buildings. Starting from a low level this share should increase quite soon. Priority for nZEB renovations should be given to buildings that are frequently visited by the public.
Discussion	By pursuing a renovation rate higher than the rate in the non-public building sector public bodies would meet the demand of taking and exemplary role and at the same time would demonstrate that a nZEB standard is feasible. From the economic perspective public bodies would relieve future public budgets as less energy costs would incur. However, increasing the renovation rate would require the allocation of sufficient finance now. In many countries budget constraints resulting from the financial crisis leave only little room for short-term financial manoeuvres even if they demonstrate to save money in the future. Here options of private financing (e.g. through public private partnerships) could play an increasing role and therefore should be thoroughly assessed.
Example	-----

[23] Proposal for a Directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC.

Establishment of refurbishment strategies	
Description	Commitment of public authorities to develop refurbishment strategies for the existing stock of public buildings. Similar to the above instrument of a "Qualified building specific refurbishment plan" public bodies should develop building specific renovation plans outlining how a building could be modernised over time to finally (in the long-term) achieve a nZEB standard. Based on the plans a schedule should be established clearly indicating in which order the buildings will be touched. Priority should be given to buildings with public traffic (in view of the exemplary role) as well as to those buildings that have a low energy standard (in view of short-term cost savings).
Discussion	A refurbishment strategy for public buildings would help public bodies to a) get an overview of the overall task of transferring the own building stock gradually towards the nZEB standard, b) create transparency for the public, c) outline reasonable refurbishment steps (in case of a staged refurbishment approach) and d) minimise the risk of lock-in effects that would harm the public budgets e.g. in the form of stranded costs in the future. However, the establishment of a building specific refurbishment plan incurs costs that need to be covered by the public budgets.
Example	Since 2011 in Germany the German Federal Agency for Real Estate Administration (BImA) is developing a long-term (2050) energy refurbishment roadmap for roughly 4.700 government-owned properties. As a starting point a database has been set up holding data on size and consumption of 40% of all these properties. Moreover for each building potential refurbishment measures (reflecting different refurbishment depths) and related costs are determined in view of the government's targets for the segment of the building sector. Based on this assessment buildings are prioritised according to their suitability for modernisation.

Further ideas for measures to trigger refurbishment activity for public buildings include ESCO or EPC schemes for public buildings while the contractor could be public or private.

6. From the policy toolbox to integrated policy packages

6.1 Rationale for establishing policy packages

As highlighted in section 3 energy efficiency potentials are hampered by barriers that can be rather specific to the different target groups. For that reason section 5.8 introduces several instrument options that are rather specific to the selected target groups. Furthermore most energy saving potentials are not inhibited only by one barrier but rather by a bundle of different barriers. For instance a building owner of a single family house might be reluctant to invest into a refurbishment measure because he might not be aware of the cost savings deriving from such a measure, he might not trust the respective calculations (information barrier) and at the same time he might not be willing to incur a debt for such a measure (financial barrier). Since generally it is difficult to design an isolated instrument that addresses several barriers simultaneously, a bundle of instruments is required to properly address the most relevant barriers at the same time – which would be necessary to trigger an investment in a modernisation measure. In other words, target specific barrier bundles call for target specific instrument bundles (IEA, 2007a; OECD, 2007).

6.2 Key considerations for defining policy packages

For the combination of different instruments to a policy package the following considerations should be taken into account (please see also section 5.1):

- Instruments should be designed as to address the main barriers that hamper investments in the efficiency of buildings. In addition the policy package should include elements as to target the needs of the major target groups. The instruments in the policy package should reflect the market maturity of the different technologies.
- If a certain barrier (e.g. a financial barrier) is addressed by two or more instruments at the same time, this should be adequately justified (e.g. by the fact, that the instruments offer different accesses to financial support which might aim at different target groups). It should be avoided that instruments are simply redundant (which might only lead to higher administrative costs).
- In general administrative costs of a policy package should be kept as low as possible. This includes the transaction costs for the state but also all other system participants. For that reason it should be assessed to which extent synergies could be exploited when administering several instruments at the same time.
- In order to increase public acceptance for the communicative perspective the policy package should be kept as simple as possible. The main elements of a package should be easy to communicate.

