WWF

SUMMARY REPORT

DECEMBER 2010

Potential Energy Savings And CO_2 Emissions Reduction

from Spain's existing residential buildings in 2020

With the collaboration of:

European Climate Foundation

With the collaboration of ETRES Consultores 
Texts: Evangelina Nucete and Manuel Romero Rincón
Translation: Veronique Bodoutchian
Layout: Eugenio Sánchez Silvela

This document is also available in Spanish at www.wwf.es.
WWF is one of the major and most effective international independent organizations aiming at the conservation of nature. WWF operates in more than 100 countries with the support of five million people worldwide.
WWF works for a living planet and its mission is to stop the environmental degradation of the planet and build a future in which humans can live in harmony with nature through the conservation of the world's biological diversity, the use of sustainable and renewable natural resources, and the reduction of pollution and wasteful consumption.

The residential sector in figures

40%

Of the EU final energy consumption comes from buildings.

106 years

to renovate half of the housing stock at current pace.

19%

Represented renovation within the total investment of the Spanish construction sector.

25,129,027

dwellings in Spain in 2008.

INTRODUCTION

The construction sector has a huge influence on the evolution of the countries´ energy consumption and CO_2 emissions. Throughout the European Union, buildings are responsible for 40% of the total energy consumption[1] and 36% of carbon dioxide emissions. In Spain, houses and buildings in the tertiary sector represent 26% of final energy consumption, 17% and 9%, respectively[2]. In addition, only the energy used in homes represents one fifth of the greenhouse gas emissions of our country. If we add to these, moreover, those arising from the construction process itself, we can conclude that **the residential sector concentrates one third of the total national greenhouse gas emissions[3].**

Nowadays, there is a wide consensus on **the strategic importance of buildings to achieve the Community objectives of energy efficiency and the reduction of greenhouse gas emissions.** The construction of new buildings under design and energy efficiency requirements that are more demanding than the current ones and require little or no energy (zero or nearly zero-energy buildings) will be an obligation for EU countries as of 31 December 2020[4].

Energy improvements on new constructions, however, **are not sufficient by themselves to reduce buildings´ energy consumption and emissions.** This would slow down the pace of the increase of these two variables, but it would not decrease them. **Emissions arising from buildings´ energy consumption are closely linked to the units already built**[5], whose historical weight is considerably higher than that of the newcomers that will gradually join this emission nucleus[6] (the annual construction rate of new buildings represents only 1% of all existing buildings). On the other hand, most of the buildings we have today were built with very low, and in some cases non-existent, energy demand requirements

WWF STATES THAT THE ONLY REALLY EFFECTIVE FORMULA TO REDUCE ENERGY EMISSIONS AND CONSUMPTION IN THE BUILDING SECTOR, IS THROUGH THE REDUCTION OF ENERGY DEMAND FROM EXISTING BUILDINGS, IMPROVING THEIR INSULATION LEVELS.

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[1] Recital 3 of Directive 2010/31/EC of the European Parliament and of the Council, dated 19 May 2010, on the energy performance of buildings (recast). The Directive defines nearly zero-energy buildings as "a building with a very high energy performance where the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produce on-site or nearby" (Art. 2.2)).

[2] Annual Report on Energy Consumption, 2008 (IDAE, December 2009), http://www.idae.es/index.php/mod.pags/mem.detalle/idpag.481/relcategoria.1368/relmenu.162.

[3] Participation of the Minister of Housing in the Joint Committee on Climate Change on 22 September 2009, http://www.mviv.es/es///pdf/intervenciones/im220909.pdf.

[4] In the case of used and publicly owned buildings, this date shall be moved forward to 31 December 2018.

[5] "A strategy to direct the construction sector towards greenhouse gas emission reduction (GHG)". Report carried out by Professor Albert Cuchí, with the collaboration of Anna Pagès, from the Polytechnic University of Catalonia, as commissioned by Spain's Ministry of Housing. October 2007. http://www.mviv.es/es/pdf/otros/doc_GEI.pdf

[6] Ibid.

Improving energy use in buildings is a key step to achieve the 20% energy savings community objectives and 30% reduction of greenhouse gas emissions by 2020. Investing in better insulated buildings would also help reduce outside energy dependence and lower energy bills of citizens, improving domestic revenues. But it is also an opportunity for economic recovery and the creation of thousands of jobs in one of the sectors most affected by the crisis and unemployment.

In a recent joint declaration, representatives of the European construction sector suggested that this is the most efficient and cost-effective way to achieve such objectives[7]. Likewise, they also recognized the need **to set binding targets for the deep energy renovation of existing buildings,** in addition to the objectives and requirements for new buildings, pursuant to the provisions of Directive 2010/31, on the energy performance of buildings. For the EU to reduce its CO2 emissions by 80-95% in 2050 compared to 1990 levels, and contribute significantly to the Community objective of energy savings of 20% by 2020, the rate of renovation of buildings will have to be multiplied by a factor which is two to three times higher than the current rate, over the next forty years[8].

Energy rehabilitation of buildings in Spain offers a huge potential for development, and the sector is ready for the challenge

The construction sector is ready to face this challenge, but appropriate policy and regulatory frameworks are needed so that these objectives are implemented successfully. Each Member State must have a strategy with well-defined long-term lines of action, both at national, regional and local levels, to tackle a deep energy renovation of the building stock. To achieve effectiveness, each country must also guarantee availability of sufficient economic, financial and fiscal means to stimulate the implementation of actions. In addition, they will have to ensure the viability of investments to the different agents involved in the building process: from the industry and the supply chain, to the owners of the buildings.

