A NATIONAL PERSPECTIVE ON SPAIN'S BUILDINGS SECTOR

A ROADMAP FOR A NEW HOUSING SECTOR

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An initiative of:

Working Group For Rehabilitation **"GTR"**

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The objective of the **Rehabilitation Working Group (GTR)** is to facilitate the transformation of Spain's buildings sector, historically dedicated to the production of new buildings, into a new sector whose objectives are the creation and maintenance of the necessary social habitat and living conditions for Spanish people. The new housing sector, thus created, can be economically viable and capable of creating and sustaining employment to deliver against Spain's constitutional right of access to housing in full consideration of the environmental and social challenges inherent in this change.

GTR's first project is the research and publication of this report. **A National Perspective on Spain's Buildings Sector. A Roadmap for a New Housing Sector.**

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Executive Summary

The opportunity to refurbish and upgrade Spanish homes is sizeable, economically feasible - with appropriate regulatory support - and can go a long way towards reforming and refocusing Spain's buildings sector which is badly impacted by the financial crisis and failing to meet the environmental challenges from Global Change. This working group[1] ("GTR") believes that 10 million Spanish primary homes built before 2001 can be transformed into low-energy, low emissions, modern housing delivering benefits to owners and occupants, and creating 110,000-130,000 stable, long-term direct jobs in a vibrant New Housing Sector ("NHS") from 2012 to 2050.

This report provides the background, structure, methodology, analysis and action plan for Spain to launch and support a new sector (NHS) capable of deploying up to Euro 10 billion a year invested in refurbishing 250-450,000 homes. These budgets will be funded by contributions from private savings, banks, refurbishment providers, ESCOs, energy companies and the State in appropriate proportions, and each receiving commensurate returns, aligned with the energy and CO2 savings, social benefits and modernization upgrades entailed in each individual or collective project.

This report provides the background, framework, methodology and analysis needed to structure an Action Plan which is capable of delivering this new sector, its benefits and transformational impacts on the existing Spanish building sector. Without a new vision and the challenges of the NHS, it is unclear how an existing Spanish building sector – dedicated purely to new buildings construction – can survive. The old business models and practices espoused by today's construction sector in Spain can be transformed through reorganization along sustainable lines into a new housing sector which meets the environmental challenges of a modern society. The strategic national vision outlined here through the definition of a roadmap which defines the NHS and its Action Plan will redirect the buildings sector to new and sustainable long-term goals of:

- Delivering Spain's residents' access to sufficient quality housing;
- Through the creation of public and private economic activity and employment;
- Sustainably compliant within Europe's 2020-2050 framework, reducing Spain's ecological and resource footprint and protecting its biodiversity.

GTR firmly believes that a new legislative framework is required for the NHS to efficiently deliver an estimated Euro 300 billion of economic savings[2] to Spain by 2050 alongside a substantial 80% decarbonization of the existing housing stock. The central pillars of this new legislative framework are outlined within the Action Plan contained in this report. We acknowledge that without legislative support the NHS may slowly emerge from the components of some of its existing stakeholders in an inefficient and hap-hazard manner. Without a clear, investible, new legislative framework, GTR believes that the result is a sector which is sub-scale, lacks vision and would inevitably lead to Spain falling well short of its aspirations to create a resource efficient economy in the context of Europe's 2020 ambitions and beyond.

As Europe redoubles its drive to promote energy efficiency through the proposed framework of a new Directive for 2012, Spain can and must harness the skills, creativity and energy of the stakeholders in its buildings sector to lay the foundations for a long-term, sustainable and valuable NHS. In this context, and to help Spain rise to the challenge facing every Member State, GTR has developed an innovative new structure and methodology to help unlock the potential in Spain's existing housing stock: Using the

1 *See Introduction Section for GTR members and history*

2 *Cumulative projected energy savings and emissions reductions valued at European market prices from 2012-2050*

best available data for Spanish homes, the GTR team has been able to segment and then sub-segment the market into ten 'hotpot' groups covering 75% of primary homes. Homes within each "hot-spot" share contextual characteristics that are important for their refurbishment like age, urban setting, number of floors and decision making body (family or community) and have been further classified into three sub-segments by energy intensity. Sensitivity analysis and modeling has then allowed GTR to map financing solutions and rates of progress onto each "hot-spot" to build a picture of the whole NHS through aggregating specific lines of activity though a detailed Action Plan.

The results of GTR's analysis are both significant and opportune: Through the provision of a solid and supportive policy framework consisting of facilitating legislation, direct subsidies, low cost finance, fiscal benefits to refurbishment and value to CO2 emissions reductions, Spain can target the deep retrofit of 10 million (64%) of its pre-2001 primary residences by 2050 to reduce their energy needs by up to 80% and hot water energy requirements by 60%. The total investment required to deliver these energy and emissions savings is estimated to be in the order of Euro 160 billion, which GTR believes will also draw-in an additional 50% of non-energy related complimentary cosmetic investment in property upgrades delivering a total sector whose aggregate size to 2050 is Euro 240 billion. Notably, GTR projects the investment needs of the NHS at the same size, Euro 240 billion, as Spain's recently approved Strategy Plan for Infrastructure and Transport (PEIT) 2005-2020. These investments and related economic activity will reposition Spain's building sector – as the NHS – and stimulate and support the numerous industries which supply that sector by improving the country's energy balance, emissions profile and resilience.

GTR's Action Plan will create a new and productive economic sector (the NHS), create long-term sustainable jobs, save energy and emissions and create the pathway for Spain's residential buildings sector to evolve in line with Europe's 2020 and 2050 targets. While the establishment of the appropriate policy and regulatory framework for the NHS is non-trivial, along with the needed transformation of the existing buildings sector, GTR believes that the economic, social and environmental benefits are worth the up-front policy and organizational work. Moreover, GTR believes that the opportunity cost to Spain of maintaining high unemployment and an inactive buildings sector is almost double the required economic stimulus recommended by GTR to create this new sector.

Spain has a unique opportunity in 2012 to demonstrate that it makes economic sense through a new policy framework to save energy and emissions from buildings. GTR is convinced that Spain has the dynamism, skills and resources required to undertake this challenge and that once stimulated the NHS will build momentum as homeowners see the value of renovation especially in the context of rising energy costs and the clear economic value of their reducing CO2 emissions. The GTR Action Plan presented here provides the direction and principles for the creation of a New Housing Sector which will be the tool through which Spain enters a new energy paradigm which is extending throughout Europe.

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Introduction

Rehabilitation Working Group (GTR)

El Grupo de Trabajo sobre Rehabilitación (GTR lit. Working Group for Rehabilitation) is a group which spontaneously formed to continue the work of a series of key forums that took place in 2010: *The International Sustainable Building Regional Conference* (SB10 Madrid), *Rehabilitation & Sustainability = Future* (R+S=F) in Barcelona and *Spain's National Environmental Conference 2010* (Conama 10)[3]. These conferences concluded that there was a need for change in the buildings sector as a means to resolve some of the challenges facing the Spanish economy and meet its environmental goals. Rehabilitation and Energy Efficiency Renovation will be a milestone for the buildings sector's transformation.

The GTR builds upon the *Cambio Global en España 2020/2050* report (Global Change for Spain 2020/2050[4]), particularly on sections related to sustainable cities and the buildings sector, where a number of GTR members participated as co-authors, and Climate Strategy's 2010 report on Financing Energy Efficiency Building Retrofits. GTR´s objective is to define a National Action Plan that will allow for the transformation of the current built environment and the buildings sector. This transformation will launch a new sector dedicated to the renovation, retrofit, operation and maintenance of appropriate and habitable housing. At its core, the GTR wants to create a new and vibrant housing sector, solidifying the citizens' right to accessible housing while taking into consideration the environmental and social challenges innate to global change, and positioning it as a key sector of the Spanish economy with substantial job creation potential.

The buildings sector has been strongly impacted by the financial crisis, however GTR believes that this creates an opportunity to restructure and re-direct its resources in a new direction to deliver a key part of a more sustainable economy in Spain. New regulatory frameworks must ease the way for the emergence of a different business model based on renovation, rather than new build, which is more consistent with the challenges Spanish society faces today. The current situation requires a country-wide strategic vision, outlined here, which supports the restructuring of the sector. While reactivating the Spanish economy, GTR´s approach also allows for the creation of a new and productive business model for the buildings sector which will reduce its impact on the environment and provide accessible housing to large segments of the population.

GTR´s Action Plan, proposed in Section 2.2, is an instrument of change designed to create a New Housing Sector ("NHS"), as described in these initial chapters. The Action Plan is a roadmap to help establish and determine the pattern of transformation as the sector evolves into a key element required to meet Spain's energy savings and emissions targets and the challenges of Global Change.

The GTR's executive committee is composed of eight members[5] with different and complimentary backgrounds related to the buildings sector; GTR also has an Advisory Panel of expert Reviewers who have read, commented on and reviewed the group's work. GTR believes that the advice and networks of the Advisory Panel reviewers will broaden the research scope of the covered topics adding an international and broader dimension to the white paper. GTR is fully independent and its opinions and reports are purely the work of its executive members as advised by reviewers each operating in their personal capacities and therefore does not represent any interests or opinions of firms or institutions.

GTR´s work does not end with the publication of this 2011 National Roadmap report, but it plans to follow this by the creation of a working group that will advance and generate support for the implementation of the action plan described in Section 2.2 of this report. The Spanish Green Building Council (GBCe) and Fundación Conama coordinate the work of the GTR. The co-authors of this report, Albert Cuchí and Peter Sweatman, have worked jointly in

3 *Arguably three of the highest profile and influential sustainability and environmental conferences in Spain.*

4 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura, Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Programa Ciudades*

5 *Alfaya Valentine, Director of Environmental Quality and Grupo Ferrovial, Luis Alvarez-Ude, CEO of Green Building Council Spain, Xavier Casanovas, Director of Rehabilitation and Environment Col·legi d'Aparelladors, Arquitectes Tècnics i Enginyers de l'Edificació de Barcelona Albert Cuchí, Professor of Polytechnic University of Catalonia and author of Building sector report "Spain 2020/2050 Global Change", Francisco Javier Gonzalez, Professor, Department of History andUrban Planning at the School of Architecture at the Universidad Europea de Madrid (UEM), Fernando Prats ,CCEIM Advisor for the program "Global Change Spain 2020/50, Peter Sweatman, Chief Executive of Climate Strategy & Partners, and Alicia Torrego Conama Foundation Manager.*

its preparation and writing on behalf of the GTR with the support, contributions and guidance of the GTR's core members and the teams at Universidad Politecnica de Catalunya and Climate Strategy & Partners. GTR was able to undertake and publish this report in 2011, thanks to the funding and additional support of both the European Climate Foundation and CCEIM which have been integral parts of the GTR process to date.

White Paper

This paper describes Spain's buildings sector and presents a strategic national vision and roadmap for its transformation and emergence from the crisis which it is in today. The coordination of a New Housing Sector in Spain along the lines presented here, in the first section of the report, will allow for the redirection of resources towards a set of sustainable and long-term goals which are defined and detailed in the latter sections of this report.

The strategic country-level vision outlined here responds to the enormous challenge inherent in and described by the Global Change 2020-2050, a report published in 2010, with contributions from many of the GTR members, which clearly articulates the issues facing Spanish society as environmental stability and climate change threaten its stability and its future existence. This is both a challenge and an opportunity and the role of the buildings sector is a decisive one to lead the economy to a more sustainable and environmentally benign place.

As introduction, this report outlines how Europe has established its roadmap for resource efficiency and long-term sustainability. Europe's responses to the challenges of global change are clearly articulated in its energy and emissions reduction targets for 2020 and long-term road map to 2050. This overall envelope for change is a particularly important driver for Spain and for the adaptation and renewal of its buildings sector.

Then the report describes the traditional buildings sector in Spain and the GTR's view of the most crucial features which need to adapt to the challenge of global change: its focus on new building construction, its increasingly negative impact on the environment through its inefficient use of resources and the excessive generation of waste and, finally, its current crisis and the fact that it will not re-emerge along the same lines that it has operated for the past decades. Against this backdrop, GTR proposes the implementation of a New Housing Sector in Spain to meet a set of new purposes. These purposes are more consistent with the necessary social function of the sector and the demands of Global Change: To ensure access to quality, affordable housing for Spain's residents, while generating a viable economic sector with sustainable employment creation and by limiting its environmental and emissions footprint.

To close the descriptive section, the report begins to assess the resources and potential of the existing buildings sector through a lens of the New Housing Sector. This section considers past patterns of business and the need to adapt and change practices. The NHS will change the focus from new build and reconfigure resources and skills towards the creation and maintenance of a necessary social habitat, in the context of the existing building stock, its present occupants and the resources which they need to maintain required levels of comfort and living conditions.

The second main segment of the report opens with a definition of the New Housing Sector, its rationale and objectives which GTR sees as delivering its goals and how it can intervene in the existing housing stock. The achievement of the NHS's objectives requires a commensurate adaptation of the existing regulatory framework and a number of parallel policies which support energy demand management, new renovation technologies, retrofit finance and the value-streams which emerge from that. Importantly, this definition closes with a review of the available sources of finance for this transformation and how the NHS will be able to most effectively mobilise these to fund the achievement of its plans.

Finally, the report proposes an Action Plan which describes a series of interventions on a newly segmented existing housing stock which can launch the new sector and establish the framework for policy and financial support of the activities it requires to reach its goals. The Action Plan outlines the value streams which must be recognised, and described in the policy framework, together with the required tools to access low-cost finance and enable householders to optimally reduce energy use and greenhouse gas emissions. This transformation will require the development of new business models, new ways of operation and technologies building and improving upon that which is available in the sector today.

The formulation of the GTR Action Plan concludes with a presentation of the expected resource implications and potential energy and emissions savings through the implementation of a phased approach to the delivery of the NHS. The plan identifies the key policy tools and timeframes by which these new levers of activity need to be redirecting resources to the segments of Spain's buildings

which present the best opportunities for efficiency. The chapter identifies and outlines the order of magnitude of investments required and the results from the successful implementation of the plan and how these fit into the context of a resource efficient Europe 2020-2050.

1. A Strategic Country-wide Vision for the Building Sector in Spain

1.1 NEW GLOBAL FRAMEWORK AND EUROPEAN POLICIES

The financial crisis, which started in 2008, exposed a need for Western countries to reconsider their existing and potentially outdated economic model for a new one which remains to be defined. Since the crisis began, governments have been reviewing their management of and approach to the global economy, paying specific attention to the need to achieve increased sustainability in a world of limited resources. In this context, and with the prospect of rising and increasingly volatile energy prices, we are witnessing increased public and private interest in and an investment focus in three inter-linked areas: Increased efficiency, improved productivity and waste reduction. This changing global paradigm is assessed in this document through a specific focus on the latest European roadmap for Energy Efficiency and its anticipated impact on the buildings sector.

GLOBAL CHANGE

The 2008 Lehman-led crisis caused the largest and most sudden drop in global economic activity of the modern era. This was manifest in a deep economic recession among the developed and emerging economies in 2009 with long lasting repercussions on the volumes and patterns of international trade[6]. The crisis raises serious questions about the viability of national economies financed by potentially unsustainable amounts of debt. During the summer and autumn of 2011, the "debt issue" returned to centre stage and continues to play a major role undermining confidence and economic growth.

One of the sectors severely affected by the crisis has been the housing sector due either to a general weakening of credit standards leading to a mortgage and housing bubble[7] and its subsequent collapse, (in the USA) or to a more "traditional" overshooting of construction and house prices (as in Spain) and their vertiginous decline.

Today, there is deep concern around the long-term sustainability of public and private debts accumulated prior to and during the crisis and around the short-termism thereby generated. Also while general economic conditions had seemed to have improved slightly; key economic sectors such as housing and construction remain in a very weak state in affected countries.

Much has been written on the causes of the financial crisis, yet a clear thread has emerged: If the global economy is not managed in a sustainable manner, we will not be able to avoid a volatile cycle of inequality and suffering of historic proportions for large segments of the world's population. It is worth noting the lessons for the future emerging from this crisis specifically in the context of a world that continuously tests its environmental limits and its access to key resources. A 2011 World Economic Forum "Global Risks Report" states: "A rapidly rising global population and growing prosperity are putting unsustainable pressures on resources. Demand for water, food and energy is expected to rise by 30-50% in the next two decades, while economic disparities incentivize short-term responses in production and consumption that undermine long-term sustainability. Shortages could cause social and political instability, geopolitical conflict and irreparable environmental damages."[8]

One of the highest profile reactions to the financial crisis of 2009 was the swift introduction of economic stimulus packages by many of the world's major governments. The stimulus investment clearly recognizes the importance of efficiency, both economic and environmental, and underlines the direction for the crisis solution: US$ 190 billion of global stimulus funds were committed across the United States, China, Korea and Europe in support of the clean energy segment of the "Green economy". Within this stimulus, the largest component, 33% or US $64 billion, was allocated to energy efficiency investments[9] and buildings are some of the "low hanging fruit". Also, China's 12th 5 year plan (2011-2015) embraces principles of efficiency and resource saving as the country is being

6 Lowry Institute for International Policy. (2009). *Working Papers in International Economics No. 2.09: The Global Financial Crisis: Causes and Consequences*

7 Spatial Economics Research Center. (2010). *Housing Markets and the Financial Crisis of 2007-2009: Lessons for the Future*

8 World Economic Forum (2011) Global Risks 2011 Sixth Edition: *An Initiative of the Risk Response Network*

9 Bloomberg New Energy Finance. (2010). *Results Book 2010*

Production index in the construction sector

Source: Eurostat News. (2011). Production index in the construction sector [Chart]. *Construction Output down by 1.8% in euro area.*

driven towards a "circular economy" and a "resource-conserving and environmentally-friendly society"[10] alongside its 2020 pledge to reduce the intensity of its greenhouse gas emissions per unit of GDP by 40-45%. GTR sees efficiency investment is a "middle path" which provides economic stimulus, productive employment and builds a sustainable future.

EUROPEAN UNION CONTEXT

Europe clearly recognises the need to adapt to a world with increasingly scarce resources underlined in its 2011 "a resource efficient Europe" initiative and in its Europe 2020 strategy[11]. Although Europe's broader commitment to sustainability and energy efficiency was conceived and established well before the 2008 crisis. Europe's 2020 energy savings target of 20%, against "business as usual", was envisioned in its 2005 Green Paper on Energy Efficiency, endorsed by Heads of State in 2007 and was adopted in June 2010 by the European Council as part of the Europe 2020 Strategy. Consequently the EU Commission adopted the Communication "Energy Efficiency Plan 2011" (March 2011) and presented a proposal for a new Energy Efficiency Directive (June 2011) that is currently being discussed in the European Parliament and Council as part of the ordinary legislative process.

Europe has an established goal of cutting its annual primary energy consumption by 20% by 2020, some 368 Mtoe from "business as usual", and expects that such energy savings will reduce its CO2 emissions by 780 million tonnes and save €100 billion in fuel costs[12] per annum. Buildings are responsible for 40% of final energy use in the EU, making them a central component of energy efficiency and savings policy is imperative to meet this goal. Energy use in many existing buildings is inefficient and can be reduced in a cost effective manner using today's technologies by some 20-50%[13] depending on the building's geographic location, its type, date of construction and use. By 2050 Europe's buildings emissions can be reduced by 80%[14].

10 Bina, O. (2010). *Responsibility for emissions and aspirations for development*

11 European Commission. (2010) *Communication from the Commission Europe 2020: A strategy for smart, sustainable and inclusive growth*

12 ManagEnergy. (2010). *Key Information related to energy efficiency*

13 WBCSD. (2009). *Energy Efficiency in Buildings: Transforming the Market. Retrieved;* US EPA. (2006). *National Action Plan for Energy Efficiency*; McKinsey & Company. (2009). *Unlocking Energy Efficiency in the US Economy*; European Carbon Foundation. (2010). *Roadmap 2050 2010: A Practical Guide to a Prosperous Low-Carbon Europe*

14 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

Europe adopted the Energy Performance of Buildings Directive (EPBD) in 2002 (2002/91/EC), as Recast (Directive 2010/31/EU) in 2010, which includes a common methodology for calculating the energy performance of buildings, minimum standards for the energy performance of new buildings and major renovations, systems for energy certification of buildings and requirements for the regular inspections of boilers and central air-conditioning systems.[15] However, many member states – including Spain[16] - had failed to fully implement the 2002 EPBD on time. The European Commission therefore proposed a recast of the directive in 2008 (adopted by the European Parliament in May 2010), which it estimated would reduce total EU Energy consumption by 5-6% and create 280,000 to 450,000 new jobs by 2020[17].

