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Energy Savings Gap in Spain

A case study: Policy assessment for energy efficiency in residential buildings

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Executive Summary

i. Context

Energy efficiency is one of the most cost effective ways to enhance security of energy supply and reduce emissions of greenhouse gases and other pollutants (EC, 2011). Therefore, the EU has set an indicative target for 2020 of 20% energy savings as part of its climate and energy policy (EC, 2010). However, even taking into account the economic recession and energy policies in place, the EU is not on track and will only reach half of the 20% energy savings target (EC, 2011; Wesselink et al, 2011).

According to the EE Plan (EC, 2011), the biggest energy savings potential in the EU lies in the building sector. However, even though there is sufficient cost-effective energy savings potential, a number of market and behavioural failures have traditionally prevented efficiency improvements. This has led to an energy savings gap, which in this study refers to the amount of additional energy savings needed in order to achieve the 20% target by 2020.

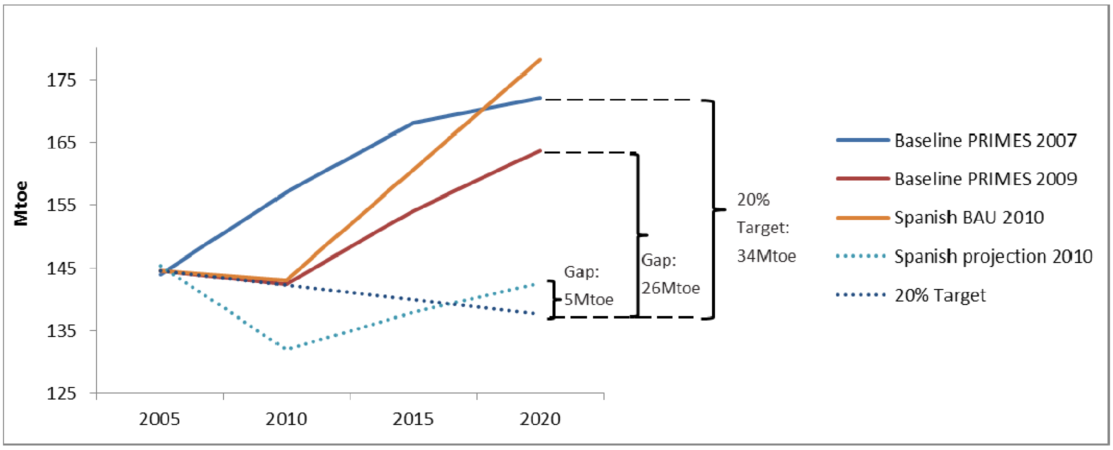
Given that it is the role of public policy to provide effective instruments to address the existing barriers and bridge the energy savings gap, this research focuses on the assessment of energy efficiency policy. First, it provides an analysis of the **energy savings gap in Spain,** by comparing the PRIMES 2007 and 2009 projections with the Spanish projections. Then, it evaluates the existing policy package aimed at improving **energy efficiency in residential buildings** in order to answer the following research question:

> *To what degree is the Spanish energy efficiency policy package for residential buildings able to bridge the energy savings gap? And how can it be improved?*

Spain will not achieve its 20% energy savings target for 2020 unless an effective and coherent policy package is in place. Considering that a big part of the potential for energy savings lies in the building sector, this research aims at evaluating the effectiveness of the Spanish policy package for energy efficiency improvements in residential buildings by using policy theory reconstruction. This will provide insights and recommendations for policy makers to improve the current policy setting in order to tap the unrealized energy savings potential in the sector.

ii. Main findings

The energy savings gap analysis shows that, according to the EU projections (PRIMES baselines 2007 and 2009), there will be a 26Mtoe gap. However, it has been shown that PRIMES 2009 overestimates the energy consumption of the residential sector by 3Mtoe, due to an overstated population projection, which leads to an actual gap of 23Mtoe. On the other hand, when considering the Spanish projections (which assume all their policies and targets are met), there is still a 5Mtoe gap with the EU target. This means that, unless additional efforts are undertaken, Spain will not achieve the 20% indicative energy savings target by 2020.



Currently, the Spanish targets regarding the residential sector do not play an important role. The 2nd NEEAP (MITyC and IDAE, 2010) states that the energy efficiency policies aimed at the residential sector will only contribute 0.2 Mtoe to the energy savings in 2020. However, the potential lying in this sector (according to WWF, 2010; Economics for Energy, 2011; Fraunhofer Institute, 2009) is over 5 Mtoe. Therefore, reinforcing the policies aimed at energy efficiency improvements in residential buildings can help bridge the Spanish energy savings gap.

In addition, given the collapse of the construction sector after the burst of the housing bubble and its significant impact in the labour market, building refurbishments are a huge opportunity for employment creation and, therefore, key for economic recovery through the promotion of the construction sector. Hence, ambitious policies in the sector would not only help bridging the energy savings gap, but they would also tackle unemployment and would help the recovery of the collapsed construction sector.

With this in mind, the current policy package aimed at improving energy efficiency in residential buildings in Spain has been evaluated. This policy package includes, at EU level, the energy performance of buildings directive (EPBD: 2010/31/EU) and the end-use efficiency & energy services directive (ESD: 2006/32/EC). Additionally, at the Spanish level, the second National Energy Efficiency Action Plan, the technical code for buildings (CTE: MF, 2006), the regulation on thermal installations in buildings (RITE: MITyC, 2006), the energy performance certification for new buildings (EPC: MITyC , 2007) and national housing and refurbishment plan ('*Plan Estatal de Vivienda y Rehabilitación 2009-2012*' – MF, 2008) have been considered. The policy package is a combination of different types of policy instruments at national and EU level, including regulatory, economic and informational instruments. However, despite the efforts made to promote energy efficiency in buildings through these policies, the policy package is not sufficient to yield the existing energy savings potential of the sector.

This is mainly due to the lack of interest on energy issues from the end users, along with the unattractiveness of energy efficiency investments and the lack of ambitious regulation, coordinated among the different actors and levels. Furthermore, more stress should be given to addressing the regulation and planning issues as well as the fragmented public administration and its consequent problems. There are implementation issues regarding the EPBD, not only at a national level (where the EPC for existing buildings has not been approved yet) but also at the regional level.

iii. Conclusions and recommendations

The current policy package is not enough to help bridge the energy savings gap and yield the energy savings potential of the residential sector. A number of recommendations are proposed to improve the existing policy package for energy efficiency improvement in residential buildings:

- **Ambitious and clear targets for energy savings.** Having set targets for energy efficiency is a great first step towards tapping the energy savings potential. However, the current EU and Spanish targets are only indicative and they are not transparent. Furthermore, they are different which creates confusion (referring to energy savings or energy intensity, as well as different baselines) and do not allow for comparison. In the residential building sector, the energy targets should be supported by ambitious objectives for household refurbishments as part of the PEVR. This would help tackle the lack of interest barrier.

- **Coherent and stable regulatory framework, focused on existing buildings**. Regulation on energy efficiency in buildings should be more stringent to comply with the EPBD recast. This involves strengthening the CTE requirements. Furthermore, it is imperative to approve and implement the EPC procedure for existing buildings as soon as possible. In Spain, the majority of buildings which will be standing in 2050 have already been built (during the construction boom period); this was before the implementation of the CTE, which implies there is plenty of room for energy efficiency improvements in the existing building stock.

- **Leverage on co-benefits: Employment creation.** At EU level, energy efficiency policy leverages on some of the co-benefits of energy efficiency such as climate mitigation, improved energy security and competitiveness. However, Spain could take advantage of the opportunity to promote the construction sector through energy efficiency in residential buildings. Building refurbishments are a huge opportunity for employment creation and, therefore, key for the economic recovery. This should make energy efficiency policy a higher priority in the political agenda.

- **Coordination and cooperation among the different public agencies.** Energy efficiency in buildings should have the coordinated support of the relevant authorities (not only MF and IDAE, but also MAGRAMA) at the national, regional and local level. The different ministries should implement joint strategies and actions aimed at yielding the energy savings potential from the sector. For example, the measures aimed at energy efficiency in residential buildings in the existing action plans (NEEAP and PEVR) could have had a greater impact if designed and implemented jointly.

- **Coordination and cooperation among the different levels: National, regional and local.** The fragmented government structure in Spain sometimes hinders the effectiveness of policies. This is aggravated due to the fact that the NEEAP (and other plans) establishes different measures for the regional authorities to implement, but it does not explain how to do this. A better coordination and control from national authorities is needed in order to ensure the proper implementation of policies at the local level. Furthermore, the role of the implementing agencies is crucial in the success of the policy instruments; hence, these agencies should have the necessary resources and skills to carry out the implementation properly. For example, guidelines and best practices regarding policy implementation could be made available to regional agencies through IDAE.

- **Monitoring of the implementation of policy measures.** Given the fragmentation that exists in Spain, it is imperative that there is monitoring (for example of the suggested indicators) in order to have a clear idea of the effectiveness of the instruments, along with aggregation of the results and databases at a national level by IDAE. Through the implementation of such a monitoring system, the local authorities would control the quality of the projects (e.g. energy performance certifications and building refurbishments), while IDAE can control the compliance of the autonomous communities to the regulation in place.

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List of Abbreviations

AI	Activity Indicator
AGE	Public administration (*Administración General del Estado*)
BAU	Business as usual
BPIE	Buildings Performance Institute Europe
CHP	Combined Heat and Power
CIEMAT	Energy, Environment and Technology Research Centre (*Centro de Investigaciones energéticas, medioambientales y tecnológicas*)
CO_2	Carbon dioxide
CTE	Spanish Technical Building Code (*Código Técnico de la Edificación*)
DB	Database
DG	Directorate-general
EC	European Commission
E4	Spanish Strategy for Energy Efficiency (*Estrategia Española de Eficiencia Energética: 2004-2012)*
EE	Energy Efficiency
EEE-F	European Energy Efficiency Fund
EEPR	European Energy Programme for Recovery
EIB	European Investment Bank
EIF	European Investment Fund
ELENA	European Local ENergy Assistance
EMU	Economic and Monetary Union
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
EPEC	European PPP Expertise Centre
ERDF	European Regional Development Fund
ESCO	Energy Service Companies
ESD	End-use Efficiency & Energy Services
ETS	Emission Trading Scheme
EU	European Union
FP7	Seventh Framework Programme for Research and Technological Development
GHG	Greenhouse gases
hh	Households
HPI	High policy intensity
HVAC	Heating Ventilation Air Conditioning
IDAE	Spanish Institute for Energy Diversification and Energy Saving (*Instituto para la Diversificación y Ahorro de Energía)*
IEA	International Energy Agency
IEE	Intelligent Energy Europe
JESSICA	Joint European Support for Sustainable Investment in City Areas
ktoe	Kilo tonne oil equivalent
kW	Kilowatt
kWh	Kilowatt hour
LED	Light-emitting diode
LPI	Low policy intensity
m^2	Square meters

MAGRAMA	Ministry of Agriculture, Food and Environment (*Ministerio de Agricultura, Alimentación y Medio Ambiente*)
MEUR	Million Euro
MF	Ministry of Public Works (*Ministerio de Fomento)*
MITyC	Ministry of Industry, Tourism and Commerce (*Ministerio de Industria, Turismo y Comercio*)
Mtoe	Mega tonne oil equivalent
MURE	*Mesures d'Utilisation Rationnelle de l'Énergie*
NEEAP	National Energy Efficiency Action Plan
NTUA	National Technical University of Athens
OECD	Organization for Economic Cooperation and Development
PEVR	National housing and refurbishment plan (*Plan Estatal de Vivienda y Rehabilitación)*
PAEE	Energy Efficiency Action Plan (*Plan de Acción de Eficiencia Energética*)
PPP	Public-Private Partnership
RD	Spanish Royal Decree
RDI	Research, Development & Innovation
REAP	Renewable Energy Action Plan
RES	Renewable Energy Sources
RITE	Spanish Regulation on Thermal Installations in Buildings (*Reglamento de Instalaciones Térmicas de los Edificios*)
TA	Technical Assistance
toe	Tonne oil equivalent
UNEP: SBCI	United Nations Environment Programme: Sustainable Buildings & Climate Initiative
VA	Voluntary Agreement
WBCSD	World Business Council for Sustainable Development
WWF	World Wildlife Fund

CHAPTER I: RESEARCH FRAMEWORK

1. Background

Energy efficiency (EE)[1] is one of the most cost effective ways to enhance security of energy supply and reduce emissions of greenhouse gases (GHG) and other pollutants (EC, 2011). Additionally, improvements in energy efficiency can reduce the need for investment in energy infrastructure, cut fuel costs, increase competitiveness and improve consumer welfare while moving towards a more sustainable energy supply. Even though there is a large energy savings potential, a number of market and behavioural failures have traditionally prevented efficiency improvements. It is the role of public policy to provide effective instruments to reduce these failures.

Thus, the EU has set an indicative target for 2020 of 20% energy savings as part of its climate and energy policy, in addition to the 20% GHG emission reduction and 20% renewable energy sources targets (EC, 2010). Even though the energy savings target is not binding, there is a connection to the 20% emission reduction binding target, which consists of the Emissions Trading System (ETS) and the Effort Sharing Decision. Under the Effort Sharing Decision, each Member State has agreed to a binding emissions target for 2020 for non-ETS sectors such as transport, housing, agriculture and waste.

In order to achieve the 20% energy savings, a variety of policies have been applied to improve energy efficiency, including building insulation programmes, building codes, appliance labelling, subsidies, and voluntary agreements on industrial energy efficiency. However, according to the Energy Efficiency Plan (EC, 2011) and the Energy Savings 2020 report (Wesselink et al, 2011), even taking into account the economic recession and energy policies in place, the EU is not on track to meet its objective, and will only reach half of the indicative 20% energy savings target. Nonetheless, there is sufficient cost-effective energy savings potential to realize this objective in 2020 (Wesselink et al, 2011).

2. Problem definition

According to the EE Plan (EC, 2011), the biggest energy savings potential in the EU lies in the building sector followed by the transport and industry sectors. Koskimäki et al (2008) states that in the building sector, the refurbishment of existing buildings accounts for over 35% of the total potential of the sector. Furthermore, the strategic importance of energy efficiency in the built environment is widely recognized (Dobbs et al, 2011; EC, 2011; WWF, 2010), and various studies assess what additional measures could be undertaken to help bridging the energy savings gap in the built environment or provide recommendations for EE policy making (see IEA, 2008; Convery, 2011; Jollands et al, 2010).

[1] *Energy efficiency* improvements refer to a reduction in the energy inputs used for a given service or level of activity. However, *energy savings* is a broader concept that also includes consumption reduction through behaviour change or decreased economic activity (Oikonomou, 2009). This study will focus on energy savings in general, given that changing behaviour from one side and technology from the other are both key issues for public energy policy.

In the EU, the building stock is responsible for about 40% of the primary energy consumption and over 25% of the CO_2 emissions (Uihlein et al, 2010; WWF, 2010). In Spain, households and commercial buildings represent 17% and 10% of final energy consumption respectively (IDAE, 2010); however, there is a convergence trend towards EU levels of household energy demand (Mendiluce et al, 2010; Tarancon et al, 2007). According to Tarancon et al (2007), this convergence is due to the increase in the number of households, the large increase expected in the penetration of air conditioning devices and electric appliances in the residential and tertiary sectors, the low and decreasing electricity prices (low according to European standards), the ineffectiveness or non-existence of campaigns for the purchase of less energy-consuming electric domestic appliances (A and B classes) and the increased building of energy-intensive malls in urban and tourist areas.

This escalation in household energy demand is one of the reasons that has led Spanish energy intensity to increase since 1990, while the opposite happened in the EU15 (Mendiluce et al, 2010). Besides this convergence to EU levels of energy consumption, the global energy demand from buildings, both residential and commercial, has steadily increased in the past years (Pérez-Lombard, 2008; EC, 2010b). This trend will continue due to population growth, increasing demand for building services and comfort levels, together with the rise in time spent inside buildings (Pérez-Lombard, 2008). Therefore, improving energy efficiency in buildings is a prime objective for energy policy at regional, national and international levels.

Various EU policies are already in place to achieve the untapped energy savings in the sector, including the end-use efficiency & energy services directive (ESD, 2006/32/EC), the energy performance of buildings directive (EPBD: 2010/31/EU), the eco-design directive (2009/125/EC) and energy labelling directive (2010/30/EU), among others. Additionally, member states have submitted their second National Energy Efficiency Action Plans (e.g. Spanish NEEAP: IDAE, 2011), which describe the energy efficiency improvement measures that are aimed at achieving their savings targets. Furthermore, Spain has also put in place different instruments to improve energy efficiency in the built environment. These include the technical code for buildings (CTE: MF, 2006), the regulation on thermal installations in buildings (RITE: MITyC, 2006), the energy performance certification for new buildings (EPC: MITyC , 2007) and national housing and refurbishment plan (‘*Plan Estatal de Vivienda y Rehabilitación 2009-2012*’ – MF, 2008). However, WWF (2010) states that these measures are not enough to improve the achieve permanent and significant reductions in energy consumption in the built environment by 2020.

Even though the energy savings target is not binding, there is a link with the Effort Sharing Decision binding targets. According to Harmsen et al (2011), at the EU level the Effort Sharing Decision is not supportive to the energy savings target; however, in the Spanish case, the Effort Sharing Decision target is more ambitious than the energy savings target. Therefore, Spain needs to go beyond closing the energy savings gap to comply with its Effort Sharing Decision target, increasing the relevance of their national energy efficiency policy. Hence, given the energy savings potential existing in the built environment and the need to reach the 20% energy savings target, an evaluation of the existing policies for energy efficiency in this sector will provide valuable information for policy makers.

3. Objectives

Spain will not achieve its 20% energy savings target for 2020 unless an effective and coherent policy package is in place. Considering that a big part of the potential for energy savings lies in the building sector, this research aims at evaluating the effectiveness of the Spanish policy package for energy efficiency improvements in residential buildings. This will provide insights and recommendations for policy makers to improve the current policy setting in order to tap the unrealized energy savings potential in the sector.

3.1. Research scope

Energy efficiency is a broad topic since it applies across sectors. In order to limit the research, this report focuses on the built environment, given its high potential for energy savings. Furthermore, the focus is on the building envelope in the residential sector. Additionally, in order to be able to assess the coherence and strategic fit between the EU and Member State policies, Spain has been selected as the geographical focus.

3.2. Research questions

Main research question:

- To what degree is the Spanish energy efficiency policy package for residential buildings able to bridge the energy savings gap? And how can it be improved?

Sub research questions:

- What is the energy savings gap that is currently not addressed by the policy package in Spain?
- To what degree can the potential available in the residential sector play a role in bridging this gap?
- What are the existing EU and Spanish policies that aim to improve EE in residential buildings?
- What are the existing barriers for energy efficiency in residential buildings? And, its co-benefits?
- How does the policy package address these barriers? How does it benefit from opportunities?
- To what degree is the policy package effective and coherent? And, how could it be improved?

3.3. Deliverables

The deliverables that will result from this research consist of:

- Analysis of the energy savings gap in Spain.
- Diagram of the policy theory underlying the policy package.
- Assessment of the policy package explaining why it is being effective in attaining the energy savings goal for the residential building sector.
- List of recommendations to improve the policy package's effectiveness towards achieving the energy savings target.

3.4. Motivation

Energy saving is currently an important policy target at the EU level for a wide variety of reasons, centred in the fact that '*Energy efficiency is the most cost effective way to reduce emissions, improve energy security and competitiveness, make energy consumption more affordable for consumers as well as create employment…*' (EC, 2010). From an environmental perspective, energy efficiency will help tackle climate change by reducing GHG emissions and other pollutants; and it will automatically increase the share of renewable energy. On the other hand, from a political perspective it will increase the security of energy supply. Finally, from an economic point of view, energy efficiency will reduce energy imports as well as the consumer's energy bill.

However, the EU will only meet half of the 20% energy savings target set for 2020 (EC, 2011). Given that the highest potential for energy savings lies in the building sector, many of the policies will aim at tapping this unrealized potential. Therefore, an assessment of the existing policy package to promote energy efficiency in the building sector is essential in order to provide an overview of its coherence and effectiveness.

4. Research methodology

This research focuses on the assessment of the policy package in place to increase energy efficiency in the built environment in Spain. In order to achieve this, the research methodology provided in Figure 1 has been used. This research provides:

- **Descriptive knowledge:** Regarding the energy efficiency barriers, energy efficiency targets and policy instruments developed in order to achieve these goals. An overview of the EU and Spanish policies for EE improvements in the built environment is provided.
- **Assessment**: The identified policy package has been assessed using policy theory in order to evaluate to what extent it is effective towards the achievement of energy savings in the built environment. The evaluation considers policy interactions at the different levels (EU and Member State for Spain), and analyses how the policy package addresses the energy efficiency barriers and co-benefits.
- **Analysis**: The evaluation provides insights regarding the underlying factors that contribute to the policy package's expected effectiveness, as well as recommendations to increase this effectiveness.

4.1. Data collection

All the data that is necessary for answering the research question has been collected from literature. International scientific journals, reports and available policy documents at both the Spanish and EU levels have been used to collect up-to-date data for the policy assessment. To support the data from the literature review, interviews have been conducted with relevant actors in the Spanish built environment and energy efficiency sectors (See Annex 1).

4.2. Steps of the research

In order to answer the research questions, the work has been structured in two main approaches as shown in Figure 1. First, there is the gap analysis, where the Spanish residential sector is described and the energy savings gap and energy savings potentials are assessed. This is followed by the policy analysis, consisting in three mains steps: First, the relevant policy package is presented and classified, at both the EU and national levels; second, there is a stakeholder analysis and an overview of the existing barriers and drivers; and, finally, the policy assessment, which includes the policy theory reconstruction and assessment of selected criteria. A detailed explanation of the steps is provided in the following sections.

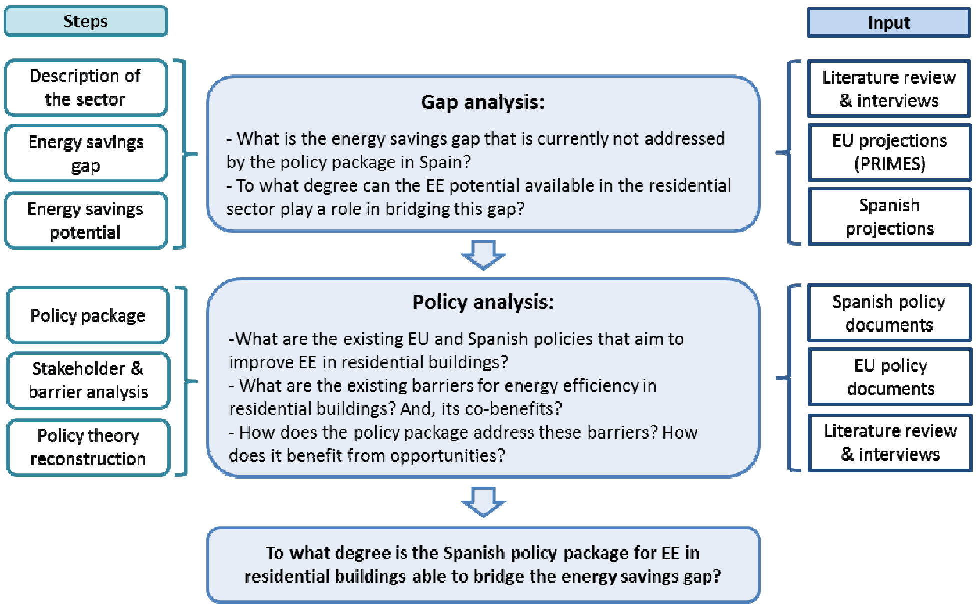


Figure 1: Diagram of the research methodology

4.2.1 Gap analysis

This chapter first provides a brief description of the residential sector in Spain; then, an assessment of the energy savings gap in Spain, at both economy level and sector level; and, finally, a review of the existing energy savings potential. The existing energy efficiency potential in residential buildings has been identified through a literature review including the Fraunhofer et al. (2009) study for the EU and the WWF (2010) report for Spain. A detailed description of the steps needed for the assessment of the energy savings gap is provided next.