THE ABSENCE OF INCENTIVES, FAILURES IN ADMINISTRATIVE MANAGEMENT, THE LACK OF ENFORCEMENT OF LEGISLATION OR THE LACK OF INFORMATION TO BUILDING USERS AND OWNERS ARE SOME OF THE BARRIERS THAT HINDER ENERGY RENOVATION OF BUILDINGS.

[7] "The Fundamental Importance of Buildings in Future EU Energy Saving Policies. An informal initiative of actors and stakeholders from the European construction sector to make input to future EU Energy Saving Strategies and Policies", version 4.0 (final), 5 July 2010. http://www.ace-cae.eu/public/contents/getdocument/content_id/868

[8] The current rate for the UE is between 1.2% -1.4% per year

DEEP ENERGY RENOVATION IN SPAIN: AN UNRESOLVED ISSUE

In recent years, several policies and regulations have been underway in Spain to improve the energy performance of the construction sector. These include the Technical Building Code (CTE) (2006), the Regulation of Thermal Installations in Buildings (2007), the Energy Certification for New Buildings (2007), the State Plan for Housing and Renovation 2009-2012 and the proceedings referred to in the Energy Efficiency and Savings Plan 2008-2012 (PAEE +). The latter provides aids for the renovation of the thermal envelope of existing buildings and promotes the construction and renovation of buildings with high energy ratings, among others.

However, many experts and professionals argue that the impact of these measures is insufficient to improve the sustainability of the sector and to promote a greater and more rapid modernization of the building stock. Although the CTE managed to include some important aspects, such as the mandatory use of solar panels in new buildings, it lacks the necessary requirements to effectively limit the demand of its thermal envelope. On the other hand, aids offered through PAEE + are mainly aimed at the renewal of equipment, rather than at solutions to limit energy demands of buildings.

Countries such as Germany, Great Britain, Holland, or France[9] have already enacted national policies to reduce energy consumption and emissions from their buildings by 2020, with well-defined and quantified energy efficiency objectives and requirements both for new buildings and for existing ones.

If Spain wants to show a firm position in the fight against climate change, it must follow the example of other European countries. To do so, it must adopt an effective deep energy renovation program for existing buildings, to turn them into a lower energy consumption sector with binding renovation goals by 2020.

In our country, renovation and particularly, the deep energy renovation of buildings, offers a wide potential for development, although it has traditionally had a residual weight within the activity sector. In 2009, renovation represented only 19% of the total investment in the construction sector in Spain, versus the average 43% in the EU. Germany, for example, works in existing buildings represent 62% of the activity of the sector and new buildings a little more than 37%[10]. The Spanish annual renovation rate is comparatively, also very low. If we consider the pace established within the State Plan for Housing and Renovation, it would take about 106 years to rehabilitate 100% of the building stock (taking as reference year the number of homes in 2008).

Building in Spain has been based on the construction of new buildings, a model whose vulnerability was highlighted after the explosion of the real estate bubble and the financial and economic crisis. **To embrace a deep energy renewal of the building stock is now more than ever, the great opportunity for the sector in order to recover from the crisis. Thus, thousands of new green jobs will be created, and it will contribute to the commitments made by our Government in the field of energy savings and the fight against climate change.**

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[9] For example, in France, all new public or private buildings built after 2010 will have to be designed in accordance with the standards of low consumption and become "energy positive" by 2020. On the other hand, existing buildings will have to be renovated to reach an average energy consumption of 90 to150 kWh/m2/year, and different fiscal and financial incentives have been established to meet the necessary investments.

[10] Report on the global situation of the Spanish real estate market, prepared by Aguirre Newmann, http://www.euroval.com/es/observatorio/documento.asp?id=959.

REPORT: "POTENTIAL ENERGY SAVINGS AND CO2 EMISSIONS REDUCTION FROM SPAIN'S EXISTING RESIDENTIAL BUILDINGS IN 2020"

WWF Spain has commissioned ETRES Consultores the carrying out of the study: **Potential energy savings and CO2 emissions reduction from Spain's existing residential buildings in 2020.** Its purpose is to show how, by means of a more coordinated and decisive policy, energy consumption and greenhouse gas emissions associated to the residential building stock can be significantly reduced, and thus ensure the contribution of this sector to the achievement of Community commitments to fight against climate change by 2020.

The specific objectives pursued in this report are as follows:

- Analyze the potential of energy savings and emissions reduction represented by residential buildings in Spain by 2020, taking into account the application of different solutions for energy improvement.
- Propose a realistic and feasible objective for the sector for a deep energy renovation of the existing residential building stock by 2020.
- Demonstrate the urgent need and the importance of promoting the deep energy renovation of existing buildings to achieve significant reductions in energy consumption and in emissions associated to the sector.

The report compares the impact of different solutions to improve energy performance in terms of energy consumption and emissions of residential buildings, taking into account the different climate conditions and building typologies existing in our geography.

The economic impact entailed by the application of different improvement solutions for a Spanish average home was also assessed.

The results obtained were finally projected on the building stock for 2011-2020, defining four scenarios based on the number of dwellings renovated in this period as a whole. Each scenario evaluated the impact of each of the improvement solutions to reduce energy consumption and emissions from the existing residential buildings in 2020, compared to 2008 levels, the last year for which official statistical information for the sector is available at the time of the study.