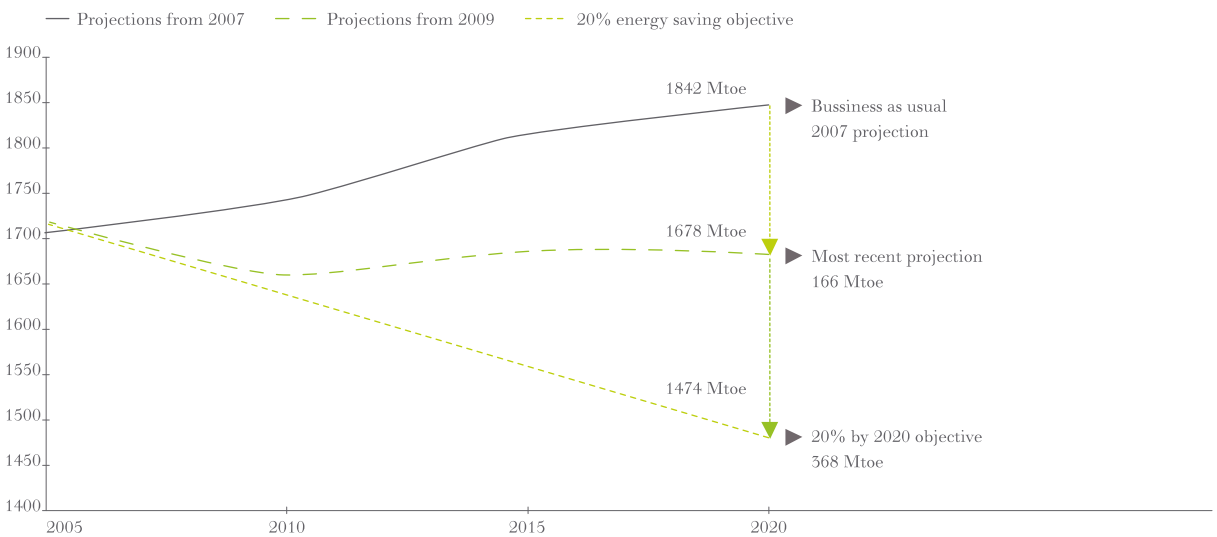
Under this Recast Directive, all new public buildings have to be "nearly zero-energy buildings" by the end of 2018, a standard that will equally apply to all new private sector buildings after 2020. A benchmarking mechanism for national energy performance requirements was also introduced to determine cost-optimal levels to be used by Member States for comparing and setting these requirements and oversight and monitoring (MV&E) has been increased. Energy performance certificates are mandatory for the rental and sale of properties, however, the Recast Directive doesn't contain mandatory energy performance requirements for existing buildings, yet Member States have to elaborate national plans that encourage owners to make energy efficiency improvements in the existing housing stock.

In 2011, the EU Commission recognised the need to redouble its efforts on Energy Efficiency as it appeared that existing policies would achieve less than half of the 20% energy savings target, and proposed a new Directive.

The EU Commission's proposal for a new Energy Efficiency Directive has six main lines of action:

1. The legal obligation to establish energy saving schemes in all Member States;

Primary energy consumption (Mtoe)*



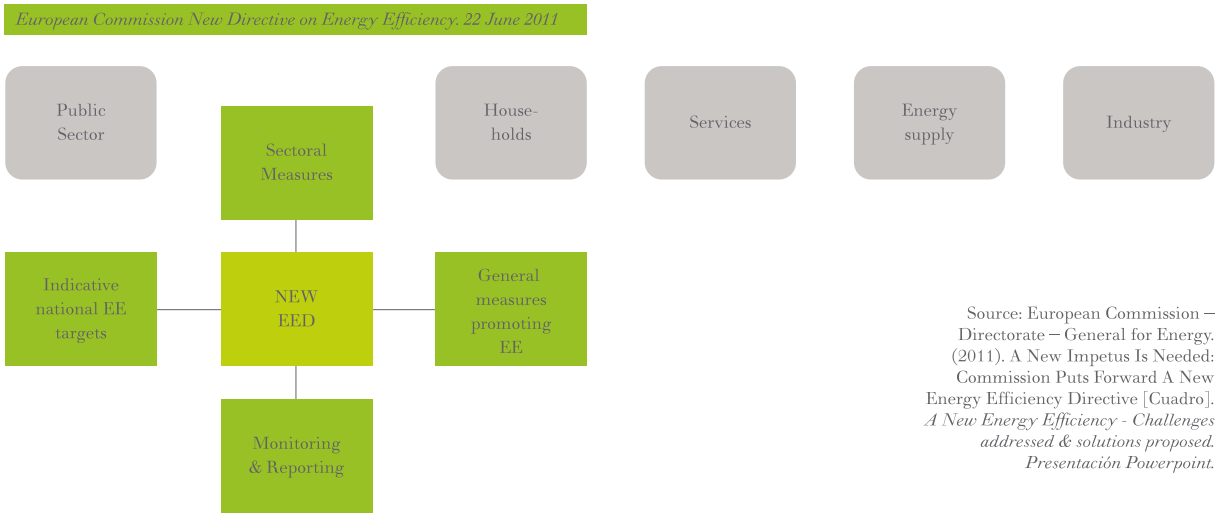
* *Gross inland consumption minus non-energy uses*

Source: European Commission. (2011) [Chart]. Energy demand stabilized but not on track to meet its target. *EU Energy 2020: A Strategy for competitive, sustainable and secure energy.*

15 European Commission Energy. (2010). *Energy Efficiency in Buildings*

16 González Alvarez, G. (2010) *Implementation of EPBD Status November 2010*

17 Elsberg, M. (2010). *European Commission. The new European Directive on Energy Performance of Buildings*



Source: European Commission – Directorate – General for Energy. (2011). A New Impetus Is Needed: Commission Puts Forward A New Energy Efficiency Directive [Cuadro]. *A New Energy Efficiency - Challenges addressed & solutions proposed. Presentación Powerpoint.*

2. Leadership from the Public sector, through example, by renovating at least 3% of the floor area of public buildings each year from 2014 and purchasing exclusively high energy performance products, services and buildings;
3. To improve transparency for energy consumers and facilitate access to potential savings;
4. To give more incentives for energy efficiency for SMEs;
5. To achieve higher efficiency in electricity generation;
6. To replace the Services and CHP Directives with a single consolidated Directive.

This new Directive will potentially have a substantial impact and provide the needed boost for achieving the 20% target, and stimulating the Energy Service Company (ESCO), energy efficiency and retrofit sectors in Europe.

The size of the opportunity remains significant and attractive: EuroAce research shows that for all existing buildings in Europe to undergo deep renovation by 2050, at least 5 million buildings would have to be renovated each year across the EU over the next 40 years[18]. Therefore, 50 million buildings of the existing European housing stock of around 210 million should have undergone deep renovation by 2020. Jointly, through the top-down pressure from the proposed Directive and the bottom-up needs of Europe's built environment, with the firms that serve it, there is sufficient incentive for this to be one of the fastest growing new sectors of the new post-crisis economy.

The Action Plan for Spain proposed in this document will contribute to reach these objectives by taking advantage of the significant opportunities that are outlined in detail in the following pages.

18 EuroAce. (2011). *Position Paper. EuroACE position on the EU Energy Efficiency Plan 2011*

1.2 A STRATEGIC NATIONAL VISION FOR THE BUILDINGS SECTOR IN SPAIN

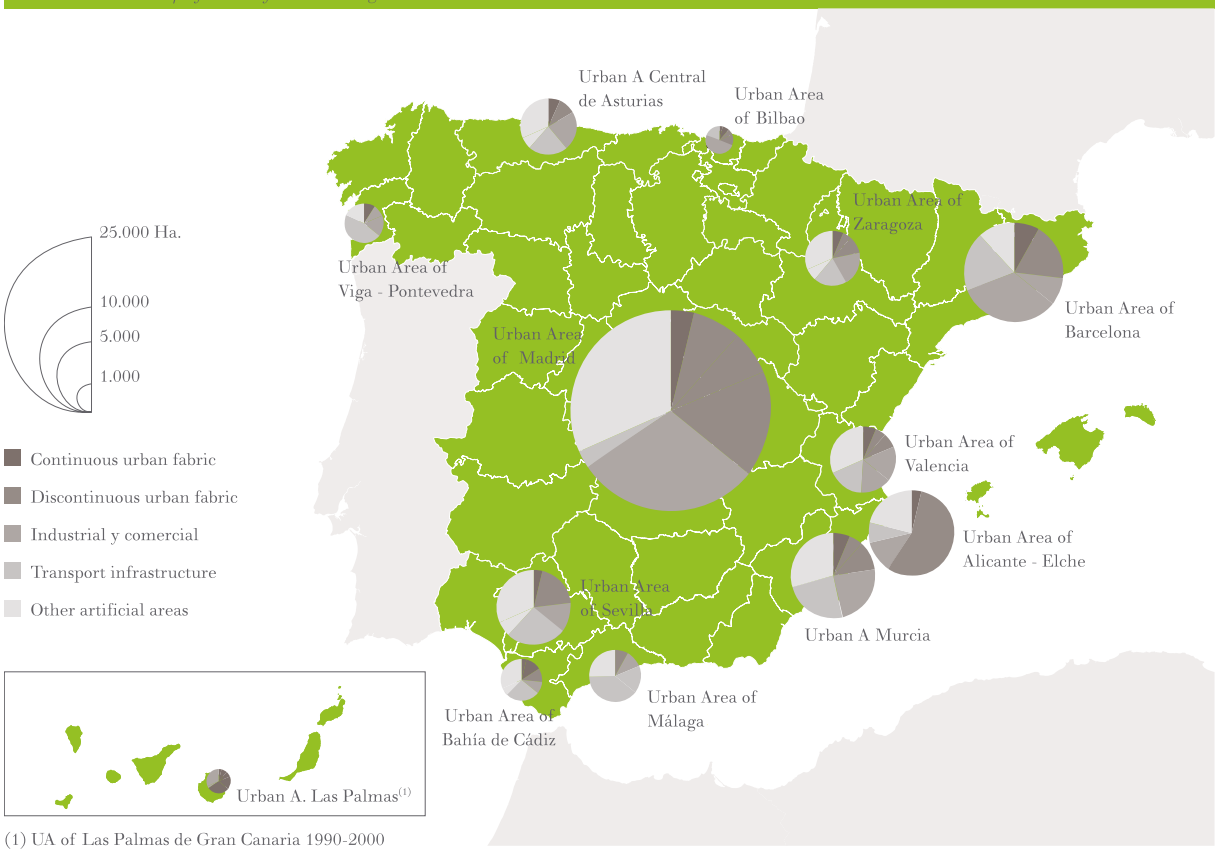
The global shift towards a sustainable economy is quickly becoming a reality in Europe, and the buildings sector has a key role to play. This transformation, however, requires a shift in the mentality of the buildings sector and its appreciation of the tasks to be undertaken. This chapter describes the required shift and the challenges facing the buildings sector in Spain, and outlines a strategic country-wide vision to focus resources on existing opportunities.

URBAN SETTINGS AND BUILDINGS IN SPAIN

Spain's buildings sector, until now, has been driven by the production of new buildings. This was a direct response to the continued increase of the Spanish population and the constant increase in housing demand for almost a century, and therefore the sector remained focused on producing the necessary buildings to support this growth.

The production of housing has also responded to the migration of the Spanish population from being predominantly rural to mainly urban. Today's population is concentrated in Madrid and along the coasts which has led to the considerable depopulation of the Spanish centre-mainland now considered a 'population atoll'. The production of housing has been accompanied by the production of the commercial buildings needed to accommodate Spain's business needs -offices, retail, services, etc.- and the modernization of Spanish society.

Crecimiento de las superficies artificiales en las grandes áreas urbanas con más de 500.000 habitantes 1987-2000



(1) UA of Las Palmas de Gran Canaria 1990-2000

Source: Ministerio de Vivienda España. (2010). Crecimiento de las superficies artificiales en las grandes áreas urbanas con más de 500.000 habitantes 1987-2000 [Chart]. Reporte acerca de la situación del sector de la vivienda en España

This evolution required a re-zoning or "urbanization" of a large amount of land and the transformation of rural pasture once devoted to traditional productive activities into urban space. Urbanization also requires infrastructures that allow access to networks/systems -mobility, energy, water, sewage systems, etc.- and, through complex social and economic procedures, it has delivered large increases in land value.

The current buildings sector (as most prominently represented in Spain by construction) has two faces: On the one hand, it is a productive sector – for the construction of new buildings - that fulfills the mandates of the Construction Planning Law (*Ley de Ordenación de la Edificación "LOE"*) as regulated by the Technical Building Code ("CTE" *Código Técnico de la Edificación*). This regulates the sector's services which take place on land urbanized by mechanisms regulated by urban planning norms. As such, the buildings sector has generated direct macroeconomic activity which represented over 10% of Spanish GDP and over 12% of employment in 2008[19] and had delivered high knock-on economic activity in the construction materials industry, associated financial sector and within buildings services.

On the other hand, during the construction boom, Spain developed no independent "living building sector" which was dedicated to the maintenance and renovation of the existing built housing stock. While most buildings, homes and the infrastructures required to support them are "existing", and define Spain's urban character, the buildings sector's focus on renovation has been marginal to date.

Spain's buildings sector also developed through the exploitation of the environment, leading to its progressive degradation and the destruction of its biophysical matrix, and the extraction of non-renewable resources with increasing disposals of waste. In Spain's particular case, urban land now accounts for 14% of the land-mass[20] - equivalent to half of the surface that is not occupied by agriculture, forestry or nature- and the expansion of cities, and the spread of second homes, often takes place on surfaces of valuable agricultural or natural land as illustrated in the chart on p. 19.

The building sector also evolved to respond to society's demand for greater "quality", resulting in the utilization of more complex technologies and components, whose manufacturing is responsible for increasing environmental impacts, and an increase in the direct requirement for buildings materials, which now exceeds 2 metric tonnes per m2 of construction[21]. Before the crisis, around 24%[22] of the total raw materials required by the Spanish society were allocated to the construction sector alone, which every year generated half a ton of waste per capita[23]. Both raw material production and waste disposal are responsible for substantial territorial impacts.

At its peak, in 2006, the production of materials needed to meet the demand of the buildings sector generated emissions of over 60 million tons of CO2e[24]. Although some construction materials were imported, and others produced domestically were exported, the buildings sector in 2006 was responsible for 14% of Spain's per capita greenhouse gas emissions (about 1.3 tonnes of CO2e per person).

However, the "in use" carbon footprint of existing buildings, through their energy use, dwarfs even peak emissions from Spain's construction boom: GHG emissions from energy use in Spanish buildings accounted for about 90 million tons of CO2[25] in 2006 - around two tonnes of CO2 per capita - which represented around one fifth of the emissions of the national economy, calculated according to the Kyoto Protocol. At a national level, 65% of buildings' energy use is in the residential sector and 35% for non-residential buildings[26] (i.e. offices and commercial not including industrial buildings). Given the greater weighting of residential and the greater regulatory barriers to energy efficiency in private homes, this study will focus on that segment.

The energy needs of the buildings sector have increased over recent years mainly due to an increased number of Spanish buildings - as a more significant driver than building energy intensity. However, part of the energy increase can be attributed to a change in the usage patterns of buildings and the need for more equipment and appliances to support the activities they contain: between

19 Ministerio de la Vivienda España. (2010). *Informe sobre la situación del sector de la vivienda en España*

20 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

21 Ibid

22 Ibid

23 Ibid

24 Cuchí, A., & Pagès, A. (2007). *Ministerio de Vivienda España: Sobre una estrategia para dirigir al sector de la edificación hacia la eficiencia en la emisión de gases de efecto invernadero (GEI)*

25 Ibid

26 European Commission Energy. (2011). *Statistics*

1990 and 2004 energy use in Spanish buildings increased by 56% per capita (with only a 12% increase in Europe over the same period) and a 38% increase in energy use per household[27].

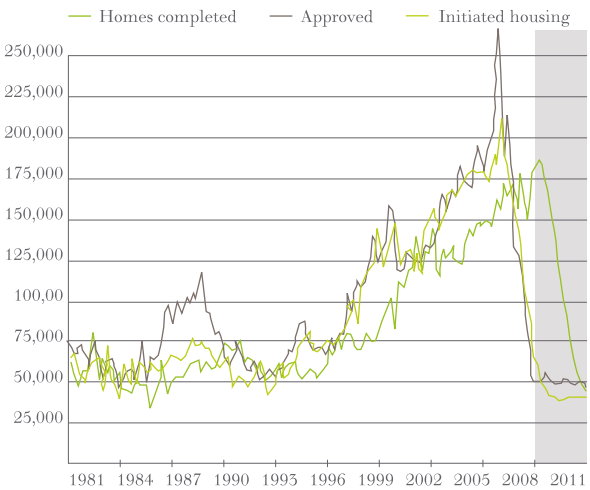
Perhaps unsurprisingly, Spain's buildings sector (as the key provider of socially required habitability) was responsible for around one third of national greenhouse gas emissions until 2008[28], including energy used in the building stock and the entire supply chain for their construction. In conclusion, the buildings sector is critical to the Spanish economy, and is a significant source of national emissions, both these factors make it central to Spain's transition to a low carbon economy and make the rapid reconfiguration of this sector and its approach a top national priority.

BUILDINGS SECTOR: A FRAMEWORK FOR CHANGE IN SPAIN

At present the buildings sector in Spain is in a deep crisis. Over the past four years the production of its main product – residential buildings - has declined some 90%[29], a victim of local overheating and the world's financial crisis. Easy credit and access to capital combined to create the Spanish property boom, and now the sector is in a difficult situation: There is an overhang of 700,000 new unsold homes in the market and many Spanish households are finding it hard to make their mortgage repayments on a debt which, in many cases exceeds, the market value of the home. In addition, the falling value of the built housing stock - which is has not yet stabilized —adds questions around the solvency of Spain's financial institutions, its households and consequently the country itself.

After a decade of rapid growth, the loss of more than one million direct jobs[30], the destruction of its productive fabric, as well as the repercussions on its supply chain in local industries, are the testimony and direct damage caused by a buildings production sector at a standstill and a Spanish economy built on and now constrained by credit. For exactly these reasons, GTR believes that, under a clear new and sustainable mandate, the buildings sector stands as a key component to help Spain forge a way out of the current crisis.

Finished housing projections - Quarterly data



Source: Servicio de Estudios Económicos BBVA. (2008). Proyecciones de vivienda terminada [Chart]. *En BBVA, Situación Inmobiliaria Diciembre 2008.*

According to the Spanish government's Statistics Office (INE) there will only be marginal population growth of one million residents in Spain between 2010 and 2020 and after that a stabilization through to 2050. Spain's "baby boom" which began to unfold 30 years ago, in the second half of the 1970s, is over and the base of the population has already begun to reduce in size. The current buildings sector crisis coincides with a young-adult segment of the population ("first time home buyers") which is much smaller than before. For the first time in a century and a half, the demand for new housing is not set to increase in the long term, but rather reduce until the crisis subsides and potentially only stabilize in coming decades.

Only an unlikely revival in the demand for secondary homes, and a continued reduction in the number of people per household towards that of surrounding European Member States, can mitigate the general downward trend for housing but even this will not be able to invert it. The buildings sector crisis is fundamental and driven by the change in demand patterns for the good it currently produces.

Solid cultural trends, which have also historically supported the sector, such as families using the purchase of a home to save, also face a crisis: The collapse of the myth

27 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

28 Cuchí, A., & Pagès, A. (2007). *Ministerio de Vivienda España: Sobre una estrategia para dirigir al sector de la edificación hacia la eficiencia en la emisión de gases de efecto invernadero (GEI)*

29 Ibid

30 Ibid

of the "safe investment" in housing, with the specter of an unpayable credit, has changed these trends, diverting household incomes into other investment areas, and has led to turmoil in the real estate sector.

For all these reasons, the 'resurrection' of Spain's buildings sector is difficult yet highly desirable, but it would also require a genuine reorganization of the sectors structure and resources: Despite the recent technological changes incentivized by the implementation of the new Spanish Technical Buildings' Codes ("CTE") and other new environmental regulations transposed by European Directives, Spain's buildings sector is far from being able to cope with the demands of the immediate future –such as the production of buildings of nearly zero carbon operational use by the end of this decade. Spain needs a New Buildings Sector capable of operating in the context of a green, low carbon and sustainable economy where urbanization and the construction of buildings fall under increasing environmental scrutiny.