Energy savings gap

An assessment of the energy savings gap (See Box 1) has been undertaken. This analysis provides insight regarding the need for additional policies targeted at energy efficiency in order to bridge this gap.

Box 1: Definition of the energy savings gap

The energy savings gap refers to the amount of additional energy savings needed in order to achieve the 20% energy savings target by 2020. It refers to the fact that the level of investment in energy efficiency and conservation measures does not reach the optimal levels, even though these measures are cost-effective and present environmental benefits (Linares et al, 2010; Gillingham et al, 2009). In other words, the gap is the proportion of energy efficiency improvement that is not realised (OECD/IEA, 2007). The existence of this gap is due to market barriers and to a lack of consideration of behavioural aspects (Linares et al, 2010; Gillingham et al, 2009; Jollands et al, 2010)

In order to assess this energy savings gap, the EU's target of 20% energy savings by 2020 has been considered as the optimal level of energy consumption. However, this target has been developed using the 2007 PRIMES baseline projections and, therefore, does not account for the economic crisis or the additional policies implemented afterwards. Furthermore, the gap analysis estimates to what extent current energy savings policies capture the potential, and compares it to the target. In order to identify the gap, both PRIMES and Spanish projections have been taken into account, as well as the effects of the recession and existing policies. Additionally, both sets of data have been compared and insights have been provided where significant differences have been found.

Data collection: This analysis has been carried out for the different sectors using the PRIMES 2007 and 2009 datasets (DG Energy, 2008; DG Energy, 2010), in order to assess the recession and new policies effects. Given the focus on the 2020 target and accuracy issues, only projections up to this date have been considered. Spanish data from the Indicative Energy Planning (MITyC, 2011), as well as from the first and second NEEAPs (MITyC and IDAE, 2007; MITyC and IDAE, 2010) have been included.

- **PRIMES data:** PRIMES is a modelling system that simulates a market equilibrium solution for energy supply and demand in the EU member states developed by the National Technical University of Athens (NTUA). This model is used as the official baseline scenario for the European Commission.
  The model is behavioural and price driven; it represents the available energy demand and supply technologies and pollution abatement technologies, as well as the considerations about market economics, industry structure, energy/environmental policies and regulation (NTUA, 2005). PRIMES is conceived for forecasting, scenario construction and policy impact analysis in different fields, including energy efficiency, in a medium to long-term horizon (NTUA, 2005). The current energy savings target for 2020 has been set using the 2007 baseline, therefore this and the 2009 baseline have been analysed.

- **Spanish data:** The main sources for the Spanish energy targets and projections are the Indicative Energy Planning (MITyC, 2011) and the second NEEAP (MITyC and IDAE, 2010). The Indicative Energy Planning considers the different policies in place, including both the NEEAP and REAP (MITyC and IDAE, 2010b). These indicative projections consider that all targets set in the policy documents will be met, unlike the PRIMES model. Therefore, there is no separation between the targets for 2020 and the national projections made by the government.

Primary energy consumption: Given that the 20% energy savings target is referred to primary energy consumption, and that the PRIMES sectorial data is given as final energy, electricity has been converted to primary energy using the efficiency factor for thermal electricity production from the PRIMES datasets (DG Energy, 2008; DG Energy, 2010). See Table 1 for the specific values used in the calculations. It is important to take into account that these conversion efficiencies are not fuel-to-electricity, but fuel-to-heat-and-electricity, so they are an overestimation of actual power efficiencies.

Table 1: Efficiency for thermal electricity production
Source: DG Energy, 2008; DG Energy, 2010

Source	2005	2010	2015	2020
PRIMES 2007	0.467	0.467	0.475	0.497
PRIMES 2009	0.467	0.451	0.456	0.460

Furthermore, to include and compare the Spanish data (MITyC and IDAE, 2010) with the PRIMES data and the 20% target, it also has to be in primary energy. However, the projections from the indicative energy planning (MITyC, 2011), used for the NEEAP, are presented in final energy and do not specify the amount of electricity used per sector. Therefore, the Spanish energy statistics (MITyC, 2010c) have been used as input to adjust the projections to primary energy consumption. The statistics provide the electricity share values (shown in Table 2), which multiplied by the total final energy provide the electricity consumption per sector. The shares from 2010 have also been used for the 2015 and 2020 Spanish projections.

Table 2: Electricity share in the different Spanish sectors
Source: MITyC, 2011c

Sector	2005	2010
Industry	25%	27%
Transport	1.19%	1.34%
Others	40%	46%

Correction for differences in historical data: The datasets have been corrected in case of statistical differences in the historical year of 2005 between the 2007 and 2009 datasets. In order to do this, the difference between the 2007 and 2009 projections for 2005 have been added or subtracted from the 2007 projections to have both coincide on the 2005 point.

Energy efficiency indicator: The basic assumption in this analysis is that the difference between PRIMES 2007 and PRIMES 2009 is fully explained by the new policies in place (which include the energy and climate package) and the recession. In order to separate this effects, a relevant activity indicator per sector is used (e.g. million Euros - MEUR). Afterwards, the energy efficiency ratio has been calculated as the (primary) energy use per activity indicator (e.g. toe/MEUR).

Determine the adjusted PRIMES 2009: PRIMES 2009 dataset can be adjusted using the 2007 efficiency ratio (considering the new policy effect) and the 2009 activity indicator (not considering the recession effect). The PRIMES 2009 adjusted with the activity indicator allows a clear separation between the recession and policy effects. (See example in Box 2).

Results: In order to compare the different projections with the targets, a graph has been made for the whole Spanish economy, and another for the residential building sector.

Box 2: Energy savings analysis - Example

- Data:

Sector:	X
Activity indicator:	Unit

PRIMES DATA 2007	2005	2010	2015	2020	
Final energy consumption	8174	9410	10160	12000	ktoe
Electricity	5847	6794	7382	7675	ktoe
Efficiency for thermal electricity production	0,467	0,467	0,475	0,497	%
Activity indicator	546	640	749	850	Unit
PRIMES DATA 2009	**2005**	**2010**	**2015**	**2020**	
Final energy consumption	8482	8617	9000	9500	ktoe
Electricity	5843	5944	6591	7150	ktoe
Efficiency for thermal electricity production	0,467	0,451	0,457	0,460	%
Activity indicator	546	600	700	800	Unit

- Primary energy (PE) = Final energy – Electricity + Electricity / Efficiency

Primary energy consumption	2005	2010	2015	2020	
PRIMES 2007	14847	17164	18319	19767	ktoe
PRIMES 2009	15152	15853	16831	17894	ktoe

- Historical Correction = PE_{2005} (2007) + [PE_{2005} (2009) – PE_{2005} (2009)]

Primary energy consumption - Corrected	2005	2010	2015	2020	
Historical correction	304				
PRIMES $2007_{corrected}$	15152	17469	18624	20072	ktoe

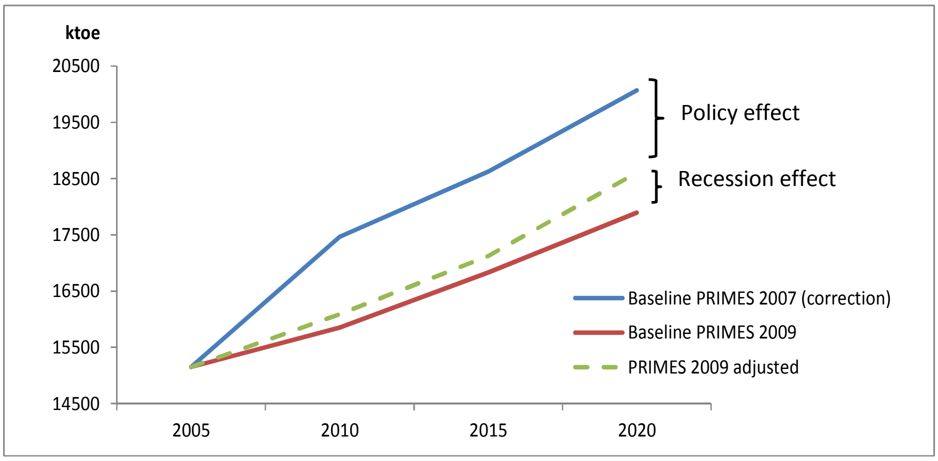
- Energy Efficiency indicator = Primary energy / Activity indicator

EE indicator	2005	2010	2015	2020	
PRIMES 2007	27	27	24	23	ktoe/Unit
PRIMES 2009	28	26	24	22	ktoe/Unit

- Adjusted PRIMES 2009 = EE indicator (2007) x Activity (2009)

	2005	2010	2015	2020	
PRIMES 2009 (adjusted)	14859	16089	17126	18605	ktoe

- Results:



4.2.2 EE policy package

This step consisted on defining and classifying, through a review of the available policy documents, the policy package to be assessed. The package includes all policy instruments that aim at improving energy efficiency in residential buildings, both from Spain and the EU.

Review of energy efficiency of policies: Spanish and EU documents have been revised in order to select the policy instruments under evaluation, according to the definition provided in Box 3. Given the continuous changes in energy efficiency policy over the last years, as well as the introduction of new instruments, this research does not focus on an ex-ante or ex-post evaluation, but on the evaluation of recently introduced policy instruments (Box 3).

Box 3: Policy instruments

Definition of policy instruments: *It is important to state that there is no standard definition for policy instruments. According to Vedung (1998), policy instruments can be understood as the set of techniques by which government authorities wield their power in attempting to ensure support and affect or prevent social change. The World Energy Council (2004) defines energy efficiency policy as all public interventions aiming at improving energy efficiency of a country, through adequate pricing, institutional setting regulations and economic or fiscal instruments.*

Recently introduced policy instruments (RIPIs): *According to Kautto et al (2005), policy instruments are 'recent' when, due to the short implementation period, they have only produced a small proportion of their outcomes. According to Mickwits (2003), RIPI evaluation differs from traditional ex post evaluation because outcomes and unanticipated effects are mostly unavailable, but there are often some implementation practices and underlying assumptions that can be empirically tested based on the available experiences. Additionally, RIPI evaluations are considered especially important because it is often easier to change an instrument before it has a long implementation history (Mickwits, 2003; Kautto et al, 2005). Given the lack of information availability, Kautto et al (2005) propose the use of policy theory to support their evaluation.*

Classification of policies: In order to better understand and assess the policy package, the policy instruments have been classified according to Vedung (1998). The main types of policy instruments, based on the degree of authoritative force, are: regulation, economic instruments and information. Regulations aim at modification of the set of options open to agents, generally by requiring performance of pre-defined standards or by commanding particular behaviours; economic policy instruments aim at altering the benefits and/or costs of the agents in order to encourage actors to implement more investments in energy efficiency; and, finally, information aims at shifting the priorities agents attached to certain issues by building awareness and managing demand (Mickwits, 2003; IEA, 2008). Some authors include additional categories such as voluntary instruments (Koeppel et al, 2007; IEA, 2008); and, organisational instruments (Klinckenberg et al, 2006). However, this research considers the classification of policy instruments aimed at energy efficiency improvements in residential buildings as presented in Table 3. Some instruments can fit two categories at the same time (e.g. Mandatory labelling is both regulation and information).

Table 3: Classification of policy instruments for energy efficiency in buildings Source: Adapted from IEA (2008), Koeppel et al (2007) and Klinckenberg et al (2006)

Type		Instrument examples
Regulation		Appliance and equipment standards
		Building codes and standards
		Energy efficiency obligations
		Mandatory audit and certification programmes
		Voluntary and negotiated energy conservation agreements
Economic	Market based	EE / White certificate schemes
		Kyoto flexibility mechanisms
		Cooperative procurement
	Fiscal	Energy or carbon taxes / Tax exemptions and reductions
		Capital subsidies, grants, subsidized and preferential loans
Information		Certification & labelling
		Awareness raising, education, information campaigns
		Public leadership programmes
		Building energy performance audits
		Detailed billing and disclosure programmes
		RDI activities and demonstration projects
		Technical assistance (TA) & training

4.2.3 Policy analysis

The policy assessment includes a sector analysis, which comprises a stakeholder analysis and an overview of the barriers to energy efficiency, as well as its drivers and co-benefits. Additionally, it provides the policy theory reconstruction and the policy assessment through selected criteria.

Sector analysis: The sector analysis comprises a stakeholder analysis and an overview of the barriers to energy efficiency in the residential sector. The existing barriers to the adoption of energy efficiency measures, as well as the co-benefits of energy efficiency, have been identified through a literature review. Additionally, interviews with relevant actors have been conducted to support these findings.

Policy theory reconstruction: In order to evaluate the policy package, policy theory has been used (See Box 4). Kautto (2005) proposes policy theory reconstruction, presented by Leeuw (2003), as the most useful for RIPIs evaluations. Policy theory reconstruction, along the guidelines of Hoogerwerf (1990) and Crabbe and Leroy (2008), allows the investigation of the assumptions and rationale behind the policy package. According to Hoogerwerf (1990), the effectiveness of the policy package largely depends on the validity of these relations given that incorrect assumptions can lead to policy failure. Therefore, a careful assessment of the underlying argumentation and assumptions (in the form of causal-, final- and normative relations) that are the reasoning behind the policies, is required.

Box 4: Policy theory

Policy theory allows the assessment of a policy package, providing relevant insight regarding its expected outcomes and effects by assessing the formulation of objectives and how well the policy instruments correspond to the objectives, as well as the underlying assumptions and links behind a policy package. According to Mickwits (2003), policy or intervention theory is a model of the causal relations that lead to a policy's ultimate outcome, on the basis of the detailed assumptions of how the policy intervention is supposed to work. Kautto et al (2005) state that policy theory can be useful for the evaluation of RIPIs. Given that evidence of final outcomes is unavailable, an intervention theory is a useful tool to overcome the lack of information and aid the use of different criteria in a meaningful way (Kautto et al, 2005).

The role of policy theory is to describe how the policy is intended to be implemented and function, and to be used as a guide for the evaluation of how the intervention has actually been implemented and what effects it has had in practice (Mickwits, 2003; Kautto et al, 2005). To predict the chances of success of the policy instruments, policy theory aims to provide insights into the opportunities, threats and insecurities that are expected to occur during the implementation of the policy. Policy theories generally consist of expectations regarding the following elements and their causal links: Actors (including agencies implementing the instrument, as well as the target groups), inputs, outputs and outcomes (immediate, intermediate and ultimate outcomes)[2].

Leeuw (2003) and Khan et al (2006) described the methodology for theory-based policy evaluation and the reconstruction of the underlying, and often implicit, policy theory. The main steps, followed in this research, are:

- **Identify** the behavioural mechanisms expected to solve the problem, as a result of the implementation of the policy instruments.
- **Link** this mechanisms with the goals of the policy instruments.
- **Evaluate** the validity of these links considering their logical consistency and the extent to which the theory focuses on variables that can be 'steered' through policy programmes.

In this research the policy reconstruction has been presented in a cognitive map, where concepts are treated as variables, and causal assumptions are treated as relations between the variables. These relations are the arrows connecting the concepts, and they have either a positive or negative sign, for positive or negative causal relations respectively. This reconstruction helps identify the goals and instruments and their correspondence with each other. Furthermore, it serves as input for the analysis regarding the selected criteria, and for the assessment regarding which barriers are addressed and to what degree.

[2] By outputs we mean items (e.g. permits, taxes) that are issued by government bodies and interface with the target group (e.g. permit holders). Outcomes are the actions taken by the target group when they encounter the outputs, but also what occurs after that in the chain of influence. Outcomes can be immediate (e.g. measures taken by a holder of a permit due to permit conditions), intermediate (e.g. reduction of emissions, demand for environmental technology) and ultimate (e.g. improved quality of the environment, impact on employment)'. (Kautto et al, 2005)

According to Kautto et al (2005), the evaluation of the validity of the propositions might be problematic due to the lack of data on outcomes; however, comparisons with earlier research and lessons learned in other evaluations provide further insight. It is also important to take into account that a main weakness of the approach is that the social and behavioural dynamics involved are not taken into account (Leeuw, 2003).

Assessment of the policy package using the selected criteria: According to Huitema et al (2011), the most common policy evaluation criteria are effectiveness and goal attainment, efficiency, cost-effectiveness, legitimacy, fairness, legal acceptability, and coordination with other policies (See Table 4 for more detail).

Table 4: Criteria for the evaluation of the policy instruments
Source: Adapted from Mickwits (2003), Koeppel et al (2007), Konidari (2007) and Huitema et al (2011)

Aspect	Criteria	Related questions
General	Relevance	To what extent are the objectives of the instrument appropriate regarding the needs perceived and the problem the intervention is meant to solve?
	Impact	Is it possible to identify impacts that are clearly due to the policy instruments and their implementation?
	Effectiveness	To what degree do the achieved outcomes correspond to the intended goals of the policy instrument? (Direct contribution to energy savings.)
	Sustainability	Will the policy instruments have a lasting effect on the state of the environment? Are there rebound effects?
	Indirect effects	What are the externalities due to the implementation of the policy instrument? E.g. emission reductions, improved air quality, etc.
	Flexibility	Can the policy instrument cope with changing conditions?
Economic	Cost-benefit	How much of a given benefit is delivered per unit of expenditure? What is the cost of each measure (e.g. in EUR/energy saved)?
	Cost-effectiveness	Could the results have been achieved with fewer resources? (Benefits are not valued in monetary terms)
Democracy related	Legitimacy	To what degree do individuals/organizations accept the policy instrument?
	Equity	How are the outcomes and costs of the policy instrument distributed? Are there 'windfall profits' or 'free riders' because of the policies? Do all participants have equal opportunities to take part in and influence the processes?
	Transparency	To what degree are the outputs and outcomes of the policy instrument, as well as the processes, observable for outsiders?
Others	Coordination	Is the policy coordinated well with other existing policies? Are there synergistic effects that increase or compromise overall effectiveness?
	Implementation capacity	Is there enough trained personnel and technological infrastructure for the implementation of the policy measures?
	Success factors	What are the success factors that determine the effectiveness of the instrument?

However, this research does not cover all criteria. Even though cost-benefit and cost-effectiveness are very relevant to the assessment of energy efficiency measures, there is a lack of available data for the scope of this research regarding the actual cost (EUR/energy saved) and co-benefits (and other indirect effects) due to the energy efficiency measures. Furthermore, the direct impact analysis is impossible for the evaluation of RIPIs, given that the outcomes have not occurred (Kautto et al, 2005).

The criteria: ‘Relevance’, ‘Effectiveness’ and ‘Legitimacy’ has been assessed for each policy instrument, using qualitative grades (‘High’, ‘Medium’ and ‘Low’). Additionally, a qualitative analysis has been carried out for the policy package as a whole regarding ‘Transparency’, ‘Equity’, ‘Sustainability’, ‘Implementation capacity’ and ‘Coordination’.

Lessons learned and recommendations: Recommendations and further insight regarding obstacles and opportunities to increase the effectiveness of the policy package has been provided.

CHAPTER II: GAP ANALYSIS

This chapter provides a characterization of the Spanish residential sector which is the focus of this research, as well as a brief description of the housing bubble that took place in Spain during the period of 1998-2006 and its effects. Section 2 analyses the energy savings gap at the economy-wide level for Spain comparing the EU and Spanish projections. The energy savings gap refers to the amount of additional energy savings needed in order to achieve the 20% energy savings target. However, these can only be achieved with an improved policy package. Finally, section 3 highlights the large potential available in the residential sector to bridge this gap.

1. Description of the Spanish residential sector

The importance of the building sector, for energy and environmental policies, arises from the fact that they constitute a 'stock' of future energy consumption and emissions (Gago et al, 2012). 44% of existing buildings in Spain are from before 1980[3] (IDAE and Eurostat, 2011), and, therefore are likely to have lower energy efficiency than modern buildings. If the lack of new construction due to the collapse of the sector is taken into account, it is clear that the retrofitting of existing buildings should be the focus of available policies.

Dwellings have particular characteristics that differentiate them from other sectors: they are long-lived and costly assets, and many agents are usually involved in this market. There are differences between new and existing buildings, and between single unit houses and multi-property houses. All these factors, as well as their interaction with geographic and climatic variation, are very relevant for the design, implementation and evaluation of policies (Gago et al, 2012). Spain has 3 500 million square meters built, of which 85% is residential buildings (WWF, 2010) which account for 17% of the Spanish final energy consumption and 25% of the electricity demand (IDAE and Eurostat, 2011). Figure 2 presents the energy consumption per household in Spain since 1990 and the split of the energy demand per use for 2009. There is a clear increase of about 50% in total energy demand per household up to 2006, due to the increase in household income and their comfort requirements (IDAE and Eurostat, 2011). This was followed by a decline mainly caused by the crisis and warmer winters, but not due to energy efficiency (WWF, 2010). The main driver for the increase in energy demand is the use of electric appliances. This indicator increased steeply in Spain until 2006, while the rest of the EU restrained its electric consumption (WWF, 2010).

[3] There is diverging information in this respect. According to the Ministry of Public Works, Spain has over 25 million households, of which over 14 million are from before 1980 (MF, 2011). This represents 56%, against the 44% stated by IDAE and Eurostat (2011).

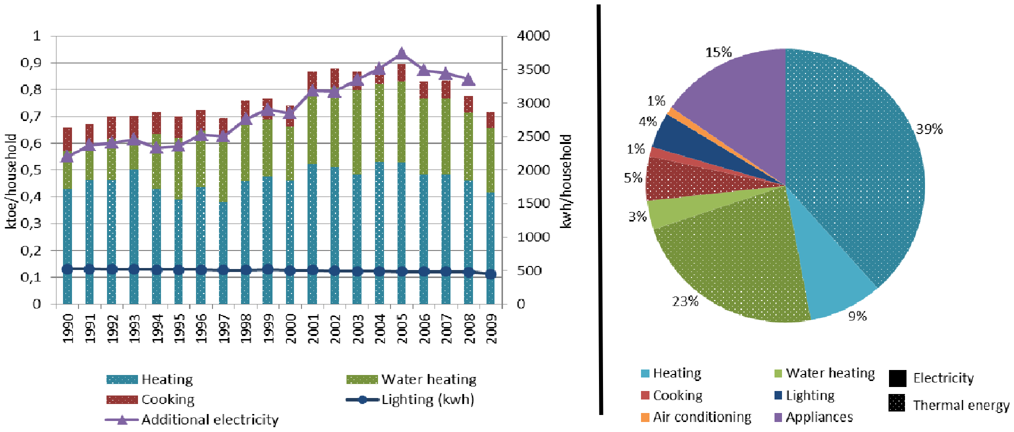


Figure 2: Energy consumption per household in Spain
Source: Adapted from IDAE (2011 and 2010)

Detailed information regarding the Spanish residential sector is presented in Table 5. The amount of dwellings in Spain is 25 million and its current rate of refurbishment is 0.47% per year (MF, 2011). However, the weight of refurbishments (as share of the total activity in the construction sector) in Spain is 15 points behind the EU average, which is the basis for the target of 35% of sector activity for refurbishments by 2020 (MF, 2011).

Table 5: Characterization of the Spanish residential sector
Source: Adapted from IDAE and Eurostat, 2011

		Blocks	Single unit	Average
Type of household		70%	30%	-
Energy consumption		0.652 toe	1.318 toe	0.852 toe
Property regime	Owned	90%	98%	92%
	Rental	10%	2%	8%
Surface		86.5 m^2	140.2 m^2	102.4 m^2
People		-	-	2.7
Age	<1979	49%	33%	44%
	1980-2005	46%	58%	49%
	>2005	6%	9%	7%

There are different factors that have significant impacts on the energy consumption and on the implementation of energy efficiency measures. Among them, it is interesting to highlight that 70% of the households are block buildings and that there is a very small rental sector (8% of the households) with home ownership being the norm (Conefrey et al, 2010). Additionally, almost a third of the total stock is holiday homes or vacant dwellings which represent a high proportion of the buildings constructed in recent years (Conefrey, 2010).