SCOPE

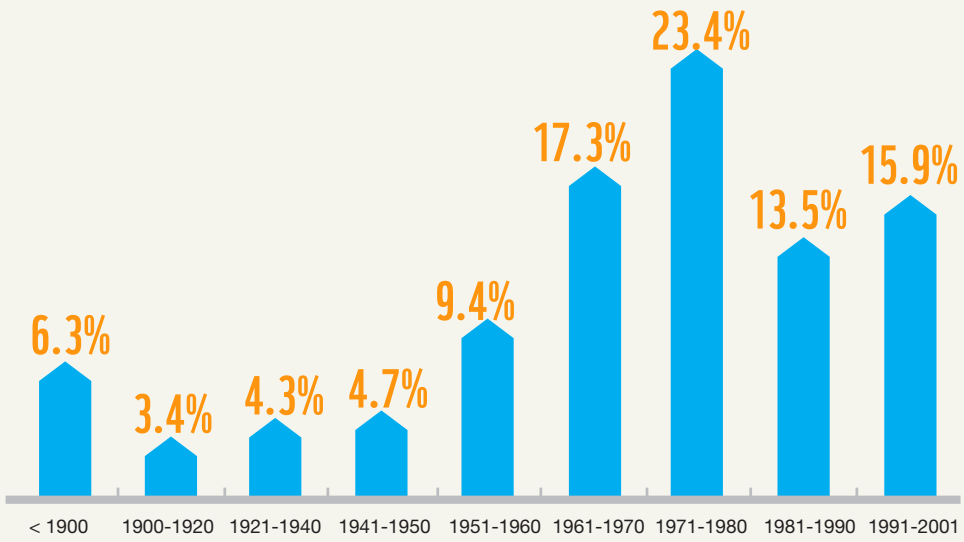
The scope of the study focuses only on **residential buildings** and does not include those for tertiary use. Residential buildings represent 85% of the surface built in our country (a total of 3,500 million m2), and 17% of final energy consumption. On the other hand, the residential and tertiary sectors have very differentiating features, both of functional type (size, hours of use, internal loads), and use (offices, shops, hospitals...), building typologies, facilities used or building solutions. These are all factors that condition the energy performance of a building, and therefore, it is not always feasible to use the same techniques of improvement in both sectors.

The analysis does not consider energy consumption and emissions caused by new dwellings incorporated to the building stock between 2009 and 2020. The energy consumption analyzed relates only to the thermal uses for heating, cooling and domestic hot water production.

Results cover all the building stock, including first and second residences, to avoid the possible rebound effect which could arise from not intervening on the latter (33% of the building stock).

Graph 1
Age distribution of Spanish building stock

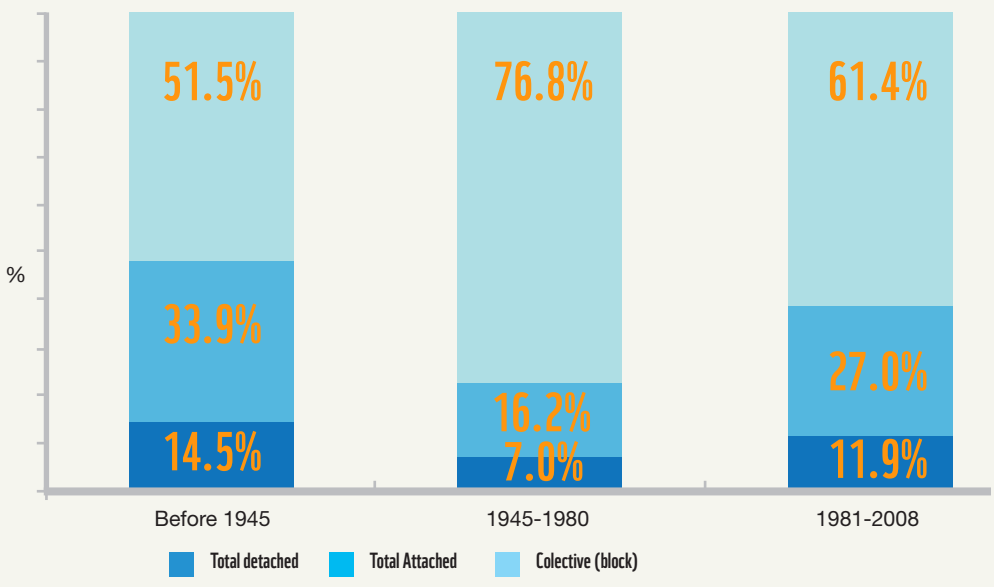
Spanish existing residential buildings are relatively new. Half of the houses in Spain are more than 30 years old, and most of them lack of minimum requirements to limit their energy demand.



Source: Population and housing census 2001, INE (Spain's National Institute of Statistics).