Yet even if this conversion were to take place, and new buildings were all to be carbon neutral, the existing housing stock would still remain a potent and significant source of carbon dioxide emissions. In a carbon constrained world, this will reduce the competitiveness of the Spanish economy by removing the emissions produced by energy use in housing which would otherwise be available for more productive areas of the national economy.

As well signaled in the reports of the Intergovernmental Panel on Climate Change (IPCC)[31], energy savings and efficiency in buildings are some of the most important short and long term sources for cost effective emissions reductions, and within the buildings category, the energy efficiency of housing stands as the most important savings area by volume of emissions. Moreover, these emissions reductions come at a low cost and as a consequence open the clear opportunity to the New Buildings Sector to transform existing housing.

The transformation of the existing housing stock, as integral part of a shift towards a low carbon and sustainable economy, will not just deliver environmental benefits but also improve the quality of the housing stock and its ability to respond to the habitability demands of Spanish society. The maintenance and upgrade of existing homes is a viable and efficient economic activity, and therefore allowing its key drivers to be riddled with complexity for homeowners, poorly supported by policies and poorly financed using business models of the past is simply not an option.

Three structural features of Spain's buildings sector continue to seriously impede the development of new and more sustainable conservation and renovation activities: Small-holder landlords, a rental market that until relatively recently promoted apathy in the conservation of buildings and the systematic support -public and private- for new construction as the solution to Spain's housing problems.

Housing is a basic social good, to which access is considered a right by the Spanish Constitution, and is an issue which concerns all citizens. Reduced or restricted access to housing impacts both new housing demand and society's living trends. Despite the boom in residential house production before the crisis, the sector was still unable to deliver full access to housing for disadvantaged parts of society, notwithstanding the production of housing that was never occupied. This also reveals the partial failure of public market incentives to well direct the sector's basic social function and which helped turn housing into a financial investment rather than a social good.

This situation often forced those who wanted to "build a home" into direct competition with those seeking "an advantageous investment", which tended to restrict access to housing for those with lower economic means –such as the young or newcomers- and added risks of exclusion for other sectors of the population -such as the elderly- who are in a precarious housing situation due to the housing tenure laws and the potential for the speculative conversion of land they occupy.

A NEW HOUSING SECTOR IN SPAIN: OBJECTIVES AND INDICATORS

Spain's buildings sector cannot, and should not, be rebuilt along the same lines as the past. The New Buildings Sector ("NBS") should be seen as the sector that creates and maintains the habitat and habitability which society requires as well as becoming the instrument through which Spain's global competitiveness can improve and its economy can reduce its environmental footprint.

This report choses to focus on residential housing because of its magnitude (in share of national GDP and emissions) and its direct impact on the lives of Spain's popula-

31 IPCC. (2007). *An Assessment of the Intergovernmental Panel on Climate Change*

tion and the consequent and necessary transformation of the part of the new buildings sector devoted to housing because of its uniquely important role in the transition to a low carbon economy.

The New Housing Sector ("NHS") shall from its very inception have a set of guiding principles which will shape its evolution. These principles are:

- **To provide accessible housing of adequate quality to Spain's residents:** A service that ensures all residents can attain a socially acceptable level of habitability, maintained and renewed according to the changing demands of society.

- **To generate viable and sustainable economic activity (public and private) capable of creating jobs:** The New Housing Sector can continue as one of Spain's determinant economic sectors, aspiring to similar importance to that which the traditional buildings sector represented historically. The NHS will be a source of sustainable, long-term jobs delivering sustainable demand to its supply-chain of industrial goods and services, which will, in turn, foster new technology development and require an environmentally sustainable economy.

- **To deliver a significant reduction of its environmental footprint while preserving and increasing territorial bio-capacity:** The environmental resource efficiency of the NHS is key, not only as a mandatory requirement but as a decisive vector in its direction and development, as a tool that will keep Spain efficient and allow the mobilization of resources activated by emissions reductions and the energy savings from renovation in the most effective manner.

The transformation of the existing buildings sector into the NHS will require the progressive conversion of: The sector's agents, responsibilities and technological capabilities; its activities related to the management, maintenance and use of housing; and its policymakers' approach to the promotion of renovation of existing buildings over new housing.

A New Housing Sector can be promptly proposed and it can already take its first steps to define early interventions to offer itself as a realistic and workable alternative to the "hope of rebirth" of the traditional buildings or construction sector, which operated in a manner which is no longer beneficial for the future of the country. The following chapters of this report outline what these first steps are and what kind of policy approach can deliver a robust and successful New Housing Sector.

Findings & Recommendations –BRIM Development

Provide adequate, good quality and accessible housing services to residents

Attain it with a strong reduction in the needed environmental footprint taking into account the preservation and increase of territorial biocapacity

Attain it generating a viable economic activity (public and private) capable of creating jobs

The Future - Next Exit

These objectives have to be contemplated in a medium 2020/30 and long term 2050 spectrum

1.3 HOUSING IN SPAIN TODAY

The redesign of Spain's housing sector, from being an instrument of home production into being a sector dedicated to creating and maintaining a necessary social habitat in an environmentally and resource efficient manner, will require a pragmatic and practical approach to the sector with sufficient and acceptable indicators defined to measure its progress.

To provide this perspective, GTR approaches the definition of Spain's Housing Sector using three key vectors: The Physical ("bricks and mortar"), the Occupants and the Resources required by those occupants. Not only do the sources of this information vary in precision and quality they do not necessarily correlate and, in fact, nor do the policy departments, instruments nor drivers which act upon them:

- **The Built Housing Stock:** This includes the physical buildings, the actual conditions of those buildings, their common traits, their technical systems, their age, their geographical distribution and their urban organization etc;
- **The Occupation of the Housing Stock:** Occupation is defined as the distribution of the resident population within the built housing stock, a distribution which represents the will and the capacity of families and individuals to organize themselves in homes, each according to their possibilities and competing with other households;
- **The Resources Used to Attain Habitability:** These include economic resources and environmental resources, and considers the economic activity created by the occupation and management of this housing stock as well as the modification and renovation required to deliver adequate levels of comfort to occupants.

BUILT HOUSING STOCK

In 2011, Spain has an estimated 10.2 million buildings[32], of which nearly 9.5 million are residential in character and contain 25 million homes. These homes occupy approximately 2,300 million square meters[33] of floor space.

The age of this housing stock, its urban or rural distribution, its typological characteristics and its state of conservation are essential information which allows us to identify and prioritize the most effective and efficient ways to improve it and the full data-sets used by GTR for this report can be found in the Appendices.

There are 8.5 million residential buildings among those constructed before 2001, which contain around 21 million homes in total of which 14.5 million are primary residences with certain common characteristics which are key to our analysis:

1. **"Older Buildings": Over 60% were built prior to 1980[34],** before the advent of any technical buildings standards or codes designed to regulate the quality of buildings built in Spain. Specifically, 60% of these buildings were built before the enactment of the first laws to include buildings insulation requirements, which while published in the mid 1970's took some time to propagate through the whole buildings sector. Among these pre-1980 homes: 15% of buildings were built before 1900, 41% between 1900-1960 and 44% from 1960-1980 (9%, 32% and 59% of households, respectively)[35]. The buildings between thirty and fifty years of age have a special significance within the housing stock as, in addition to their conservation and service status, more than 1.2 million of these primary homes have deficiencies and there are interesting possibilities for the upgrade their vital technical systems.
2. **"Rural Dwellings": Nearly half of the buildings registered in the 2001 census, or over 40% of these households, are located in rural areas in population centers of less than 10.000 inhabitants.** Interestingly, aside from a wide territorial dispersion, 90% of these rural residential buildings have 1 to 3 floors, which is over 45% of all homes constructed before 2001.
3. **"Home Concentration": There are high household concentrations in housing blocks each with 5 or more housing units in:** Over half of the housing units[36] of the housing stock are concentrated in less

32 January 1, 2011 Estimate. INE. (2001). *Population and Housing Census 2001*; Ministerio de Fomento España. (2009) *Construcción de Edificios 2004 - 2008: Licencias Municipales de Obra*

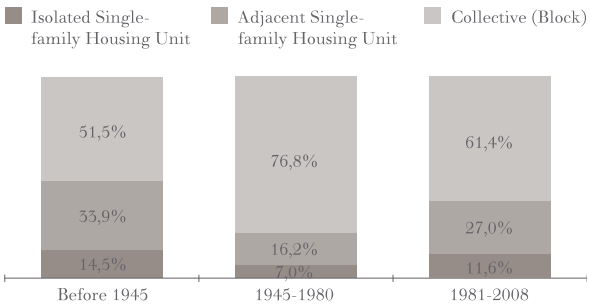
33 BarcelonaTech (UPC) data extracted *from Ministerio de Fomento, INE's Population and Housing Census 2001, and Colegios de Aparejadores and Arquitectos Técnicos*

34 INE.(2001). *Population and Housing Census 2001. All subsequent data relating to this sub-section is extracted from the same source, unless otherwise indicated*

35 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

36 Own Estimation. Sources: INE. (2001). Population and Housing Census 2001; Ministerio de Fomento España. (2009). *Construcción de Edificios 2004 - 2008: Licencias Municipales de Obra*

than 10% of the physical buildings each with 5 or more units in. This underlines the two key characteristics which define Spanish homes : Their dispersion or the shared community buildings which polarize the sector and require well planned intervention.



Source: INE (2001). Distribución de viviendas por edad y tipo de edificio [Cuadro]. En Martin, C. (Ed.). *Potencial de ahorro energético y de reducción de emisiones de CO2 del parque residencial existente en 2020 WWF Diciembre de 2010.*

In addition to the above, geographic location plays key role determining energy demand and the habitability of Spanish buildings and it is the local Autonomous Regional Government which holds the administrative powers over housing (a key State actor in housing alongside the central administration). Typological profiles also differ dramatically between communities: For example, single family buildings are predominant in Andalucía, while multi-family buildings are predominant in Madrid.

HOUSING STOCK OCCUPANCY

Occupancy characteristics determine the aptness of the housing stock to deliver the social habitat and living conditions that the population demands. Occupancy is also a key driver of the quantity of resources needed to provide these conditions. On January 1st 2011, Spanish homes housed 47 million people with the following key characteristics:

- **In 2008 primary residences accounted for 65% of the built housing stock.** Around 25% are secondary homes and unoccupied housing units accounted for some 10%[37]. Both the percentage of secondary homes and empty housing units has experienced steady growth despite the increasing Spanish resident population, while the number of people per household has decreased from 3.36 in 1991 to 2.90 in 2001[38]. This number was estimated at 2.81 inhabitants in 2008[39], closer to the European average of 2.65 people per household[40]. In 2001, primary residences with households of 1 or 2 members represented 45% of the housing stock and 42% of its total useful living area[41].
- **In 2009 owner-occupied property accounted for 82% of Spain's primary housing,** and renting only accounted for 12% of the housing stock. This is a key Spanish characteristic which is both a break from the very distant past and quite different from many of its European neighbours. The evolution of home occupation shows a long-term convergence towards home-ownership models similar to those of other neighbouring countries (i.e. more rentals and lower owner-occupier), but also underscores the role of the home as principal household investment as aside from a simple delivery of socially necessary living space.
- **Nearly 30% of homes are "over occupied" or occupied at "below capacity".** Overcrowding is defined by law as when the space or housing services are less than socially recognized norms for its occupants; however occupation at "below capacity" is socially accepted, even aspirational and normatively unregulated. Overcrowding (found in less than 1% of the housing stock) implies a lack of acceptable housing conditions; yet occupation at "below capacity" (found in 27% of the primary housing units with a space / occupants ratio of over 3x the average of habitability standards) could be linked to inefficiencies in resource usage and certainly can provide an indication of where potential savings could be made. Both situations are important to note and can be addressed in different ways in the context of the NHS.

Interestingly, the overall reduction in Spanish household size and the increased incidence of housing stock occupied at "below capacity", which are changes outpacing even population growth, are both social features facilitated by the housing boom and that have also been supported the "home as financial investment" trends in recent years. Notably public policy has been a facilitator of these trends and supported home ownership as well as housing access as a basic public good.

37 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

38 Ibid

39 Ibid

40 Ibid

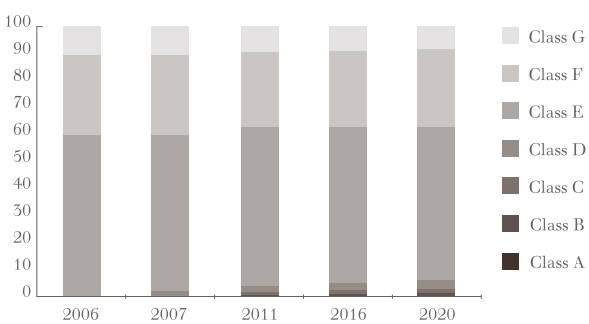
41 INE. (2001). *Population and Housing Census 2001*

RESOURCES USED IN HABITABILITY

To deliver adequate living conditions, occupants clearly require additional resources aside from the simple housing shell. Actual levels of comfort are determined by the needs of each occupant, and what they can afford, and the technology and equipment required to deliver home functionality as well as electrical power, gas, water and sewage systems.

While the traditional buildings sector in 2005 represented 10% of Spanish GDP, 5.7% of employment (more than double the European average), the proportion of household income spent on housing and to provide adequate comfort in Spanish homes is surprisingly low: In 2009[42], 29% of total family income was spent on housing (some Euro 150 billion annually) and of that amount only 10% was spent on the energy needed to provide habitability and use.

Around 50% of household energy use is required to heat or provide air conditioning to homes (some 95,000 GWh/ year)[43]. This should be considered in the context of the existing air-conditioning/ heating systems available in Spanish homes: In 2001 half of Spain's primary homes did not have any permanently installed heating systems and some 15% of households did not heat their primary homes at all. In addition, around 46% of Spanish households use electricity for energy to heat their homes (as opposed to gas, fuel oil or biomass). The emissions of CO2 attributable to heating systems found in primary housing units and air conditioning were 16.5 million[44] tons of CO2/ year.



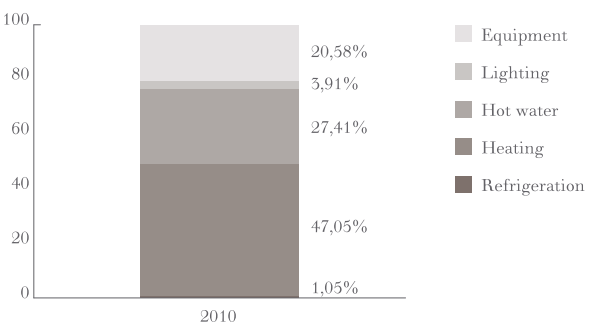
Source: IDAE. (2011). Previsión de la evolución de la clase energética en los edificios considerada en el plan [Cuadro]. En Ministerio de Industria, Turismo y Comercio España, *Plan de Acción de Ahorro y Eficiencia Energética 2011-2020*

With comfort levels held constant at 2007 levels, the renovation of all Spanish housing stock to level of the requirements of Spain's 2006 Technical Buildings Code (CTE) currently active for new build housing would result in a 30%[45] reduction in household energy consumption and annual cost savings of around Euro 5 billion.

Furthermore, the capacity for improvements in energy efficiency of Spain's housing stock through demand management and the increased insulation and efficiency of air conditioning / heating installations is considerable: Over 90%[46] or Spain's residential homes are Efficiency grades G, F and E as shown in the exhibit.

Information and awareness campaigns will continue to play an important role to combat the opposite trends in increasing resident comfort with a greater demand for refrigeration; however a new energy pricing policy linking efficiency with energy costs is a critical step to improve householder motivations to renovate their homes.

As further evidence of the need for home energy renovation, in 2009, 6% of the population[47] did not consider the winter thermal comfort of their home as adequate. This is a key indicator to consider when identifying the "energy poor" and even more relevant during periods of economic crisis. A new sector can work to prioritize the delivery of minimum adequate habitability standards, and in turn avoid an increased incidence of 'energy poverty' (the absence of minimum conditions of comfort in the home to ensure the health of its residents).



Source: IDAE. (2011). Distribución del consumo energía final Sector Edificios DOMÉSTICO (2010) [Cuadro]. En Ministerio de Industria, Turismo y Comercio España, *Plan de Acción de Ahorro y Eficiencia Energética 2011-2020.*

42 INE. (2011). *Household Budget Survey: Base 2006*

43 BarcelonaTech (UPC) data extracted from IDEA and Eurostat: Energy Statistics. European Comission

44 INE. (2011). *Household Budget Survey: Base 2006*

45 Own elaboration based on sources: IDAE. (2011). *Código Técnico de la Edificación*; Martin, C. (Ed.). (2010). *Potential Energy Savings and CO2 Emissions Reduction from Spain's existing residential buildings in 2020. WWF Spain*

46 IDEA. (2011). En Ministerio de Industria, Turismo y Comercio España: *Plan de Acción de Ahorro y Eficiencia Energética 2011-2020*

47 INE. (2011). *Living Conditions Survey*

2. The GTR Action Plan for the Launch of a New Housing Sector in Spain

2.1 THE NEED FOR SPAIN'S NEW HOUSING SECTOR

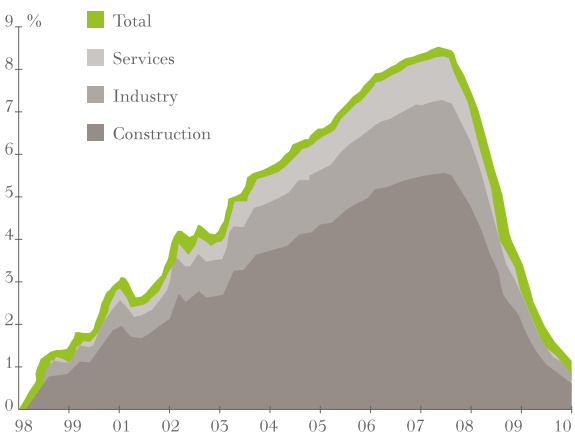
The current buildings sector in Spain is a producer of residential buildings which has been primarily driven by the expansion of the residential housing stock. This existing buildings sector had expanded to satisfy an ever increasing demand for housing in new household structures (closer to those of neighbouring European countries) that have emerged in Spanish society. The result is that recently this buildings sector allocated over a third of its production to the construction of second homes and over 700,000[48] currently empty housing units.

Spain's public administration has promoted just public policies to support access to housing for the underprivileged. Yet even these social policies have included market oriented and stimulative measures whose outcomes have been to push the buildings sector to simply produce for its key role in creating jobs, absorbing labour and driving a long and local supply chain as a key component of the Spanish economy.

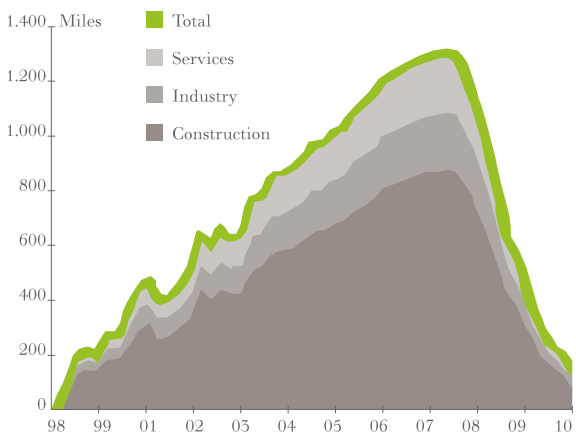
The existing buildings sector's overall organization neglects the urban environment which is produces. The roles and responsibilities of its agents, its business models, its technical and quality regulations, the construction procedures and materials, its financing and its legal frameworks (primarily designed to deploy structures in green or brown field sites) produce new homes and they must all change. A very quick analysis of the decision makers, market structures and required legal frameworks for Spanish building renovation reveals a distinct difference in agent, responsibilities and focus from the traditional construction sector. This new sector requires different technical solutions, regulatory requirements and business models from the past.