Furthermore, half of the Spanish households have one or two members; and only 9% has more than 5 members. It is also interesting to note that single unit buildings consume twice more than block apartments. Besides the type of building and the amount of family members of each household, the climatic region also has an important effect on the energy consumption; especially due to HVAC systems. In average, heating accounts for 47% while air conditioning accounts for 19% of the energy demand (IDAE and Eurostat, 2011), and is also the main source of household energy expenditure (Labandeira et al, 2011).

The housing bubble in Spain

Currently, due to the burst of the latest housing bubble and the Euro crisis, the construction sector has collapsed (Fundación Entorno, 2010). There have been three major housing bubbles in Spain's history during the past half century: 1969–1974, 1986–1992 and 1998–2006 (González Pérez, 2010). According to González Pérez (2010), they all appeared within favourable political and economic settings: the Spanish developmental of the 1960s; the entry into the European Economic Community in 1986; and, the Economic and Monetary Union (EMU) and the adoption of the euro as the common currency in 1999. Furthermore, the three bubbles led to the same disastrous consequences for the Spanish economy: housing oversupply, a pronounced foreign deficit, soaring housing prices, and their subsequent fall (González Pérez, 2010; Conefrey et al, 2010).

Because of its potential for residential tourism, Spain was a magnet for global speculators, which led it to become the EU country with the most dwellings per thousand inhabitants, the most empty houses, and the most second homes (González Pérez, 2010). In the period from 2001 to 2008, the average growth rate was of 585 064 dwellings per year (13 000 new dwellings per million inhabitants); while in most of the EU countries it was 5 000 new dwellings per million inhabitants (WWF, 2010). The construction sector steadily increased its share of the Spanish GDP, from 6.9% in 1995 to a high of 10.8% in 2006 (González Pérez, 2010). However, the collapse of the real estate bubble in 2007 plunged the housing market into the longest and most intense recession in the country's recent history.

During the bubble there was a shift of resources towards the building and construction sector, including a dramatic increase in the labour force employed in the sector (Conefrey, 2010). Even though a significant part of the additional labour force came from immigration, there was also a major impact on the domestic labour market. This development would not have been very serious if the reallocation of resources had been permanent; however, it was temporary due to a catching up in the stock of dwellings. Therefore, the collapse in housing output in Spain is releasing major resources, especially labour, resulting in a very rapid rise in the unemployment rate (Conefrey et al, 2010), which has risen up to over 20% (OECD, 2011).

2. Analysis of the energy savings gap in Spain

The energy savings gap refers to the amount of additional energy savings needed in order to achieve the 20% energy savings target. In other words, the proportion of energy efficiency improvement that is not realised (OECD/IEA, 2007). This section aims to assess this energy savings gap in Spain using the PRIMES and Spanish projections, comparing them with the targets set by the EU and the Spanish government.

The measures in the 2nd Spanish NEEAP aim to provide a final energy saving of 17,8 Mtoe in 2020 and a primary energy saving of 35,6 Mtoe calculated with reference to 2007. This is comparable to the 20% indicative target of 34,4 Mtoe primary energy saving, also calculated with reference to the PRIMES 2007 projection.

2.1. Data collection

A summary of the data used for the analysis is presented in Table 6. The main data collected is the energy consumption and activity indicators (AI) per sector. Additionally, for the Spanish data, the BAU scenario has been defined as the Spanish projection plus the savings considered by the NEEAP.

Table 6: Collected data for Spain for the whole economy and the residential sectors
Source: DG Energy, 2008; DG Energy, 2010; MITyC and IDAE, 2010; INE, 2010

Spanish economy		2005	2010	2015	2020	
PRIMES 2007	Primary energy consumption	144	157	168	172	Mtoe
	AI: GDP	906	1065	1242	1411	in 000 MEUR05
PRIMES 2009	Primary energy consumption	145	142	154	164	Mtoe
	AI: GDP	909	949	1099	1285	in 000 MEUR05
Spanish projections 2010	Primary energy consumption	145	132	138	143	Mtoe
	Primary energy savings		11		36	Mtoe
Residential		**2005**	**2010**	**2015**	**2020**	
PRIMES 2007	Final energy consumption	15150	16865	17666	17768	ktoe
	Electricity	5488	6592	7143	7415	ktoe
	AI: Income	550056	641555	742298	837123	MEUR 05
	AI: Population	43	44	45	46	m inhabitants
PRIMES 2009	Final energy consumption	15168	16074	17586	17976	ktoe
	Electricity	5488	5766	6687	7490	ktoe
	AI: Income	525124	538469	619579	701356	MEUR 05
	AI: Population	43	47	49	51	m inhabitants
Spanish projections 2010	AI: Population	43	46	47	47	m inhabitants

A significant difference is observed in the Spanish population projections from PRIMES 2007 and 2009. PRIMES 2007 projected 46 million inhabitants by 2020, while PRIMES 2009 projected 51 million and the Spanish National Institute of Statistics (INE, 2010) projected 47 million. This overestimation of the Spanish population from PRIMES 2009 could be due to the fact that during the first decade of the millennia, the Spanish population increased by 5.9 million while it is expected that during 2010-2019 the increase would be of only 1.2 million (INE, 2010). In any case, this proved to have significant effects in the estimation of the energy consumption in the residential sector, and also in the 'Others' sector (the sum of residential, tertiary and agriculture). Therefore, an additional adjustment of the PRIMES 2009 projections was made considering the PRIMES 2007 population.

2.2. Primary energy consumption

Given that the 20% energy savings target is referred to primary energy consumption, the final energy consumption has been converted to primary energy. This has been done by first obtaining the amount of electricity used, directly from the PRIMES datasets or using Table 2 for the Spanish projections. The electricity has been converted to primary energy with the efficiency factor for thermal electricity production from the PRIMES datasets (See Table 1 for the specific values used in the calculations). The total energy consumption is then recalculated and the results are presented in Table 7.

Table 7: Primary energy consumption

Sector		2005	2010	2015	2020	Unit
Residential	PRIMES 2007	21414	24388	25561	25272	ktoe
Residential	PRIMES 2009	21432	23093	25531	26769	ktoe

2.3. Energy efficiency indicators

The energy efficiency ratio is calculated as the (primary) energy use per activity indicator. Results are presented in Table 8. Energy efficiency would be expected to improve along time and with the latest projections (e.g. EE is better in 2020 than in 2010, and EE is better in the 2009 projection than in the 2007 projection).

Table 8: Energy efficiency indicators

Sector		2005	2010	2015	2020	Unit
Spanish economy	PRIMES 2007	159	147	135	122	ktoe/MEUR
	PRIMES 2009	159	150	140	127	ktoe/MEUR
Residential (AI: MEUR)	PRIMES 2007	0,039	0,038	0,034	0,030	ktoe/MEUR
	PRIMES 2009	0,041	0,043	0,041	0,038	ktoe/MEUR
Residential (AI: population)	PRIMES 2007	497	549	565	555	ktoe/M hab
	PRIMES 2009	498	495	517	524	ktoe/M hab

It is interesting to observe that energy efficiency trends in the 2009 projection are worse than in the 2007 projection when considering the GDP or income as indicators. This could be related to the effects of the recession. However, the opposite occurs when using population as the activity indicator. Furthermore, in this case, energy efficiency is also decreasing over time. This is due to the convergence towards EU levels of household energy demand (Mendiluce et al, 2010; Tarancon et al, 2007). This is connected to the increasing demand for building services and comfort levels (including the large increase expected in the penetration of HVAC systems and other electric appliances), together with the rise in time spent inside buildings (Pérez-Lombard, 2008; Tarancon et al, 2007).

Given this difference in the population projections an additional adjustment to the PRIMES 2009 baseline was made. Table 9 shows the results of multiplying the PRIMES 2009 energy efficiency indicators by the PRIMES 2007 population projection.

Table 9: PRIMES 2009 adjusted to population

	2005	2010	2015	2020	Unit
Residential sector	21436	21985	23403	23862	Ktoe

2.4. Results

An analysis of the PRIMES database for 2007 and 2009 in Spain has been conducted. The main assumption is that the differences between both datasets are due to the new policies introduced and to the economic recession. Furthermore, the projections and historical numbers from the Spanish NEEAP are also taken into consideration.

2.4.1 Spanish economy

Figure 3 shows the Spanish and EU energy consumption projections for Spain from 2005 to 2010, together with the 20% energy savings target. This 20% indicative target for primary energy savings is calculated as 20% of the PRIMES 2007 projection for 2020, equivalent to 34Mtoe. On the other hand, the Spanish projection 2010 assumes the achievement of the target set in the NEEAP of a 2% improvement in energy intensity per year. Nonetheless, there is a gap of 5Mtoe between these targets.

The PRIMES 2007 baseline is comparable to the Spanish BAU scenario; while the trend in the Spanish projection is similar to that on the PRIMES 2009 baseline. This trends seem sensible due to the fact that PRIMES 2007 and BAU do not account for the energy efficiency policies in Spain, while PRIMES 2009 and the Spanish projection consider the NEEAP and its effects. However, the Spanish projections assume a higher policy effect compared to PRIMES 2009 after 2010.

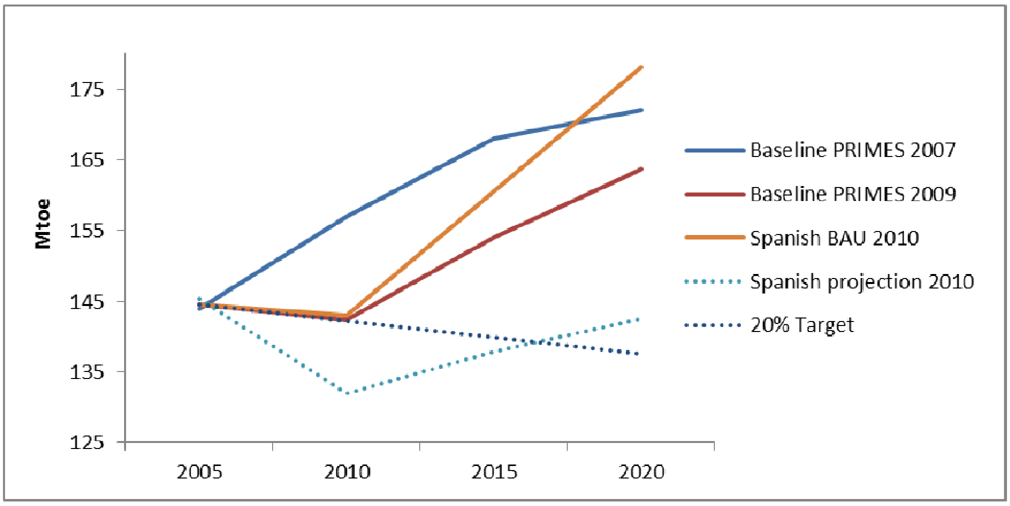


Figure 3: Primary energy demand for Spain

2.4.2 Residential sector

Figure 4 shows the primary energy demand for the residential sector. No analysis can be properly made for given the changes in the PRIMES projections. In addition, there is no available sector data for Spain which prevents comparisons at this level. However, the adjusted PRIMES 2009 baseline considering the PRIMES 2007 population projection (which is closer to the Spanish estimations) accounts for a 3Mtoe overestimation. This implies that the energy savings gap is actually overestimated in 3Mtoe.

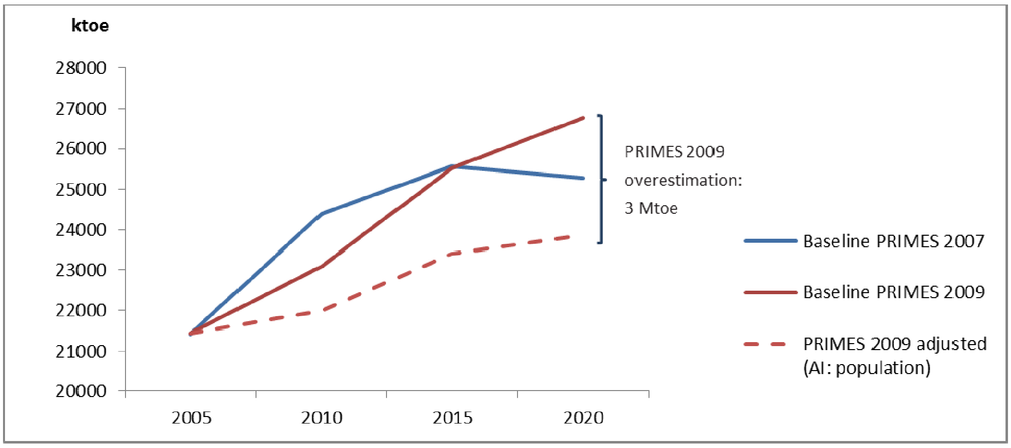


Figure 4: Primary energy consumption for residential sector

However, the results obtained using the methodology proposed in CHAPTER I:4.2.1 do not provide the expected explanation of a partial policy effect and a partial recession effect between PRIMES 2007 and 2009. This is mainly due to the big differences in the datasets, such as the projections for population which are significantly higher in 2009. These differences in the 2007 and 2009 projections have further implications, given that the 20% target has been set according to the 2007 dataset.

3. Energy savings potential in the residential sector

According to McKinsey's Global GHG abatement cost curve (2009b), not only there is large potential for energy savings in buildings, these measures are usually ranked among the most cost-effective to reduce energy consumption. Different studies have focused in assessing the energy savings potential in buildings at the EU and Spanish levels (See Fraunhofer et al, 2009; Wesselink et al, 2011; Economics for Energy, 2011; WWF, 2010; McKinsey, 2009b). Furthermore, other studies have explained in detail the available options and energy efficiency measures needed to achieve those potentials (See Levine et al, 2007; Enerbuilding, 2007). According to Gago et al (2012), most of these energy efficiency measures in buildings are already mature, as they have been widely studied and applied, and many possibilities are already available in the market. However, there is a crucial distinction between new and existing buildings when implementing energy efficiency measures. Some measures are likely to be cheaper and with a higher potential in new buildings; while others are only applicable to new buildings.

3.1. EU-wide study on energy saving potentials

The Fraunhofer Institute (2009) conducted the most comprehensive EU-wide study on energy savings potential. This study assessed the energy savings potential for end-use sectors in the EU Member States using the MURE (Mesures d'Utilisation Rationnelle de l'Énergie) simulation tool. It is based on the economic drivers such as defined by the 2007 EU Baseline Scenario (DG Energy, 2008). The energy savings potential identified by the Fraunhofer study is the savings potential that can be realized beyond the 2007 EU Baseline Scenario in the period 2005 to 2020. The results from the Fraunhofer (2009) study were used for the 'Energy savings 2020' report (Wesselink et al, 2011). Wesselink et al (2011) argue that the High Policy Intensity (HPI) Scenario of the Fraunhofer study fits best with the 20% energy savings ambition of the European Commission. The HPI scenario assumes a major policy effort to overcome energy efficiency barriers and includes energy efficiency measures that are cost-effective from an end-user perspective.

Figure 5 shows the HPI energy savings potential such as identified by Fraunhofer (2009) to be realized from 2005 until the target year 2020. Transport provides the highest energy savings potential, followed by households, industry and the tertiary sector (commercial and public services). While in the residential sector, most of the available potential belongs to heating in new buildings, followed by heating in new buildings, water heating and electrical appliances.

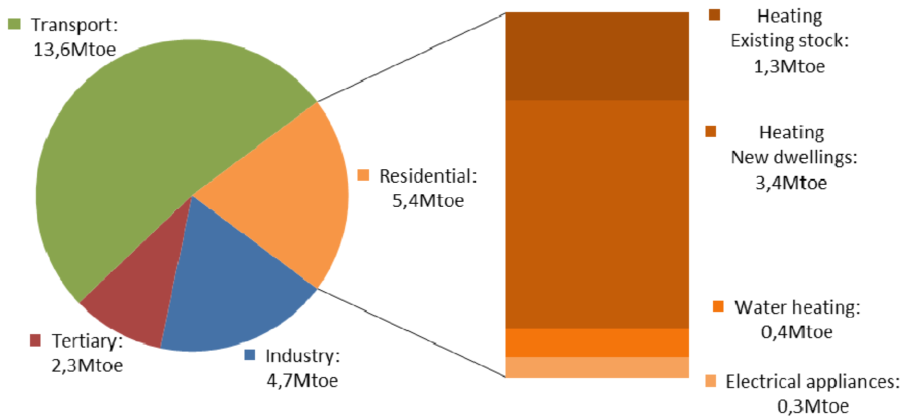


Figure 5: Energy savings potential in Spain by 2020 – HPI scenario
Source: Adapted from Fraunhofer Institute (2009) cited by Wesselink et al (2011)

However, the ktoe figures should be carefully interpreted. The Fraunhofer study used 2005 as the base year and assumed uptake of additional policy measures which have actually been delayed or implemented in weaker form than needed to realize the potential. These delays in the past 7 years have postponed the implementation of the potential. On the other hand, this study does not take into account the impact of the economic recession of 2008/2009. The lower level of energy consumption being the result of the recession means that the energy savings potentials are also lower.

It is interesting to see that most of the potential in the residential sector is heating in new buildings, given the collapse of the building industry. This is significantly contradictory with other studies such as the one by WWF (2010) which states that most of the potential is in reducing the heating demand of existing buildings. An explanation for this could be the fact that in the baseline, the construction trend of the early 2000s was maintained. This would imply an increased amount of new houses in the coming periods and, therefore, an increased potential for energy savings in the new houses. Another explanation would be the base years used for each study. WWF (2010) uses 2008 as base year; while Fraunhofer (2009) uses 2005 as base year including the whole construction boom and, overall, a longer analysis period from 2005 to 2020.

3.2. Spanish studies on energy saving potentials

Economics for Energy (2011) developed a study of the economic potential for the reduction of the Spanish energy demand by 2030. This study calculated the expected energy savings for the on-going policy trend (including for instance the NEEAP and REAP) in their trend scenario. This scenario provides energy savings of 36Mtoe by 2030. The policy scenario provides the additional energy savings potential that would result if there are further policy efforts and a higher political commitment to promote the most energy efficient technologies. This scenario provides 20Mtoe of energy savings in addition to the already expected 36Mtoe due to the existing policy trend. The expected energy savings from both the trend and policy scenarios are shown in Figure 6. The highest potential lies in the generation sector, followed by transport and residential buildings.

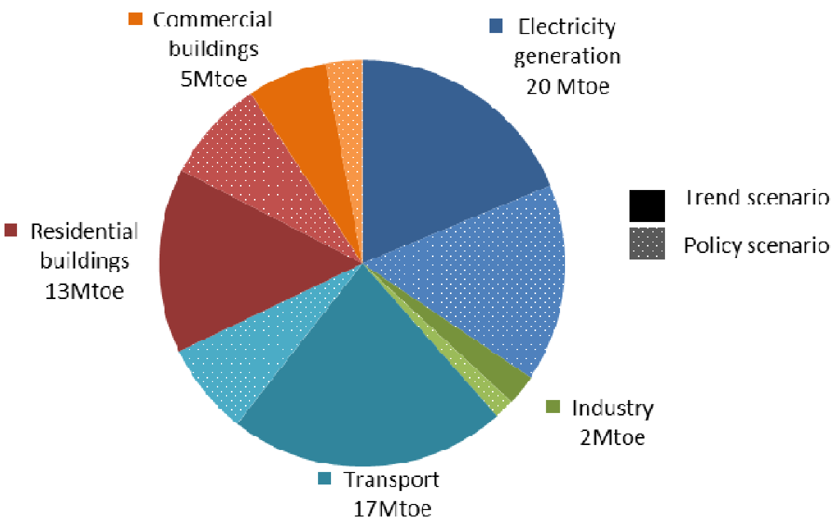


Figure 6: Distribution of the energy savings potential per sector in Spain by 2030 – Trend scenario
Source: Adapted from Economics for Energy (2011)

The detailed potential for the residential sector, according to the Economics for Energy report (2011) is presented in Figure 7. The overall potential of the residential sector, if additional policy efforts are undertaken, is of 13Mtoe by 2030. A large part of this is due to the increased use of efficient and regular heat pumps, solar water heaters and condensed gas heaters. Heat pumps and condensed gas heaters explain a large part of the potential grouped under 'others' in the trend scenario in Figure 7.

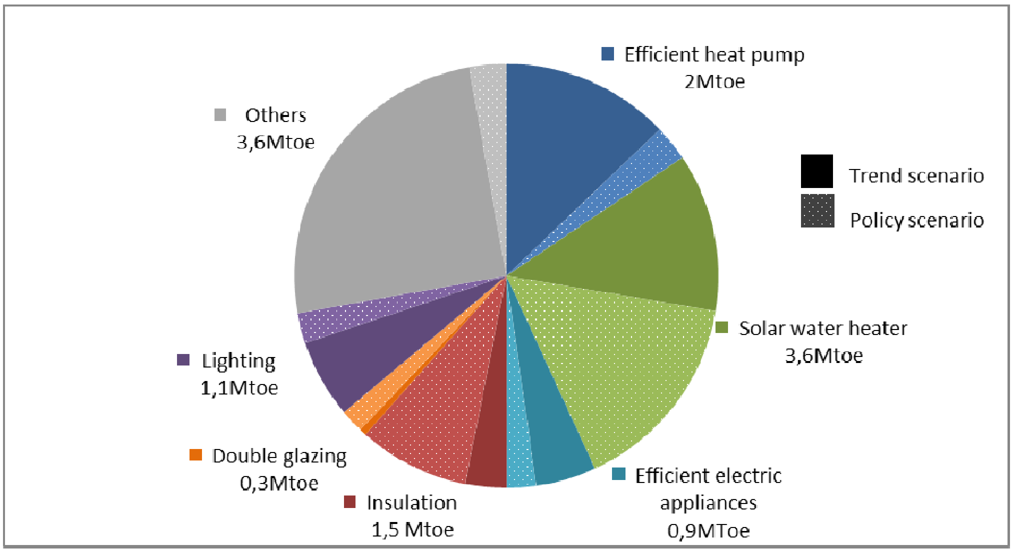


Figure 7: Potential for the reduction of energy demand in the Spanish residential building sector in 2030
Source: Adapted from Economics for Energy (2011)

WWF Spain (2010) developed a bottom-up study to assess the energy savings potential of the existing households in Spain. Furthermore, the WWF study (2012) reinforces those results and analyses the challenges and funding opportunities to achieve the existing potential. The 2010 study considered different measures for energy savings including insulation, renewal of appliances, inclusion of renewable energy and a combination of them. The results showed that a household's energy consumption can be decreased by 80% if comprehensive energy efficiency measures are undertaken. Furthermore, it concludes that a 30% energy consumption reduction (around 4.5 Mtoe) in existing buildings by 2020 (compared to 2008) is technically and economically feasible. However, the current refurbishment rate of 0.47% should be significantly increased to between 2% and 4%. The study emphasizes the need to increase the investment in refurbishment, which only represented 19% of the total investment in the construction sector during 2009, compared to 43% for the EU.

4. Analysis and conclusions

This chapter has presented a characterization of the residential building sector in Spain and its potential, as well as the existing energy savings gap. The main findings from the sector description showed that the residential building sector in Spain has collapsed due to the burst of the housing bubble. This has had a significant impact in the labour market. In addition, given that the bubble took place between 1998 and 2006, these new buildings do not comply with the latest building code which was established just after the bubble burst. Therefore, this and the fact that 44% of the buildings are from before 1980, when there was no regulation, implies that existing buildings have the biggest potential for energy efficiency improvement. Hence, current policy should focus on building refurbishments rather than new construction.