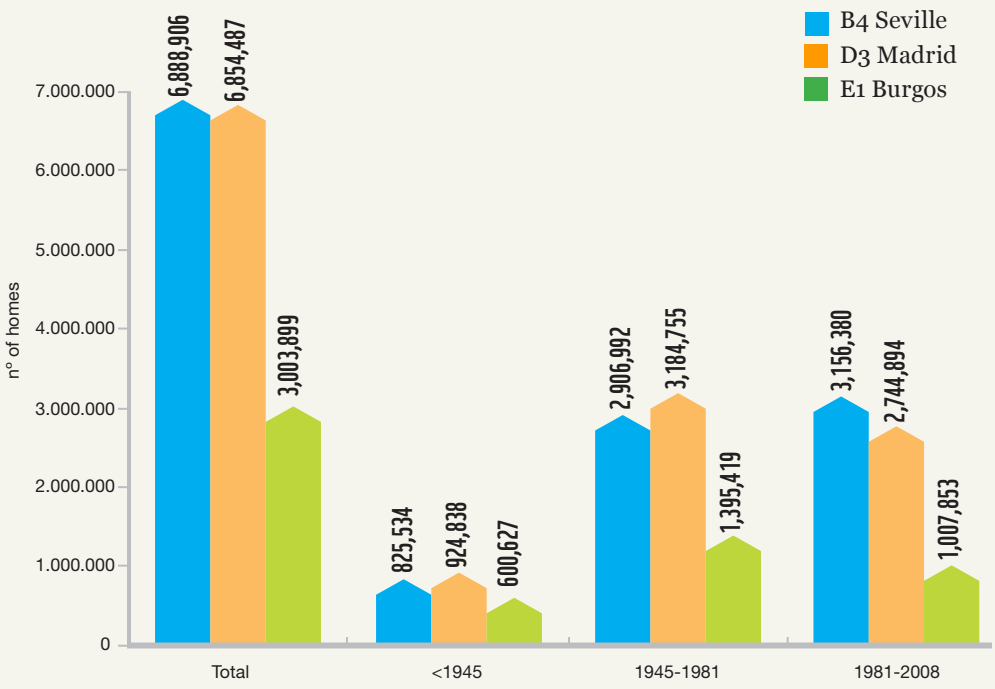
Graph 2
Distribution of buildings in terms of age and type

Existing buildings represent a total of 3,500 million m2 built, of which 85% is destined for residential uses, and the remaining 15% to other tertiary uses, primarily for administrative and commercial purposes.



Source: Population and housing census 2001, INE (Spain's National Institute of Statistics), and Ministry of Housing (2002-2008).

Graph 3
Distribution of dwellings in terms of age and climate zone



Source: Population and housing census 2001, INE (Spain's National Institute of Statistics), and Ministry of Housing (2002-2008).

Between 2001 and 2008, existing buildings grew at an average annual pace of 585,064 dwellings (13 thousand new homes per million inhabitants per year), when in most European countries, this pace was 5 thousand homes per million inhabitants.

METHODOLOGY

The methodology followed in the study has been based on the use of the LIDER[11] application that determines the energy demand for heating and cooling of the building, taking into account the climate data of the area in which it is located and their geometric, constructive and operational parameters. Information obtained with LIDER has been transferred to the official program of Energy performance of buildings (CALENER) to determine the energy demands for heating and cooling, final energy consumption and CO2 emissions.

ENERGY IMPROVEMENTS CONSIDERED

A total of five improvements for existing dwellings of different nature have been considered, and their effect has been compared with respect to a situation in which no intervention was carried out on the building stock, for different types of buildings and climate zones.

[11] IT program of the general verification option of the requirement for Energy Demand Limitation (HE1), established in the Basic Document of Energy Saving of the CTE, of the Ministry of Housing and IDAE.

E1 TREND

Initial situation of the building without renovation.

E2 INSULATION+ [1ST IMPROVEMENT INSULATION LEVELS]

It considers an improvement of the maximum levels permitted currently referred to under HE1 of the CTE[12] for thermal transmittance parameters of soils, covers and facades as well as measures to improve treatment of cracks and thermal bridges (table I)

E3 INSULATION ++ [2ND IMPROVEMENT INSULATION LEVELS]

The improvements introduced in the E2 solution (Insulation+) are reinforced to incorporate criteria used in the PassivHaus standard: a highly isolated building envelope (maximum U-value of 0.15 W/ m^2 K) and heat recovery for the air extracted from the house (table I)[13].

E4 RENEWABLES

The incorporation of facilities for the use of solar thermal energy to produce domestic hot water (coverage 60% - 70%, according to the climate zone) and photovoltaic solar energy for electricity consumption (10%) are considered.

E5 RENOVE PLANS

The impact on energy consumption of the existing residential buildings of the implementation of the Renove Plans for boilers and air conditioners are considered, according to the development they are experiencing in the different Autonomous Communities with the implementation of the Savings and Energy Efficiency Plan 2008-2012.

E6 MIX

The combined action of planned improvement on the insulation of the building under E3 (Insulation ++), E4 (Renewables) and E5 (Renove Plans) is analyzed

[12] Energy Demand Limitation (HE1), established in the Basic Document of Energy Saving of the Technical Building Code. These improvements are based on the impact study carried out by ETRES Consultores for ANDIMAT as a proposal for the first and second review of the CTE: http://www.etresconsultores.es/consultoria/revision-cte-he1/.

[13] Ibid 12.