While the process of deep building renovation or rehabilitation mimics the key steps involved in the construction of a building the providers of these services are presently of varied quality and poorly organized. The lack

Cumulative growth of domestic production and contributions by sector



Accumulated variation of employment in the rama (in jobs)



Source: INE, & Banco de España. (2011). Impactos de la Inversión en Vivienda sobre las Ramas de Actividad (En la Producción y el Empleo) [Cuadro]. En Maza, L. A., y Peñaloza, J. M. (2011). *Banco de España: La Situación Actual del Ajuste de la Inversión Residencial en España.*

of an efficient and independent sector dedicated to the renovation, refurbishment and performance management of buildings in Spain has resulted in the fragmentation and separation of the basic maintenance facilities

48 Europapress (2011, Septiembre 14). *Fomento viaja a Alemania con inmobiliarias y bancos para tratar de reducir el 'stock' de viviendas*

(such as cleaning, security, minor works and the maintenance of systems and machines) from space and energy management. These disparate activities are deregulated and governed independently without a sectoral purpose, which has allowed the current buildings sector to ignore the long-term impacts of the output of its core business, (i.e. the affordable and sustainable habitability of existing buildings).

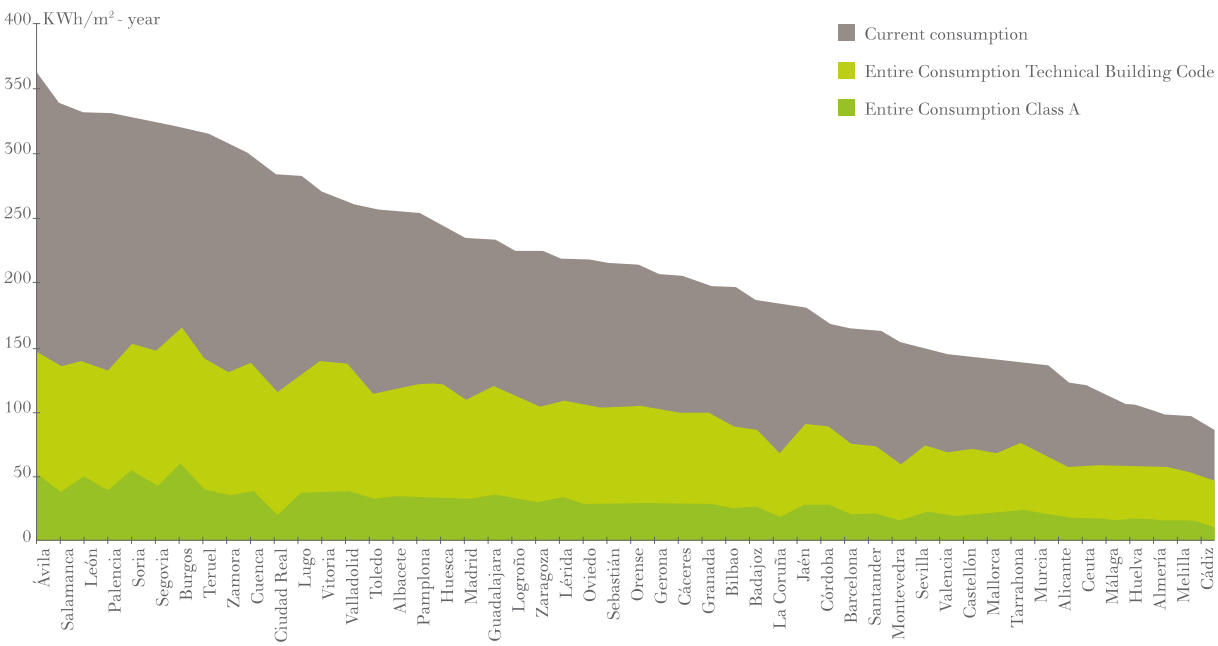
Finally, the key regulatory policy defining quality standards for the buildings sector were designed, implemented and directed towards the production of new homes and overlook existing housing stock conditions. The 2006 Technical Buildings Code ("CTE") defines the technical features required for Spanish buildings and was exclusively drafted for the construction of new buildings, and for major rehabilitation works. The CTE is an inappropriate tool from which to build a New Housing Sector as it is insufficient and does not create the conditions for the renovation of the existing housing stock. Even standard rehabilitation activities require parties to rework an appropriate approach to determine that activity alone. The critical issue will be to produce a flexible buildings code that can be practically applied to the renovation of existing buildings and which does not require an overly rigid and formalistic "construction style" procedure but that ensures the quality of the intervention for all building residents.

NECESSARY POLICIES OF THE NEW HOUSING SECTOR IN SPAIN

The three principles which GTR proposes for Spain's New Housing Sector ("NHS") entail a radical redesign of the objectives, organization and structure of the existing housing sector. This redesign should be done in conjunction with a new productive business model which will convert and reconfigure the sector and its logistical chain.

The change can begin when the NHS replaces the existing buildings sector as the renovation or rehabilitation of an existing building becomes the major sector activity and an improved economic and sustainable habitat as the new finished product of this new sector. The intervention of the NHS occurs not only at the level of the physical housing stock, but around the interaction of its occupants with the physical building and also on the resources used by these occupants to acquire the quality of habitability they desire. The potential for resource efficiency and relative degree of ambition of the current buildings codes are illustrated below for different regions of Spain:

Consumption per m² of the housing stock in Spain



Source: Ministerio de Industria, Turismo y Comercio España. (2011). Consumo por m² del parque de edificios en España [Cuadro]. Plan de *Plan de Acción de Ahorro y Eficiencia Energética 2011-2020 Presentación Powerpoint.*

The ambition of the NHS can reach up to the level of medium-term urban scale intervention but also must address changes in both tenant-landlord regulation and, more broadly, the sustainable regulation of project management and results orientation for new deliverables in the context of an existing home. This likely means the involvement of new participants in the NHS –public sector entities with new roles, homeowners, tenants, resident communities and building managers- and to align them with a set of new responsibilities implied by the NHS principles. In addition, the NHS will need to include resource operators which produce and monitor habitability. Many of these resource operators will come from the traditional construction sector –who have a clear role for scale projects and infrastructure issues in the NHS (such as the renovation and rehabilitation of large project and their respective impacts on water supplies, energy, communications, sanitation, etc.) - yet their activities will be increasingly focused on the generation of efficient livability and reduced environmental impacts, while maintaining the required habitability.

New areas of activity, new actors and new responsibilities require new management and regulatory frameworks to regulate their actions and to define and ensure the quality of their performance. The NHS requires the creation of a new institutional, legal and financial framework which it will need to accomplish its purpose. The NHS also needs to configure a new business model to ensure that its principal activities, the renovation and refurbishment of existing buildings, are economically viable and sustainable. The NHS regulatory frameworks and its new business models can be derived from the existing structures and resources of the traditional buildings sector but will also need to integrate new areas and incorporate best practice from countries in Europe already ahead of Spain in the development of their own renovation sector.

To achieve this a set of transitional goals can be established to allow for the reconfiguration of the resources in the existing buildings sector to adapt to the objectives of the NHS in an efficient and timely manner, together with the appropriate funds to support this conversion. The entities forming the NHS and their respective agents need to agree an Action Plan which channels combined resources together to identify detailed changes to the regulatory framework and ensure that the sector is viable and sustainable. Finally, there need to be defined a set of key quantitative sectoral indicators which can be measured and monitored to ensure the NHS meets its new goals.

OBJECTIVES FOR THE NEW HOUSING SECTOR

Spain's NHS is designed to deliver home improvements through renovation and refurbishment in an economically and environmentally manner and inline with Europe's targets. The three guiding objectives which GTR believes will deliver these results for the NHS are:

1. **Focus on the efficient use of resources:** Until recently, resource and energy efficiency has not been an important factor for the buildings sector. Resource consumption by Spanish households has increased unabated in parallel with the needs of society to attain ever higher levels of comfort and home appliance functionality. For the NHS, it is essential to increase the resource efficiency of homes through productive investments to improve buildings' energy efficiency and reduce their environmental impacts. Saving energy and emissions is a direct source of value to households over time and the NHS needs to help decision makers take sound long-term economic decisions as well as improve short-term usage patterns and behaviour.

2. **Improve the habitability and technical facilities of buildings.** Spanish society's demands on housing have evolved towards a socially recognized habitability standard[49] which requires the built housing stock to adapt its facilities to those standards. Today's socially acceptable quality of life increasingly includes access to health, education, culture, sports, leisure etc. which are not a part of the home but its surroundings. Certain urban models which provide access to these services do so in an energy intensive and enviornmentally impactful manner. The NHS needs to contemplate the social, energy and environmental impacts of the home's habitat also at a neighbourhood and urban level.

   Yet a material segment of Spain's housing stock has either partially or entirely lost its original function (i.e. has a different use or lies derelict). This functional loss has lead to an increased decay of the physical structure where buildings have not been maintained properly, nor refurbished nor replaced and have aged and deteriorated. Finally, there is a small segment of Spain's housing stock that lack a set of fundamental facilities which ensure its basic habitability, and this must be addressed.

49 Spanish Government (1978), *Spanish Constitution: article 47 – Right to Housing*

3. **Improving affordable access to housing.** This is defined as the ability for households to have a decent and adequate housing unit. The permanent inability of certain segments of society (notwithstanding a socially recognized right) to access housing has negative impacts on society. Not only does this represent Spain's failure to comply with a constitutional right, and the additional failure of the public sector to deliver it, it also entails a series of public and private sector costs which need to be more transparently and clearly articulated to allow parties to come together and resolve the issue and increase housing affordability. This issue can be assessed from new perspectives, such as the pricing of the risk of loss of housing for households, and is now uniquely important because of the economic crisis in Spain, with its high unemployment rates and with many households struggling to meet their housing costs.

   From this perspective, the concept of urban vulnerability, understood as fragility in situations of pressure or change, helps characterize the social content of the housing stock for two reasons: firstly, because it applies to whole neighbourhoods and their urban structure; and secondly, as it helps channel resources for large scale renovations of whole neighbourhood areas which can connect the physical deficiencies of the residential homes with the community's social needs and demographic characteristics.

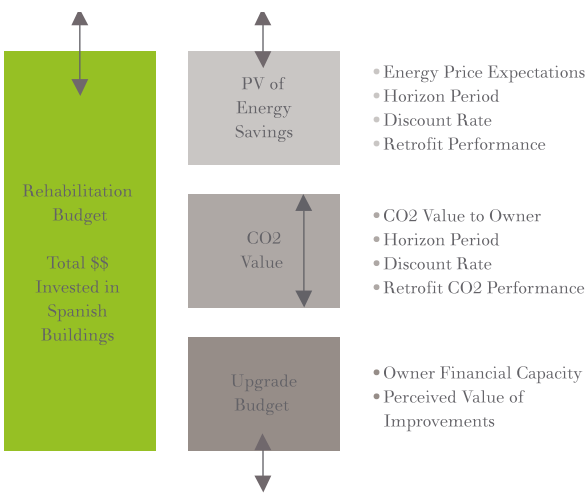
SOURCES OF FINANCE FOR HOME RENOVATION

Investment capital for Spain's home renovation will come from just six possible sources: Government, Building Owner, Building Occupier, Bank, Renovation Contractor[50] and/or Energy Supplier. The amount of capital that is made available by each of these sources for buildings renovation depends upon three factors: 1) the source's access to and cost of funds; 2) its perception of the risk/ return characteristics of the renovation investment; and 3) other competing investment priorities. Each potential supplier of investment capital perceives different value in the renovation, for example: Government perceives the value of greater employment, lower social security payments, higher tax receipts, reduced national energy imports and lower national CO2 emissions (a significant series of benefits); however, the energy cost savings resulting from the refurbishment are only perceived by the Building Occupier and any value enhancement (in case of sale) of the property, due to improvements in quality and habitability, are only valued by the Building's Owner (who may or may not be the same as its Occupier).

In the absence of further enabling legislation in Spain, today's process by which banks, electrical utilities, home renovation contractors (as integral part of the NHS) and ESCOs can deploy their capital into individual retrofit projects in Spain is relatively complex and risky. This is made more difficult by the fact that home occupants, small ESCOs and other SMEs have higher financing costs and shorter term access to funds, when compared with large electrical companies and banks. This restricts the length of the payback periods over which time home occupants and SMEs can fund savings from their home renovation activities and as individuals or small enterprises they also find it hard to aggregate solutions and to reduce the transaction costs (and complexity) among the many components of a renovation or renovations required.

In simple terms, the total national budget for the home renovation sector in Spain is the sum of the annual amounts of investment capital made available from our six identified sources and as described in the following chart:

Total National Renovation Budget = Present Value of (Energy Savings and CO2 Value) + Perceived Value of Improvements



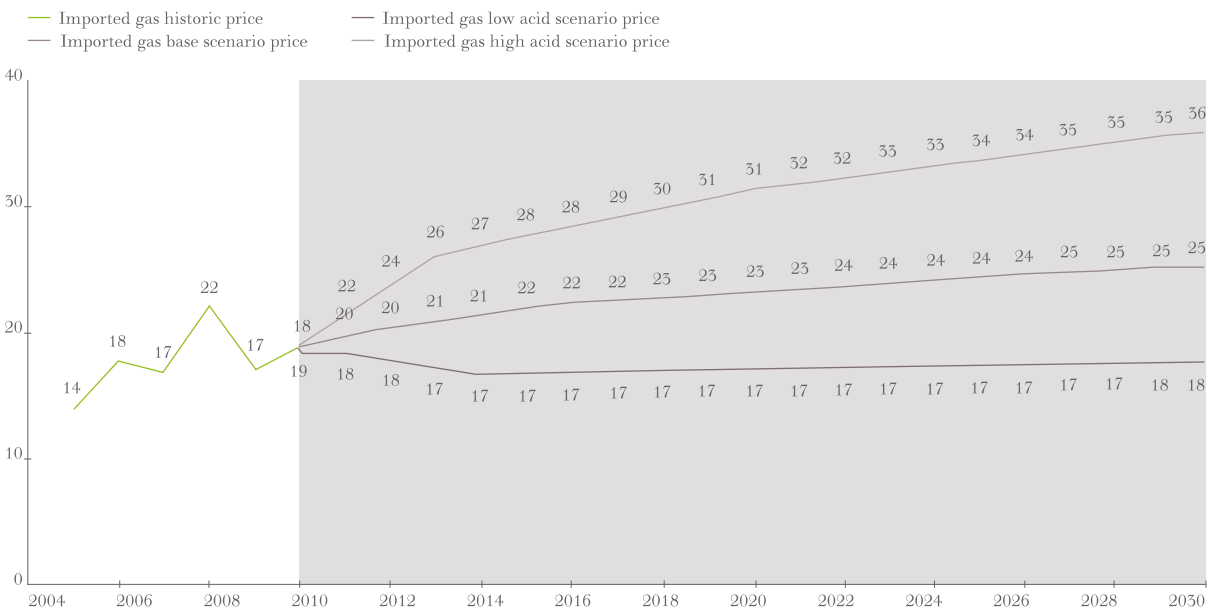
This illustration leads to the following observations for the financial success of the NHS:

50 Renovation Contractor includes Construction Companies, Retrofitters and ESCOs (whose contract terms are linked to subsequent energy performance)

1. **Maximize the national renovation budget:** If the Government wishes to maximise the job creation and fiscal, social and environmental impacts inherent in a national refurbishment plan then it needs to maximise the total amount of investment capital made available for renovation and rehabilitation (including both public and private investments). This means modifying existing legislation to make private investments in buildings renovation and refurbishment easier and the use of new policy tools (such as white certificate programmes, fiscal benefits or "on bill" finance) to ensure the engagement and focus of powerful players such as Utilities, Banks and Construction firms.
2. **Place a tangible value on CO2 reductions:** A concrete and tangible value must be placed upon the CO2 emissions savings resulting from renovation activities otherwise that segment of value and therefore private investment capital will not be made available. This can be achieved through the placement of a regulatory obligation on home energy suppliers or through the direct provision of tradable certificates to the entity which funds the renovation, clearly subject to its correct performance.
3. **Reduce the risk assigned to investment returns in energy efficiency renovations:** The discount rate used by third parties to evaluate the present value of the future energy savings resulting from home renovations (creating the amount of capital they are willing to invest) must be as low as possible. This means that the funder's assessment of the risk associated with the production of real energy savings needs to be as low as possible. The funder's cost of capital and cost effective access to long-term debt also underlies the formation of this discount rate.

Various design features[51] of renovation and refurbishment policies and market structure can significantly impact the risk perceptions of investors regarding individual refurbishments such as: Standardized approach based around known retrofit components and standard documentation, renovation sector maturity, experience and economies of

Projections of Natural Gas Prices in Spain in 2010 Constant Euros (Euro per MWh)



Fuente: Boston Consulting Group. (2010). Figura 2.2-3 Proyecciones del precio del gas natural en España, Precio Gas en España en € 2010 (€/MWh) [Cuadro]. En Ministerio de Industria, Turismo y Comercio España, Plan de Acción Nacional de Energías Renovables de España (PANER) 2011-2020.

51 Climate Strategy & Partners. (2010). *Financing Energy Efficiency Building Retrofits: International Policy and Business Model Review and Regulatory Alternatives for Spain.* Madrid, Spain: Managan, K. & Sweatman, P., R.

scale, the existence or lack thereof of enabling Government legislation (especially around community decision making, fiscal incentives, rights to savings, standards and "on bill" finance) and finally a clear consumer communication of the benefits of renovation through various competing and trusted distribution channels (such as banks, utilities, renovation contractors, retrofit providers and other participants in the NHS).

Finally, the Building Occupant's and retrofit funder's expectation of future energy prices will significantly impact their expected returns for home energy renovations and their attractiveness. There are several convergent factors which point to the likelihood of steeply rising consumer energy prices in Spain in the coming years such as the increased import costs for gas and oil and the reversal and repayment of the electricity tariff deficit. These factors together could deliver a 20-50% increase in core consumer energy prices over a 5 year time horizon[52].

Recent analysis suggests that Member States can productively invest between 0.5-0.8%[53] of their GDP per annum in the refurbishment of existing buildings to meet the 2020 Energy Efficiency targets. With Spain's GDP of over Euro 1 trillion[54], this suggests that the total size of the refurbishment sector in Spain ought to be in the order of Euro 5-8 billion per annum. The structure of the sector and government policy should seek to maximise the engagement of financing entities dedicated to energy efficiency and to guarantee investment returns. Given the size of the potential market, its diversity (geographically and in terms of segmentation) and the need to build a new refurbishment sector, the engagement of policymakers in sector design, public-private finance and facilitating legislation is critical and urgent.

Finally financing alone, is not sufficient to drive the NHS as there are numerous non-financial hurdles to renovation which can only be removed or overcome with a strongly supportive policy regime and communication plan.

52 Boston Consulting Group (2011). *Evolución Tecnológica y Prospectiva de Costes de las Energías Renovables: Estudio Técnico PER 2011-2020*

53 Climate Strategy & Partners., & Eurima (2011). *Financing Mechanisms for Europe's Buildings Renovation: An Assessment and Structuring Recommendations for Funding European 2020 Retrofits Targets.* Madrid, Spain: Sweatman, P., R.

54 The Economist. (2010). *Pocket World in Figures 2011 Edition*

2.2 THE ACTION PLAN

The creation of a New Housing Sector ("NHS" - *Nuevo Sector de la Vivienda*) requires an Action Plan capable of captivating sector participants, aligning their interests while stimulating and keeping pace with the ability of traditional players to realign their resources to deliver Spain's share of the European transformation to a low carbon economy. The GTR Action Plan highlights areas for strategic and policy intervention, it defines those necessary actions and the detailed policies to enable it and it proposes a series of indicators through which to track the sector's development.

The GTR Action Plan's recommended pathway requires the transformation of the regulatory framework, policies and financial approach to the sector as re-aligned to the needs of the NHS. The Action Plan also prompts the development of new activities and skills which support the NHS and its goals. This plan is not supposed to precisely determine the NHS, but be its point of departure from the past and launch-pad to the future defining new roles, agents and activities that are consistent with the following guiding principles:

1. **Delivery of an NHS oriented to the future**, recovering and empowering knowledge and productive capabilities in a sustainable economy with long-term employment that is capable of delivering the country's economic and environmental targets in the context of a sustainable European roadmap.
2. **Being practical and pragmatic** when drafting plans that are consistent with the country's long term objectives giving priority to activities which are the most productive, transformative and easiest to identify for short-term execution.
3. **Focusing first on areas that generate a tangible value**, such as energy efficiency and emissions reductions, which are sources of economic value that can attract the required financing to kick-start this transition to a low carbon economy.
4. **To avoid the negative impacts —environmental and social- inherent in the traditional buildings sector**, such as the systematic occupation of agricultural land, speculation, the generation of direct or indirect waste and the creation of unnecessary, locked-in energy demand.
5. **Stimulate sector supply chains** in the industrial and service sectors delivering to the NHS, with attention to their own low carbon transformation helping deliver a cleaner output with a lower greenhouse gas and waste footprint and which prompts the use of renewable materials to enhance Spain's biophysical production capacity.
6. **Build on the knowledge and capabilities of the current buildings sector** to jumpstart the NHS and take full advantage of its present resources and expertise.
7. **Act in full awareness** of the parallel needs of society and address its recognized habitability needs and move to reduce the risk of social exclusion.