The gap analysis, on the other hand, showed that there is a 26Mtoe energy savings gap economy wide according to the PRIMES projections. And, the residential building sector seems to have an energy savings potential of around 5Mtoe in 2020 to help bridge this gap. Further analysis regarding the energy savings gap and the existing potential in the residential sector is presented in the following subsections.

4.1. The Spanish energy savings gap

It was not possible to assess the effect of the recession or new implemented policies, mainly due to the poor data quality and the big changes between the PRIMES 2007 and PRIMES 2009. A clear example of these changes is the projected population for Spain. PRIMES 2007 projected 46 million inhabitants by 2020, while PRIMES 2009 projected 51 million and the Spanish National Institute of Statistics (INE, 2010) projected 47.2 million. This difference in the population projection leads to an overestimation of the energy consumption by 2020 of 3Mtoe in the residential sector.

Nonetheless, an overall analysis regarding the energy savings gap was still performed. According to the PRIMES 2009, current energy efficiency policy will not be able to achieve the 20% energy savings target by 2020 in Spain, leading to an energy savings gap of 26 Mtoe. This means that the only 8Mtoe out of the 34Mtoe target will be achieved. However, the Spanish projections assume that their national target of a 2% improvement in final energy intensity per year will be achieved. This implies that the gap towards the 20% energy efficiency target, according to the Spanish projections, is only of 5 Mtoe. This is a big difference in expectations between the EU (whose official projections are the PRIMES baselines) and the Spanish government; however, Spanish projections are very optimistic, assuming that all measures will be completely effective in all sectors. In other words, the Spanish projections should be considered as targets only and not as a the expected outcome of the policy implementation.

Therefore, in order to bridge the energy savings gap projected by the PRIMES 2009 baseline, further policy action should be carried out. These additional policies should focus on the transport and built environment sectors, which have the most available energy savings potential.

4.2. The energy savings potential and the Spanish energy savings targets

This chapter has shown that the potential for energy savings in the residential sector is large enough to be of significant help in bridging this gap. Focus should be specially in existing buildings which have the largest energy savings potential given that the construction sector has collapsed and that recent construction (from the housing bubble) does not comply with the 2006 CTE. However, when compared with the energy savings targets from the NEEAP (MITyC and IDAE, 2010) shown in Table 10, it is clear that the existing potential is not fully tapped. The NEEAP only accounts for 161 ktoe energy savings in 2020 due to measures regarding the thermal envelope and thermal equipment in the residential sector (including new and existing buildings). When comparing this to the 4,5Mtoe (WWF, 2010) only for existing buildings or the 5,4Mtoe for the whole sector (Fraunhofer et al, 2009) it is clear that there are still huge opportunities, and that energy refurbishments can provide and additional amount of savings not yet considered in Spain’s NEEAP that would help bridging the energy savings gap. Therefore, the next chapter will provide further insight regarding the available policy instruments aimed at improving energy efficiency in residential buildings and assess their effectiveness at yielding the existing potential in the sector.

Table 10: Energy savings targets in the Spanish building sector
Source: 2nd Spanish NEEAP (MITyC and IDAE, 2010)

Sector	Final energy savings		
	2016	2020	
Residential	119	211	ktoe
- *Thermal envelope and thermal equipment*	*85*	*161*	ktoe
- *Lighting*	*34*	*50*	ktoe
Tertiary	2 497	2 736	ktoe
- *Thermal envelope and thermal equipment*	*1 858*	*1 944*	ktoe
- *Lighting*	*639*	*792*	ktoe
Equipment	57	-80	ktoe
Total	**2 674**	**2 867**	**ktoe**

CHAPTER III: POLICY PACKAGE

This chapter provides an overview of the existing policies aimed at promoting energy efficiency improvements in the residential building sector. Section 1 describes the relevant plans, directives, decisions and other initiatives at EU level. Section 2 describes the Spanish policies and instruments, and section 3 provides the classification of the different policy instruments and a brief analysis regarding the policy package and the link between the European and Spanish instruments.

1. EU policy package

This section provides an overview of recent EU energy efficiency policies, especially those targeting energy efficiency improvements in residential buildings. While these are implemented by individual countries, the EU plays an essential role in creating a framework enabling countries to overcome barriers impeding energy efficiency improvement measures in this sector. The main policy document is the Energy Efficiency Plan 2011 (EC, 2011), which is supported by several directives and additional programmes and initiatives, as mentioned in the following sections.

1.1. Relevant plans

1.1.1 Energy Efficiency Plan (2011)

The Energy Efficiency Plan, published in March 2011, is the main policy document at EU level regarding energy efficiency (EC, 2011). It focuses on the EU's 20 % indicative target aimed at reducing primary energy consumption by 2020 and the fact that, given the current trend, the EU will only achieve half of this target. In order to get back on track, it emphasises the need to reduce final energy consumption in the building sector, as this sector is responsible for almost 40 % of the final energy consumption in Europe. In order to effectively promote low energy consumption in the built environment, the EE Plan focuses on tackling the heat consumption in buildings; training architects, engineers and technicians; promoting Energy Service Companies (ESCOs) as catalysts for renovation; and, addressing legal obstacles.

1.1.2 Climate and Energy Package

Through the Climate and Energy Package, the EU agreed to implement the 20-20-20 targets: by 2020, reduce by 20% the GHG emissions (below 1990 levels), reduce by 20% the primary energy consumption (compared with projected levels) and to reach 20 % of renewables in total energy consumption in the EU. It creates pressure to improve energy efficiency but does not address it directly, as it comprises the following:

- A revision and strengthening of the Emissions Trading System (ETS).
- An 'Effort Sharing Decision' governing emissions from sectors not covered by the ETS, such as transport, housing, agriculture and waste. Under the Decision each Member State has agreed to a binding national emissions limitation target for

2020. For Spain, this target is -10% in 2020 compared to 2005 GHG emission levels.

- Binding national targets for renewable energy which collectively will lift the average renewable share across the EU to 20% by 2020. The target for Spain is 20% share of RES in 2020.
- A legal framework to promote the development and safe use of carbon capture and storage (CCS).

1.2. Directives and decisions

1.2.1 Effort Sharing Decision (406/2009/EC)

The Effort Sharing Decision establishes annual binding GHG emission targets for Member States for the period 2013–2020. These targets concern the emissions from sectors not included in the EU ETS– such as transport, buildings, agriculture and waste. Each Member State will contribute to this effort according to its relative wealth and, overall, it will deliver a 10% reduction of emissions from the covered sectors in 2020 compared with 2005 levels. Together with the reduction of the ETS, it needs to accomplish the overall emission reduction goal of the EU Climate and Energy package (20% below 1990 levels by 2020). This Effort Sharing Decision is supported by the different directives described before, that aim to reduce GHG emissions.

1.2.2 Energy Performance of Buildings (EPBD, 2010/31/EC)

The EPBD, first adopted in 2002, is the main legislative instrument at EU level to achieve energy performance in buildings. Member States must apply minimum requirements as regards the energy performance of new and existing buildings, ensure the certification of their energy performance and require the regular inspection of boilers and air conditioning systems in buildings. Furthermore, the 2010 recast requires Member States to move towards new and retrofitted nearly-zero energy buildings by 31 December 2020 (31 December 2018 for public buildings), and the application of a cost-optimal methodology for setting minimum requirements for both the envelope and the technical systems. Additionally, the scope of the building stock that falls under the directive is extended (the 1000 m2 floor area threshold has been eliminated); certification will be mandatory for any buildings constructed, sold or rented out, as well as for those buildings where over 500 m2 (250m2 from 2015) is occupied by a public authority and frequently visited by the public; information campaigns by member states shall target building owners and tenants on aspects related to certification, inspection and possible energy performance improvements.

1.2.3 End-use Efficiency & Energy Services (ESD, 2006/32/EC)

The directive provides a framework for energy end-use efficiency and energy services in order to make the end use of energy more economic and efficient. This will be achieved by establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end use of energy; as well as by creating the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency. The directive applies to the distribution and retail sale of energy, as well as the delivery of measures to improve end-use energy efficiency, with the exception of activities included in the GHG ETS. The directive provides:

- **General targets for saving energy**: Member States must adopt and achieve an indicative energy saving target of 9% by 2016 in the framework of a national energy efficiency action plan (NEEAP). This includes obligatory monitoring and reporting.
- **Exemplary role of the public sector:** Member States must ensure that the public sector adopts measures to improve energy efficiency, inform the public and businesses of the measures adopted and promote the exchange of good practice.
- **Promotion of energy end-use efficiency and energy services:** Member States will transfer Energy Services and Energy Performance Contracting into their action plans and legislation. Furthermore, Member States will ensure that energy companies supply information on their final customers needed to develop and implement programmes to improve energy efficiency; additionally, offer and promote energy services and/or energy audits and/or measures to improve energy efficiency or contribute to the financial instruments for improving energy efficiency. Furthermore, Member States must also ensure that end-users are provided with competitively priced individual metering and informative billing that shows their actual energy consumption.

1.2.4 Proposal for new EE directive (EC, 2011b)

Currently there is a proposal for a new energy efficiency directive that would repeal directives 2004/8/EC (CHP) and 2006/32/EC (ESD) under discussion in the European Council and Parliament. The main measures, related to the built environment, comprised in this proposal are:

- **Legal obligation to establish energy saving schemes in all Member States**: Energy distributors or retail energy sales companies will be obliged to save every year 1,5 % of their energy sales, by volume, through the implementation of energy efficiency measures among their final energy customers.
- **Public sector to lead by example:** Public bodies will have a legal obligation to purchase energy efficient buildings, products and services. Furthermore, the renovation rate for public buildings will be at least 3% of their total floor area per year.
- **Major energy savings for consumers**: Easy and free-of-charge access to data on real-time and historical energy consumption through more accurate individual metering will empower consumers to better manage their energy consumption. Billing should be based on the actual consumption reflecting data from the metering.

The new directive proposes binding measures instead of binding targets. However, it proposes that each Member State sets its own non-binding national energy efficiency target, and if by 2014 the 20% target is not likely to be achieved, the EC will propose binding targets.

1.3. Other programmes and initiatives

1.3.1 Intelligent Energy Europe Programme (1639/2006/EC)

The Intelligent Energy Europe (IEE) programme was launched in 2003 by the European Commission and is now a part of the Competitiveness and Innovation Framework Programme (1639/2006/EC). It focuses on energy efficiency, renewable energy sources and energy diversification by supporting the use and dissemination of clean and sustainable solutions, as well as Europe-wide exchange of related knowledge and know-how.

The current programme runs until 2013, with a budget of € 730 million available to fund projects and put into place a range of European portals, facilities and initiatives (See Figure 8). It comprises components of project funding; procurement of products and services; technical assistance with facilities as ELENA and the ManagEnergy portal; training with initiatives such as BuildUp Skills; local voluntary agreements through the Covenant of Mayors; and, information and awareness raising with components such as U4Energy and the Sustainable Energy Week and European Campaign.

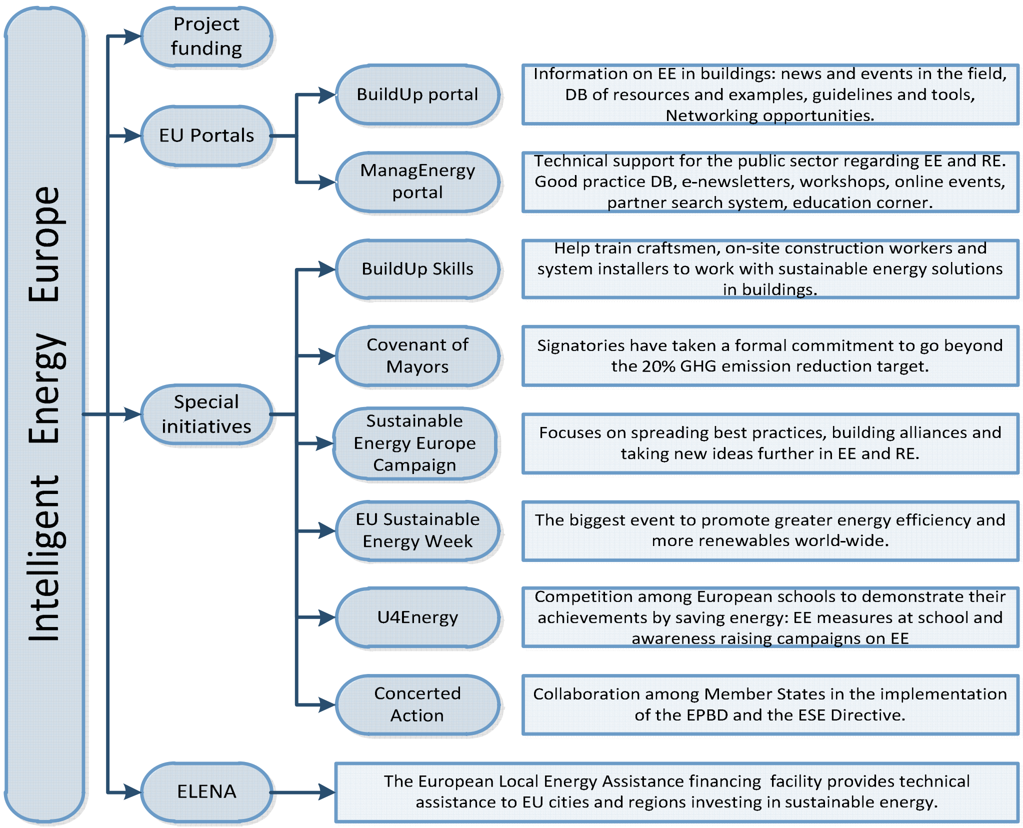


Figure 8: Overview of the IEE programme

Source: Based on information available on the IEE website[4]

[4] http://ec.europa.eu/energy/intelligent/

Spain is active in IEE projects, as seen in Table 11. 13% of its projects are aimed specifically at energy efficiency in buildings, while an additional 18% of the projects promote energy efficiency in an integrated and supportive way. These projects include programmes for energy efficient behaviour, education on energy efficiency, financial mechanisms, monitoring and evaluation, local energy leadership and sustainable energy communities. However, most of the IEE projects in which Spain is involved are related to renewable energies.

Table 11: Amount of IEE projects in Spain
Source: Adapted from the IEE online project database[5]

Status	On-going	Under negotiation	Closed	Total
EE in buildings	5	4	28	**37**
EE in industry	2	3	17	**22**
EE in products & equipment	5	2	10	**17**
Integrated initiatives & support to EE	12	3	35	**50**
Renewable energy	39	0	78	**117**
Transport	11	4	19	**34**
Total	**74**	**16**	**187**	**277**

Besides its involvement in IEE projects, over 1000 Spanish communities have signed the Covenant of Mayors, making a voluntary commitment to meet and exceed the EU 20% CO_2 reduction objective through increased energy efficiency and development of RES by implementing Sustainable Energy Action Plans[6]. *Figure 9* shows the evolution of the amount of signatories since the implementation of the initiative up to this year. From this figure it is clear that local Spanish authorities were very involved from the beginning of the initiative. Furthermore, there are 19 Spanish 'Benchmarks of Excellence', out of 175 total available, and serve as best practice examples for other communities in the EU.

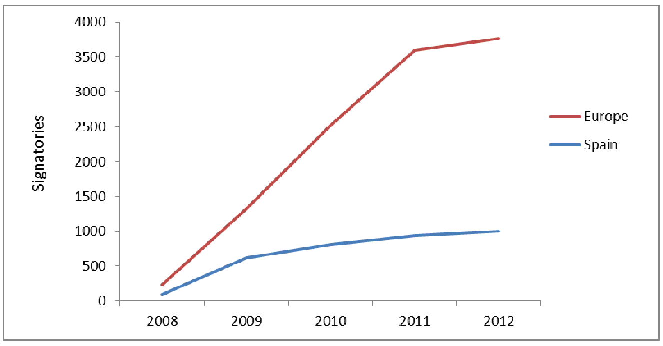


Figure 9: Amount of signatories of the Covenant of Mayors
Source: Adapted from the Covenant of Mayors' online database[7]

[5] Online database (http://www.eaci-projects.eu/iee/page/Page.jsp), accessed in April, 2012.
[6] Online database (http://www.conventiondesmaires.eu/about/signatories_en.html), accessed in April, 2012.
[7] http://www.conventiondesmaires.eu/about/signatories_en.html

1.3.2 Seventh Framework Programme for Research and Technological Development (FP7)

The FP7 is the EU's main instrument for funding research in Europe and it will run from 2007 to 2013. Its budget, allocated to the energy sector, is of € 2.3 billion (2007 - 2013), 7% of the cooperation budget. Furthermore, key aspects of the FP7 on energy research involve smart energy networks, energy efficiency & savings, and knowledge for energy policy making. This Programme comprises the following initiatives:

Smart cities: This initiative aims at triggering the mass market take-up of energy efficiency technologies *(SET Plan: EC, 2009).* This Initiative will support cities in taking ambitious and pioneering measures to progress by 2020 towards a 40% reduction of GHG emissions through sustainable use and production of energy. The initiative builds up on the Covenant of Mayors and CONCERTO initiatives. However, no selection of cities has been made yet.

CONCERTO: The CONCERTO initiative addresses the challenges of creating a more sustainable future for Europe's energy needs, where communities and projects work to deliver the highest possible level of self-supply of energy. It aims to demonstrate that the optimisation of the building sector of whole communities is more efficient and cheaper than optimisation of each building individually. Projects have been developed in 5 Spanish sites, out of a total of 57 sites[8].

Energy-efficient buildings Private-Public Partnership (EeB PPP): Energy-efficient buildings (EeB) PPP consists of a financial envelope of € 1 billion in the period 2010-2013 to boost the construction sector. The PPP aims at promoting green technologies and the development of energy efficient systems and materials in new and renovated buildings in order to reduce their energy consumption and CO_2 emissions. According to their Project Review (EeB and ECTP, 2011), Spain has been involved in 17 out of 22 projects funded under the first call.

1.3.3 EU Funds

The EU has different funds that can be used to finance energy efficiency projects. The most relevant ones for this study are presented below.

Regional policy[9]: EU regional policy is financed by three main funds, which can be used under some or all of the regional policy objectives: European Regional Development Fund (ERDF), European Social Fund and the Cohesion Fund. The ERDF, for example, funds some of the Spanish research programmes on energy efficiency and buildings (See section 2.1.5). In addition to the funds, there are financial instruments set up to provide technical assistance for access to the funds. One of this instruments is JESSICA (Joint European Support for Sustainable Investment in City Areas): A mechanism that enables managing authorities to use structural funds from the ERDF for investments, loans and guarantees to projects forming part of an integrated plan for sustainable urban

[8] http://concerto.eu/

[9] http://ec.europa.eu/regional_policy/index_en.cfm

development. Such investments can include EE. During 2011 the FIDAE, a JESSICA holding fund, was created to promote EE and RES in ten Spanish regions as a joint initiative between IDAE and the EIB[10].

European Energy Programme for Recovery (EEPR): The EEPR, established by Regulation (EC) No 663/20091, is one of the major initiatives taken by the EU to address the global economic and financial crisis. It co-finances projects on energy infrastructure, offshore wind and carbon capture and storage. Moreover, the scope of the EEPR has been expanded by allocating unspent funds to the energy efficiency and renewable energy sectors through the EEE-F. The European Energy Efficiency Fund[11] (EEE-F) is a dedicated investment fund complemented by technical assistance and awareness raising components. It offers a wide range of financial products to public authorities for investments in energy saving, energy efficiency and renewable energy projects, particularly in urban settings, achieving at least 20% energy saving or GHG emission reduction.

2. Spanish policy package

This section focuses on the most relevant policy instruments at national level in Spain. According to Labandeira et al (2011), energy efficiency policy is essential in Spain due to the acute energy dependence and the fact that Spain is not meeting the Kyoto objectives. More effort is required to meet its objective especially in the non ETS sectors, such as transport and buildings (Martínez de Alegria Mancisidor et al, 2009). Therefore, Spain developed a Strategy for Energy Efficiency (E4: ME, 2004) which comprised two Action Plans for the periods of 2005-2007 (PAE4) and 2008-2012 (PAE4+: MITyC and IDAE, 2007). The latter of which was presented as the first NEEAP to the EU according to the 2006/32/EC Directive regarding EE, setting as the main target annual improvements of 2% in energy efficiency intensity (instead of the 1% proposed by the directive). Additionally, for the period 2011-2020, Spain has presented to the EU its second NEEAP (MITyC and IDAE, 2010). This document, together with the Renewable Energy Action Plan, gives special attention to energy efficiency in residential buildings due to its high energy savings potential.

2.1. Relevant plans, programmes and initiatives

2.1.1 Spanish Strategy for Climate Change and Clean Energy: 2007-2012-2020

The Spanish Strategy for Climate Change and Clean Energy is a part of the national strategy for sustainable development, and it focuses on measures tackling climate change and promoting clean energy. Actions in both sectors are closely related given that measures promoting clean energy have a direct impact in GHG emission reduction and, therefore, in climate change (Ministerio de Medio Ambiente, 2007). The measures related to the built environment are found in both, the climate change chapter and the clean energy chapter. This strategy aims to support the existing E4 and second NEEAP

[10] http://www.eib.org/about/press/2011/2011-099-espana-creacion-del-fondo-fidae-para-eficiencia-energetica-y-renovables-que-alcanzara-a-10-comunidades-autonomas-espanolas.htm?lang=-en

[11] http://www.eeef.eu/

and provided additional measures and indicators. However, there is a lack of integration among the documents and ministries.

2.1.2 Action Plan for EE: 2011-2020 (Second NEEAP)

The main target of this plan is to achieve a 2% reduction in final energy intensity per year. The energy savings are split across the different sectors as shown in *Table 12*, focusing mainly in the transport and building sectors.

Table 12: Energy savings targets in Spain per sector
Source: 2nd Spanish NEEAP (MITyC and IDAE, 2010)

Sector	Primary energy savings		Final energy savings		
	2016	2020	2016	2020	
Transport	8 680	11 752	6 921	9 023	ktoe
Industry	2 151	4 996	2 489	4 489	ktoe
Others	6 516	7 527	3 766	4 330	ktoe
Buildings and equipment	5 096	5 567	2 674	2 867	ktoe
Agricultural and fisheries	1 289	1 665	1 036	1 338	ktoe
Public services	131	295	56	125	ktoe
Energy transformation	9 172	11 312	-	-	ktoe
Total	**26 519**	**35 585**	**13 176**	**17 842**	ktoe

For the building sector, the plan focuses on seven measures, summarized in Table 13. These measures are supported mainly by the existing regulation (which will be explained in the following section), financial instruments (mainly subsidies and RENOVE programmes), and information measures (including training activities and databases). However, there is no detail as to how to implement this measures, as this is the autonomous communities' responsibility.

Table 13: Overview of the measures proposed in the NEEAP for buildings and equipment
Source: Adapted from Spanish NEEAP (MITyC and IDAE, 2010)

Measure	Scope	Investment 2011-2020
Improve thermal envelope of existing buildings	58.1 million m^2/year of constructed area	5 594MEUR of which 20% public support
Improve EE in thermal installations	8.200 MW thermal/year from thermal installations	7 258MEUR of which 4% public support
Improve interior lighting	20 million m^2/year of constructed in tertiary sector + Replacement of 34 million incandescent lamps	8 763MEUR of which 2% public support
Construction and renovation of A/B energy buildings	8.2 million m^2/year of constructed area	4 858MEUR of which 16% public support
Zero energy buildings	10 000m^2/year of constructed area	19 MEUR of which 26% public support
Improve EE in cold commercial plants	Installed capacity of 1 MW electrical per year in industrial refrigeration	20 MEUR of which 25% public support
Improve EE of electrical appliances	300 000 appliances/year	800MEUR of which 63% public support

2.1.3 National housing and refurbishment plan (PEVR: 2009-2012)

The PEVR (MF, 2008) focuses, among other objectives, on reinforcing refurbishments and improvements in existing buildings; orienting all interventions to improving energy efficiency and accessibility; and, providing support through the information and assistance offices in the autonomous communities. Furthermore, it considers 996 000 interventions to facilitate access to housing and to improve the existing housing through RENOVE aids for energy efficiency and accessibility (See section 2.2.4). The Ministry of Economy allocated 110 mEUR from the special national fund for the activation of the economy to the Ministry of Public Works for the implementation of the PEVR (Ministerio de Economía y Hacienda, 2008). The subsidies and fiscal incentives considered in this plan are detailed in section 2.2.4.