6.3 Exemplary policy packages

One of the main goals of the Entranze project is to quantitatively assess the impact of different policy packages in terms of a set of indicators such as reduced final energy consumption and GHG emissions, cost implications (e.g. investment costs, avoided fuel costs, cost allocation), funding needs etc. The results will allow policy makers to learn about the quantitative impact of different policy approaches and to make better informed decisions. For that reason the policy packages that will be subject to the modelling activities in the other work packages should cover a rather broad spectrum of options. One option to define the policy packages would be to choose policy sets according to distinct “policy lines”.

- For instance a policy package could lay a focus on regulatory measures. Such a package could involve tightening the building code, implementing replacement obligations (e.g. for boilers) and/or unconditional refurbishment obligations (e.g. for the structural components of a building) as well as implementing a use obligation for RES-H.
- Another policy line would focus on financial support that is offered by state-financed support programs. The core of such a policy package would be grant programs, soft loans, tax incentives that could incentivise building owners to make investments in refurbishment measures.
- Another potential policy line could strengthen support and financing activities within the market. Under such a policy line the state would create the framework conditions and support would be given independent from public budgets. Typical instruments within such a policy package would be energy saving obligations under which obliged market actors would start to establish support programs for refurbishment measures. Also typical price-based (e.g. premium schemes) or quantity-based (e.g. quota schemes) approaches could be taken up as long as it is ensured that the support costs are covered by the market participants (finally ending with the end consumer).

In any case a policy package should be set up in view of a long-term strategy for the whole building sector. The strategy should include a long-term goal (expressed in form of a set of indicators) but also milestones that should be met during the sector transformation from the status quo today towards the long-term goal.

The selection of instruments is one important step in setting up different policy packages. Of similar importance is the question how the different instruments are designed in detail. Often the impact of a political intervention is more dependent on the core design parameters of an instrument than on the question which instrument is applied. For a grant program important design parameters are the grant level(s), potentially tiered according to the efficiency level of a measure, the eligibility to the program etc. For the quantitative impact assessment these parameters must be set. Another dimension is the time. Policy sets might change over time. This applies to the selection of instru-

ments within a package but also to the evolution of the specific instrument designs. The time dimension needs to be taken into account as well when the policy sets are set up.

Table 4 and Table 5 illustrate examples how policy packages could be designed following above stated principles.

Table 4: Exemplary policy package focussing on regulatory measures

Policy Set: Focus on regulatory measures																		
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New buildings																		
Building code	Gradual tightening towards nZEB standard								nZEB standard									
RES-H use obligation		15% obligation					20% obligation					25% obligation						
Financial support	Moderate support for construction of nZEB buildings																	
Existing buildings																		
Building code		20% tightening					Further 10% tightening					Further 10% tightening						
Building code		Increasing compliance rate by appropriate measures																
Replacement requirement windows		Replacement of single glazing windows										Replacement of simple double glazing windows						
Phase out requirement boilers		Replacement of boilers older than 25 years																
RES-H use obligation (trigger: boiler replacement)		10% obligation					15% obligation					20% obligation						
Financial support	Moderate support for modernisation measures that exceed building code																	

The left side of an instrument bar indicates the implementation year of the measure.

Table 5: Exemplary policy package strengthening support and financing activities within the market

Policy Set: Strengthening support and financing activities within the market																		
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New buildings																		
Building code	Gradual tightening towards nZEB standard								nZEB standard									
Financial support	Moderate support for construction of nZEB buildings																	

Financial support	Moderate support for RES-H installations							
Existing buildings								
Building code		Moderate tightening						
Replacement requirement windows				Replacement of single glazing windows				
Energy saving obligation			1,5% obligation while half of the savings come from refurbishment measures					
Financial support	Moderate support for modernisation measures that exceed building code							
RES-H quota scheme on energy suppliers		10% obligation		15% obligation		20% obligation		

The left side of an instrument bar indicates the implementation year of the measure.