GTR recognizes the value-streams and savings generated through investment in energy efficiency, and appropriately compensated emissions reductions, as a way to stimulate investment and jumpstart the NHS. The regulatory, legislative and technological changes required to ensure the viability of these investments will open a path for the sustainable transformation of the housing sector. This section describes the roadmap by which, through viable investments and a coherent action plan, the NHS can be built and implemented.

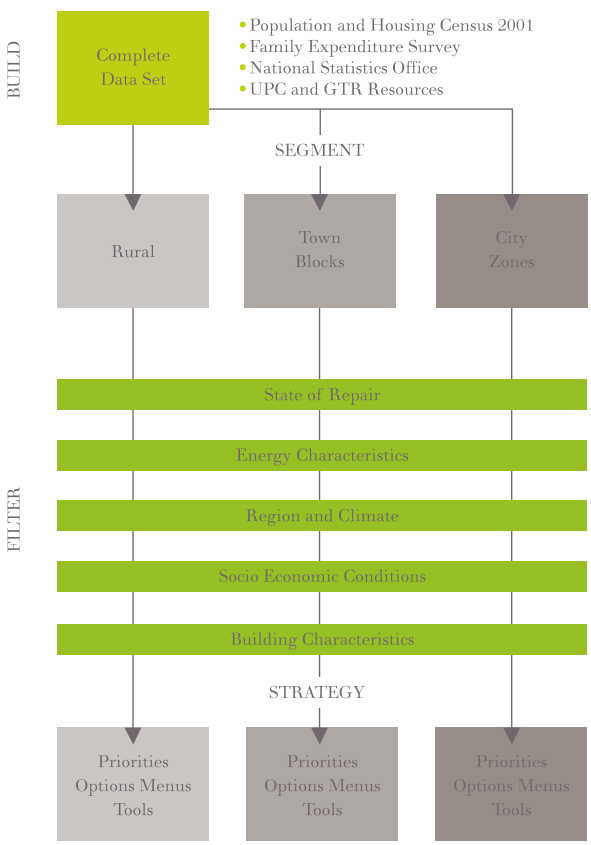
In the context of the above guidelines, GTR has developed a methodology which segments and highlights areas for priority focus (subject to economic viability) and intervention. Both the intervention scope and proposed actions require the immediate enactment of normative, legal, and financial policies which address current policy and behavioural hurdles and that support the NHS's long-term sustainable future. Through this priority approach the NHS will be better equipped and funded to deliver Spain's social priorities and the key elements required in the context of a sustainable Europe.

The GTR methodology has four key steps:

1. **Adequately segment[55] the existing housing stock** to provide visibility and adapt intervention resources to the reality of Spain's buildings, using the best available information. This requires the full cross referencing of national housing information (such as the 2001 Census and National Statistics Office data) with GTR's own databases and energy information taken from alternative sources (such as IDAE and MyTIC) to obtain a useful level of granularity upon which to build recommendations.

55 *Numerous studies and interviews suggest that segmentation is a fundamental precedent to a practical and actionable national plan, as working with high-level averages and medians does not provide significant insight to promote sufficient detail to be practical. GTR notes that availability and quality of Spanish data is not ideal and that the investment to improve data quality is paramount for the sector.*

2. **Determine "hot-spots" or quantitatively significant groups of homes with homogeneous characteristics.** These "hot-spots" should include concentrations of primary residences with a level of consistent technical, administrative and economic procedures which can guide the key elements of the design of a national renovation action plan.
3. **Undertake a detailed assessment of these "hot-spots"**, channeling primary segmentation data through a series of filters (energy consumption, building conditions, socio-economic status, geography and financial capacity of the occupants) in order to determine their habitability, energy, and social characteristics; as well as their investment needs and the possibilities for the amortization and repayment of such investments.
4. **Determine the relevant actions to include in an Action Plan:** This plan needs to first address the high energy intensity regions of the "hot-spots" and then, with economies of scale, learning and so on, address the remaining homes as momentum and resources have entered the sector.



The proposed methodology is designed within the constraints of the currently available information sources. It seeks to determine accessible priority areas for intervention with sufficient critical mass, rather than generating sets of data that specify the exact feasibility of each of the individual interventions. GTR believes that this approach highlights the areas on which to focus resources and implementation strategies and illustrates the individual retrofitting action menus.

While the quality of the housing information in Spain is lower than in many other European countries, GTR's procedures can be adjusted to provide useful insights by cross-comparing three data sets: built housing stock, occupancy and resources employed.

The most complete data source on Spain's housing sector is the 2001 Population and Housing Census (updated by the results of the next Census which will be published in 2012). In the decade separating the 2001 Census from today, the building stock, the population and the required resources for delivering required habitability have changed a fair amount. While we cannot rule-out the eventual need to intervene in homes built over the last 10 years at some point in the future, we focus our segmentation and methodology only on homes built before 2001. GTR believes that the Action Plan will create a vibrant sector with the internal creativity and critical mass to develop tools and forms of intervention to address more recently built buildings once the plan is underway.

There are, of course, recent studies which partially, and incompletely, update the 2001 information[56] which have allowed us to profile and cross check our analysis and add depth and insight to our conclusions. Our analysis of the more recent data does, however, allow us to confirm that nothing therein, if improved or better prepared, nor among comparable European studies, causes GTR to materially change its recommendations that the NHS can start with pre-2001 homes, as we believe that many of the most energy inefficient structures are among them.

SEGMENTATION OF THE HOUSING SECTOR IN SPAIN

Spanish household survey data allows us to define four characteristics for initial segmentation, as reasonable guides of both the quality and efficiency of homes and

56 INE. (2011). *Living Conditions Survey*; INE. (2011). *Household Budget Survey*; INE. (2011). *European Union Household Panel*

their inherent management and intervention possibilities:

1. **Building´s Age:** Spanish buildings built before 1960 have very different architectural and service characteristics than those built afterwards. In addition, while homes built after 1980 were required to use some forms of thermal insulation, under mid-1970s introduced buildings' technical codes, these levels are far from those which today we consider sufficient nor optimal.
2. **Building´s height:** Census data permits home segmentation within certain groupings of the number of floors of a building and this allows for a better appreciation of the construction systems used on facades and roves and their respective proportions compared to their inhabited area. This has impacts on both energy efficiency and the costs of intervention in these homes.
3. **Home Urban Surroundings:** National statistics data allows the identification of homes in three settings: In rural areas (jurisdictions of less than 10,000 inhabitants), small or medium urban towns (between 10,000 and 100,000 inhabitants) or large cities (with more than 100,000 inhabitants) and this in turn helps determine the possible range of interventions as well as helping describe the kinds of entities which may intervene as well as the administrative bodies which oversee them;
4. **Single family units vs. Multi-unit apartment buildings:** This is a clear guide to the decision making structures for renovation and whether the decision is that of a single family head or the board of a community of property owners;

The following diagram shows the results of GTR´s initial intersection of the data with these four characteristics to create a series of "hot-spots" - areas of concentration of homes with homogeneous characteristics with between 400,000 and 2.6 million units in each segment. These areas are highlighted in boxes in the table below (color intensity denotes the relative weighting of each "hot-spot"):

Number of primary homes. According to year of construction, number of homes in the building, size of population center and floors above ground level

		1			≥ 2			Nº of homes
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	Size of population center
< 1960	1 - 3	1.257.020	269.136	118.483	301.546	177.826	148.985	A
	≥ 4	593	428	356	135.609	384.999	1.114.148	B
1960 - 1980	1 - 3	834.358	251.277	67.753	358.810	211.583	97.215	C
	≥ 4	859	527	388	406.082	1.281.739	2.577.719	D - E - F
1981 - 2001	1 - 3	1.123.581	358.603	101.816	402.281	232.208	87.126	G - H
	≥ 4	1.479	1.272	1.131	281.421	668.325	869.166	I - J
Construction year	Floors above ground level							Hotspots

Source and year of references: 2001 Population and Housing Census.

'HOT-SPOTS'

The ten "hot-spots" identified contain 15 million homes (74% of the 20 million pre-2001 built homes), of which 10.5 million are primary residences (75% of pre-2001 primary residences and 65% of the estimated primary homes existing in 2011). These proportions are broadly similar as assessed by surface area (m2) of primary housing units and for population occupancy data. Each "hot-spot" is further detailed in the charts included in the Appendices to this report. The following table shows the distribution of the housing stock across the identified "hot-spots" labeled A through J for future reference:

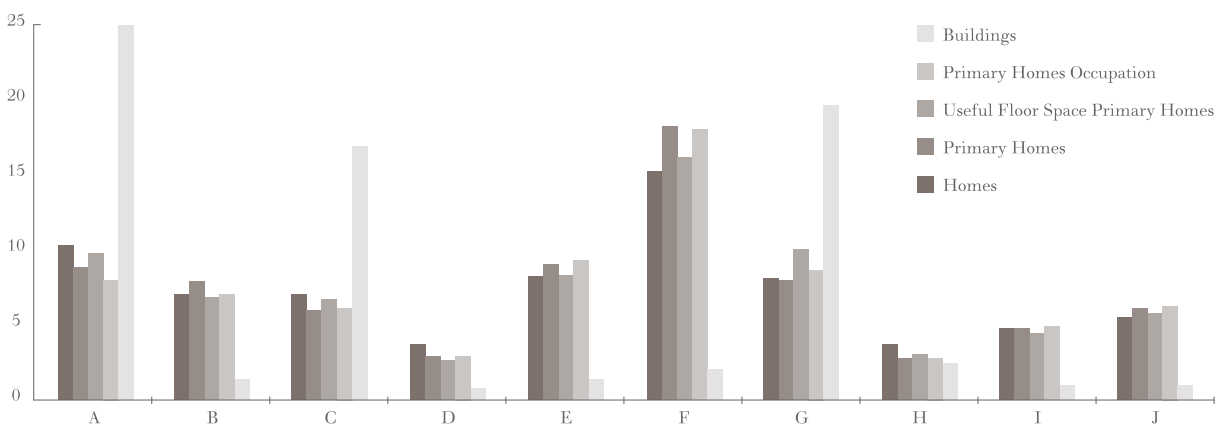
Features and quantification of Hotspots

	A	B	C	D	E	F	G	H	I	J
Nº of homes	1	≥ 2	1	≥ 2	≥ 2	≥ 2	1	≥ 2	≥ 2	≥ 2
Size of population center	< 10.000 h	> 100.000 h	< 10.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h
Year of contruction	< 1960	< 1960	1960 - 1980	1960 - 1980	1960 - 1980	1960 - 1980	1981 - 2001	1981 - 2001	1981 - 2001	1981 - 2001
Floors above ground level	1 - 3	≥ 4	1 - 3	≥ 4	≥ 4	≥ 4	1 - 3	1 - 3	≥ 4	≥ 4

	A	B	C	D	E	F	G	H	I	J	Hotspot	Espain
Homes	2.156.985 10,34%	1.465.122 7,02%	1.459.203 7,00%	766.716 3,68%	1.736.877 8,33%	3.179.423 15,24%	1.692.560 8,11%	767.666 3,68%	991.864 4,75%	1.142.192 5,48%	15.358.608 73,63%	20.859.821 100%
Primary Homes	1.257.020 8,90%	1.114.148 7,89%	834.358 5,91%	406.082 2,87%	1.281.739 9,07%	2.577.719 18,25%	1.123.581 7,95%	402.281 2,85%	668.325 4,73%	869.166 6,15%	10.534.419 74,58%	14.125.848 100%
Useful Floor Space Primary Homes	128.827 9,78%	90.064 6,83%	88.032 6,68%	35.165 2,67%	109.369 8,30%	212.227 16,11%	132.157 10,03%	39.818 3,02%	59.979 4,55%	75.934 5,76%	971.572 73,73%	1.317.742 100%
Primary Homes Occupation	3.246.499 8,03%	2.826.981 6,99%	2.495.936 6,17%	1.177.834 2,91%	3.774.334 9,34%	7.305.099 18,07%	3.542.961 8,76%	1.138.445 2,82%	1.968.929 4,87%	2.539.511 6,28%	30.016.529 74,26%	40.421.822 100%
Buildings	2.158.288 25,03%	113.552 1,32%	1.460.097 16,93%	62.026 0,72%	123.478 1,43%	174.242 2,02%	1.693.465 19,64%	216.053 2,51%	74.678 0,87%	73.639 0,85%	6.149.518 71,31%	8.623.875 100%

Source and year of references: 2001 Population and Housing Census.

The ten identified "hot-spots" fall in three transversal groups: single-family homes located in rural areas ("hot-spots" A, C, G), multi-family buildings mainly built in large urban areas ("hot-spots" B, F, J), and the remainder of the "hot-spots" which are blocks of apartments in small to medium urban town centers (D, E, H, I) which are also mostly buildings under thirty years old. The following chart breaks out the relevant shares of homes, primary residences, area, occupancy and building number for each "hot-spot":



In the appendices, we provide a series of geographical heat-maps which locate home concentrations for each of the ten identified "hot-spots". This gives insights into the levels of regional concentration and strategies for operators in the NHS as well as helping to identify roles for the local governments mainly implicated in the high density regions.

The results and the concentrations in this initial segmentation support the GTR methodology and allow us to prepare certain aggregate views of intervention options and build-up a year-on-year, realistic approach to the NHS. Following GTR's guidelines, we can determine lines of action within each "hot-spot" and build the overall direction and 2020, 2030 and 2050 objectives for the New Housing Sector in Spain. Consequently, the Action Plan which evolves can provide reasonable estimates of the amounts of public and private support required, and when it is required. It also gives visibility to the new legislation necessary to provide the incentives and support to deliver the NHS in a manner consistent with the aggregate actions from each of the "hot-spots" and the priorities meeting Spain's sustainable economy objectives.

Each of the "hot-spots" identified has been assessed in the context of the objectives and possibilities of the NHS. From this analysis, with a financial overlay, we are able to compare results within each "hot-spot", as well as between them, and estimate the resources required to deliver the target outcomes.

'HOT-SPOT' ANALYSIS

To determine the investments required to improve the energy efficiency of each "hot-spot", and when the market will begin to engage with the "hot-spot", we determine for each "hot-spot" a necessary investment cost[57] (adapted over time by inflation and a "technology curve") and compare that with the present value, calculated at an anticipated cost of renovation finance, of reasonably expected energy and emissions savings plus any direct subsidies. If the required investment is lower than the funds available from savings and subsidies then the "hot spot" is activated, if not then this "hot spot" is re-calculated for the following year.

To assess the investment returns of energy efficiency intervention, we consider the savings delivered in reduced heating and/or cooling (representing around 50% of total household energy consumption) as the principal basis for the returns for our calculations, supplemented by a smaller input from savings delivered from the solar heating of hot water (Water heating accounts for around 26% of household energy needs). Our model "deep renovations" target the reduction of the heating / cooling needs of households by some 80% and the energy needs for hot water by 60%.

The remaining household energy use – appliances and lighting – will be reduced through the replacement of appliances and through more efficient equipment and has little direct impact on the activities of the NHS. The only appliances which we include in the "normal" activities of the NHS are new heating equipment and air conditioning systems which, when replaced in conjunction with a replanning of the house ventilation and insulation, the NHS can clearly intervene as this is a "whole of house" approach to the building and its envelope, as opposed to direct equipment swap.

While demand for air conditioning in Spain is increasing (in 2001, the energy used for cooling homes was only 2%[58] of that required for heating), we view it from the perspective of obtaining a reduced relative consumption from a steadily increasing demand, and hence in our calculations (based around 2001 census data) it does not produce material cost savings. Specifically, GTR recommends urgent action to prevent the rapid spread of highly inefficient – and cheap – air conditioners whose negative impact on home energy demand is significant, and expensive. In addition, GTR clearly supports the increased penetration of smart demand management tools for Spanish households (such as smart appliances, thermostats and controls for air conditioning, which today has no easily observable impact in aggregate from our data) and believes that this will form part of the future renovation menus as the NHS develops.

Finally, it is clear that Spain's current energy policies do not promote the uptake of low energy systems nor energy efficiency renovation in a sufficiently clear manner to enable gross energy demand to be managed and met more economically.

The GTR "Hot-Spot" analysis has been undertaken as follows:

57 *Determined through the best estimates of the GTR desk research combined with the analysis from WWF's December 2010 Study by Martin*, C. (Ed.). (2010). *and, the BPIE research for the Renovate Europe Campaign 2011 and the real-life experience of its members in the execution of Spanish renovations.*

58 BarcelonaTech (UPC) estimates based on various IDAE publications

1. **Determine the "business as usual" heating requirements** in a typical year for primary residences in Spain[59]. This is done by distributing among the households the fuel consumption and emissions associated with a "standardized need" (determined by the degree-days for each of Spain's climate zones taking into account the building characteristics, area and typology) which assumes that all homes attain the same level of comfort[60].
2. **Determine the energy consumption and emissions associated** with this annual heating consumption for the housing units within each "hot-spot";
3. **Define the target level of intervention for each household.** GTR believes that the optimal and sustainable approach for NHS will target the delivery of energy efficiency in the "hot-spot" housing units as follows:
   - When practical and viable we propose the maximum level of improvements for the home (a "deep renovation" or "deep retrofit") with the focus on insulation and a change of boiler to meet modern European insulation and ventilation standards. GTR targets an average energy consumption reduction for heating of 80%[61].
   - Install solar thermal panels to supply 60% of the household's demand for hot water to reduce the consumption and emissions from energy to hear water by 60%.
4. **Determine the costs of implementing home improvement** menus for the "hot-spots" through the GTR methodology as described in the introduction paragraph.
5. **Group households within the "hot-spots" by energy intensity:** Within each "hot-spot" we are able to sub-divide homes into three bands (largely through geography and floor space):
   - *Band 1* contains the households that account for 50% of all energy consumption for heating purposes in the entire 'hotspot' and are homes where it is likely investment in energy efficiency will have higher returns;
   - *Band 2* contains the households which make-up the rest of the top-half (50%) of the numerical total of the "hot-spot" and hence capturing with Band 1 50% of the most energy intense households in the "hot-spot";
   - *Band 3* contains the half of the homes within each "hot-spot" (the lowest energy intense half) which consume the least amounts of energy for heating/ cooling due to a combination of location temperate zones, having low energy habits and/ or low occupancy levels.
6. **Determine the net present value of the cost savings due to the interventions** in the different bands of the different "hot-spots" and estimating investment returns produced.
7. **Recognise 'energy poor' housing units** such that a policy mechanism can be created to prioritise the public investment to address this potential area of exclusion and deliver additional CO2 emissions reductions and energy savings.
8. **Identify housing units with structural improvement needs** and the associated additional investment which is required to upgrade these to 'normal' conditions.

This methodology provides us a solid basis from which to prioritise and qualify lines of action, with approximate numbers for a viable plan based on delivering the optimal effect on the home bands within each "hot-spot" with appropriate deep renovations. The results of the application of this methodology on the "hot-spots" is further illustrated in the tables in the Appendices.

Naturally, investments in energy efficiency require a structurally sound housing stock and does not replace the need for socially appropriate action to provide and maintain reasonable quality housing. These measures are seen by GTR as highly complimentary with its programme.

To accurately measure the need for improvements in the habitability and performance of the housing stock we have analysed each "hot-spot" using three criteria: the actual conservation status, the need for renovation due to a building's age and the minimum affordable requirements for habitation:

1. **Minimum levels of habitability:** Homes require basic in-home services -such as drinking water supply, sanitation, cleanliness – and the absence of these essential hygiene services also correlates with residential exclusion. This information is also supplemented by Census data including the existence of elevators, telephone lines or an installed central heating system.
2. **State of Conservation:** The 2001 census qualifies buildings as good, deficient, bad and dilapidated (the latter not considered as being unrecoverable) based

59 INE. (2001). *Population and Housing Census 2001*

60 *At this point it should be stressed that a real improvement of households' energy consumption will not take place without interventions on user behavior-via of tariffs, through tariffs and awareness campaigns that address the stabilization of the comfort levels within reasonable margins, as well as to understand that improving energy efficiency of buildings does not guarantee comfort conditions.*

61 WWF (2010), refers to profile E6

upon the quality of the housing stock in basic areas such as structural strength and weather resistance of the building and its facilities. GTR proposes sets of options to overcome poor or bad building conditions and accomplish a basic living quality using the census data on conservation and age.