2.1.4 ESCO Plans

Spain has launched two plans to promote the contracting of energy services in order to achieve energy savings in public buildings: Plan 330 ESCOs (Plan 330 ESEs: MITyC, 2010) and Plan 2000 ESCOs (Plan 2000 ESEs: MITyC, 2010b). The first one aims at reducing the energy consumption in 330 public buildings by 20% by 2016, through energy service contracts realised by ESCOs; while the second one is an extension of the first one, increasing the amount to 2 000 public buildings and maintaining the 20% energy savings by 2016 target. This second plan is divided in three sub-programmes according to the ownership of the buildings: Local, Autonomous and General State Administration. The main aim of both plans is the development of the ESCO market and the reduction of energy consumption of public buildings.

Both plans promote the contracting of energy services and provide financial aid from a financial and incentives line, and from the ICO line - Sustainable Economy for ESCOs to realise investments in energy saving and energy efficiency measures. In addition, the Economy Ministry allocated 380 mEUR from the special national fund for the activation of the economy to the Home Office for the construction, adaptation, refurbishment and improvement of public buildings (Ministerio de Economía y Hacienda, 2008).

2.1.5 National Plan for Research, Development and Innovation: 2008-2012

The National RDI Plan has Energy and Climate Change as an strategic action across sectors, with special attention to the transport and building sectors. The Spanish government, through its Energy, Environment and Technology Research Centre (CIEMAT), has led important research regarding energy efficient buildings. Most of this programmes have both national and ERDF funding. The national funding comes from the special national fund for the activation of the economy, which allocates 490 mEUR allocated to the Science and Innovation Ministry of which 180 mEUR are directly allocated to energy RDI (Ministerio de Economía y Hacienda, 2008). Some of the most relevant programmes are mentioned below:

- **Arfrisol – Bioclimatic architecture and solar cooling research project[12]:** Its aim is to prove the convenience of bioclimatic architecture and solar energy to

[12] www.arfrisol.es

improve thermal conditioning in office buildings, in terms of heating and cooling.

- **Plan E – Envite:** The objective of this demonstration project is to analyse and evaluate the thermal behaviour of residential and office buildings, using different energy saving measures. It is part of the National RDI Plan.
- **Celsius – Innpacto:** This project aims at designing, monitoring and evaluating different bioclimatic solutions to improve energy efficiency in buildings.
- **Depoligen – Innpacto:** This project aims at developing technologies for 'zero emission' buildings, neighbourhoods and districts. It considers both residential and commercial buildings. Research areas are the improvement of the energy demand, poly-generation and coherent energy management.

2.2. Other policy instruments

2.2.1 Technical Building Code (CTE)

The RD 314/2006 establishes the latest Technical Building Code (CTE). The CTE includes a Basic Energy Saving Document (DB HE Energía) which establishes the energy efficiency and renewable energy requirements for new buildings. A building that fulfils these requirements would save 30-40% of the energy consumption compared to the old legislation (Ministerio de Medio Ambiente y Medio Rural y Marino, 2011). The document comprises the following sections:

- *HE1: Energy demand limit*. This sets the requirements for the reduction in energy demand from heating and cooling are presented. Compliance with this requirement can be verified through a prescriptive option, using tables and other performance-based information, based on an information programme that compares energy demand from heating and cooling in the building in question with that of a hypothetical building reference that strictly meets current legislation.
- *HE2: Efficiency of thermal installations.* This is linked to RITE and its specific requirements.
- *HE3: Energy efficiency of lighting installations* regulates the energy efficiency of interior lighting. It obliges compliance with an energy efficiency value for the installation, VEEI (W/m^2 x 100 lux), different according to the buildings' area of activity. It also includes obligations relative to the regulation and control of lighting and especially with the use of natural light.
- *HE4: Minimum contribution from solar energy for water heating* which has to be between 30% and 70% of the annual energy consumption.
- *HE5: Minimum contribution from solar energy to electricity*.

According to Martínez de Alegria Mancisidor et al (2009), there are doubts regarding the effectiveness of this instrument because it does not include quantitative information on energy consumption in buildings, measured as kWh/m^2 year. Furthermore, the regulations proposed in the CTE are less restrictive than in neighboring countries (Asdrubali et al, 2008).

An important consideration regarding building codes is that they are usually restricted to new buildings, which in the Spanish context limits its effectiveness due to the collapse of the building sector. Furthermore, Gago et al (2012) mention that their effectiveness depends on how they are designed and on the relative importance of new buildings in the overall stock (which is very low for the Spanish case). It is also complex to devise uniform requirements for such a complex sector, where building type and climate region play such an important role.

2.2.2 Regulation on Thermal Installations in Buildings (RITE)

The RD 1027/2007 establishes the 'Regulation on Thermal Installations in Buildings' (RITE). The RITE includes document *HE2- Output from thermal installations* which regulates the energy efficiency of thermal installations relative to heating, cooling, ventilation and sanitary hot water production as well as the regular energy efficiency inspections. The RITE sets the minimum frequency of inspections depending on the type of fuel used and the installation's nominal power. In addition, the RITE establishes the requirements for thermal installations in buildings, as well as their design and sizing, assembly, maintenance and inspection. The main requirements stated are the improved energy performance and better insulation in the equipment, as well as the increased use of renewables, the incorporation of energy recovery systems and the use of residual energy. It also requires the gradual abolishment of the most contaminating solid fuels and the least efficient equipment.

2.2.3 Energy performance certification (EPC)

The RD 47/2007 establishes the 'Basic procedure for the energy certification of new buildings'. This procedure is applicable to new buildings and modifications, reforms or renewals of existing buildings, with a useful surface area of 1.000 m2 where more than 25% is renewed. The recording, external control and inspection of the energy efficiency certificates is the responsibility of the Autonomous Communities (AC). In terms of violations and sanctions, those are set out in RD 1/2007, for the protection of consumers and users. Furthermore, this RD sets out that all buildings occupied by the Public Administration or by institutions providing public services to a significant number of people, with a useful surface area greater than 1.000 m2, will be required to display, somewhere clearly visible to the public, its energy efficiency label.

EPC not only offers detailed information about the future energy demand, but also generates incentives for investing in energy efficiency because it is reasonable to expect price increases in buildings with better certifications (Gago et al, 2012). The EPC is a very powerful instrument and can be a central piece of the policy package. It has different roles: It provides information to consumers on energy efficiency, it creates incentives for agents to invest in energy efficiency (so long as the real estate market capitalizes the information), and it is a linking mechanism to other instruments such as subsidies.

2.2.4 NEEAP and PEVR financial incentives

Both the NEEAP and the PEVR provide incentives to support the proposed measures for energy efficiency improvements in residential buildings (including improvements in thermal installations, lighting and building envelope). This financial incentives include subsidies, tax exemptions and tax reductions. This is in line with Gago et al (2012), who indicate that tax exemptions and subsidies for investments are the incentives mostly used to enhance energy efficiency in buildings; while energy taxes and tradable permits have been widely applied for energy intensive users.

NEEAP and PEVR subsidies: The available funds from the NEEAP and PEVR are handled by national authorities (IDAE and the ministry of Public Works). These authorities sign cooperation agreements with the relevant authorities at the regional level and assign their available budget. These assigned lines of economic support are created annually and managed directly by the autonomous communities. Examples of sub-programmes led by autonomous communities are subsidies for comprehensive refurbishments and RENOVE schemes. The specific requirements and eligibility criteria for these sub-programmes are defined by the autonomous communities themselves. In the first case, the beneficiary (usually home owner or project developer) has to undertake the refurbishment and apply for the subsidy through the relevant authority from the autonomous community and then has to wait for this application to be approved in order to get a refund. RENOVE schemes however, have a different structure.

RENOVE schemes are common due to the success of the RENOVE programmes for household appliances which made possible the replacement of 3 million conventional appliances for efficient ones[13]. The RENOVE schemes allow the beneficiary to buy partially subsidized products or equipment without the need of any paperwork at certified establishments that are part of the programme. The equipment has been pre-approved due to its better energy performance according to certain standards. The establishments selling the equipment apply for the subsidy providing the appropriate documentation to the autonomous community. This scheme allows the final beneficiary to avoid the waiting time and administrative burden that comes along with the application to an individual subsidy directly through the autonomous community, as well as the upfront payment of the total investment cost.

Fiscal incentives: Fiscal incentives are directly linked to comprehensive household refurbishments. The PEVR 2009-2012 offers a reduction from 18% to 8% taxes over household refurbishments. However, this incentive is not linked to any energy efficiency requirements. In addition, RD 5/2011 establishes tax exemptions up to 20% of the cost of the refurbishments carried out from May 2011 to December 2012 (MF, 2011b). This tax exemption is linked to the fact that the refurbishment is aimed at improving energy efficiency, using renewable energy, promoting accessibility, among other objectives explicitly stated in the PEVR.

3. Analysis and conclusions

This section provides a brief analysis regarding the selected policy package. First, an overview of the policy package along with its classification is given. A brief assessment of the implementation of the EU directives in Spain, and of Spain's involvement in EU

[13] http://www.idae.es/index.php/idpag.58/relcategoria.1161/relmenu.68/mod.pags/mem.detalle

programmes and initiatives is provided, as well as an overall analysis of the Spanish policy documents.

3.1. Overview and classification of the policy instruments

Table 14 shows a summary of the instruments, at both EU and national level, that aim at promoting energy efficiency measures in buildings. It also classifies these policy instruments according to the methodology described in CHAPTER I:4.2.2. Regulation is the main instrument for the improvement of energy efficiency in existing buildings and it is complemented with elements such as building certification, auditing and the creation of a market for energy services. This implies a combination of regulatory, economic and informational instruments which, according to Klickenberg et al (2006) is needed in order to effectively promote energy efficiency in buildings.

Regulation requires performance of pre-defined standards (e.g. through the EPBD) or commands particular behaviours, but they require the mitigation of weaknesses like compliance and legitimacy. Economic instruments encourage the implementation of energy efficiency investments by providing incentives (e.g. such as those provided by the Spanish NEAP and PEVR); and, finally, information aims at shifting the actors' priorities acting as supporting tools. By addressing different barriers at the same time through different instruments, the policy package is likely to be more relevant, have a greater impact and be more sustainable (IEA, 2008).

Table 14: Classification of the policy instruments

Instrument	Reference	Description	Classification
Effort Sharing Decision	EU Decision	Annual binding targets for GHG emissions from non ETS sectors such as transport and buildings.	Regulation
EPBD	EU Directive	- Building requirements. - Energy performance certification of buildings. - EE audits.	Regulation + Information
EE & Energy Services directive (ESD)	EU Directive	- Indicative energy savings target. - Public sector purchasing policy considering EE. - Promotion of ESCOs. - Individual metering and informative billing.	Regulation + Information
New EE directive	EU Directive	- Binding energy saving schemes for energy providers. - Mandatory renovation rate for public buildings. - Individual metering and informative billing.	Regulation + Information
IEE	EU - IEE	Funds projects in the EU that support EE and RES.	Economic
ELENA	EU - IEE	Funds for TA for local investments in sustainable energy.	Economic (TA)
Covenant of Mayors	EU - IEE	Local VAs to exceed the 20% GHG target through EE and RES.	Information (VA)
Concerted Action	EU - IEE	Cooperation to implement EPBD and energy efficiency directive.	Information
Other IEE	EU - IEE	- BuildUp skills: Training for craftsmen - BuildUp portal: Exchange best practices - ManagEnergy Portal: Technical support and information.	Economic (training & TA) + Information
Smart cities	EU - FP7	Supports pioneering cities to reduce 40% of GHG by 2020.	Information
CONCERTO	EU - FP7	Demonstration project where communities and projects work together to deliver the highest level of self-supply of energy.	Information
EeB	EU - FP7	Research programme for green technologies and EE in buildings.	Information
JESSICA	EU Regional policy	Funds projects forming part of an integrated plan for sustainable urban development.	Economic
EEE-F	EU - EEPR	Funds EE and RES investments, TA and awareness raising.	Economic + Information

ESCO Plans	ES - ESD	Reduce energy consumption in public buildings through energy service contracting	Regulation
CTE	ES - EPBD	EE requirements for buildings	Regulation
EPC	ES - EPBD	Energy certification of new buildings	Information
RITE	ES - EPBD	Regulation & inspection of thermal installations	Regulation
NEEAP subsidies	ES - NEEAP	Subsidies for EE measures (inc. RENOVE plans)	Economic
PEVR subsidies	ES - PEVR	Subsidies for household refurbishments	Economic
PEVR fiscal incentives	ES - PEVR	Tax exemptions and reductions for household refurbishments	Economic

3.2. Enforcement of EU directives

The main directives analysed are the EPBD and the ESD. In both cases Spain has taken steps to transpose them; however, the EPC procedure for existing buildings is still missing. In addition, Spain acknowledges the need for updates and modifications in the existing regulation in order to transpose the EPBD recast in its 2nd NEEAP. Further detail regarding the implementation of both directives is provided below.

EPBD: The RITE, CTE and EPC are all part of the transposition of the EPBD. In addition, Spain acknowledges in its NEEAP the need to develop new policy instruments or modify the existing ones to comply with the EPBD recast. Even though most of the directive has been transposed, the actual implementation of the RITE, CTE and EPC is undertaken at the local level. This leads to compliance and monitoring issues; for example, there is no central database for EPC.

In addition, Spain is still behind in the implementation of the EPBD regarding the '*Energy efficiency certification of existing buildings'.* The report from the EPBD Concerted Action – IEE (Gonzáles Álvarez, 2011) states that additional legal basis was needed in order to transpose. However, even though the legal issues have been solved, the royal decree has not been approved yet; this has led the EU to take infringement procedures against Spain (WWF, 2012). The royal decree is now under discussion and it is expected to be implemented by January 2013.[14] The next step once this decree is published, will be to combined the financial incentives from the NEEAP and PEVR to the improvement on the building energy rating.

ESD: The NEEAP and ESCO plans have been established to comply with the ESD. In addition, to comply with the exemplary role of the public sector, the EE Action Plan for the General Administration of the State was implemented as part of the E4 with the aim of introducing energy efficiency criteria in competitive tendering for public contracts and the objective of getting savings equivalent to 9% by 2010 and 20% by 2016. Furthermore, the law concerning Public Sector Contracts was modified in order to include PPP, allowing the contracting of energy services (Law 30/2007), and the decree RD 6/2010, concerning measures for the promotion of the economic recovery, incorporates the concept of ESCO into Spanish law, making modifications in order to have a more dynamic contracting process. IDAE has already prepared a standard model for contracting energy services and technical maintenance for buildings of the Public Administration.

[14] http://www.idealista.com/news/archivo/2012/02/09/0397377-industria-exigira-que-todas-las-viviendas-que-se-vendan-o-alquilen-cuenten-con-un-certificado-ene?xtor=EPR-75-[esta_pasando_20120209]-20120209-[notinmo_1_titular]-[]-[]

3.3. Participation of Spain in EU programmes and initiatives

The EU is proving to effectively take on the role of leading and facilitating the transformation towards energy efficiency buildings, due to the variety of policy tools available to it at different levels of government and society (IEA, 2008). Furthermore, Spain is actively taking part in the available EU programmes and initiatives: 37 of the 277 IEE projects are aimed specifically at energy efficiency in buildings; over 1000 Spanish communities have signed the Covenant of Mayors; CONCERTO projects have been developed in 5 Spanish sites; and, Spain has been involved in 17 out of 22 projects funded by the EeB PPP. It is harder to assess to what extent the available funds, such as ERDF and EEE-F, are being used given that there are no available databases. However, several of the research and demonstration projects under Spain's National Plan for RDI take advantage of ERDF funding.

3.4. Spanish policy

Spain has put in place several plans and programmes to promote energy efficiency from the national level. However, these are poorly structured and lack integration. In addition to those explained in this document, there are other plans (Plan for energy savings and emission reductions in transport and buildings; Plan for intensified energy efficiency; EE Action Plan for the public sector – PAEE AGE) but the connection among them is not clear, which makes it difficult for them to reinforce and support each other. This is related to the involvement of different ministries (MF, MITyC, MAGRAMA) and the lack of coordination among them. A clear example is the lack of coordination between the PEVR and NEEAP and their subsidies for energy efficiency in buildings.

A key problem regarding all these plans is that the local authorities are responsible for their implementation, and there is no control on how/when this is done. This is aggravated due to the fact that the NEEAP (and other plans) establishes different measures but does not explain how these will be implemented. Even though this is a task for the regional authorities, guidelines and best practices should be made available through IDAE. Furthermore, IDAE should provide training for the local authorities to promote a homogenous implementation of the instruments; and each local agency should ensure the proper training to those in the field (such as technicians and auditors).

Finally, there is no (explicit) connection between the Spanish energy savings target for 2020 and the European 20% target. Overall, the Spanish targets are not transparent as they do not show clearly the baseline or reference year to which they refer, making the analysis and monitoring of these targets more complicated.

CHAPTER IV: POLICY ANALYSIS

This chapter analyses the policy package described in the previous chapter. In order to do this, section 1 provides a stakeholder analysis, an overview of the barriers to energy efficiency improvement, and the co-benefits to energy efficiency based on a literature review and on stakeholder interviews. Section 2 focuses on the assessment, using policy theory reconstruction to evaluate the underlying assumptions and to what degree the identified barriers are addressed by the policy package. The methodology and theory is described in CHAPTER I:4.2.3. The output from this chapter serves as input for the recommendations provided in CHAPTER V:.

1. Sector analysis

1.1. Stakeholder analysis

According to Crabbe et al (2008), policy making and policy implementation are multi-actor processes. Therefore, in order to identify the barriers regarding energy saving policies in the building sector, it is important to first determine which relevant actors are involved. The improvement of energy performance of buildings is determined by the decisions of a large number of people, including building owners, managers and developers, particularly in multi-family, commercial and public buildings (BPIE, 2011). In a stakeholder analysis several actors were identified, each with their own interests, roles and views on the subject. The different stakeholders were identified through a literature review (see IDAE and A3E, 2011 and WBCSD, 2007) and interviews (see Annex 1), and are presented in Figure 10.

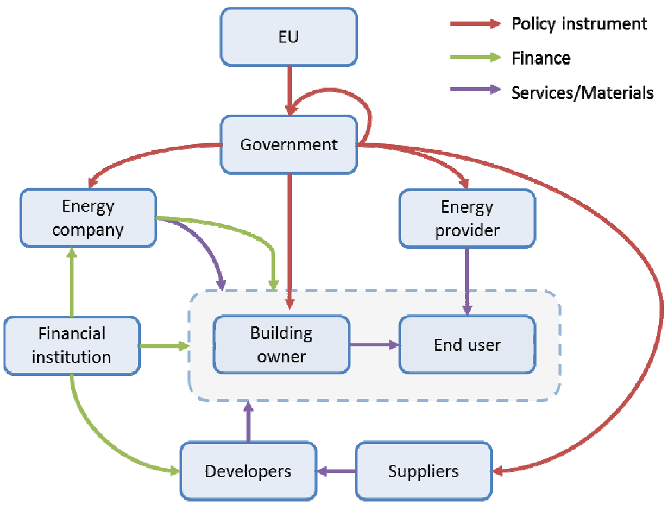


Figure 10: Stakeholders
Source: Adapted from IDAE and A3E (2011) and WBCSD (2007)

European Union: The EU provides the directives that steer and influence the Member State's policies. The energy efficiency policies are directly linked with energy policy, resource efficiency policy and climate policy.

Government: The public administration consists of different stakeholders, playing a role on the local and national levels. Its role includes the development of regulations and strategies regarding energy efficiency, as well as the use of energy (public procurement). According to Martínez de Alegria Mancisidor et al (2009), due to the highly decentralized administrative system in force, the national government, autonomous communities and to a lesser extent, local entities, have important contributions in the energy sector.

- ***Ministry of Industry, Tourism and Commerce (MITyC)*:** This ministry has an energy Secretariat which is in charge of all energy related issues.
- ***Institute for Energy Diversification and Energy Saving (IDAE):*** IDAE is the Spanish institution in charge of the execution of the NEEAP and REAP, which have to be developed through collaboration agreements signed between the Spanish Government and the autonomous communities. It is part of the MITyC, through the Energy Secretariat.
- ***Ministry of Public Works (MF):*** This ministry is in charge of housing policy. It is responsible for the implementation of the PEVR and its subsidy schemes for household refurbishments.
- ***Ministry of Agriculture, Food and Environment (MAGRAMA):*** This ministry is responsible for the environment and, therefore, for the Spanish Strategy for Climate Change and Clean Energy.
- ***Local energy agencies*:** In Spain, energy agencies are the local government authorities executing the national measures, through cooperation agreements with IDAE. Some examples are FENERCOM in Madrid (Fundación de la Energía de la Comunidad de Madrid), ICAEN in Cataluña (Institut Català d'Energia) and EVE in the Vasque Country (Ente Vasco de la Energía).

Developers: Developers are the primary actors in commercial construction and are frequently speculative, which results in a short-term focus on buildings' financial value. Therefore, they might only be interested in energy efficiency if it is a significant factor in the buying decision. On the other hand, developers who hold property to receive income from tenants have a longer term view, which may make energy-saving investments attractive. However, developers may not be able to reap the benefits of such investments, as energy cost saving goes to the occupier. This barrier, split incentives, will be discussed in the barrier section.

Building owners: Though they have little influence on the development of policies, they do have significant influence on the outcome and success of those policies, since they are generally the ones making the decision on implementing energy efficiency measures. In Spain, over 80% of the residential buildings are owner occupied (BPIE, 2011), which makes residential building owners a very relevant group of actors, given that they are likely to make investments with longer payback times. However it is also important to consider those owners who rent their buildings, making their interests different from those of end users; or those who buy to sell or lease.

End users: End users are the ones who actually pay for the energy consumption in buildings; therefore, any energy efficiency measures will benefit them directly. However, they may not be in a position to make the necessary investments. This depends on the financial arrangements among owners, agents and users (which may include a fixed energy fee regardless of consumption.

Energy companies: These are organizations that provide energy services to final users. This group of actors include Energy Service Companies (ESCOs), Energy Certification, Energy Audits, Consultancy, etc. Energy companies would like their name to be linked to any initiatives that promote sustainability. Furthermore, they try to inform homeowners on possibilities for energy efficiency improvements.

Energy providers: Their role is to provide energy to the final consumer. ESCOs can, as part as their contracts, act as energy providers. On the one hand energy companies want to make profit, but on the other hand they want to improve their image by showing an interest in measures to reduce energy use.

Financial institutions: In order to implement energy efficiency measures, access to finance is key. Different financing institutions at different levels provide finance for energy efficiency investments. Capital providers, such as lenders or investors, are overwhelmingly concerned with the risk and return equation.

An overview of the relevant actors is provided in *Table 15*, along with their main role and interest in promoting energy efficiency improvements.