Chart I. Improvements of the insulation levels of the buildings considered in the study

			Climate zone					
			B4 (Seville)		D3 (Madrid)		E1 (Burgos)	
			e2	e3	e2	e3	e2	e3
Facades - U (W/m²·K)			0.32 (1.07)	0.15 (1.07)	0.23 (0.86)	0.15 (0.86)	0.16 (0.74)	0.15 (0.74)
Covers - U (W/m²·K)			0.24 (0.59)	0.15 (0.59)	0.18 (0.49)	0.15 (0.49)	0.16 (0.46)	0.15 (0.46)
Floors - U (W/m²·K)			0.45 (0.68)	0.15 (0.68)	0.35 (0.64)	0.15 (0.64)	0.22 (0.62)	0.15 (0.62)
Openings	**Frames – U** (W/m².K)		2.20 (5.70)	2.20 (5.70)	1.80 (3.50)	1,60 (3.50)	1.80 (3.10)	1.60 (3.10)
	Glass	**U (W/ m2.K)**	2.70 (5.70)	2.20 (5.70)	2.30 (3.50)	1.60 (3.50)	2.30 (3.10)	1,60 (3,10)
		g solar factor - g	0.65	0.60	0.70	0.65	0.75	0.75
Carpentry airtightness (m³/h.m²)			50 (50)	27 (50)	27 (27)	9 (27)	27 (27)	9 (27)

You may find additional information about the technical report at: www.wwf.es/que_hacemos/cambioclimatico/nuestras_soluciones/edificios_eficientes.

The values shown in parentheses are those currently required by the CTE HE1 section. The CTE imposes no direct requirement for the “g” solar factor of glass. Improvements based on the impact study by ETRES Consultores for ANDIMAT as a proposal for the first and second review of the CTE.

OTHER INITIAL CONDITIONS

Three climate zones have been considered: B4 (Seville), D3 (Madrid) and E1 (Burgos), as a result of regrouping the twelve climate zones established in HE1-CTE[14]

Existing residential buildings have been divided chronologically in three stages, according to the construction year and the thermal characteristics required by the legislation of the time.

Construction year	Applied criteria
Before 1945	Period prior to the civil war. Very thick walls and thermal inertia.
Between 1945 and 1981	Post-war period. Since the beginning of double-insulated walls until the year of the actual implementation of the first Spanish thermal regulation on thermal conditions, RD 2429/1979 (NBE-CT/79).
Between 1981 and 2008	Application period of the NBE-CT/79 until the effective implementation of the current thermal regulation: DB-HE of the CTE.

The impact of energy improvement on three types of buildings has been analyzed: detached single-family homes, attached single-family homes and block collective homes. For each of them, two typologies of buildings have been considered, producing in turn a total of six types of buildings studied.

Thermal installations. For each building analyzed three possible combinations were considered:

Domestic hot water (DHW)	Heating	Cooling
Electric boiler	Electric radiators	With no installation
Conventional boiler LPG*	Electric radiators	Direct expansion (split).
Mixed conventional boiler with gas oil/ natural gas		Direct expansion (split).

*LPG = Liquefied Petroleum Gases

[14]Basic Document of Energy Saving DB-HE of the Technical Building Code.

RESULTS OF THE ANALYSIS

RESULTS PER DWELLING

Measures related to the improvement of insulation levels are the ones that offer the best results per house in terms of energy savings, reduction of emissions and economic profitability. With the modernization of thermal equipment and the installation of solar energy systems, the average housing consumption can be reduced between 12.4% and 23.2%, respectively, while increasing the levels of insulation of the building would bring much higher reductions, between 57% and 72%, depending on the depth of the improvements carried out.

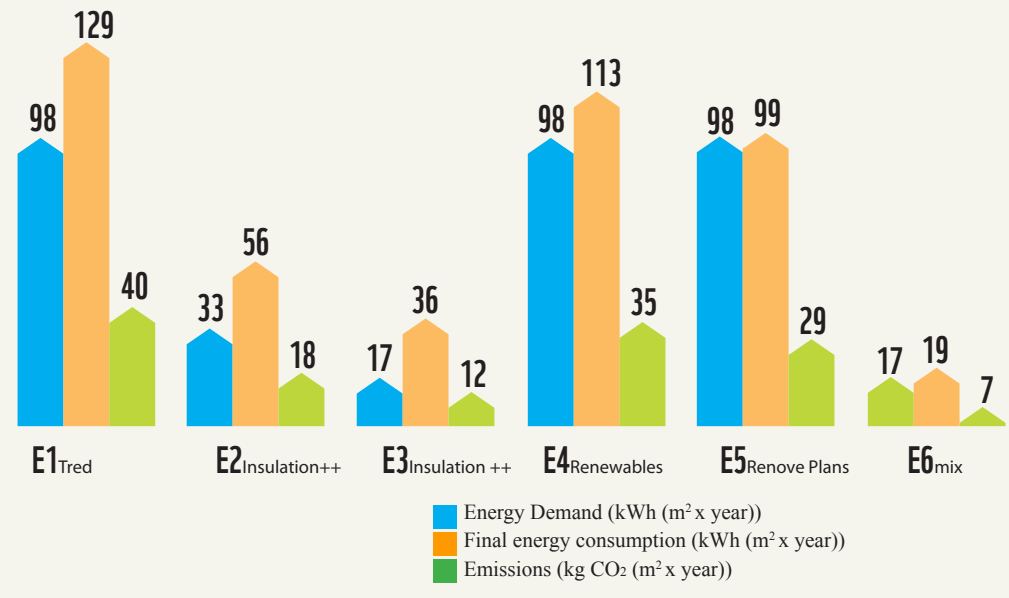
The effect of incorporating more efficient equipment and solar facilities, after having previously improved the levels of insulation of the building with criteria close to that of passive homes, would further reduce energy consumption by more than 85% and CO2 emissions per house by more than 82%, with respect to those the same building would have without the improvement.

Despite the greater initial investment, the economic savings generated by improving housing insulation is four times higher than the benefits achieved if only air conditioning equipment are upgraded or solar systems are installed in buildings.