3. **Affordable Upgrade Works:** Depending on the age of the building, we determine an update menu that can improve the performance and the equipment of the housing unit to the same quality level that the market now recognizes as "standard". The value source for such investments is derived from the value gap which exists between the market value of a building in a poor state of repair and the market value of the upgraded unit (and excludes energy efficiency value streams).

Through application of the above criteria in each "hotspot", a range of total investment needs can be approximated (over and above the energy efficiency requirements) which enables the identification of segments of the building stock which require structural upgrades before energy efficiency investments are feasible. The application of these criteria helps determine the priority areas for social intervention in the built housing stock, but doesn't provide such granular detail to be able to specify the specific investment size for each specific building.

GTR believes that the NHS should strive to secure both minimum habitability standards as well as energy efficiency, as these are the concepts inherent in the constitutional description of 'decent and adequate housing'. The NHS will need to act directly on the habitability of buildings and to upgrade general buildings infrastructure in order to secure an appropriate trajectory to attain the longer-term sustainability targets commensurate with a 2050 horizon.

The application of the three GTR criteria for building quality improvements requires the following total investment resources[62]:

Obtaining the minimum levels of habitability: ***€ 1,000 Million***
Obtaining optimal conditions: ***€ 20,000 Million***
Obtaining the complete update of all housing units in the housing stock: ***up to € 300,000 Million***

Finally, we have assessed Spanish households' theoretical investment capacity and its relationship to the state of repair of the home they occupy. Our interest was to identify and begin to understand the needs for additional investment to intervene in the state of repair of the existing housing stock, better understand the willingness of families to invest in improving their homes and their energy efficiency and its sensitivity to investment returns, incomes or access to savings.

Using the 2001 Census data crossed with a 2009 family income data table, we are able to provide the following insights into physical home state of repair and income:

Constructed park. Households by average annual household net income bracket and state of the building

Unit: Homes		Good	Deficient	Bad	Ruinous	Not applicable	TOTAL
A	> 40.000 €	968.514	41.535	11.058	5.996	4.858	1.031.761
B	20.000-40.000 €	6.540.556	414.898	96.238	43.1778	27.732	7.122.602
C	< 20.000 €	3.683.108	357.861	80.017	27.162	16.478	4.164.626
-	Sin datos	1.702.780	112.130	27.940	11.110	12.240	1.866.200
	TOTAL	12.894.758	926.424	215.253	87.446	61.308	14.185.189
A	> 40.000 €	6,8%	0,3%	0,1%	0,0%	0,0%	7,3%
B	20.000-40.000 €	46,1%	2,9%	0,7%	0,3%	0,2%	50,2%
C	< 20.000 €	26,0%	2,5%	0,6%	0,2%	0,1%	29,4%
-	Sin datos	12,0%	0,8%	0,2%	0,1%	0,1%	13,2%
	TOTAL	90,9%	6,5%	1,5%	0,6%	0,4%	100%

Source: 2001 Population and Housing Census, 2009 Living Conditions Survey.

The above correlations between household incomes and a buildings' state of repair better allows us to consider the levels of potential subsidy required for these investments and incorporate this knowledge into the recommendations emerging from the GTR Action Plan.

62 *See Apendix for further details. Figures based upon GTR expert cal culations from executive members involved in these habitability improvements.*

THE ACTION PLAN

The GTR Action Plan targets the deep renovation of 10 million of Spain's most energy intensive primary residences (some 64% of all of those primary homes built before 2001). The individual interventions contemplated together target the reduction of each home's needs for heating / cooling by 80% and its requirements for energy to heat water by 60%. The specific intervention menus include hyper-efficient thermal insulation and ventilation mechanisms to meet European standards, high efficiency condensing boilers, smart thermostat controls and high efficiency solar thermal panel systems.

The table below outlines the high-level indicators and ambitions of GTR's Action Plan with final targets for 2050 and interim goals for 2020 and 2030. GTR believes that Spain can cost efficiently support a programme of deep renovation of its housing stock targeting the completion of 10 million deep renovations by 2050 which alongside complimentary measures described here can attain an 80% overall reduction in CO2 emissions from Spanish housing. In the interim years the targets are 2 million homes with 27% CO2 emissions reductions by 2020 and 6 million homes with a 55% emissions reduction for those Spanish properties constructed before 2001. Finally, by 2050 we also expect to have improved over 1 million homes with structural deficiencies and at risk of "energy poverty" thereby reducing considerably the risks of social exclusion.

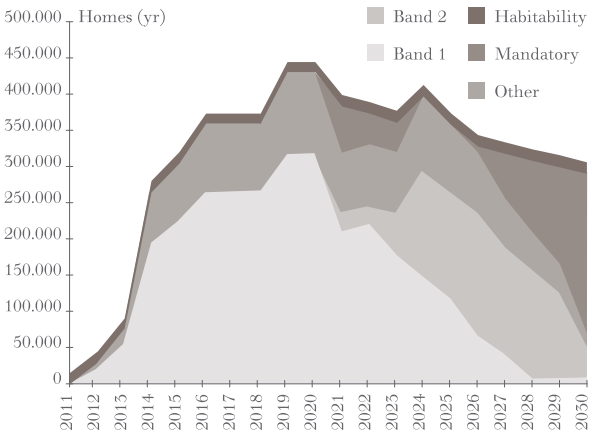
The NHS can deliver long-term and sustainable economic activity as described below with a clear policy commitment and levels of policy support which can deliver the following:

- Low cost, long-term financing for deep renovation – example: 20 years at rates of 5%;
- A clear and bankable value to households, funders or utilities for the CO2 savings delivered;
- Up to 25% "kick-start" subsidies paid up-front during the initial stages of each "hot-spot" to stimulate the "deep renovation" market for some sectors of society and tax benefits for others;
- Post-2020, a mandatory policy ensuring that the NHS renovation activity reaches a minimum of 3% of Spanish primary residences per annum;

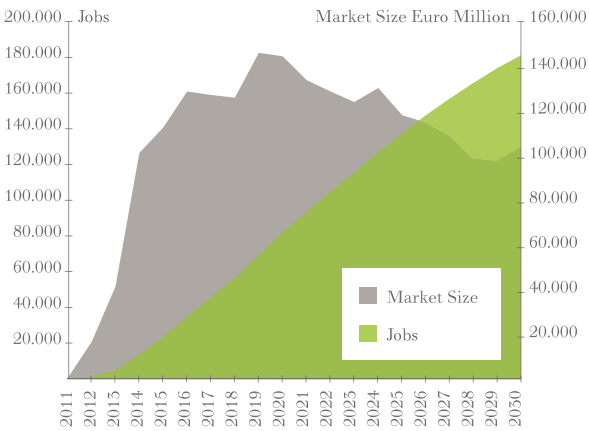
Target's for GTR's Action Plan

	2020	2030	2050
Number of Homes Reformed (2012-year)	2.600.000	6.000.000	10.000.000
% of 2001 Primary Residential Homes	16%	37%	64%
Aggregate Investment in Housing (Euro mm)	65.000 €	150.000 €	240.000 €
Cumulative Investment only in Energy Efficiency	43.333 €	100.000 €	160.000 €
Energy Saved in Year (GWhr)	23.000	49.000	70.000
Cumulative Energy Savings since 2012 (GWh)	88.000	470.000	1.700.000
CO2 Saved in Year ('000 Tons)	5.700	11.000	13.000
% Reductions vs 2001 Residential Homes (inc. other measures)	27%	55%	80%
Cumulative CO2 savings from 2012 '000 Tons	23.000	110.000	370.000
Accumulated Savings Energy and CO2 from 2012 (Euro mm)	8.900 €	62.000 €	300.000 €
Jobs Sustained (Period Average)	**130.000**	**140.000**	**110.000**
Subsidy Cost per Job (average over period)	**12.535 €**	**11.230 €**	**n/a**

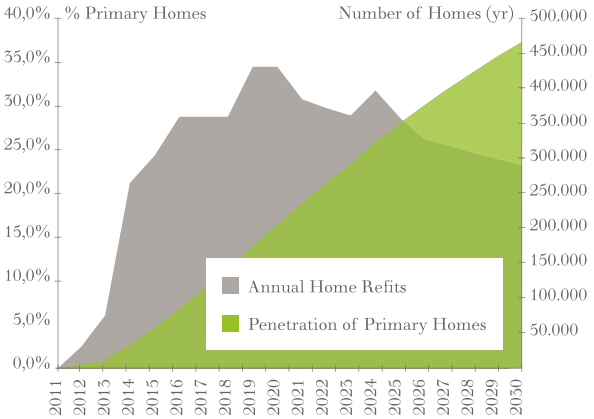
With the above stimulus framework, GTR believes that the NHS economic profile is described here:



The following chart illustrates how this Action Plan creates a home renovation market with an aggregate value of nearly Euro 150 billion by 2030 alongside with the NHS sustaining long-term productive employment for over 130-140,00 individuals as an average over the period:



Spain can reform 37% of its most energy intensive primary housing units (those built prior to 2001) by 2030, following GTR´s Action Plan and then subsequently continue retrofitting at a mandatory 3% annual rate, equivalent to 300,000+ housing units per year until 2050, which gives the NHS sustainability and ensures that Spain can deliver upon its commensurate share of Europe's 2050 energy and emissions reductions targets from the household sector:



KEY ASSUMPTIONS FOR THE GTR ACTION PLAN

Supporting this Action Plan is a series of key assumptions which have allowed the GTR to develop its models and conclusions. Several factors have a significant impact on the results and are considered central for policy-makers to consider in the delivery of critical mass and a vibrant NHS:

- **"Deep Renovation" interventions are proposed which deliver 80% reductions[63] in heating/ cooling energy needs combined with an additional 16% energy saving from deploying solar thermal panels to cover 60% of hot water needs.** The GTR Action Plan is built upon the premise that it will be more efficient for Spain to intervene in each home once (to do a "deep renovation") and that in this single intervention it is sensible to attain the highest standards of cost optimum efficiency. This requires levels of ambition aligned with the highest standards of insulation and retrofit available in Europe, but also ensures a vibrant and stimulative NHS. This plan contemplates a series of financial measures which provide significant risk sharing and low cost finance enabling households to take a long-term view and will reduce annual repayments to levels which can be covered by savings.

- **Low Cost, Long-term Financing, e.g. 5% fixed rate for 20 years, distributed by ICO in partnership**

63 *In line with the E6 Scenario in WWF's December 2010 white paper and those contemplated in BPIE's recent modeling for the Renovate Europe campaign.*

with Spanish banks: It is clear that the financing required to deliver deep renovation where investment costs are covered by the energy savings has to be long term (eg. Over 20 years, like a mortgage) and needs to be "low cost" (e.g. 5% per annum fixed rate). This factor has been recognized in other European countries committed to deep retrofits through the use of special products ("Green Mortgages"), the UK's Green Deal and through low cost state bank programs which promote deep renovation (e.g. KfW in Germany with interest rates of 2.75%). While the present financial crisis makes the procurement of long-term, low cost debt harder, GTR strongly believes that it is exactly this kind of stimulus that home-owners need to be able to have confidence in undertaking deep renovations.

- **Declining 25% up-front direct Subsidy or Income Tax deductions for up to Euro 20,000 of the investment cost of the deep renovation work to "kick start" the NHS:** To ensure that the NHS will act in all areas of society in a balanced way these subsidies are required to accelerate activity, especially in segments with poor access to capital and those outside the most energy intense segments of the market in early years. These numbers will decrease over 10 years and GTR anticipates that no direct cost subsidies should be necessary much after 2020 when the mandatory rules take effect. This direct State subsidy will be recovered many times over through decreased benefits payments, increased tax revenues from the NHS employees and positive knock-on macro-economic effects.

- **"Technology Curve" of -1% (pa) Nominal Cost Reductions for Deep Renovations:** We assume that the price of retrofitting a housing unit will reduce at an annual rate of -1% until 2050 in nominal terms, ***with a long-term Spanish inflation rate expectation of 2% and therefore -3% real cost savings.*** We believe that these real cost reductions will be delivered through economies of scale, competition on margins, improved contractual procedures and lower transaction costs. We do not assume reductions in labour costs nor in the cost of raw materials, but in the efficiency of use of both. We also note that our "technology improvement curve" is not as aggressive as for other new markets nor as illustrated in other analysis on this subject[64].

- **Additional Rehabilitation Spending Knock-on Effects of Deep Energy Efficiency Renovation on Cosmetic areas of 2 to 1:** At the intervention scale of deep renovations it is often the case that homeowners decide to make non-energy related investments at the same time as the retrofit, such as cosmetic improvements, new lifts and other quality improvements which increase the property's value and living comfort. In Germany, this extra investment can be as high as 1:1 (one euro extra for non energy related upgrades alongside every euro invested in deep retrofits), however given different availability of household savings, GTR is using a 2:1 ratio for its Spanish base case.

- **Price of domestic gas (0.0558[65] euros/kWh) rising along the "high case" scenario taken from the BCG Study for IDAE[66].** While we do not intend to forecast the exact evolution of energy prices over the next 20 years, GTR does assume that the cost of insulation and deep retrofit of housing does not increase at the same rate as gas prices (i.e. gas prices increase at a faster rate than the cost of refurbishment). In addition, GTR subscribes to the theory that Spanish energy prices will also tend towards the European norms and that existing anomalies will quickly be passed through in terms of extra costs to energy consumers.

- **CO2 Savings Assigned an Economic Value to Home Occupant equal to 15% of the Value of the Energy Saved:** Energy efficiency refurbishment at the scale demanded by this Action Plan will have a significant impact on Spain´s national CO2 emissions. Without a white certificate program or other ways to compensate the householder or the investor directly for the emissions reductions generated by the reform, the household project can lose up to 15% of its real returns. A mandatory white certificate programme for utilities is one option to allow this value to be captured and passed onto the funder of the retrofit, and there are others, the key for this Action Plan is that this value is captured and that households reducing their emissions through deep retrofits are adequately compensated for this. In Spain, GTR considers that the use of environmentally weighted tax systems ('bonus-malus') which penalize energy intensity and

64 BPIE. (2011). *Europe's Buildings under the Microscope: A country-by country review of the energy performance of buildings*

65 Europe's Energy Portal (2011). *Natural Gas Households: Reference Month: June, 2011*

66 Boston Consulting Group (2011). *Evolución Tecnológica y Prospectiva de Costes de las Energías Renovables: Estudio Técnico PER 2011-2020*

benefits more efficient users (such as modifications to the property tax, IBI) – which can be revenue-neutral – can also be used as a way to provide carbon value and support the rational use of energy and the deep retrofit market.

- **GTR assumes that for every Euro 1 million invested in deep renovations there are 18 sustainable jobs created in the NHS.** This figure comes from desk based research summarising the average findings of 15 international white papers and studies on the subject and coincide with recent work undertaken by local Spanish groups. We provide the full references to these works in a Table in the Appendices. Furthermore, according to Spain's 2009-2012 Housing and Rehabilitation Plan, investment in quality and energy efficiency improvements of homes can generate an economic stimulus of 2.6x that investment.

In parallel to this deep renovation programme, which is focused on the delivery of energy savings for heating, cooling and hot water, GTR also expects other complimentary policies will operate simultaneously acting on other areas of energy consumption and emissions, such as:

1. **Improved Efficiency of Appliances** which can reduce the 23% of energy spent on this segment by 80% by 2050. This entails the progressive change of home appliances and lighting systems for others that are more efficient and that follows lines already developed in national plans for energy efficiency and industrial development. GTR anticipates that by 2020 lighting emissions can be reduced by 30%, by 50% in 2030 and held there to 2050; while EU Energy Appliance Standards will see emissions from electro domestic appliances fall by 20% in 2020, 40% in 2030 and 60% by 2050.
2. **Smart Control systems and the reduced use of inefficient cooling systems,** which represent today, along with appliances, the most critical factor influencing a rise in energy consumption in homes. Preventive incentive policies -commercial and industrial - are the recommended option to halt the spread of inefficient refrigeration systems and poorly insulated homes. Notwithstanding this, and the implementation of the Ecodesign Directive, Spain's aggregate household energy demand, even for more efficient air conditioning, is expected to double by 2020 and then double again by 2030 as the country plays "catch-up" in terms of number of homes with these installations.
3. **Decarbonization of Spain's Energy Mix:** GTR has used the forecast evolution of emissions intensity for electricity generation from Spain's Renewable Energy Roadmap for 2050[67] where the penetration of renewable energy and other zero emissions technologies in Spain reaches 40% by 2020, 60% by 2030 and 80% by 2050.
4. **Fuel Switching for Heating and Hot-Water:** Many Spanish households still rely on the direct burning of coal and fuel oil to generate heat. Changing these practices for biomass, ground heat pumps or other cleaner energy sources would significantly reduce emissions from these homes. GTR believes that the likely impacts of this increasing trend of fuel switching, after initial replacement of "low hanging fruit" (fuel-oil and coal), will rise with cost reductions in heat pump technology after 2020. For the purpose of the Action Plan we anticipate reductions of greenhouse gas emissions from these actions at 5% by 2020, 20% by 2030 and 60% by 2050.

These complimentary actions, together with the anticipated CO2 emissions reductions from the successful execution of the Action Plan by the NHS, can deliver an overall household emissions reduction rate for Spain of -27% by 2020, -55% by 2030 and -80% by 2050.

PHASED ROLL-OUT OF THE GTR ACTION PLAN

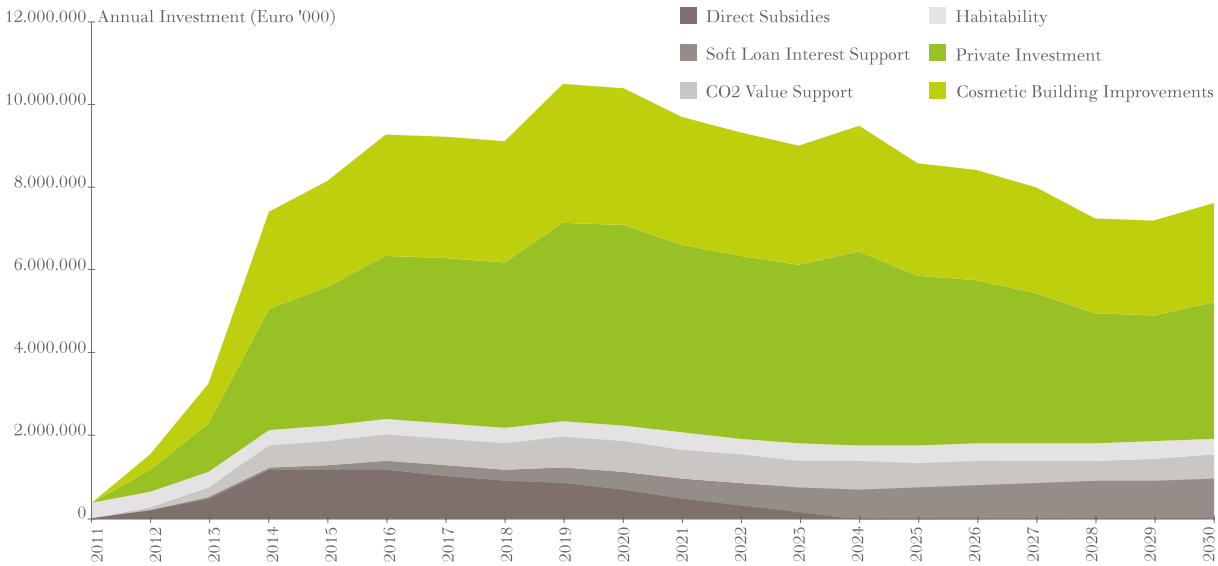
The Action Plan proposed in this report begins in 2012 and extends until to the 2050 horizon, while ensuring that Spain's actions are commensurate with Europe's 2020 and longer term objectives by acting directly on an annual average of 250,000 houses through deep retrofit in the 2012-2020 period rising to around a peak in the 2020-2030 decade of over 350,000 renovated a year and subsequently flattening out to a longer term rate around 300,000 housing units per annum until 2050.