Table 15: Overview of the stakeholders

Stakeholder	Role	Interest
European Union	Policy making, information & awareness raising	GHG reduction & energy independence
Public administration	Policy making, information & awareness raising	GHG reduction & energy independence
Energy agencies	Policy implementation	GHG reduction & energy independence
Building owners	Decision making	Attract tenants / Energy cost savings
End users	Profit from EE measures	Energy cost savings
Energy companies	Implementing EE measures, information & awareness	Enhanced public image
Finance institutions	Financing EE investments	Enhanced public image

1.2. Co-benefits of energy efficiency in residential buildings

Energy efficiency improvements not only imply energy savings. According to a study from the Sustainable Building and Climate Initiative (UNEP: SBCI, 2009), energy efficiency measures for buildings can stimulate the growth of new businesses and jobs, as well as, better housing and access to clean energy and water. This section presents an overview of the co-benefits of energy efficiency improvements in buildings, based on Levine et al (2007), Gago et al (2012) and EuroACE (2010). If these co-benefits are included in the economic analysis, the economic attractiveness of various energy efficiency options may increase considerably (Levine et al, 2007). Furthermore, these co-benefits contribute to other social development goals, allowing for strategic alliances with other policy fields and providing broader societal support for energy efficiency goals (Levine et al, 2007; Convery, 2011).

- **Climate mitigation and reduced air pollution**: Energy savings, and thus, reduced fuel consumption decrease GHG and other pollutant emissions. Therefore, besides contributing to the GHG emission reduction goals, local and regional air quality is improved contributing to public health.

- **Energy security:** Additional co-benefits include improved energy security and system reliability due to reduced energy demand and, thus, dependence on foreign energy supply (Lawrence et al, 2005). In addition, the reduced energy demand will moderate the impacts of energy extraction, production and supply.

- **Employment creation & new business opportunities:** Energy efficiency investments have positive effects on employment, directly by creating new jobs in the manufacturing and installation of energy efficiency measures; and, indirectly through the economic multiplier effects of spending the money saved on energy costs. In Spain, WWF (2010) stresses that energy refurbishments are a huge opportunity for employment creation and, therefore, key for the economic recovery, especially nowadays due to the current inactivity of the sector and its high unemployment rates. The refurbishment of 10 million dwellings into low energy households between 2012 and 2050 would generate between 110 000 and 130 000 direct jobs (Cuchí et al, 2011).

  Additional economic benefits include promoting innovation by creating market opportunities for new or more efficient technologies and by providing certain incentives for demonstration and market transformation. Furthermore, it offers large possibilities for new businesses such as ESCOs.

- **Improved social welfare and poverty alleviation:** Improving residential energy efficiency helps households cope with the burden of paying utility bills and helps them afford adequate energy services. Energy conservation may result in net savings for households, which increases their disposable income. This is an important benefit for less affluent households, even more so due to the current economic recession in Spain. Improving energy efficiency in these homes is a major component of strategies to eradicate fuel poverty[15].

- **Improved health, quality of life and comfort*:*** The diffusion of new technologies contributes to an improved quality of life and increases the value of buildings. Improved thermal comfort and the substantially reduced level of outdoor noise infiltration due to triple-glazed windows or high-performance wall and roof insulation are examples of this. Also, better-insulated buildings eliminate moisture problems and, thus, reduce the risk of mould build-up and associated health risks. Additional social benefits include lower risk of ill health caused by cold/hot homes, particularly for those on low-incomes, disability benefits, or elderly householders. Finally, well-designed energy efficient buildings often improve occupant productivity.

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[15] ***Fuel poverty***: The inability to afford basic energy services to meet minimal needs or comfort standards.

1.3. Barriers to energy efficiency in buildings

There is a large untapped cost-effective potential for energy efficiency improvements, or energy efficiency gap (see OECD/IEA, 2007; Thollander et al, 2010; McKinsey, 2009b). According to Gago et al (2012), there are two explanations for this: Either that these energy efficiency measures are not cost effective, due to understated costs or overestimated benefits; or, there are barriers in the real state sector that strongly affect investment decisions on energy efficiency.

In Spain, energy efficiency measures for residential buildings appear to be cost effective (WWF, 2010; WWF, 2012); therefore, in order to promote energy efficiency improvements, the existing barriers that prevent energy efficiency investments have been analysed in the following section. There have been multiple studies on barriers to energy efficiency over the last years (See BPIE, 2011; Thollander et al, 2010; Fundación Entorno, 2010; Jollands et al, 2010; Mc Kinsey and Company, 2009; Parfomak et al, 2009; Gillingham et al, 2009; IEA, 2008; OECD/IEA, 2007; Lawrence et al, 2005). This section has been developed based on a literature review and the interviews conducted to relevant stakeholders (Annex 1). The barriers can be grouped in: financial barriers; institutional and administrative barriers; and, awareness and information barriers, and they have been rated qualitatively on their relevance in the sector.

1.3.1 Financial barriers

Access to finance: This barrier refers to a lack of funds and/or inability to secure finance on acceptable terms; in other words, significant restrictions on capital availability. Low-income households have limited access to credit and face high financing costs as the result of their economic status or 'credit-worthiness' which inhibits investments in energy efficiency (Bodach et al, 2010). In particular, the small-sized energy efficiency projects (very common in the building environment) have a hard time accessing funds (Levine et al, 2007). Their perceived high risks, related to a lack of information and awareness, discourage investors and banks who tend to see them as 'too much effort for too little profit'.

Moreover, the impact of the economic crisis has lasted longer in Spain than in many other countries, and its main effects include higher unemployment (above 20%) and larger government deficit (OECD, 2011). This also affects the lending markets such that consumers and financial institutions are less willing to take risks. As such, the current credit crunch is another obstacle to investing in energy efficiency. Furthermore, the crisis has limited the available public funds, which is causing cuts in the designated resources for energy efficiency due to the Spanish austerity plans (since energy efficiency is not considered a priority). This barrier is considered to have intermediate relevance.

High initial investment & payback expectations: Most of the energy efficiency projects are financially rational, but they often have long payback periods (more than 10 years) which make them unattractive. Parfomak et al (2009) states that consumers are often reluctant to pay more upfront to purchase products with lower life cycle costs. The "first cost" barrier of energy efficiency measures in existing buildings appears due to the limited time an occupant has to recover the investment through savings in their energy bills, increasing the perceived risks (UNEP: SBCI, 2009). This is supported by a case study conducted in Brazil (Bodach et al, 2010), which concluded that the high initial costs are considered to be the major barrier to energy efficiency in social housing. There are other initial costs such as those associated with consultant fees to gather information about new technologies or current resource use (Lawrence et al, 2005); and, hidden costs such as transaction costs and the inconveniences of a retrofit (Gago et al, 2012). This barrier, as the previous one, is considered to have intermediate relevance.

Competing decisions & low priority of energy issues: According to Khan et al (2006) the consumers' lack of interest in energy efficiency measures may be considered as an umbrella barrier. Investors prioritise what are perceived as core investments. In Spain, the expenditure in energy only represents 3% of general expenditures in buildings of the tertiary sector and households, which makes energy saving measures a minor concern (MITyC and IDAE, 2007). Consumers invest in upgrades of their buildings for safety, health, comfort, aesthetics, reliability, convenience, and status reasons. Energy efficiency rarely is a high priority issue relative to these other factors, therefore, the relevance of this barrier is rated as high.

Also, the invisibility of implemented energy efficiency measures can play a role in the decision-making process for investments – which makes energy efficiency less 'attractive' as an investment option. From a public perspective, due to the crisis and given the need to reduce the public deficit, energy efficiency investments are not a priority in Spain as other issues such as employment creation are more pressing.

Price signals: Energy pricing structures often do not reflect the full (environmental) costs, affect the profitability of energy efficiency investments (Linares et al, 2010). Energy subsidies and the uncertainty due to volatility in energy prices are also concerns when evaluating EE investment options. The relevance of this barrier is low.

1.3.2 Institutional and administrative barriers

Regulatory and planning issues: Regulatory barriers are, perhaps, the most important in Spain, and as such are rated highly relevant. There is regulation in place (CTE, RITE, Procedure for energy certification of new buildings), but it is not stringent enough (WWF, 2010). Furthermore, most of it is applicable to new buildings, and its impact is null due to the collapse of the construction sector. For existing buildings, which yield the higher energy efficiency potential, Spain is lagging behind in the transposition of the EPBD, and currently has an on-going infringement procedure (due to lack of regulation regarding EPC for existing buildings). This delays and gaps in the transposition of EU directives prevent the expected investments in energy efficiency in buildings (BPIE, 2011). In addition, there are different ministries involved in the planning regarding energy efficiency but there is a lack of coordination and cooperation among them which leads to duplication of efforts and inefficient policy instruments.

Fragmented public administration: The structure of the public administration, which has a central government that provides the framework regulation, and multiple autonomous communities which implement it, makes the implementation and monitoring of regulation complicated. This fragmentation can be ineffective due to duplicity of functions and lack of control, which leads to a poor implementation at the local level (WWF, 2010). Therefore, there is a need for greater coordination between national, regional and local policies, in particular in the transport and housing sectors (Ministerio de Hacienda y Administraciones Públicas, 2011). Also, there is a lack of coordinated monitoring and verification procedures for energy savings; along with a lack of control regarding the compliance of the existing regulation (WWF, 2010), which is exacerbated by the fragmented government structure. This institutional barrier is also considered highly relevant.

Administrative procedures: The administrative procedures can be very complex, slow and in-transparent. These procedures can be a barrier when trying to obtain financial incentives, public or EU funding; or when trying to obtain the permits needed to undertake comprehensive refurbishments. The relevance of this barrier has been rated low.

Multi-stakeholder issues: The traditional building design process and fragmented market structure is also a very significant barrier (Levine et al, 2007). Buildings have a long life cycle with many different stakeholders involved in different phases of a building's life, such as property developers and financiers, architects, engineers, building managers, occupants and owners (UNEP: SBCI, 2009). Assuring the long-term energy performance of buildings is all the more difficult when decisions at each stage involve multiple stakeholders, and even more so when there are few opportunities or incentives for coordination between them. This division of responsibilities often contributes to suboptimal results. During the operation phase of the building it can be very difficult to agree on energy efficiency investments (such as an energy refurbishment), due to the difficult (or lack of) coordination among stakeholders who have to either approve a decision or make a financial contribution. In Spain, 70% of households are part of apartment buildings (IDAE and EUROSTAT, 2011), which is why this barrier's relevance has been rated as intermediate.

Split incentives: Misplaced or split incentives occur when the agent paying for the investment is not the one who receives the benefits from it (Linares et al, 2010). According to BPIE (2011), this might be the most complex and long-standing barrier related to energy efficiency in buildings. A classic example is the 'landlord-tenant problem', which occurs when the landlord wants to minimise his capital costs by providing the least-first-cost equipment; while the tenant wants to maximise energy savings in order to benefit from a reduction in costs in the energy bills (OECD/IEA, 2007). However, for the Spanish residential sector, this barrier is not very significant, as less than 10% of the households are rented (IDAE and Eurostat, 2011). Nonetheless, this can also occur when designing new buildings: Decisions regarding the energy features of a new building are often made by builders who focus on the highest revenues at the lowest cost, therefore divorcing the interests of the builder/investor and the occupant who assumes the energy costs (Levine et al, 2007 and Gago et al, 2012).

1.3.3 Information and awareness barriers

Lack of awareness of potential: The awareness of the energy efficiency potential is a pre-requisite that determines the success of the energy efficiency investments. At an academic level, there is information available regarding the energy savings potential in the built environment (WWF, 2010; Economics for Energy, 2011). However, this has been only partially translated to the policy and consumer spheres, and this is why this barrier is rated with intermediate relevance.

Insufficient and inaccurate information: Imperfect information can cause agents to make suboptimal investments. Energy efficiency measures are often not undertaken as a result of lack of information on the part of the consumer, a lack of confidence in the information, or high transaction costs for obtaining reliable information (Parfomak et al, 2009). Information can be related to energy consumption and energy costs (e.g. utility bills); the availability and reliability of energy efficiency technologies; and, the different financing possibilities available (among investors and financial institutions). The lack of visibility of the energy costs is also a barrier for consumers, given that it prevents a change in the consumer's behaviour (Mc Kinsey, 2009b). However, the relevance of this barrier has been rated as low.

Skill & knowledge related to building professionals: The insufficient capacity and technical expertise of those responsible for energy efficiency is also a relevant barrier. This also involves the lack of skills to take full advantage of the existing financing instruments. This is especially important at the local level, which is responsible for the actual implementation of the policies, and is therefore rated with intermediate relevance.

1.3.4 Overview of the barriers and qualitative rating

There are many barriers that prevent energy efficiency improvements in residential buildings. According to the analysis and the interviews carried out with relevant stakeholders, the different barriers have been rated qualitatively on their relevance. An overview of the main barriers and their rating is provided in

Table 16. The most relevant barriers identified are the lack of interest in energy efficiency improvement measures, as well as the lack of stringent and comprehensive regulation, coordinated among the different stakeholders involved and its proper implementation. The lack of interest in energy efficiency is reinforced by the long payback periods, small size and high perceived risks of energy efficiency investments. The policy theory reconstruction, in section 2.2, evaluates to what degree the current policy package is addressing these barriers.

Table 16: Overview of the barriers to energy efficiency in buildings in Spain

Area	Barrier	Relevance
Financial	Access to finance	Intermediate
	High initial investment/Payback expectations	Intermediate
	Competing decisions/Low priority of energy issues	High
	Price signals	Low
Institutional & administrative	Regulatory & planning issues	High
	Fragmented public administration	High
	Administrative procedures	Low
	Multi-stakeholder issues	Intermediate
	Split incentives	Low
Information & awareness	Lack of awareness of potential	Intermediate
	Insufficient/inaccurate information	Low
	Skill & knowledge	Intermediate

2. Policy analysis

The policy assessment was carried out for the Spanish policy package described in CHAPTER III:. The analysis includes the identification of the policy objectives and the assessment of policy theory reconstruction. This assessment includes an evaluation of the underlying assumptions, the policy overlaps and the rebound and free-rider effects that could occur in such a package. This assessment was complemented by a literature review on the different studies that assess the available mechanisms to promote energy efficiency in buildings (See Gago et al, 2012; WWF, 2012; BPIE, 2010; UNEP: SBCI, 2009; Koeppel et al, 2007; Klinckenberg et al, 2006).

2.1. Policy objectives

The global objectives of the policies intended for energy efficiency in buildings include the reduction of GHG emissions, a secure energy supply and a competitive economy. Furthermore, these policies have intermediate, specific and operational objectives that go from the reduction of primary energy consumption to triggering the renovation process in buildings. Figure 11 shows the objective tree for the energy efficiency policy based on the relevant policy documents analysed and showing these different levels. Some of this objectives are in line with the co-benefits mentioned in section 1.2, however these can be further exploited, especially at the Spanish level.

2.2. Policy theory reconstruction

Figure 12 presents the policy theory reconstruction for the selected policy package, showing the underlying assumptions and how these policies are expected to address the analysed barriers and achieve the policy objectives. According to Khan et al (2006) the most important steps in the policy theory are depicted in the form of cause-impact relationships. These start with the launching of the policy instrument and end with the achievement of the energy savings, and involve intermediate steps that link them together. The arrows show these cause-impact relationships connecting the concepts, and they have either a positive (+) or negative (-) sign, for positive or negative causal relations respectively. For example, more demonstration projects will increase the amount of available information and the level of awareness (+); while, more subsidies will decrease the perceived risks of energy efficiency investments (-).

The cognitive map shows how Spain has implemented certain instruments as a result of the EU instruments. Furthermore, it shows how these instruments are expected to achieve the policy goal of improving the energy performance in buildings and generating energy savings, which lead to the co-benefits and additional objectives mentioned in section 1.2 and Figure 11 respectively.

The EPC for existing buildings is included in the figure; however, it is important to keep in mind that this has not been approved yet at the national level.

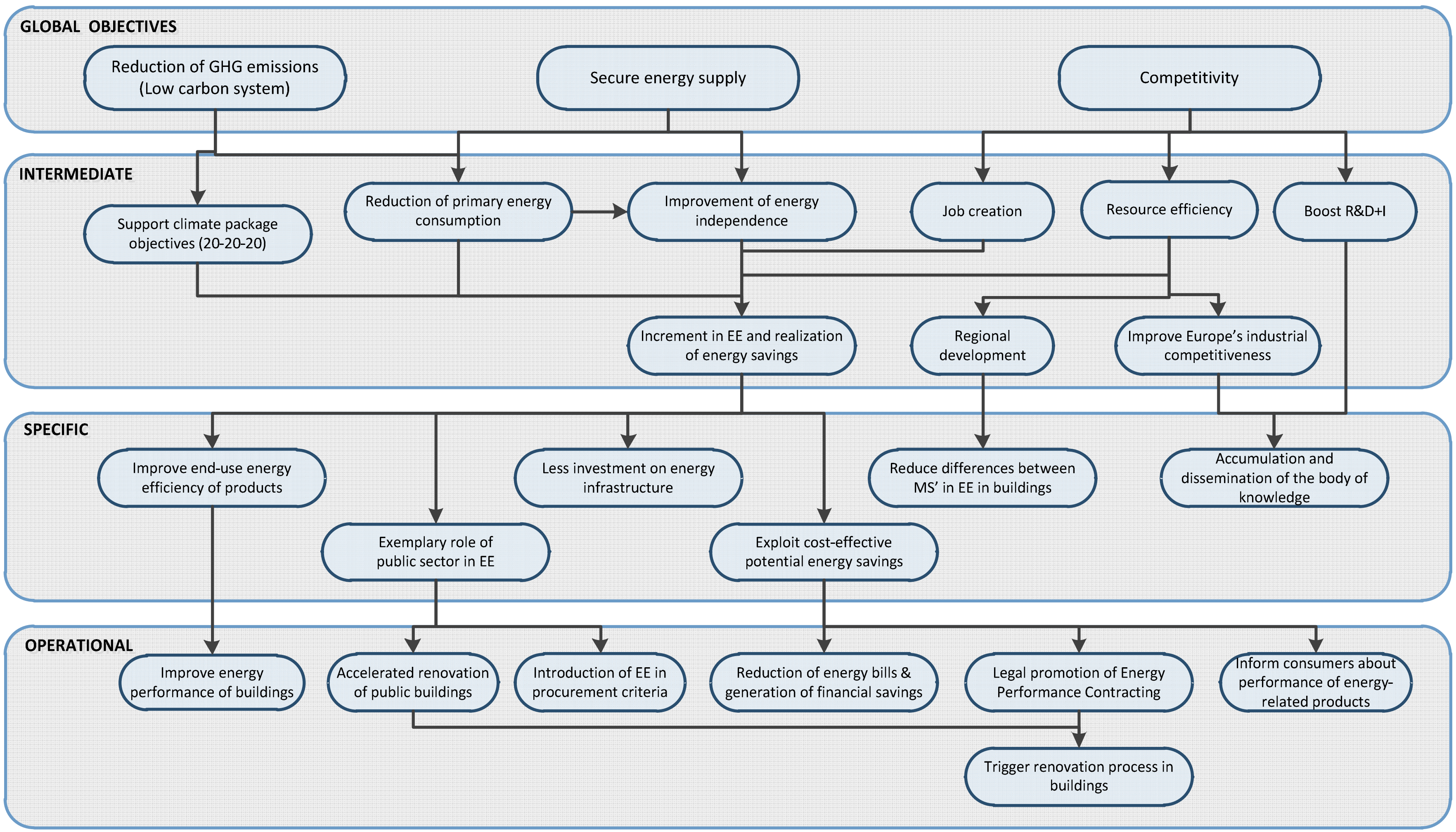


Figure 11: Objective tree for energy efficiency in the built environment
Source: Based on EE Plan (EC, 2011)

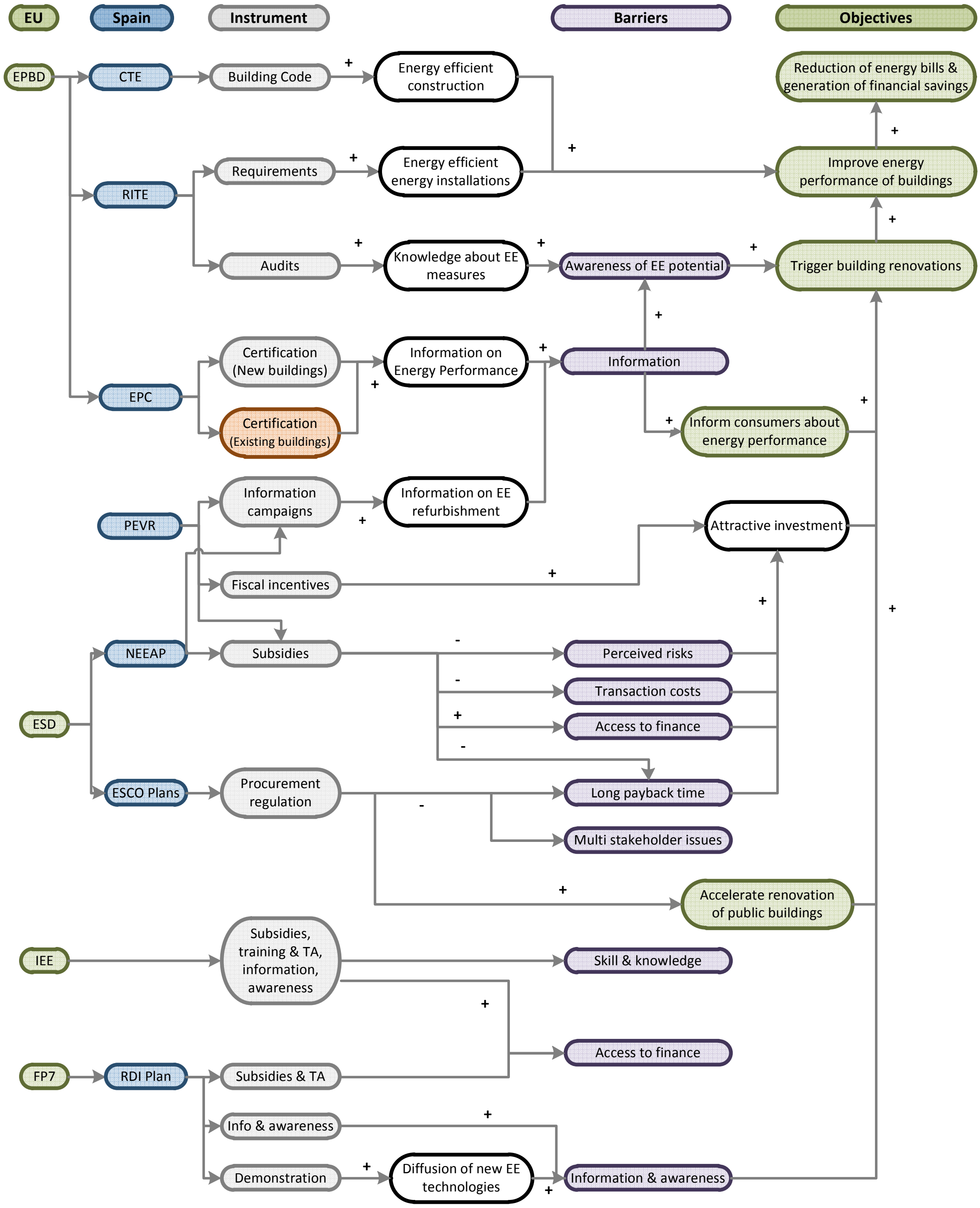


Figure 12: Reconstruction theory diagram

2.2.1 Assessment of the underlying assumptions

The policy theory reconstruction has been developed at a high level. However, each of the instruments is based on assumptions, which are discussed below. The validity of the underlying assumptions can be a success or failure factor of the implementation of the policy package, which makes their analysis an important step in the policy evaluation.

Building code (CTE): This instrument assumes that all new buildings will be more energy efficient given that they follow its requirements; however, the requirements are not stringent enough. Furthermore, most of the new buildings were constructed before the CTE was in place, during the construction boom, and do not comply with its requirements. Currently, there are a limited amount of buildings being built due to the collapse of the building sector, which makes the impact of this regulation minimal.