The renewal of equipment is the solution that requires the lowest initial investment (34.34 €/ m2), but the savings generated in an average house are of little significance: less than 200 €/ year. In addition, payback periods are high, around 30 years, which can be reduced to 20 years in case of receiving investment aids.

E2 (Insulation+) and E3 (Insulation++) improvements have significantly higher investment costs (56.18 €/ m2 and 76.55 €/ m2), but the economic savings are much higher (455 €/ year and 578 €/ year), with much shorter and affordable payback periods for owners of dwellings, 10-11 years, respectively. These times can be reduced, in turn, to 6.5 - 7.2 years in the case of receiving investment aids as the ones existing today.

Chart 4
Impact of energy improvement proposals on an average home in Spain



Comparatively, the installation of solar systems for self-consumption would be today the least cost-effective solution from the economic point of view.

The E6 improvement, combining a mixture of the above solutions, would represent the highest initial investment per house (184 €/ m2) and would generate the greatest annual economic savings, close to 700 € / year. Payback periods are between 19 and 29 years, similar to those obtained by equipment renewal.

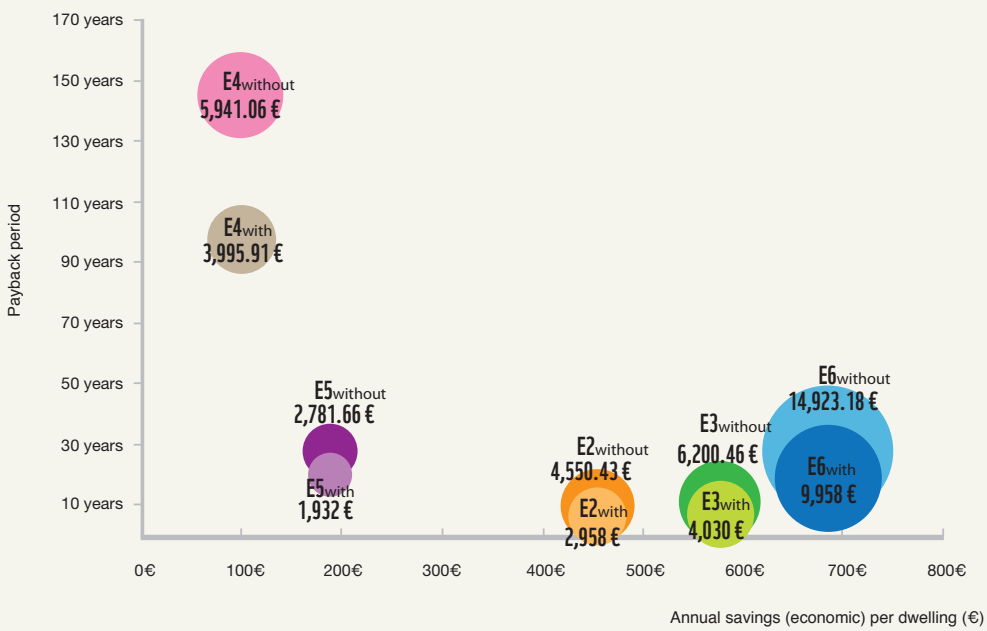
Chart IV
Decrease of final energy consumption with respect to a home before renovation (in %)

Type of building	Detached single-family home	Attached single-family	Block collective	Average home
E2 Insulation+	-60.2	-57.0	-55.8	**-56.9**
E3 Insulation++	-70.0	-68.6	-74.6	**-72.1**
E4 Renewables	-11.7	-15.1	-11.2	**-12.4**
E5 Renove Plan	-25.0	-26.3	-21.1	**-23.2**
E6 mix	-83.6	-83.6	-86.4	**-85.2**

Decrease of CO_2 emissions with respect to a home before renovation (in %)

Type of building	Detached single-family home	Attached single-family	Block collective	Average home
E2 Insulation+	-58.3	-55.2	-54.7	**-55.3**
E3 Insulation++	-67.5	-66.6	-72.7	**-70.0**
E4 Renewables	-12.2	-14.3	-10.8	**-12.0**
E5 Renove Plan	-29.5	-30.1	-26.4	**-28.0**
E6 mix	-80.2	-80.6	-83.5	**-82.3**

Graph 5
Comparison of improvement profitability, with and without financial aid



The diameter of the circles represents the investment cost.

E1 Trend- E2 Insulation+ - E3 Insulation++ - E4 Renewables - E5 Renove Plan - E6 mix

RESULTS OF EXISTING BUILDINGS

Under the analyzed impact scenarios, the intervention from 117,500 homes per year, coincides with the rate of annual renovation foreseen under the State Plan for Housing and Renovation 2009-2011, to 1,250,000 homes per year, which means multiplying by 9.6 the rate above. Taking into account these rhythms, in the next ten years it might be possible to renovate between 4.5% and 49.7% of the buildings existing in 2008, producing different results on the evolution of final energy consumption and CO2 emissions of all existing buildings towards 2020.