The Action Plan anticipates a total upgrade investment in existing pre-2001 Spanish homes of Euro 240,000 million (of which Euro 160,000 million produces energy and CO2 savings, and Euro 80,000 is cosmetic, structural and other) over 38 years until 2050. It is interesting to compare this with that proposed to invest in Strategic Infrastructure and Transport in Spain 2005-2020 (15 years) which is the same Euro 240 billion, and was recently unanimously approved by Spain's Parliament. The investment period for

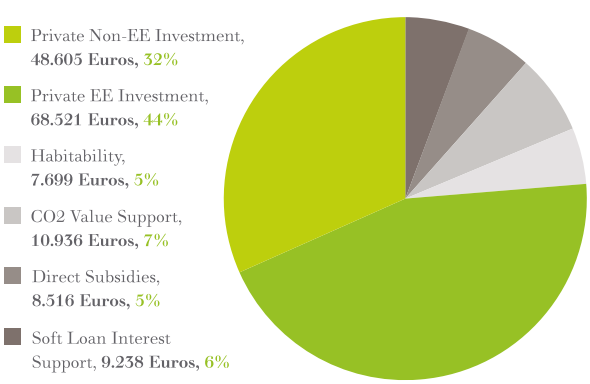
67 Consejo Construcción Verde España, Asociación Sostenebilidad y Arquitectura , Centro Complutence de Estudios e Informacion Ambiental, & Fudación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

strategic and transport infrastructure is different (in fact 15 years, under half the time) and the returns are not mainly supported by energy and CO2 savings, nor do they improve Spanish homes, but if decisions of that magnitude can be taken in other sectors, the decision over this Action Plan is clearly feasible.

The GTR Action Plan envisages a sector which can deliver up to Euro 10,000 million of annual investment in Spanish homes, and the jobs associated, with approximately 25% policy support in aggregate deployed as illustrated here:



Between 2020 and 2030, GTR believes that the level of policy support through direct subsidies, fiscal measures, soft loans, CO2 value recognition and habitability investments of under 25% of the total investment in the sector, with the following distribution:



GTR believes that a total household investment from 2012-2020 of over Euro 100,000 million can be stimulated with an adequate policy framework coupled with Euro 8,500 million direct subsidy or fiscal stimulus, Euro 9,000 million of soft loan interest subsidy, Euro 11,000 million of CO2 Value Support and Euro 7,500 million in Habitability Support - which is 24% of the total.

This Action Plan can deliver energy savings of 1.7 million GWh and emissions reductions of 370 million tCO2e by 2050, which GTR estimates is worth Euro 300 billion from 2012-2050, a slightly higher number than its total investment cost (based upon "high case" energy price forecasts and an average period CO2 price of Euro 50 per ton). These emissions savings from the deep renovation of 10 million pre-2001 Spanish homes deliver a 34% reduction of aggregate emissions from the 25 million total Spanish homes standing in 2011. The remaining 46% of emissions reductions from the housing sector (to get to 80% reductions by 2050) are delivered by the parallel policy actions on lighting, appliances and de-carbonization of the electricity generation in Spain.

The GTR Action Plan targets the creation of 130,000 jobs in its first decade until 2020 when the total rises to 140,000 until 2030 when we anticipate that the long-term trend will be above 110,000. GTR estimates that the total public subsidy required to support these jobs is in the order of Euro 11-12,000 per job created per annum (reducing over time). Needless to say that the launch of the NHS will also have a significantly stimulate effect around the supply chains to the new sector and should increase Government revenues from taxation and reduce certain social expenditures.

This Action Plan would be rolled out in four stages:

1. **2012-2014 "Policy Design and Launch Phase":** A short 2 year window to establish the regulatory framework, the ICO low interest loan programs, CO2 value support and cost and fiscal subsidies schemes and target NHS resources on band 1 of "hot-spots" A, C, E, F and G, where the returns on future energy savings at 2012-2014 energy prices are profitable.
   - In addition, in this the first phase NHS participants will analyze the areas for intervention involved the second stage and contribute and complete the necessary processes and regulatory changes to make deep renovation attractive. This needs to include the establishment of a mechanism through which to compensate households for CO2 savings (or if not allow for the proportionate increase in direct or indirect subsidies) and consider the possible gradation of property taxes (IBI) depending upon energy certification - excepting cases of energy poverty. In addition, promotional work and education programmes will be key to help home owners understand how to purchase deep renovations and remove split incentives and other hurdles[68].

2. **2014-2020 "Roll-out and Scale-up":** This second phase of high activity takes place as the policy framework stimulates the NHS and participants act on band 1 of all the "hot-spots", as well as the most energy intensive homes among the 35% of Spanish households not contained in the "hot-spots" at the same rate. At this point the Direct subsidies are still required but decline year by year until they are phased out entirely just after 2020. Low cost finance, valuation of CO2 emissions reductions and fiscal support will continue to be a feature of this market to ensure renovation is "deep" and that Spain retains its potential to cost effectively meet 2050 decarbonization targets.
   - The second phase "roll-out" includes the deep retrofit of more than 350,000 homes per year with annual sector investments reaching Euro 10 billion, generating over 140,000 sustainable jobs and resulting in significant savings for the citizenry and country in energy and emissions.

3. **2020-2030 "Steady-State":** In the decade after 2020, the Action Plan moves into a third stage, in which the NHS begins to operate on band 2 of the "hot-spots" and other segments of the housing stock. GTR believes that unless energy and CO2 prices have increased substantially faster than projected, a "mandatory" pace of 3% deep renovation across households can be considered (as the "stick" working in tandem with the considerable economic "carrots" offered by Government during 2012-2020). At this time, Government may consider new policies such as minimum energy certification levels, 'bonus-malus' taxation systems and other standards based policies by region to ensure that energy intense homes receive attention. These policies may not be necessary if cultural approach to renovation has shifted or NHS has developed new technologies and significant cost reductions which render a "stick" approach unnecessary to maintain the 3% renovation target.

4. **2030-2050 "Mandatory Energy Performance":** GTR imagines that after 2030 the NHS may enter a final phase where Spain introduces a mandatory minimum level of energy efficiency for its buildings in order to complete the programme and meet the 2050 emissions reductions targets. This may not be necessary if the NHS has developed so far and fast that the world looks radically different in 2030 from the one which gave birth to the NHS in 2011, however GTR believes that idea of deep renovation for inefficient housing at some point becoming mandatory is an interesting incentive for "early movers" to kick-start the sector.

To be viable, the Action Plan requires decisive and effective actions in the detection and removal of barriers that may prevent a swift and efficient transformation of the existing buildings sector into the NHS. The 2012-2014 phase will signal the Government's unambiguous and clear commitment by conducting trial groundwork on the existing housing stock to establish the NHS's necessary managerial structure. This phase will also see the development of a special legal and financial framework,

68 Climate Strategy & Partners. (2010). *Financing Energy Efficiency Building Retrofits: International Policy and Business Model Review and Regulatory Alternatives for Spain. Madrid, Spain:* Managan, K. & Sweatman, P., R.

that secures deep renovation investments and ensures the stability of the procedures and regulations that support the economic and technical feasibility of the proposed interventions.

By 2014-2015 it should be possible to establish the framework for a new law, the NHS Sector Management Housing Act which establishes institutionally-determined aims and objectives for the sector, recognizes and articulates the role of different actors, establishes and regulates the different renovation business models. This will also seek efficiency in the performance of various local and regional government actors, depending on the particular needs of each hotspot and its geographical location. This new law may also help support the distribution, organization and implementation of mechanisms to underline investment returns through energy savings and emissions reductions and reinforce the mechanisms of state support. This new Act can help organize and coordinate the NHS across other laws and regulations which affect the use, possession and intervention by the NHS in existing buildings and other legal frameworks affected by the performance of the NHS. Finally, GTR expects Spain will take into account the models and other frameworks established in other countries, as well as the various solutions that have overcome bottle-necks and hurdles in the investment in energy efficiency as clear reference.

Naturally, this Action Plan does not exhaust the possibilities or needs of the NHS. There are areas for improvement in Spain's housing stock which are not covered here and potentially the constitutional right of access to housing together with the financial crisis creates conditions which are not contemplated here. It is also clear that some of the homes built after 2001 will require renovation at some point before 2050, and we will have greater visibility on this when the results of the 2011 Census are available in 2012. Once launched the NHS will become a living and vibrant sector which will be able to self-improve as the Action Plan is met and the challenges highlight by Global Change are manifest.

If the GTR Action Plan is executed, as described here, we expect the NHS to meet the following milestones:

- **To deep retrofit 2 million Spanish homes by 2020,** which represents 16% of the primary housing stock built before 2001. This requires an investment of € 43,300 million, and would result in an annual saving of 23 million MWh and reductions of 5.7 million tCO2 which cumulatively over the 2012-2020 period would be 88 million MWh and 23 million tCO2, worth approximately Euro 9 billion. Deep renovation together with parallel measures designed to reduce household energy consumption have the potential to reduce Spain's CO2 emissions from housing by 27% by 2020.
  These results require the supportive regulatory framework outlined and access to financing for 20 years at 5% interest rates, direct subsidy or fiscal support and CO2 value together worth just under 25% of the total investment budget of the NHS.

- **To deep retrofit 6 million Spanish homes by 2030,** which represents 37% of the primary housing stock built before 2001. This requires an investment of € 100,000 million, and would result in an annual saving of 49 million MWh and reductions of 11 million tCO2 which cumulatively over the 2012-2030 period would be 470 million MWh and 110 million tCO2, worth approximately Euro 62 billion. Deep renovation together with parallel measures designed to reduce household energy consumption have the potential to reduce Spain's CO2 emissions from housing by 55% by 2030.
  This is achieved through the now mature and sizeable rehabilitation sector (NHS) which has evolved over a decade and created cost savings, new technologies and delivers energy efficiency measures and local renewable energy solutions at competitive costs allowing Spain to work well within the context of European targets.

- **To deep retrofit 11 million Spanish homes before 2050.** This requires an investment of € 160,000 million, and would result in an annual saving of 70 million MWh and reductions of 13 million tCO2 which cumulatively over the 2012-2050 period would be 1,700 million MWh and 370 million tCO2, worth approximately Euro 300 billion. Deep renovation together with parallel measures designed to reduce household energy consumption have the potential to reduce Spain's CO2 emissions from housing by 80% by 2050.

GTR is confident that Spain has the opportunity to convert much of the knowledge, skills and resources of its existing workforce, spread across its core regions, to develop vibrant new economic activity in a sector which addresses the cost effective upgrade and renovation of its housing stock. While this opportunity faces organisational, behavioural, financial and cultural hurdles, GTR strongly believes that it is the right opportunity for Spain to engage in and will deliver national and private benefits which greatly outweigh these challenges.

Parque construido

Número de viviendas principales

según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población, plantas sobre rasante del edificio y superficie de la vivienda

Fuente: Censo de Población y Viviendas 2001

						Plantas sobre rasante del edificio	1 - 3				4 - 9				> 9			
						Superficie de la vivienda	< 60 m2	61-90 m2	91-120 m2	> 120 m2	< 60 m2	61-90 m2	91-120 m2	> 120 m2	< 60 m2	61-90 m2	91-120 m2	> 120 m2
Año de construcción	Nº de viviendas	Dimensión del núcleo	14.125.848				6.399.607				6.658.038				1.068.203			
							725.422	2.466.901	1.948.583	1.258.701	1.159.160	3.745.090	1.359.246	394.542	119.685	581.584	268.301	98.633
hasta 1960	1	< 10.000 h	3.909.129	1.646.016	1.257.613		168.437	465.402	392.658	230.523	83	244	146	120	0	0	0	0
		10.000 a 100.000 h			269.564		32.282	103.703	83.017	50.134	58	187	107	76	0	0	0	0
		> 100.000 h			118.839		24.370	47.775	27.965	18.373	66	165	78	47	0	0	0	0
	2 - 4	< 10.000 h		535.711	268.698		37.596	103.680	77.100	37.104	1.906	6.149	3.767	1.396	0	0	0	0
		10.000 a 100.000 h			152.497		22.451	56.003	33.273	15.383	3.532	11.840	6.906	3.109	0	0	0	0
		> 100.000 h			114.516		23.844	36.175	14.733	7.197	7.410	14.564	7.089	3.504	0	0	0	0
	5 - 39	< 10.000 h		1.553.735	157.851		10.889	23.148	8.358	2.938	19.307	64.527	21.826	4.749	217	1.090	604	198
		10.000 a 100.000 h			377.701		16.014	24.202	7.416	2.489	57.756	180.471	63.495	16.663	676	4.516	2.893	1.110
		> 100.000 h			1.018.183		31.268	25.660	6.089	2.348	279.301	403.270	151.341	73.339	5.793	20.061	11.292	8.421
	40 ó más	< 10.000 h		173.667	10.606		209	310	140	74	1.177	3.677	1.462	541	777	1.393	651	195
		10.000 a 100.000 h			32.627		139	221	169	66	3.109	11.060	4.635	1.079	2.613	6.674	2.390	472
		> 100.000 h			130.434		637	628	253	153	30.100	39.250	14.307	4.242	8.192	21.903	8.498	2.271
1961 - 1980	1	< 10.000 h	6.088.310	1.155.162	835.217		68.614	301.006	302.658	162.080	129	391	223	116	0	0	0	0
		10.000 a 100.000 h			251.804		20.596	100.230	82.471	47.980	55	258	140	74	0	0	0	0
		> 100.000 h			68.141		9.954	26.437	17.509	13.853	73	179	83	53	0	0	0	0
	2 - 4	< 10.000 h		517.094	287.823		27.272	108.423	91.965	37.588	1.757	9.851	8.160	2.807	0	0	0	0
		10.000 a 100.000 h			157.944		14.131	57.433	39.032	15.606	2.249	14.120	10.979	4.394	0	0	0	0
		> 100.000 h			71.327		10.053	23.489	9.868	4.073	3.822	12.298	5.704	2.020	0	0	0	0
	5 - 39	< 10.000 h		3.671.856	442.666		13.051	49.660	21.837	6.324	34.532	209.931	81.599	15.910	583	4.830	2.932	1.477
		10.000 a 100.000 h			1.183.651		13.513	47.732	17.149	5.418	124.407	635.181	230.729	54.867	3.716	27.964	16.424	6.551
		> 100.000 h			2.045.539		16.642	23.667	6.228	2.342	379.112	964.327	285.247	86.991	26.509	151.762	68.897	33.815
	40 ó más	< 10.000 h		744.198	34.403		759	968	676	287	3.720	9.141	4.483	1.391	2.097	7.188	2.705	988
		10.000 a 100.000 h			151.727		283	782	359	145	11.059	43.194	17.655	4.017	12.359	43.118	15.891	2.865
		> 100.000 h			558.068		121	405	164	163	37.945	107.213	41.105	12.146	44.455	203.888	85.311	25.152
1981 - 2001	1	< 10.000 h	4.128.409	1.587.882	1.125.060		64.408	345.846	376.538	336.789	202	690	379	208	0	0	0	0
		10.000 a 100.000 h			359.875		14.015	115.896	110.006	118.686	188	608	322	154	0	0	0	0
		> 100.000 h			102.947		6.273	32.036	25.564	37.943	270	556	214	91	0	0	0	0
	2 - 4	< 10.000 h		431.679	266.327		22.809	95.068	84.381	50.152	1.233	5.611	4.962	2.111	0	0	0	0
		10.000 a 100.000 h			120.885		9.183	44.058	32.282	19.253	1.363	6.753	5.283	2.710	0	0	0	0
		> 100.000 h			44.467		5.298	14.693	7.678	5.402	1.996	5.224	2.927	1.248	0	1	0	0
	5 - 39	< 10.000 h		1.908.565	394.388		16.764	86.297	31.724	11.202	20.521	150.873	61.139	12.679	230	1.798	944	217
		10.000 a 100.000 h			728.434		12.845	74.442	27.057	10.548	41.517	367.045	144.571	38.256	550	6.359	3.813	1.431
		> 100.000 h			785.743		9.081	27.852	10.585	4.832	73.245	407.871	155.581	36.969	3.259	31.644	18.235	6.589
	40 ó más	< 10.000 h		200.283	22.987		755	1.644	905	580	2.898	7.856	2.528	822	922	2.700	1.169	208
		10.000 a 100.000 h			51.214		363	1.191	556	430	4.831	20.690	7.528	1.853	1.297	7.527	4.240	708
		> 100.000 h			126.082		503	739	220	243	8.231	29.825	12.546	3.790	5.440	37.168	21.412	5.965

"Hot-Spots" by Surface Area

Superficie de las viviendas principales ($10^3 m^2$)
según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio
Fuente y año de referencia: Censo de Población y Viviendas 2001

Año de construcción	Plantas sobre rasante	1			≥ 2			Nº de viviendas / Dimensión del núcleo	Hotspots
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h		
< 1960	1 - 3	**128.827**	27.754	11.314	28.630	15.607	11.368	A	
	≥ 4	66	43	35	11.308	32.175	**90.064**	B	
1960 - 1980	1 - 3	**88.032**	26.441	7.115	34.378	19.321	7.875	C	
	≥ 4	83	53	36	**35.165**	**109.369**	**212.227**	D - E - F	
1981 - 2001	1 - 3	**132.157**	44.048	13.038	**39.818**	22.275	7.956	G - H	
	≥ 4	145	120	100	24.885	**59.979**	**75.934**	I - J	

"Hot-Spots" by All Homes

Número de viviendas
según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio
Fuente y año de referencia: Censo de Población y Viviendas 2001

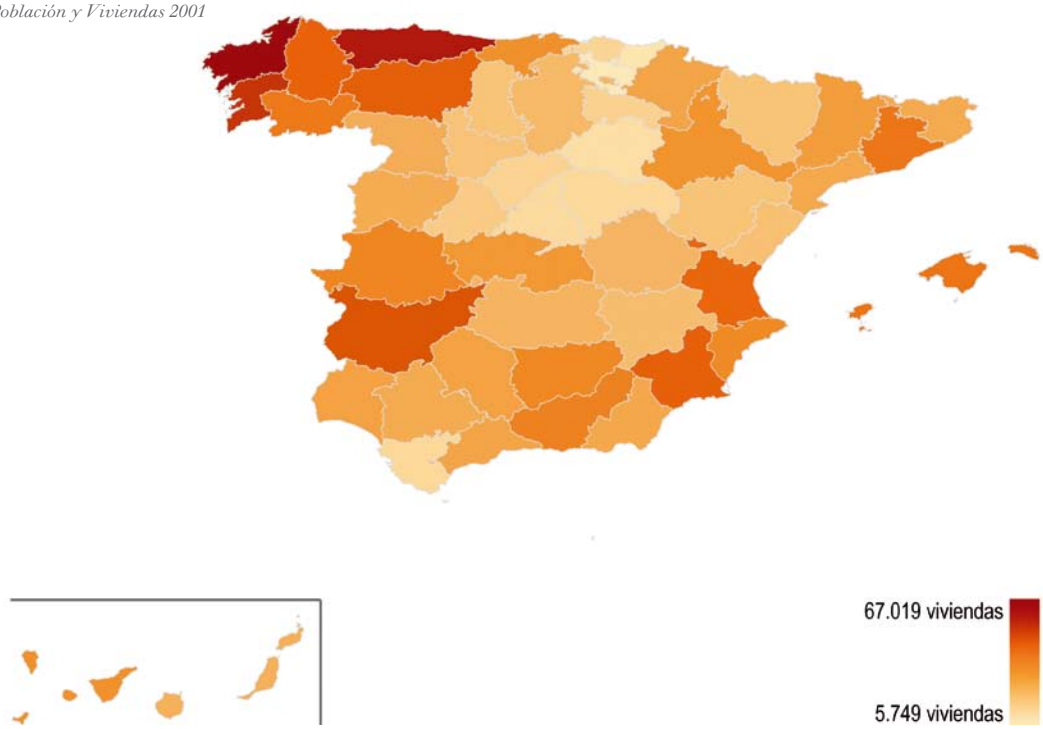
Año de construcción	Plantas sobre rasante	1			≥ 2			Nº de viviendas / Dimensión del núcleo	Hotspots
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h		
< 1960	1 - 3	**2.156.985**	394.439	169.676	491.361	256.836	213.202	A	
	≥ 4	762	598	535	244.628	537.257	**1.465.122**	B	
1960 - 1980	1 - 3	**1.459.203**	350.462	93.553	643.553	299.470	130.362	C	
	≥ 4	1.277	764	548	**766.716**	**1.736.877**	**3.179.423**	D - E - F	
1981 - 2001	1 - 3	**1.692.560**	435.873	117.080	**767.666**	352.661	123.165	G - H	
	≥ 4	1.948	1.536	1.281	638.386	**991.864**	**1.142.192**	I - J	