7. References

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Annex: Overview of barriers (Heiskanen et al., 2012)

Most critical barriers in owner-occupied single-family homes

		AT	BG	CZ	DE	FI	FR	IT	RO	ES
Uncertainties in cost effectiveness	Conflicting information, mistrust of information	■		■	■	■		■		
	Heterogeneous outcomes				■				■	
	Uncertainty in measurement & verification				■			■		
Financial barriers	High initial costs	■	■	■	■	■	■	■	■	■
	Long payback time	■		■	■	■	■	■	■	■
	Access to/cost of capital		■	■	■	■	■	■	■	■
	Unwillingness to incur debts	■		■	■	■		■	■	■
	Low/uncertain resale value of property				■	■				
Lack of information & skills	Lack of customer attention and interest	■		■	■					
	Lack of customer knowledge	■	■	■		■		■		
	Lack of reliable advice					■		■	■	
	Unsophisticated financial analysis							■	■	
Transaction costs	Lack of skilled service providers	■					■	■	■	
	High information search costs	■			■	■	■	■		
	Switching costs, concerns over disruption	■								
	Risks of failures in renovation	■								

Most critical barriers in owner-occupied multi-family buildings

		AT	BG	CZ	DE	FI	FR	IT	RO	ES
Uncertainties in cost effectiveness	Conflicting information, mistrust of information	■	■	■	■		■	■		
	Heterogeneous outcomes	■			■	■	■		■	
	Uncertainty in measurement & verification	■			■			■		
Financial barriers	High initial costs	■	■	■	■		■	■	■	■
	Long payback time	■		■	■	■	■	■	■	■
	Access to/cost of capital		■	■			■	■	■	■
	Unwillingness to incur debts				■			■	■	■
	Low/uncertain resale value of property					■				
Organizational problems	Landlord-tenant dilemma			■	■					
	Collective decision problems	■	■	■	■	■	■	■	■	■
	Short timeframe of decisions	■	■							
Lack of information & skills	Lack of customer attention and interest	■	■				■			
	Lack of customer knowledge	■	■	■		■	■	■		
	Lack of reliable advice		■	■		■		■	■	
	Unsophisticated financial analysis							■	■	
Transaction costs	Lack of skilled service providers	■	■		■	■		■	■	
	High information search costs	■			■		■	■		
	Switching costs, concerns over disruption	■	■			■				
	Risks of failures in renovation	■	■							

Most critical barriers in social/professionally owned rental housing

		AT	BG	CZ	DE	FI	FR	IT	RO	ES
Uncertainties in cost effectiveness	Conflicting information, mistrust of information		■	■				■		
	Heterogeneous outcomes								■	
	Uncertainty in measurement & verification		■	■				■		
Financial barriers	High initial costs		■				■	■	■	■
	Long payback time		■	■	■	■	■	■		■
	Access to/cost of capital		■				■	■	■	■
	Unwillingness to incur debts		■					■	■	■
	Occupant take-back		■		■			■		■
	Low/uncertain resale value of property				■			■		
Organizational problems	Landlord-tenant dilemma		■	■	■		■	■	■	■
	Collective decision problems		■	■				■		
	Short timeframe of decisions		■	■						
Lack of information & skills	Lack of customer attention and interest		■					■	■	
	Lack of customer knowledge		■	■				■		
	Lack of reliable advice								■	
	Unsophisticated financial analysis									
Transaction costs	Lack of skilled service providers	■						■	■	
	High information search costs							■		
	Switching costs, concerns over disruption	■				■				
	Risks of failures in renovation	■	■				■			

Most critical barriers in public buildings

		AT	BG	CZ	DE	FI	FR	IT	RO	ES
Uncertainties in cost effectiveness	Conflicting information, mistrust of information			■					■	
	Heterogeneous outcomes					■		■	■	
	Uncertainty in measurement & verification						■	■		
Financial barriers	High initial costs	■	■	■	■	*	■	■	■	■
	Long payback time	■				■		■	■	■
	Access to/cost of capital		■	■	■	*	■	■	■	■
	Unwillingness to incur debts							■	■	
	Occupant take-back									
	Low/uncertain resale value of property					*				
Organizational problems	Landlord-tenant dilemma									
	Collective decision problems	■		■			■		■	
	Short timeframe of decisions			■		*				
	Public budgeting practices	■	■	■	■	■	■	■	■	■
Lack of information & skills	Lack of customer attention and interest		■			*			■	■
	Lack of customer knowledge			■		*	■			
	Lack of reliable advice					*			■	■
	Unsophisticated financial analysis									

Transaction costs	Lack of skilled service providers					*				
	High information search costs					*				
	Switching costs, concerns over disruption									
	Risks of failures in renovation									

*= small municipalities