Chart V
Projection on the total existing buildings between 2011 and 2020

	Annual rate of renovated homes (dwellings/ year)	Total number of homes renovated in 2020	% of total existing buildings renovated between 2011 and 2020, with respect to base year*	Number of years needed to renovate 50% of the total existing
T1	117,500	1,175,000	4.5%	106 years (2116)
T2	312,500	3,125,000	12.4%	40 years (2050)
T3	625,500	6,255,000	24.5%	20 years (2030)
T4	1,250,000	12,500,000	49.7%	10 years (2020)

Base year= 2008

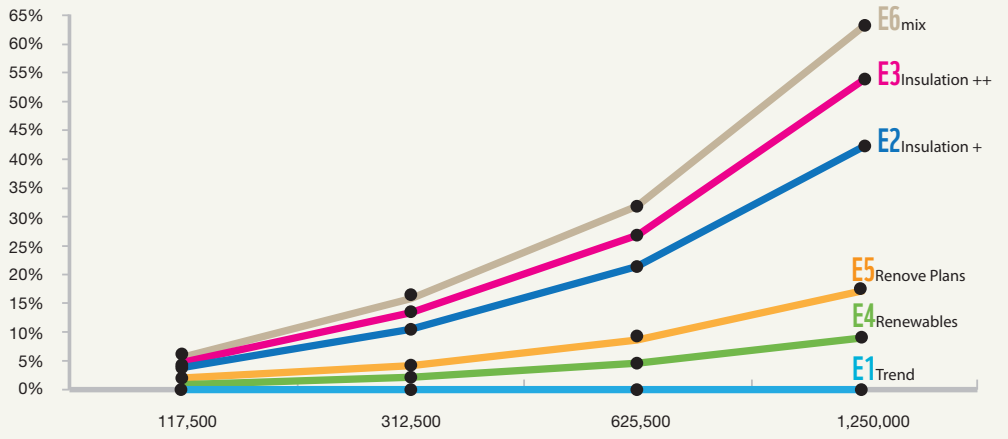
The energy savings obtained for the period 2011-2020 in the four impact scenarios are indisputably greater the higher the number of renovated homes. In all of them, the most significant effects are achieved by implementing solutions that directly affect thermal demand of buildings; that is, by improving housing insulation levels.

With the E2 improvement (Insulation+), the energy consumption of existing buildings could decrease up to 42% in 2020, with respect to 2008, which would mean cumulative savings of more than 400,000 GWh for the period 2011-2020. In the case of applying even more demanding renovation criteria, close to the standards of passive houses (E3 improvement (Insulation++)), savings would reach up to 54% and the domestic energy bill would decrease more than 500,000 GWh for the entire period.

Furthermore, measures such as the renovation of thermal installations or the incorporation of solar systems to dwellings represent, comparatively, a very low impact on the reduction of energy consumption of existing buildings. In the first case, the maximum savings obtained by 2020 do not exceed 17% in the best scenarios, and in the second case, just 9%.

Taking into account these same improvements after having submitted the buildings to a deep energy renovation with criteria close to the standards of passive houses (E6 improvement (Mix)), the impact on energy savings in existing buildings would be maximum. Final energy consumption in 2020 would decrease up to 64% with respect to 2008, and more than 600,000 kWh between 2011 and 2020 would not be consumed.

Graph 6
Decrease of final energy consumption of the building stock in 2020*, based on the total number of homes renovated between 2011 and 2020.



* Base year= 2008.

Chart VI
Cumulative final energy savings of existing buildings* between 2011 and 2020 (GWh

Total number of homes renovated per year	117,500	312,500	625,500	1,250,000
E1 Trend	0	0	0	0
E2 Insulation +	38,425	102,193	204,550	408,773
E3 Insulation ++	48,758	129,677	259,561	518,707
E4 Renewables	8,411	22,370	44,777	89,481
E5 Renove Plans	15,650	41,622	83,310	166,488
E6 mix	57,575	153,126	306,497	612,503

*Total existing buildings corresponding to 2008. Results calculated on the basis of an average home in Spain.

Chart VII
Cumulative CO_2 emission reduction of existing buildings* between 2011 and 2020

Total number of homes renovated per year	117,500	312,500	625,500	1,250,000
E1 Trend	0	0	0	0
E2 Insulation +	11,581	30,802	61,653	123,207
E3 Insulation ++	14,677	39,034	78,130	156,135
E4 Renewables	2,516	6,692	13,394	26,766
E5 Renove Plans	5,845	15,546	31,117	62,184
E6 mix	17,196	45,733	91,539	182,931

*Total existing buildings corresponding to 2008. Results calculated on the basis of an average home in Spain.

By evaluating only the options that support reductions in thermal demand, it can be observed that, to achieve savings in 2020 that are at the same time significant in terms of results and that can be assumed from the technical and economic point of view by the sector, **it would be necessary to renovate throughout the 2011-2020 period between 20% and 40% of the buildings existing in 2008; that is, between five hundred thousand and one million homes a year.** Depending on the improvement applied, by 2020 **energy consumption could decrease between 30% and 50% with respect to 2008**, with highly differentiated economic impacts according to the type of measure and the number of annual dwellings to be renovated.

Chart VIII

Building stock in 2008: 25.129.027
Average cost per Ton CO2 = 10 €.