RITE: The main issue related to the RITE is the energy audits. The underlying assumptions regarding this instrument is that auditors are properly trained and provide quality reports with the identified energy efficiency measures. Furthermore, the availability of the information does not imply that the consumers will implement these measures (because of the barriers listed in section 1.3). In order to make these audits more effective could be to provide financial incentives and link them to the implementation of the recommended energy efficiency measures or the quality of the audit reports.

Energy performance certification (EPC): This instrument implies that certificates are issued, that they provide accurate information and that consumers consider the information when buying/renting a building, making them more energy conscious. Furthermore, property owners would get higher prices, making energy efficiency investments more attractive. However, these are weak assumptions: Consumers are not significantly influenced by the energy rating when making a decision since they face additional barriers in this stage such as bounded rationality and competing decisions; and its effect as an incentive for energy efficiency investments depends on consumer valuing highly energy efficient buildings.

Furthermore, the lack of compliance from Spain regarding energy certification of existing buildings makes this a very weak instrument. This is due to the fact that existing buildings are much more relevant than new ones. Besides, the fragmented structure of the government is not strong enough to monitor and ensure compliance of the certifications of new buildings. An example of this is the lack of a central EPC register.

NEEAP and PEVR financial incentives: Consumers must be aware of these instruments in order for them to be effective. Therefore, they should always be accompanied with information programmes, and it is not clear if this is the case. Furthermore, the PEVR subsidies and fiscal incentives should depend on energy efficiency requirements to be granted. Even though this is proposed in the *Plan for energy savings, energy efficiency and emission reductions in transport and buildings (MF, 2011)*, this has not yet been fully implemented. There is a link with the EPC rating for some of the PEVR refurbishment subsidies; however, the lack of the EPC procedure for existing buildings limits the effectiveness of this.

ESCO plans: Third party financing can help address some of the barriers regarding energy efficiency. Therefore, the ESCO plans are a valuable instrument. However, these plans' main focus is the promotion of the ESCO market by the mandatory use of ESCOs to reduce 20% of the energy consumption of public buildings. A main assumption for this instrument is that these plans will stimulate the ESCO market, which will promote energy efficiency also in private buildings. However, this is a relatively new market and it will need more support, both legal and financial, in order to become mainstream.

2.2.2 Addressing the identified barriers

The policy theory diagram in Figure 12 also allows to assess which of the identified barriers are being addressed. Even though the policy package considers many of the identified barriers, there are still some which are not tackled. Most of the financial barriers are addressed by the PEVR and NEEAP subsidies as well as the fiscal incentives; while the information and awareness barriers are addressed by the EPC, RITE (through the audits), demonstration projects from the RDI plan and information campaigns from the PEVR and NEEAP. However, most of the institutional and administrative barriers are not tackled.

In particular, more stress should be given to addressing the regulation and planning issues as well as the fragmented public administration and its consequent problems. This could be done by giving IDAE a more relevant role in ensuring the timely and effective implementation of the existing regulation at the local level. However, it is imperative to have sufficient political will to keep energy efficiency in the agenda and to make it a priority. Harnessing the co-benefits detailed in section 1.2 can be of significant help for this, especially if highlighting the opportunities energy efficiency presents for job creation and for the alleviation of the current crisis.

Finally, some barriers can be better tackled at a local level. For example, bundling small projects in order to more easily access finance could be encouraged by the local energy agencies. However, it is difficult to assess this as every autonomous community has the right to implement and control the particular instruments independently. IDAE, as national authority, could have a more pressing role in promoting and sharing best practices among the different local energy agencies and in compiling information regarding the implementation of regulation at the national level.

2.2.3 Indicators

In order to measure if the cause-impact relation between the policy instruments and the energy savings actually exists, a set of indicators should be measured. However, due to the narrow scope of this research,

Table 17 suggest some indicators, but these have not been measured.

Table 17: Key monitoring indicators
Source: Adapted from Khan et al (2006)

Instrument	Key indicators
CTE	- Number of checks carried out - Number of non compliant permits/buildings - Number of sanctions - Number, variety and costs of energy saving measures
RITE	- Number and quality of assigned auditors - Number and quality of audits carried out - Number of advised measures with acceptable payback times - Number of recipients that implement improvements - Number, variety and costs of energy saving measures implemented
EPC	- Number of certificates issued - Share of buildings with high energy performance - Level of awareness of the energy performance of buildings
NEEAP & PEVR financial incentives	- Number of eligible actors that are aware of the scheme - Number of eligible actors that apply for the scheme - Number of rejected/approved applications - Amount of subsidies provided
ESCO Plans	- Number of public buildings refurbished - Amount of energy savings per building

2.2.4 Policy overlaps

Khan et al (2006) mention that policy instruments often interact with other policy instruments, which can either reinforce or mitigate its implementation. This section intends to analyse this effects.

- **ESCO plans:** The ESCO plans, promote the development of the ESCO industry; however, they also provide energy savings in the public sector. This implies compliance with the energy efficiency directive. These plans could also serve as a way for energy retailers to comply with the 1,5% energy savings requirement proposed in the new energy efficiency directive. However, in order for these plans to be effective, there should be additional monitoring and measuring of the actual savings. Currently the focus is on developing the ESCO market and not on the energy savings which might limit the actual contribution towards bridging the energy savings gap. Furthermore, these plans could also aim at residential buildings instead of focusing only on public buildings. A link could be made with the PEVR in order to promote ESCOs in household energy refurbishments.

- **NEEAP and PEVR:** Even though there is a strong link between the NEEAP and the PEVR regarding energy efficiency in buildings, there is no strong coordination among the relevant authorities at the national or local levels. Both plans independently provide subsidies for energy efficiency in households. Currently, there are PEVR subsidies for new buildings linked to the EPC ratings; however, an important next step is to link the other financial incentives with EPC ratings for existing buildings (once the royal decree is approved).

- **Climate Change Action:** Energy efficiency policies also support the climate change action led by MAGRAMA (Ministerio de Medio Ambiente y Medio Rural y

Marino, 2011). Even though energy efficiency policies for buildings are part of the action taken to tackle climate change in Spain, a stronger connection could be made. Furthermore, there are horizontal actions such as green public procurement, RDI, awareness raising and education programmes which also (could) touch upon energy efficiency.

- **Growth and Employment:** The national reform programme of 2011 (Ministerio de Hacienda y Administraciones Públicas, 2011) mentions energy and climate as key challenges regarding growth and employment. However, energy refurbishments could be key to promote employment, especially now that Spain has over 20% unemployment (OECD, 2011), and this link could be exploited further.

3. Analysis and conclusions

The first section of this chapter has identified the main stakeholders, barriers and co-benefits related to energy efficiency in residential buildings; while, the second section has assessed the existing policy package using policy theory reconstruction and the insights gained from the previous sections.

The analysis has proved that the policy package does not address the low priority given to energy issues which could be considered the main barrier for energy efficiency improvement in residential buildings. This is directly related to the regulatory and planning issues in the sector. The fact that there is no joint initiative from the MITyC and the MF makes the case for energy efficiency in buildings lose strength. In addition, the existing plans (NEEAP and PEVR) do not stress enough the additional benefits provided by energy efficiency measures such as improved comfort for the final user and employment creation in the construction sector.

Furthermore, the existing regulatory instruments which have a higher potential to yield the energy savings potential of the sector have not been implemented properly or have not been implemented at all (as in the case of the EPC for existing residential buildings).

3.1. Assessment of the selected criteria

As mentioned in the methodology section, a selection of criteria were used in order to assess the policy instruments. Relevance, effectiveness and legitimacy were assessed for each policy instrument; while transparency, equity, sustainability, implementation and coordination were assessed for the whole policy package. This qualitative and subjective assessment is meant to provide insight as to where additional focus should be placed. Furthermore, this assessment is used as input for the recommendations given in the following section.

Table 18: Assessment of the policy instruments

Criteria	CTE	RITE	EPC	PEVR	NEEAP	ESCO plans
Relevance	High	Medium	Medium	High	High	Medium
Legitimacy	High	High	Medium	Medium	Medium	Medium
Effectiveness	Low	Medium	Low	Low	Low	Low
Transparency	Low: Despite the fact that the policy documents are available, the fragmented structure of the government in Spain and the independence of the autonomous communities to implement the policy instruments make the policy process less transparent.					
Equity	Medium: Even though the programmes provide equal opportunities to all participants, there might still be free riders (especially when concerning subsidies and incentives). Furthermore, low income households might have a harder time accessing the benefits of the available programmes due to lack of resources to gather the required documents to apply.					
Sustainability	High: Given that most of the plans have a long term horizon and that the improvements made in buildings will also last for a long time due to their life-span, the policy package will have a long lasting effect. (This could be diminished by the rebound effect, in case it was significant).					
Implementation	Low: The limited public resources due to the crisis along with the low priority given to energy efficiency lead to a meagre implementation of the instruments at the local level. Furthermore, the fragmented policy structure and the lack of control/monitoring from a national level give way to poor implementation of the existing policies.					
Coordination	Low: Synergies between the NEEAP and the PEVR could be exploited further. Even more, EE in buildings could be a way to help the construction sector overcome its collapse, providing employment and opportunities. In addition, coordination between local and national authorities could be improved to ensure proper enforcement of the regulation.					

3.2. Policy recommendations

The current policy package is not enough to help bridge the energy savings gap and yield the energy savings potential of the residential sector. Based on the insights gained in this chapter, a number of recommendations are proposed to improve the existing policy package for energy efficiency improvement in residential buildings:

- **Ambitious and clear targets for energy savings.** Having set targets for energy efficiency is a great first step towards tapping the energy savings potential. However, the current EU and Spanish targets are only indicative and they are not transparent. Furthermore, they are different which creates confusion (referring to energy savings or energy intensity, as well as different baselines) and does not allow for comparison. In the residential building sector, the energy targets should be supported by ambitious objectives for household refurbishments as part of the PEVR. This would help tackle the lack of interest barrier.

- **Coherent and stable regulatory framework, focused on existing buildings**. Regulation on energy efficiency in buildings should be more stringent to comply with the EPBD recast. This involves strengthening the CTE requirements. Furthermore, it is imperative to approve and implement the EPC procedure for existing buildings as soon as possible. In Spain, the majority of buildings which will be standing in 2050 have already been built (during the construction boom period); this was before the implementation of the CTE, which implies there is plenty of room for energy efficiency improvements in the existing building stock.

- **Leverage on co-benefits: Employment creation.** At EU level, energy efficiency policy leverages on some of the co-benefits of energy efficiency such as climate mitigation, improved energy security and competitiveness. However, Spain could take advantage of the opportunity to promote the construction sector through energy efficiency in residential buildings. Building refurbishments are a huge opportunity for employment creation and, therefore, key for the economic recovery. This should make energy efficiency policy a higher priority in the political agenda.

- **Coordination and cooperation among the different public agencies.** Energy efficiency in buildings should have the coordinated support of the relevant authorities (not only MF and IDAE, but also MAGRAMA) at the national, regional and local level. The different ministries should implement joint strategies and actions aimed at yielding the energy savings potential from the sector. For example, the measures aimed at energy efficiency in residential buildings in the existing action plans (NEEAP and PEVR) could have had a greater impact if designed and implemented jointly.

- **Coordination and cooperation among the different levels: National, regional and local.** The fragmented government structure in Spain sometimes hinders the effectiveness of policies. This is aggravated due to the fact that the NEEAP (and other plans) establishes different measures for the regional authorities to implement, but it does not explain how to do this. A better coordination and control from national authorities is needed in order to ensure the proper implementation of policies at the local level. Furthermore, the role of the implementing agencies is crucial in the success of the policy instruments; hence, these agencies should have the necessary resources and skills to carry out the implementation properly. For example, guidelines and best practices regarding policy implementation could be made available to regional agencies through IDAE.

- **Monitoring of the implementation of policy measures.** Given the fragmentation that exists in Spain, it is imperative that there is monitoring (for example of the suggested indicators) in order to have a clear idea of the effectiveness of the instruments, along with aggregation of the results and databases at a national level by IDAE. Through the implementation of such a monitoring system, the local authorities would control the quality of the projects (e.g. energy performance certifications and building refurbishments), while IDAE can control the compliance of the autonomous communities to the regulation in place.

CHAPTER V: CONCLUSION

1. Discussion

Throughout the research, there were a number of unexpected difficulties and practical difficulties. This section gives a short explanation of the problems encountered and their implications.

Information. The lack of information was an issue during the course of the research. In the gap analysis this was significant. The PRIMES 2007 data proved to be inaccurate; and the changes from the 2007 to 2009 baseline made the analysis almost impossible. Furthermore, there was no available projections regarding the energy consumption from the Spanish government, which made the comparisons limited. In the policy analysis, information was also an issue. The policy documents were accessible, although from (many) different ministries and public agencies. However, the fact that there were so many stakeholders involved made the amount of documentation too high, making it difficult to analyse them all in detail. In addition, the lack of compiled information and monitoring of the implemented policies was also an issue. No central databases are available, given that the implementation of the policies is done at the local level.

Policy theory reconstruction. The policy theory reconstruction could have been more detailed. In order to do this, a second round of interviews with relevant stakeholders would have been required. An additional issue was the lack of interviews with representatives from IDAE, given the political uncertainty context while the interviews were conducted. This could have provided better insight to understand the underlying assumptions as to how the policy instruments were implemented and how they are expected to work. Nonetheless, the outcome already provides an interesting overview of the existing policy instruments and how they are expected to address the barriers and achieve the targets.

2. Further research

Increasing energy efficiency in buildings is a complex issue, especially due to the wide range of actors involved. This study was an attempt to understand the importance of the building sector regarding energy savings; and, to evaluate the policy framework in place that aims to stimulate EE in buildings. However, the findings are not intended to be taken as comprehensive solutions or recommendations to the challenge at hand, but as contribution to a growing understanding of policy making in the sector. Furthermore, in the broader societal context, taking into consideration the huge unemployment, the collapse of the construction sector, the economic crisis and high government deficits, energy efficiency in residential buildings presents a huge opportunity. Integrated and ambitious policies in energy efficiency could be a way to employ all the idle workers from the construction sector and boost the Spanish economy. This requires further research, considering more than only policies aimed at energy efficiency.

A more in-depth analysis, considering the local level, as well as the actual free-rider effect and rebound effect, could have provided further understanding of the effectiveness of the policy package because of the relevance of Autonomous Communities in the implementation and enforcement of Spanish policy. Also, other instruments are available for policy evaluation besides policy theory reconstruction. Analysing the data from different perspectives could strengthen the findings of the research. For example, transition theory could expand on the challenge to transition the existing building stock to low-energy or net zero buildings, and network theory could provide further understanding regarding the links among the different actors. Additionally, the results could be complemented with a cost effectiveness analysis, considering both rebound and free-rider effects. Grösche et al (2008) found that 50% of the German households which received subsidies for energy retrofits were willing to pay more than the cost without subsidy, and therefore they free rode on the programme. In Spain this could be the case with the NEEAP and PEVR subsidies, as well as with the RENOVE programmes.

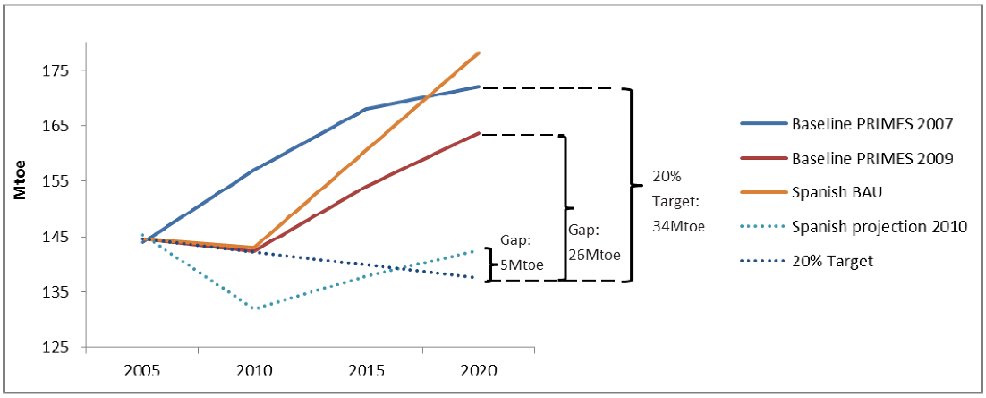
3. Conclusion

This research aimed to assess how energy efficiency policies in the Spanish residential building sector can help bridge the existing energy savings gap. Through policy theory reconstruction, this study has shown that the current policy package is not enough to help closing this gap and to yield the available potential in the sector. This is in line with the findings of the WWF report (2010), which states that in order to tap the potential for energy savings that exists in the residential sector, additional policy efforts should be undertaken. Additional relevant findings are presented in Box 5.

Box 5: Key findings

RQ: What is the energy savings gap that is currently not addressed by the policy package in Spain?

According to the PRIMES 2009, current energy efficiency policy will not be able to achieve the 20% energy savings target by 2020 in Spain, leading to an energy savings gap of 26 Mtoe. The effective implementation of the 2nd Spanish NEEAP, achieving all its proposed targets, would still lead to a 5 Mtoe gap.



RQ: To what degree can the potential available in the residential sector play a role in bridging this gap?

The potential for energy savings in the residential sector is large enough to be of significant help in bridging this gap. Focus should be specially in existing buildings which have the largest energy savings potential given that the construction sector has collapsed and that recent construction (from the housing bubble) does not comply with the 2006 CTE. However, this potential is not tapped by the current energy efficiency policy; the 2nd NEEAP states that the energy efficiency policies aimed at the residential sector will only contribute 0.2 Mtoe to the energy savings in 2020. Nonetheless, the potential lying in this sector (according to WWF, 2010; Economics for Energy, 2011; Fraunhofer Institute, 2009) is over 5 Mtoe. This is just enough to close the 5Mtoe gap that Spanish planning does not account for.

RQ: What are the existing EU and Spanish policies that aim to improve EE in residential buildings?

There are a number of policies at EU and Spanish level aimed at improving energy efficiency in residential buildings. The main instruments in Spain are the CTE, RITE, EPC and the NEEAP and PEVR along with their financial incentives. At the EU level, the Energy Efficiency plan and the EPBD and ESD are the most relevant instruments. Furthermore, Spain takes active part of various EU initiatives such as IEE and FP7. Overall, there is a combination of regulatory, economic and informational instruments to promote energy efficiency in buildings.

RQ: What are the existing barriers for energy efficiency in residential buildings? Does the policy package address them?

Despite the policy efforts to stimulate the implementation of energy efficiency measures in buildings, the existing potential for energy savings in the built environment is still far from being achieved. This is partly due to barriers such as the lack of interests from the consumers; the unattractiveness of the investments (due to the long payback periods, their small size and the high perceived risks); and, the lack of ambitious and comprehensive regulation, coordinated among the different actors and levels. Most of the financial barriers are partially addressed by the PEVR and NEEAP financial incentives; the information and awareness barriers are addressed by the EPC, RITE (through the audits), demonstration projects and information campaigns. However, most of the institutional and administrative barriers are not tackled. In particular, more stress should be given to addressing the regulation and planning issues as well as the fragmented public administration and its consequent problems.

RQ: What are the co-benefits of energy efficiency in residential buildings? Does the policy package benefit from them?

Energy efficiency has many co-benefits, including climate change mitigation, improved energy security and competitiveness. Given the collapse of the construction sector after the burst of the housing bubble and its significant impact in the labour market, the most relevant co-benefit in Spain is job creation. Building refurbishments are a huge opportunity for employment creation and, therefore, key for economic recovery through the promotion of the construction sector. Currently, energy refurbishments for households are a priority; however, there is no coordinated strategy between the relevant authorities (MF and IDAE) but rather two separate plans. One focuses on household refurbishments and the other one in energy efficiency (PEVR and NEEAP respectively).

RQ: To what degree is the policy package effective and coherent? And, how could it be improved?

The policy package needs to ambitiously focus on existing buildings; however, there is no EPC for existing buildings yet which has a detrimental impact on the effectiveness of the package. A list of recommendations to improve the policy package has been proposed, including joining efforts from the different ministries involved (MITyC – IDAE , MF and MAGRAMA) and designing a joint strategy for energy refurbishments in buildings which would leverage on the opportunity for employment creation and recovery of the construction sector. In addition, cooperation and coordination between local and national authorities is key to ensure the proper implementation of the policy instruments; therefore, IDAE should have a more pressing role specially in knowledge sharing and monitoring regarding the implementation of the policy instruments.

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ANNEX 1: INTERVIEWS

	Institution	Contact	Phone	Mail
1	Isuno Energy	Nuria Valero	93 187 6937	nuriavalero83@gmail.com
2	FENERCOM	Regina Nicolás	91 353 2197	rnicolas@fenercom.com
3	CIEMAT	Maria Rosario Heras	91 346 6305	mrosario.heras@ciemat.es
4	SEE	Francisco Maciá Tomás	91 349 7429	SGPES@minetur.es
5	WWF	Georgios Tragopoulos	91 354 0578	gtragopoulos@wwf.es
6	A3E	Antonio Lopez Nava	91 761 0250	alnava@asociacion3e.org
7	Economics for Energy	Pedro Linares	91 540 6257	pedro.linares@upcomillas.es
8	Ministerio de Fomento	Luis Vega	91 728 4004	lvega@mviv.es
		Javier Serra Tomé	91 728 4000	jserra@mviv.es
9	Ecorys	Begoña Solorzano	91 598 0851	a.solorzano@es.ecorys.com
10	Fundación Entorno	Jesus Aisa	91 575 6394	Jesus.aisa@fundacionentorno.org

1.	Isuno energy
Date and time	3/2 at 2:00pm
Contact person	Nuria Valero

Summary:

Organización política en España: Las comunidades autónomas tienen competencias exclusivas. El estado provee un marco y las CCAA lo desarrollan en las regiones (similar al proceso de trasposición de directivas). Responsable del sector energía a nivel nacional: Ministerio de Industria, Energía y Turismo (MITyC – ex Industria, Turismo y Comercio).

Ejemplo: Certificación energética de edificios. El CTE propone requerimientos nacionales mínimos, pero las CCAA y municipalidades pueden ser más exigentes. (Cataluña tiene un decreto específico).

Barrera principal: Marco regulatorio inestable / Sector construcción hundido

Resultado de la coyuntura económica: Construcción busca diversificar, incluyendo RES y EE. Algunas empresas proveedoras de tecnología funcionan como ESCOs para vender sus productos.

27/01: suspensión de las primas para energías renovables, incluye cogeneración. Esto genera más desempleo (tasa actual de 24% y subiendo).

Políticas:

- Calificación energética: CALENER (certificación A/B/C etc. Solo para edificios nuevos o ciertas renovaciones integrales)
- No hay certificación para edificios existentes.
- Requisitos mínimos: LIDER (Define si cumple con requerimientos del CTE de demanda térmica). Los software fueron desarrollados por el estado (actor sin experiencia en esto) para que sean gratuitos y accesibles. Sin embargo, esto generó problemas dado que no hay una empresa responsable de brindar servicio técnico. Además, el software es poco amigable, difícil de usar, con fallas.

Contacto: Más información sobre certificación energética: ICAEN (Cristian Paños) -> Consultar sobre proyecciones.

2.	FENERCOM (Fundación de la Energía de la Comunidad de Madrid)
Date and time	17/2 at 9:00am
Contact person	Regina Nicolás Millán - Foreign Affairs & Project Manager

Summary

FENERCOM es la agencia de energía de Madrid, creada en 2006 como parte de **IEE.** Es una fundación que cuenta con la participación del gobierno nacional, del gobierno regional, universidades, la cámara de comercio, sectores profesionales (como instaladores) y empresas energéticas. Su composición como fundación le permite ser independiente, contar con mayores fondos (privados) y tener un mayor control sobre su uso.

Estructura: El gobierno nacional asigna los fondos a las distintas CCAA. La dirección general de industria, energía y minas (a nivel regional) asigna los fondos y prioridades a las agencias de energía (p.e. FENERCOM).

Instrumentos de información: FENERCOM brinda cursos (p.e. para profesionales del sector), conferencias semanales, congresos y foros. Además, publica libros y folletos para promover la EE en edificación y realiza campañas escolares para sensibilizar a la población. FENERCOM cuenta también con una página web, newsletter, publicaciones online, campañas de radio y TV (especialmente para los programas RENOVE → Integración horizontal de los intrumentos).

Planes RENOVE: FENERCOM implementa los planes RENOVE. Estos, en el sector EE en la edificación incluyen los planes de ascensores, ventanas, calderas (individuales y comunales), sistemas de detección presencial, aire acondicionado, electrodomésticos. Además, existen los planes de apoyo a las energías renovables e iluminación exterior (para ayuntamientos). Los planes RENOVE se agotan rápido (especialmente aquellos que implican inversiones más pequeñas como calderas). Estos son ejecutados por asociaciones de instaladores. Por ejemplo los planes RENOVE de aire acondicionado y calderas son manejados por ASEFOSAM. FENERCOM no tiene proyectos directos como otras agencias de energía.

Ejecición de planes RENOVE: Se firma un contrato con el ente ejecutor donde se pone de maera explítica todas las condiciones y requerimientos. Para controlar que se hayan realizado lo pagos, FENERCOM realiza llamadas e inspecciones para comprobar las instalaciones. Además, el ente ejecutor debe asegurarse de contar con la autorización del ciudadano (firma de documentos) y debe certificar que los equipos reemplazados se han dispuesto de manera adecuada (certificado de achatarramiento). Los ciudadanos deben probar que su quipo viejo cumple con las inspecciones obligatorias definidas por las regulaciones vigentes. FENERCOM presenta a IDAE tablas y reportes detallados y agregados sobre los ahorros energéticos logrados.

Barreras: Barrera principal es la cultural y de falta de formación. Los programas de la UE (IEE, FP7, Manage Energy) son relativamente nuevos. La población no conoce las oportunidades (lack of awareness) y prefiere invertir solo cuando los equipos ya no funcionan. Además, la barrera económica.

Contactos: ASEFOSAM: Miguel Angel Sagredo (masagredo@asefosam.com)

3.	CIEMAT (Centro de Investigación del medio ambiente, energia y tecnologia)
Date and time	20/2 at 10:00am
Contact person	Maria Rosario Heras - Directora de la Unidad de EE en edificación

Summary:

Historia: En 1982 se cambió la junta de energía nuclear por el CIEMAT, ENRESA (residuos) y el consejo de seguridad nuclear. En 1986 se empezó con los programas: **PASSYS** (Probar diferentes componentes de edificación); **PASTOR** (Iluminación natural); **MONITOR** (Monitoreo y balance energético de edificios en viviendas sociales por segundo); **SOLINFO** (Información y difusión sobre energía solar); y **ARCHISOL** (Arquitectura solar). En 1989 se publicó el manual de diseño bioclimático en Barcelona (CLA: Clima, lugar y arquitectura).

CIEMAT: Su mayor rol es el de coordinar, impulsar e involucrar a los distintos grupos de investigación. Además, colabora con medios de comunicación y con educación. Los principales enfoques en el sector edificación son la arquitectura bioclimática y energía solar. Existe un potencial de ahorro de más del 60% en calefacción y refrigeración solo usando un buen diseño.

Programas actuales:

- **S3PAS:** Simulación de sistemas solares pasivos (parte del programa PASSPORT+ de la UE).
- **PASSYS:** Las células de ensayo también su usan para probar techos.
- **ARFRISOL (2005-2012):** 80% a 90% de ahorro energético en oficinas.

Directivas y regulaciones relevantes:

- **Directivas:** EPBD; EE; SAVE (1993)
- Norma básica de edificación (1979)
- CTE: Adapta la norma básica incluyendo la directiva de EE (SAVE)
- 2002: Regulaciones municipales, p.e. Madrid, Cataluña y Sevilla (luego son obligatorias con la nueva CTE).
- Nueva CTE (2006): Después del boom de la construcción. Require reducir la demanda energética e integrar captadores solares para agua sanitaria caliente. Es un medio y no un fin, se debe adaptar constantemente (p.e. incluir calefacción y 'frio solar'). No incluye edificios existentes.
- CEVPO (Calificación energética de vviendas de protección oficial) – 1995/1997
- Ley de Economía Sostenible

Sector residencial en España:

- 80% de las viviendas están adosadas o en bloque.
- Síndrome de edificio enfermo: A/C y calefacción contaminan la calidad del aire interior (IAQ).
- CALENER: Mediciones en diseño (no hay mediciones reales).
- Boom de la construcción: 400 000 nuevas viviendas de protección oficial (VPO), pero no todas usan medidas de arquitectura bioclimática.
- Sector donde importan las 'modas'. Actualmente no se conoce mucho sobre el consumo energético. Falta concientizar a los técnicos. Las constructoras están involucradas en temas de EE porque debido a la crisis 'no hay otra cosa que hacer'. Cada vez hay más gente involucrada. Arquitectos consideran más la sostenibilidad (p.e. smart cities: residuos, energía, movilidad).

Barreras: Económicas → Subvencionar la rehabilitación energética o proveer hipotecas verdes.

Objetivos: Se cumplirá con RES pero no con CO_2 o EE.

4.	SEE (Secretaría de Estado de la Energía, MITyC)
Date and time	21/2 at 9:00am
Contact person	Dr. Francisco Maciá Tomás - Subdirector general de planificación energética

Summary:

El rol de la SEE es desarrollar la política energética española. Dos grandes pilares son las energías renovables y la eficiencia y ahorro energéticos. En el 2004 se elaboró la estrategia de EE, y luego sus dos planes de acción (2005-2007 y 2008-2012), y en el 2011 se elaboró el segundo NEEAP (2011-2020) más ligado a los compromisos adquiridos con la UE.

Regulación:

- **CTE** (2007): Traspone EPBD (2002). Comprende 4RDs, de los cuales hay 3 aprobados.
- **RITE**: Larga trayectoria en el tema de equipamientos en edificios. Requiere por ejemplo termostatos en cada radiador y medidores en cada vivienda (control individual).
- **Certificación en edificios nuevos:** RD aprobado
- **Certificación en edificios existentes:** Se propuso el RD pero el consejo de estado dijo que no había habilitación legal para imponer dichos requisitos sobre los dueños o inquilinos de propiedades existentes. Hacía falta una ley para que el estado disponga de dicha habilitación legal. Por ello se dio la Ley de Economía Sostenible (2011). Sin embargo, el RD no se aprobó dado que debido a la crisis este decreto sería una traba al fomento de venta y alquiler de viviendas que el estado promovía. La UE demandó a España ante el tribunal dado que no cumplió con la EPBD (2002) y por ello, a la fecha, el RD culminó su plazo en consulta pública y está a la espera de ser aprobado.

Ayudas:

- **Planes RENOVE:** Son ayudas para cambiar equipos por otros más eficientes. Estas se proporcionan a través del IDAE, en cooperación con cada CCAA.
- **Bombillas:** En el 2009 hubo una gran campaña para promover el uso de bombillas de bajo consumo, a través de la cual el MITyC envió un bono a los ciudadanos con su factura de luz para cambiarlo gratuitamente por una bombilla en las oficinas de Correos. Se entregaron más de 18 millones de bombillas, lo cual concientizó a los ciudadanos y promovió el uso y fabricación de estas nuevas bombillas, que por ello, bajaron de precio.

Los planes cuestan, y se están cuestionando debido a la crisis. Sin embargo, no se ha tomado una decisión aún, debido en parte al cambio de directivos en el IDAE. La voluntad de seguir mejorando la EE está presente, pero la coyuntura es un problema.

Objetivo: El objetivo español es mejorar la intensidad energética (final) en un 2% anual. El objetivo de la UE es 'absurdo' dado que es absoluto. Por ejemplo, con la crisis es más fácil tener un objetivo en intensidad energética; de otra manera, el objetivo de la UE se podría cumplir sin tomar medidas.

Planificación energética: Los cambios estructurales que ha sufrido España afectan la EE (Fig. 33 del documento de Planificación Energética). Este efecto es importante dado que en el periodo 2000-2010 la industria pierde peso mientras el sector servicios gana peso. Esto reduce la intensidad en un 1%. Por otro lado, desde el 2005 se ha mejorado la EE en términos intrasectoriales en un 2%. La intensidad energética primaria era mayor a la final debido a CHP. Ahora, debido a la liberalización de la industria y a la inclusión de RES (100% eficiencia) esto va cambiando).

Proyecciones: La proyección del escenario central toma el objetivo de mejora del 2% de la intensidad energética. Estas se hacen en la SEE, con datos propios y se basa en el PBI. El objetivo total es 20% de mejora en la intensidad energética, basados en 2005.

Documentación: Revisar las planificaciones de infraestructura (2002-2016 y 2008-2016). Ver cap. 3 y 9 de la revisión 2006 y cap.2 (Previsión energética española).

5.	WWF
Date and time	21/2 at 11:00am
Contact person	Georgios Tragopoulos

Summary:

Alegaciones contra NEEAP: No hay un objetivo vinculante, son medidas genéricas y es poco ambicioso. EE necesita más movimiento, dado que es una oportunidad para generar empleo. Se necesita más voluntad política.

El CTE tiene límites muy bajos, y además no hay certificación para todos los edificios (no se hace nada con edificios existentes que se venden o alquilan). La implementación de la certificación de edificios nuevos no ha sido óptima, pues hay edificios no certificados.

Hay potencial técnico/económico de renovar 30% del parque hasta el 2020, y a partir del 2020 ya no se necesitaría fomento estatal para el sector. Esto implica pasar de una tasa de renovación del 0.5% a 1.5% y reforzar el CTE, además de tasa de 3% para edificios públicos (incluyendo aquellos alquilados). El estudio de potencial se realizó de manera bottom-up considerando distintas zonas climáticas y antigüedad de los edificios.

Las rehabilitaciones profundas son menos del 75% de las rehabilitaciones, dado que la inversión está alrededor de los 20 000 EUR.

Objetivos EE: Considerar EE de acuerdo al PBI no tiene sentido, especialmente en época de crisis. Esto es debido a que puede haber menor consumo de energía debido a un menor PBI, pero no necesariamente a medidas de EE (p.e. sector edificación colapsado y sector industria con baja producción). Los objetivos de la UE y de España deberían ser claros y absolutos.

Barreras:

- Hay mayor conciencia, pero no se toma acción debido a la crisis. Además hay otras organizaciones con intereses propios como las petrolíferas, suministradoras de energía, nucleares, ESCOS (implementan medidas activas, no pasivas).
- Barreras económicas y falta de educación de los ciudadanos. Es necesario cambiar la mentalidad de los ciudadanos (p.e. glaerías solares usadas como armarios).
- Fragmentación entre gobierno central y CCAA. Cada CCAA toma decisiones propias, no hay una estrategia central y no funciona (p.e. hay corrupción y burocracia).

Problema: Del 2000 al 2010 fue el boom de construcción, pero no se aplica el CTE porque este fue aprobado en 2007.

Algunas viviendas de protección oficial usan arquitectura bioclimática demostrando que es accesible (poco presupuesto).

La crisis es una oportunidad para cambiar. La rehabilitación de edificios es la única solución que le daría una inyección a la economía.

Revisar: Documentos proporcionados (alegaciones al NEEAP y nueva publicación)

6.	A3E (Asociación de Empresas de Eficiencia Energética)
Date and time	21/2 at 2:00pm
Contact person	Antonio Lopez Nava

Summary:

Fundado en 2009 como una iniciativa de empresas consultoras que realizaban auditorías energéticas. Actualmente tiene más de 50 empresas (generación, distribución, consultoras y fabricantes de equipos (todas involucradas en conseguir un consumo más eficiente de la energía).

A3E tiene un carácter práctico: Desarrollar conocimiento técnico (a través de grupos de trabajo), dinamizar el sector, apoyar iniciativas y concientizar (Generar demanda).

Eficiencia energética: Desconcierto, las empresas no ven el negocio aunque buscan posicionarse en EE (buscan diversificar su negocio por la crisis). Pero, 'suena más de lo que hay'. EE es un concepto generalista, difícil de acotar y concretar. Además es transversal.

Barreras: Falta concienciación, regulación (no hay normativa p.e. para edificios existentes) y financiación. Los bancos no conocen el sector, los beneficios o cómo analizar los riesgos.

EE edificios: Atrasados en trasponer EPBD (Calificación energética de edificios existentes) → multa.

Auditorías energéticas: Subvenciones (directas al beneficiario) para financiar auditorías energéticas que estimen el potencial de ahorro y propongan las medidas necesarias, pero no hay requisitos (ni de calidad ni de implementación de las medidas sugeridas). Las auditorias deben ser re-prestigiadas (muchas fueron de mala calidad, previniendo cualquier inversión en medidas), de alcance adecuado. P.e. EVE (país Vasco) mide la calidad de las auditorías y paga el 75% de lo que creen que el reporte vale. El 75% de las subvenciones las aplica las CCAA y el 25% IDAE para proyectos estratégicos. Los convenios de colaboración IDAE/CCAA tienen requerimiento, lo que hace que la implementación aunque fragmentada, sea similar a nivel nacional.

- **Proceso:** Beneficiario obtiene la auditoría y con el reporte obtiene la subvención.
- **Racionalización:** La auditoría es un coste mientras que la implementación de las medidas son una inversión**.**

Los cambios políticos generan desconfianza lo que dificulta la inversión.

Sugerencias:

- Hacer obligatorias auditorías energéticas y la implementación de las medidas recomendadas.
- Más concienciación.
- Más seguridad jurídica para el cliente y las ESE (Ley EE). Reglas comunes y estables.
- Incentivos que provean acceso a la financiación y dinamización del sector.
- Desarrollo de estándares contractuales (conocimiento jurídico contractual).
- Más inversión en I+D+i.

7.	Economics for Energy / Universidad Comillas
Date and time	21/2 at 4:30pm
Contact person	Pedro Linares

Summary:

Si los objetivos 20-20-20 se cumplen, no será debido a las medidas políticas implementadas. La mayor cantidad de medidas son para el sector industria, que ya es eficiente. El mayor problema son los sectores transporte y edificación. En el sector transporte se han establecido 'medidas sin mordida' y en el sector edificación el CTE (2006). Sin embargo, no hay casas nuevas debido a la crisis y el colapso del sector construcción luego del boom de la última decada. Además, tampoco se está haciendo rehabilitación energética. Esto se debe a que sólo una rehabilitación energética es muy cara, sólo es rentable cuando es parte de otra rehabilitación (p.e. de la fachada por temas de construcción). [McKinsey considera la rehabilitación energética como una gran alternativa).

Las medidas son 'wishful thinking' y subvenciones. El cambio de gobierno ha hecho una pausa temporal debido a la crisis pero continuará la misma línea.

Hay 'awareness' pero los ciudadanos quieren rentabilidad. Sólo consideran inversiones que se paguen en 3 años, y las de EE toman más tiempo. Es difícil ganar dinero con EE, por ende tampoco tienen poder de lobby. (Ni los que están a favor ni los que están en contra, porque no hay inversiones).

Contacto: Peter Sweatman (Climate Stratey & Partners) → Buscar informe sobre EE en edificación y financiación, del 2011.

Sugerencias: Incrementar el precio de la energía y tratar el tema de cambio de actitudes y comportamientos. O implementar prohibiciones (p.e. CTE) aunque no es muy recomendable sí es efectivo.

ESCOs: No tienen negocio. Lo único rentable y tiene potencial es cambiar calderas por otras más eficientes. El resto son ahorros pequeños y complicados de gestionar e inversiones grandes.

Planes RENOVE: Subvenciones para cambiar equipos por otros más eficientes. Mucho free riding. Otro problema es 'beer fridge', a veces en lugar de deshacerse del equipo viejo, mantienen ambos consumiendo más enegía. Sin embargo, algunos planes RENOVE requerían el achatarramiento o correcta disposición de los equipos viejos, pero no es 100% fiable. Único beneficio: Concienciación sobre etiquetas energéticas. Sin embargo, se deben retirar luego de cumplido dicho fin.

Proyecciones: No hay proyecciones oficiales. Sólo objetivos nacionales y proyeccions que van de acuerdo a dichos objetivos.

La crisis está muy ligada al consumo energético. Podría tardar 4 o 5 años en salir de la crisis. Hay un incremento en la intensidad energética, tal vez por sectores intensivos o por el sector residencial.

8.	ATECOS / Fundación entorno – Debate on ESCOs and EE
Date and time	22/2 at 4:00pm
Contact person	Jesus Aisa

Summary:

Documentos: @ www.fundacionentorno.org

- **Construimos valor (2007):** EE en la edificación
- **Por activa y por pasiva (2009)**: Ventajas de la EE en la edificación.

Riesgos ESCOs:

- **Técnico:** Capacidades técnicas y experiencia en diseño e implementación.
    - **Auditorías energéticas:** Deben ser exhaustivas (no usar solo CALENER/LIDER), usando mediciones de campo, un análisis histórico de la facturación y de los hábitos de los usuarios. Así como simulaciones energéticas dinámicas.
- **Operativo:** Comportamiento de los equipos, no se obtienen los rendimientos esperados.
    - Implicar a los fabricantes en la fase de proyecto y exigir q se cumplan los rendimientos (p.e. mantenimiento obligatorio de parte del fabricante).
- **Mercado:** Incertidumbre sobre precio de energía y regulación.
- **Usuario:** Uso correcto de instalaciones, educación.
    - Formación en el uso de las instalaciones (p.e. manuales de buenas prácticas).
    - Contajes individualizados.
    - Protocolos de medida y verificación.
- **Financiero:** Variables económicas del cliente y el entorno.

Claves de la EE:

- **Aspecto tecnológico:** Existen tecnologías maduras (p.e. CHP, LED, etc). Pero es necesario tener formación técnica para que la consultora y otros profesionales conozcan estas soluciones.
- **Tema normativo/legislativo:** Es fundamental tener estabilidad normativa. La línea debe ser continua independientemente de la situación política y económica.
    - P.e. retiraron primas, decreto que anula régimen especial alterando proyectos RES/CHP.
    - RD 47/2007: No hay registro de la calificación energética porque depende de las CCAA. No es una realidad.
    - Calificación de edificios existentes. Falta enfoque en rehabilitación de edificios. Los tiempos y requisitos son ‘light’.
- **Financiación:**
    - Modelo ESCO
    - No hay inversión
- **Confianza del cliente final en EE**
    - Concientizar al usuario a través de conferencias, etc.
    - **Flexibilidad:** Adaptar servicios a los clientes. Por ejemplo, tener más modelos de contratos (IDAE solo tiene un modelo)
    - **Transparencia:** Necesidad de empresas especializadas para que las ESCOs no lo asuman todo.

9.	Ministerio de Fomento
Date and time	27/2 at 9:00am
Contact person	Luis Vega & Javier Serra Tomé

Summary:

Relación CTE y crisis: En 1979 se elaboró el primer CTE debido a la crisis energética de 1970. El nuevo CTE (2006) se elaboró a partir de la ley de ordenamiento de la edificación (1999). Este CTE dispone de requisitos de EE en el DBHE. Sin embargo, el boom de la edificación fue antes de que este entrara en vigencia (principios del 2000), y en el 2007 decrece. Desde inicios de la crisis la construcción nueva es muy escasa.

Certificación energética: Como parte de la trasposición de la EPBD (2002), en 2007 se publicó un RD 47/2007 para la certificación energética de edificios nuevos (usando los programas CALENER y LIDER). Las CCAA se encargan de elaborar normas complementarias, así como de vigilar, inspeccionar, registrar y comprobar la implementación de este RD. Este año se espera aprobar el RD xx/2012 para edificios nuevos que utilizará una metodología simplificada.

Revisiones: Debido a la nueva Directiva (EPBD, 2010) es necesario revisar el RITE y CTE utilizando la metodología del coste óptimo. En el 2012 se deberían aprobar las revisiones tanto para edificios nuevos como existentes. La ampliación del CTE se enfocará en la rehabilitación. La revisión del CTE unificará el CTE del 2007 con los nuevos requerimientos de la EPBD (2010), e incluirá cumplir una letra mínima (certificación energética).

Modificaciones planeadas para el 2012, 2016 y 2020. En el 2012 se quieren coordinar las escalas de calificación energética con los requerimientos del CTE. En el 2016, pasar a consumos (unificar demanda, instalaciones y RES). En 2020 ajustar números, requerimientos, etc. El papel ejemplarizante del estado es importante.

Porcentaje de ahorro de 20 a 30% con base en 2006.

Regulación:

- CTE, 2006 y revisión 2012
- RD Certificación energética, 2007 (edificios nuevos) y 2012 (edificios viejos) – Esquema similar al francés
- RITE, 2007
- ITE (Inspección Técnica de Edificios) – Es necesario ligarla a la calificación energética.

Ayudas: A veces estas ayudas son compatibles entre ellas.

- PEVR (Gob. Central) – Focalizado en viviendas (Hay objetivos en el PEVR: número de intervenciones). Proporciona subsidios si hay rehabilitaciones que mejoren la calificación energética de los edificios.
- PAEE (Gob. Central/IDAE) – Generalmente para sector terciario (30% de los fondos del PAEE son para estrategias ejemplarizantes y el resto para iniciativas de las CCAA, p.e. planes RENOVE)
- Planes RENOVE de CCAA – Fondos del PAEE (Subsidios tramitados por asociación)
- Planes de rehabilitación de CCAA

Información y formación: IDAE y agencias de energía de las CCAA proveen información a estudiantes, profesionales y público en general. El Ministerio de Fomento provee cursos de formación sobre el CTE para hacer aplicable la reglamentación.

Barreras:

- España tiene una mala cultura de mantenimiento.
- **Estructura estatal muy fragmentada**: El gobierno central no tiene mucha jurisdicción sobre las CCAA, por lo que las exigencias son de carácter básico.
- Déficit en rehabilitación, por ello se necesita enfocar el nuevo CTE en ello y proveer incentivos.
- Mucha edificación obsoleta.

- Es posible disponer obligaciones cuando el edificio se está diseñando, ya que los costes no son muy altos. Pero es difícil obligar edificios ya existentes.
- Poca sensibilidad. (Aunque también depende del clima).

Sugerencia: Ventanilla única para los distintos trámites (p.e. ayudas).

Rehabilitaciones:

- Dependen del usuario.
- Requieren licencias municipales (aquí se podrían obtener estadísticas, pero están esparcidas y el nivel de detalle depende de la municipalidad). No hay registro nacional o completo.

Contactos: Pedro Prieto (Director EE Edificación); Marcos Gonzales (empleado del IDAE para DG energy en Bruselas); Luis Mateo (ANDIMAD).

Webs:

- www.ITEweb.com (ICCL – Instituto de Construcción de Castilla-León)
- www.codigotecnico.org (Centro de investigación Toroja)

Publicaciones

- Implementing the EPBD
- Informe ASIEPI (Coste óptimo)
- Planes RENOVE (ANDIMAD)

10.	**Ecorys**
Date and time	27/2 at 9:00am
Contact person	Begoña Solorzano

Summary:

EE: Empresas son más interesadas por el ahorro (más que particulares).

Barreras:

- Falta concientizar al ciudadano. Ha habido campañas a nivel central (bombillas y RENOVE).
- Luego del boom de construcción, el sector está parado (pero esto no es solo por la crisis).
- Dado que el gobierno es descentralizado, las CCAA hacen lo que quieren. Además hay duplicidad de competencias.
- Desconocimiento de las oportunidades.
- Gente mayor. (Es más difícil cambiar su mentalidad).

Regiones más involucradas en temas de energía y medio ambiente:

- Cataluña
- País Vasco
- Navarra

Contactos en la Agencia Extremeña: (Proyectos SUDOE: E4R, ENERBUILCA, OPTIMAGRID)

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