Final E consumption decrease of the building stock (2008)	Final energy savings of the building stock in 2020 (GWh)	Average annual emissions savings (kTon CO2/year)	Improvement applied	Number of dwellings that should be renovated per year	Total number of dwellings renovated between 2011and 2020	% of the renovated building stock in 2020 (with respect to 2008)	Annual investment without financial aid (million €/ year)	Annual investment with present financial aid (million €/ year)	Annual average economic savings as a result of decreased energy consumption + emissions (million €/ year)	Average savings as a result of decreased emissions (million €)	CO2 Ton/ € decrease (without financial aid)	CO2 Ton/ € decrease (with financial aid)
			E2	890,000	8,900,000	35	4,050	2,632	2,312	872	462	300
30%	52,554	8,717	E3	700,000	7,000,000	28	4,340	2,821			496	323
			E6	590,000	5,900,000	23	8,805	5,875			1,020	680
			E2	1,050,000	10,500,000	42	4,778	3,106	2,713	1,023	462	300
35%	61,313	10,230	E3	820,000	8,200,000	33	5,084	3,305			496	323
			E6	690,000	6,900,000	27	10,297	6,871			1,020	680
40%	70,072	11,662	E3	930,000	9.300,000	37	5,766	3,748	3,100	1,166	496	323
			E6	800,000	8,000,000	32	11,939	7,966			1,020	680
50%	87,590	14,488	E6	990,000	9,900,000	39	14,774	9,858	3,872	1,449	1,020	680

MAJOR CONCLUSIONS

Taking into account the results of the study, WWF concludes as follows:

The Spanish residential sector has the technical and economic capacity to assume **the objective of reducing the final energy consumption in total existing buildings by at least 30% by 2020, compared to 2008.** To do so, it would be necessary **to renovate between five hundred thousand and 1 million homes a year**, which represents 2% and 4% of the existing residential buildings in 2008. This would mean to increase between 3 and 7 times the renovation rate referred to in the current State Plan for Housing and Renovation.

To achieve this goal, **priority must be given to the improvement of thermal insulation levels of the building envelope, through deep energy renovation.** The criteria considered should be more demanding than those set out in the current Technical Building Code, **close to the standards of passive houses.**

To decrease the final consumption of existing buildings by 30% would mean t**o stop emitting an average 8.7 million Tons of CO2 per year**, and this would generate **average annual savings of 2,312 million €**. For the period 2011-2020, the average cumulative final energy savings would amount to more than 290 TWh.

If the thermal envelope of buildings is not previously optimized, measures such as the improvement of energy efficiency of facilities or the incorporation of renewable energies in homes (solar) would have **very limited effects on the integral improvement of existing buildings.**

WWF considers that current energy efficiency and housing policies are not enough to achieve significant and permanent reductions over time of energy consumption and emissions from the residential sector by 2020. It is essential to encourage a strong package of policies to support deep energy renovation of buildings, as well as to establish adequate financial and fiscal mechanisms to fund these actions. To achieve this, it will be necessary to substantially increase the pace of renovation of existing buildings and strengthen the demand of insulation levels, as well as to prioritize public aid for those measures that help curb energy demand of buildings. All this should be complemented with support lines for the renewal of equipment in favour of low energy consumption and zero carbon technologies.

RECOMMENDATIONS ADN ASKS

To ensure the significant contribution of the building sector to energy savings and CO2 emission reduction by 2020, **WWF asks:**

1. **To establish a binding national objective for 2020 to renew the total existing buildings in depth,** to decrease final energy consumption by at least 30%, with respect to the building stock in 2008. This objective must be implemented through an **Action Plan for a Deep Energy Renovation of Existing Buildings**, indicating clearly the measures and actions, terms and budgets that are necessary to achieve the goal.

2. **To strengthen the energy requirements of the Spanish legislation for buildings,** in particular, the Basic Document of Energy Saving DB-HE of the CTE, to reach the levels of our neighbour European countries. This basic document should incorporate a unique section with requirements applicable to existing buildings much more demanding than the current ones. This would stress the importance of reducing the maximum allowed values of thermal transmittance for floors, walls and facades to levels close to the ones employed in the PassivHaus standard (maximum U-value of 0.15 W/ m2 K), taking into account the different climate characteristics of the Spanish geography, as well as the values for airtightness of carpentry and heat recovery for the air extracted from buildings.

3. **To ensure compliance with building regulations and control the quality of deep energy renovation projects** carried out in dwellings.

Action on the residential sector should be prioritized towards improving the thermal envelope of houses.

4. **To increase the support available to address the investment costs of renovation works and achieve the objectives fixed for the existing building stock.** The lack of initial funding remains a barrier to the renovation of existing buildings. Therefore, owners of dwellings should be provided sufficient financial and tax incentives to invest in the improvement of the energy efficiency of their buildings. These instruments include tax rebates on income tax or property tax, granting low-interest loans as well as direct subsidies and other mechanisms such as the financing of projects by third parties.

5. **To incorporate criteria for deep energy renovation in the mechanisms for municipal licenses of building renovations must be a prerequisite** to gain access to aids, plans and programmes adopted by the various public administrations. Therefore, it is essential to adapt local regulations to incorporate energy saving policy requirements applicable to existing buildings.

6. **To improve coordination and cooperation mechanisms between the administrations** at national, regional and local level to ensure the correct implementation of actions foreseen in the different housing, energy efficiency and energy saving plans and programmes.

7. **To promote awareness and the enforcement of the regulatory requirements on energy savings and efficiency applicable to existing buildings within the provincial and local administrations,** through training and awareness-raising activities addressed to their technical staff.

8. **Develop public awareness programs** to inform owners and tenants about the benefits of deep energy renovation of buildings, energy savings and GHG emission reduction, as well as about existing economic aids and fiscal and financial mechanisms. In this sense, we recommend to establish a **citizen's advice service** to respond to the demands and concerns of citizens about buildings' renovation and to provide appropriate advice on everything they may need.