Geographical Distribution of *"Hot-Spots"*

Hotspot A

Número de viviendas principales según provincia

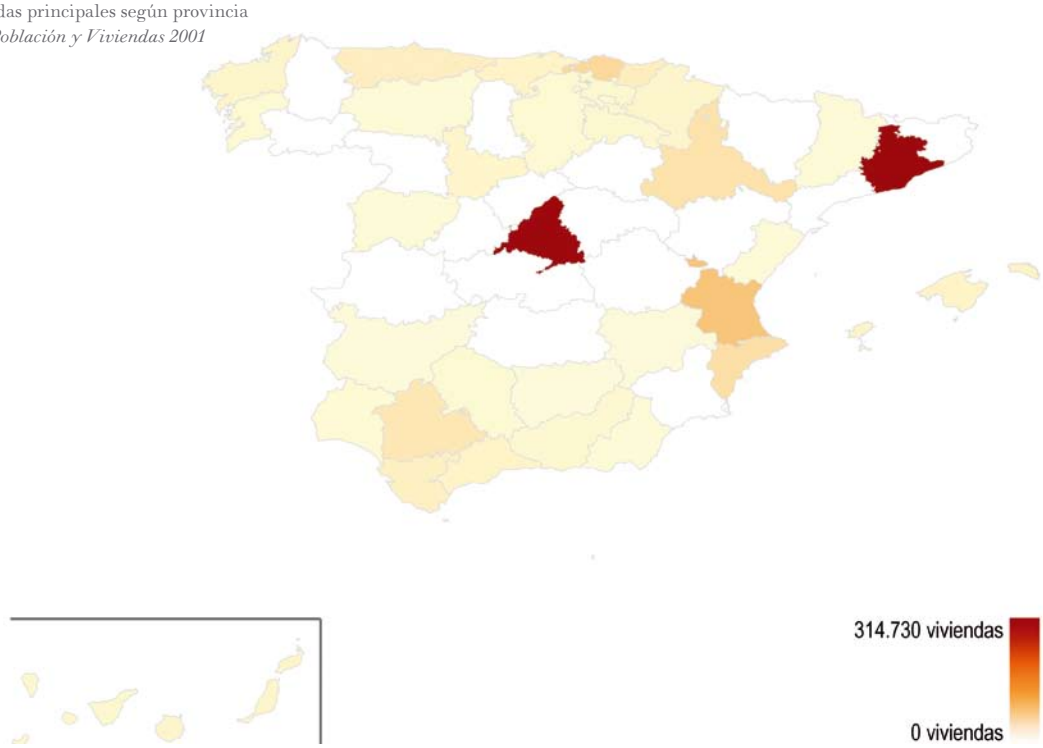
Fuente: Censo de Población y Viviendas 2001



Hotspot B

Número de viviendas principales según provincia

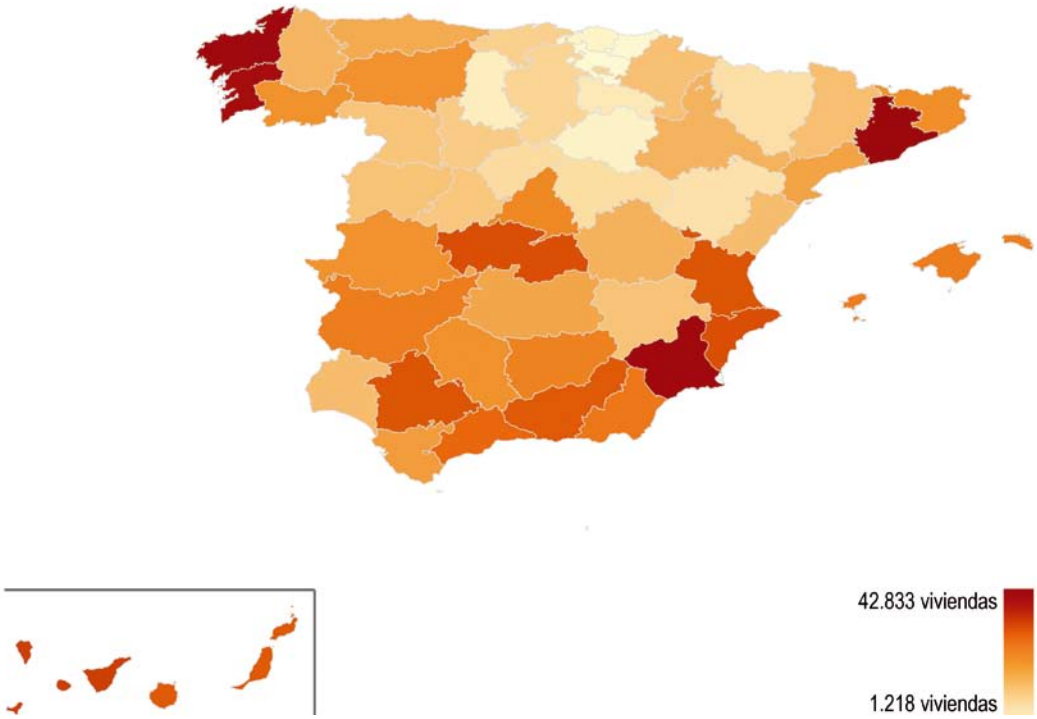
Fuente: Censo de Población y Viviendas 2001



Hotspot C

Número de viviendas principales según provincia

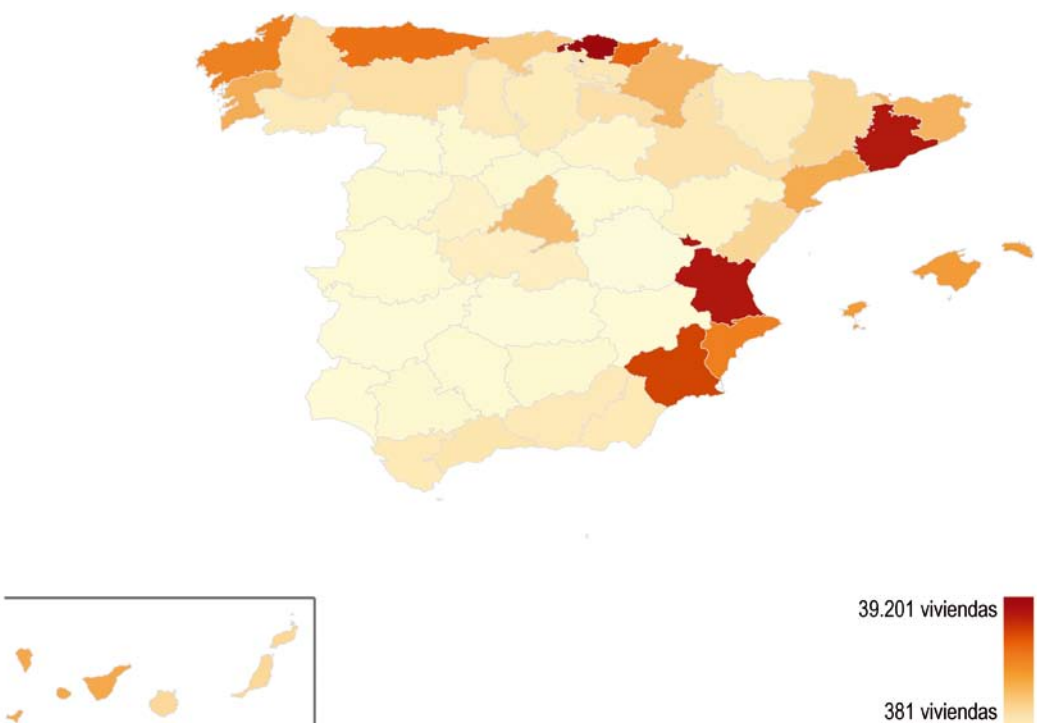
Fuente: Censo de Población y Viviendas 2001



Hotspot D

Número de viviendas principales según provincia

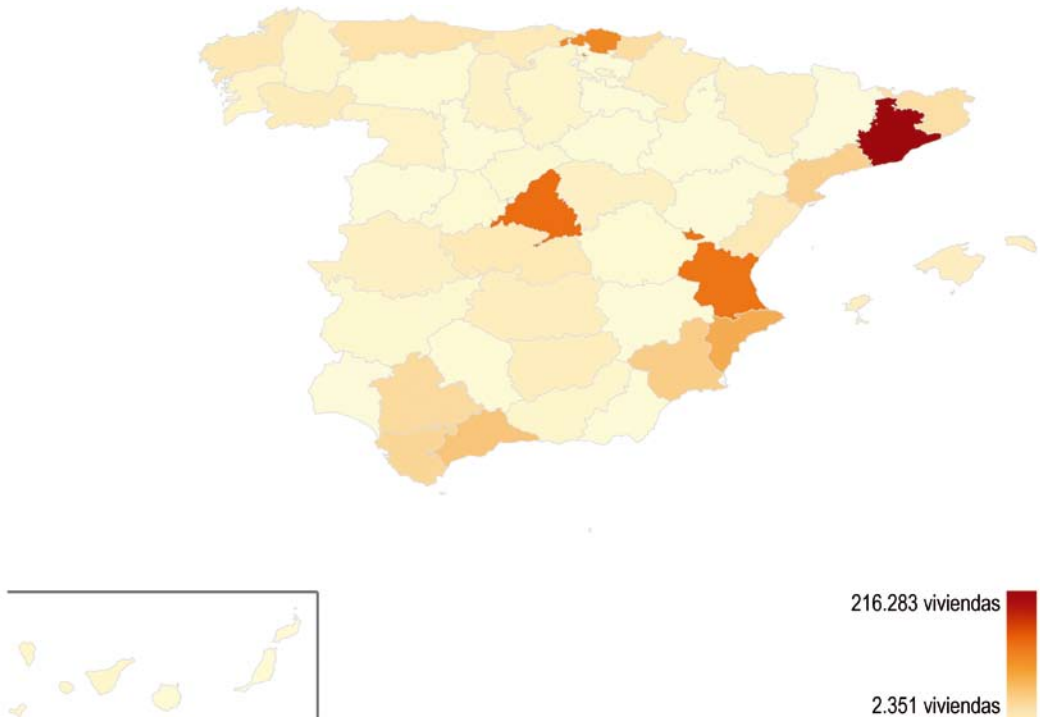
Fuente: Censo de Población y Viviendas 2001



Hotspot E

Número de viviendas principales según provincia

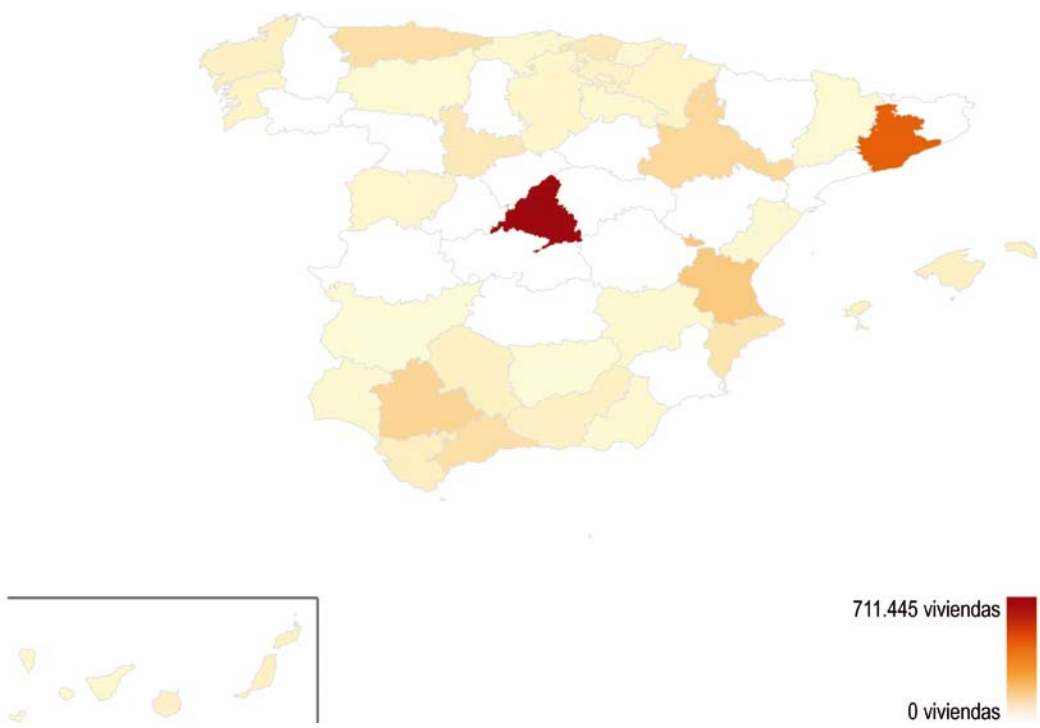
Fuente: Censo de Población y Viviendas 2001



Hotspot F

Número de viviendas principales según provincia

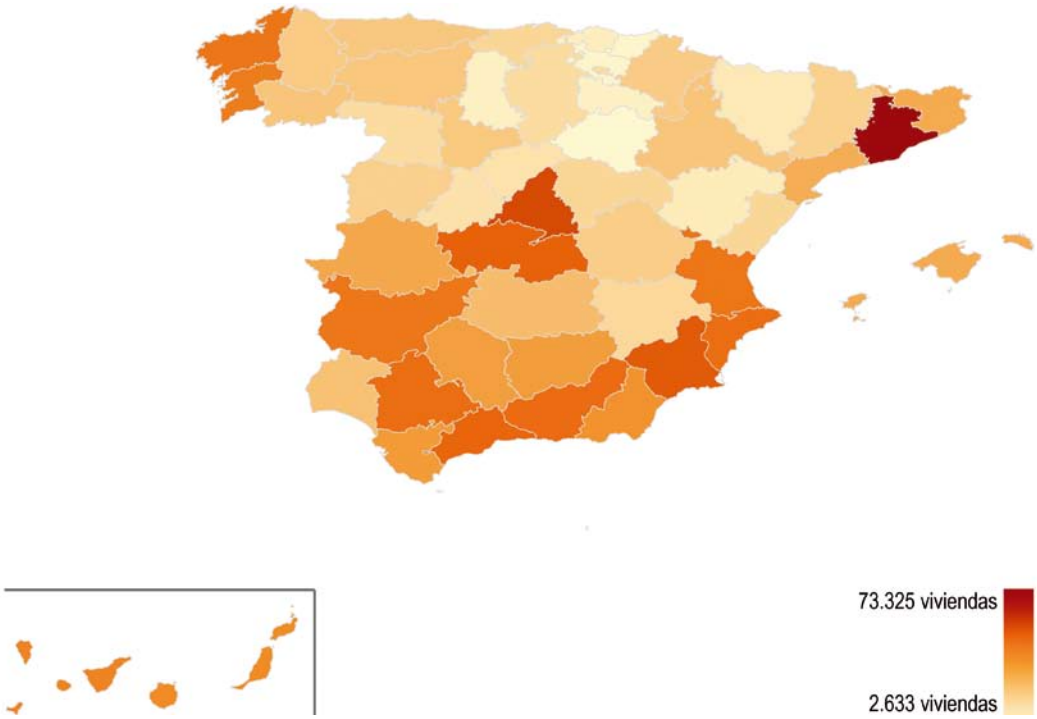
Fuente: Censo de Población y Viviendas 2001



Hotspot G

Número de viviendas principales según provincia

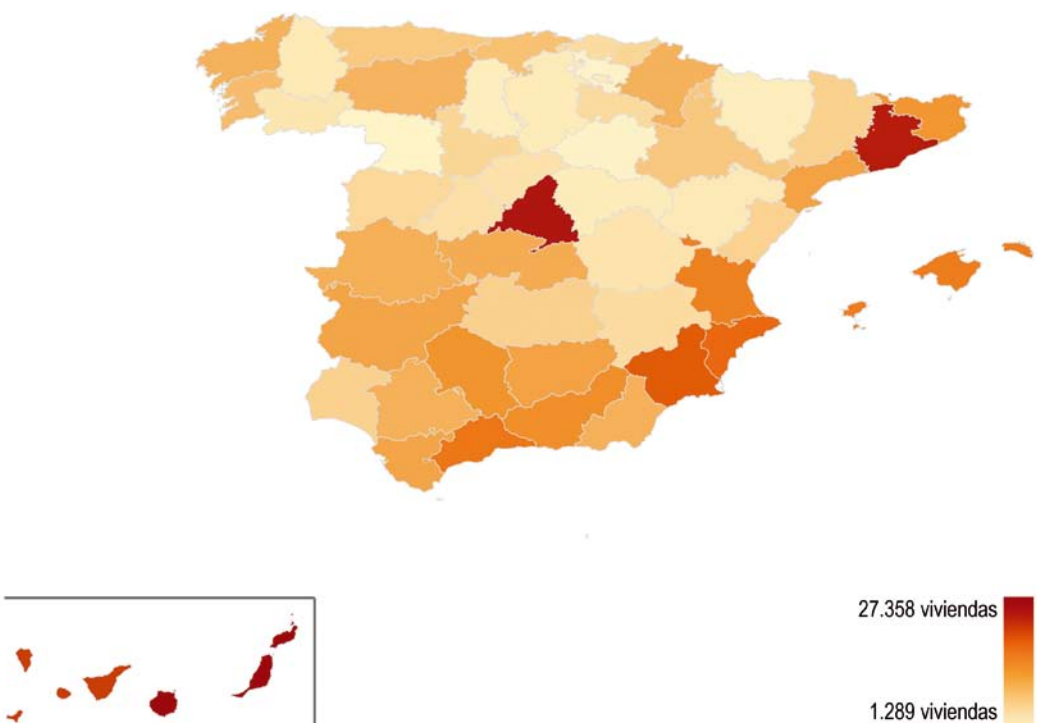
Fuente: Censo de Población y Viviendas 2001



Hotspot H

Número de viviendas principales según provincia

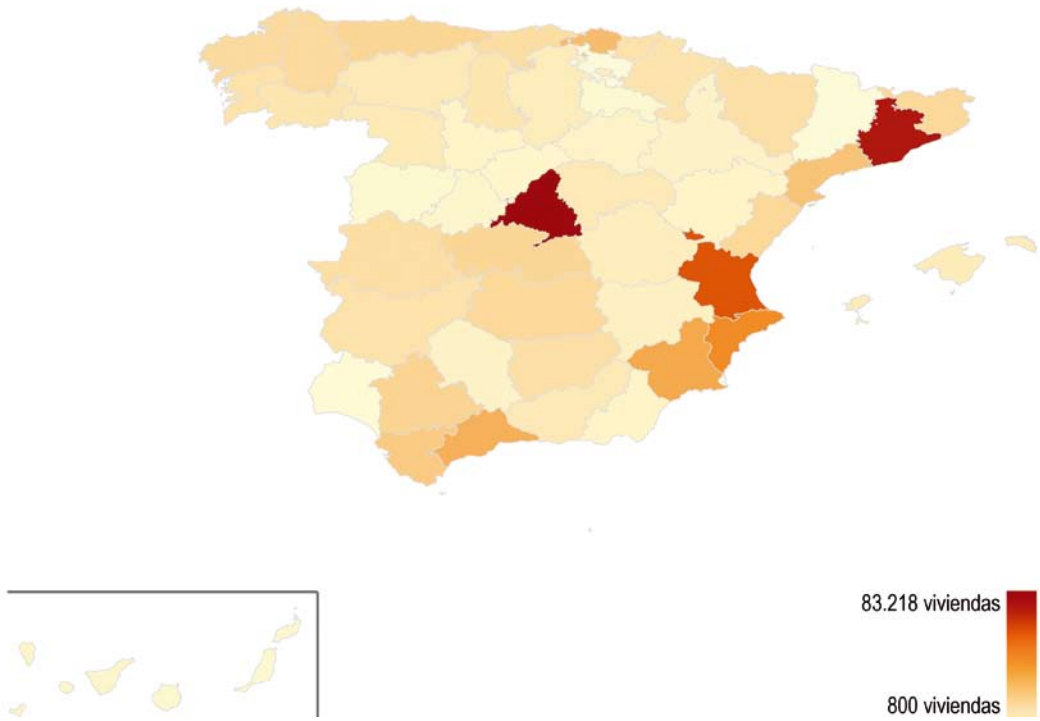
Fuente: Censo de Población y Viviendas 2001



Hotspot I

Número de viviendas principales según provincia

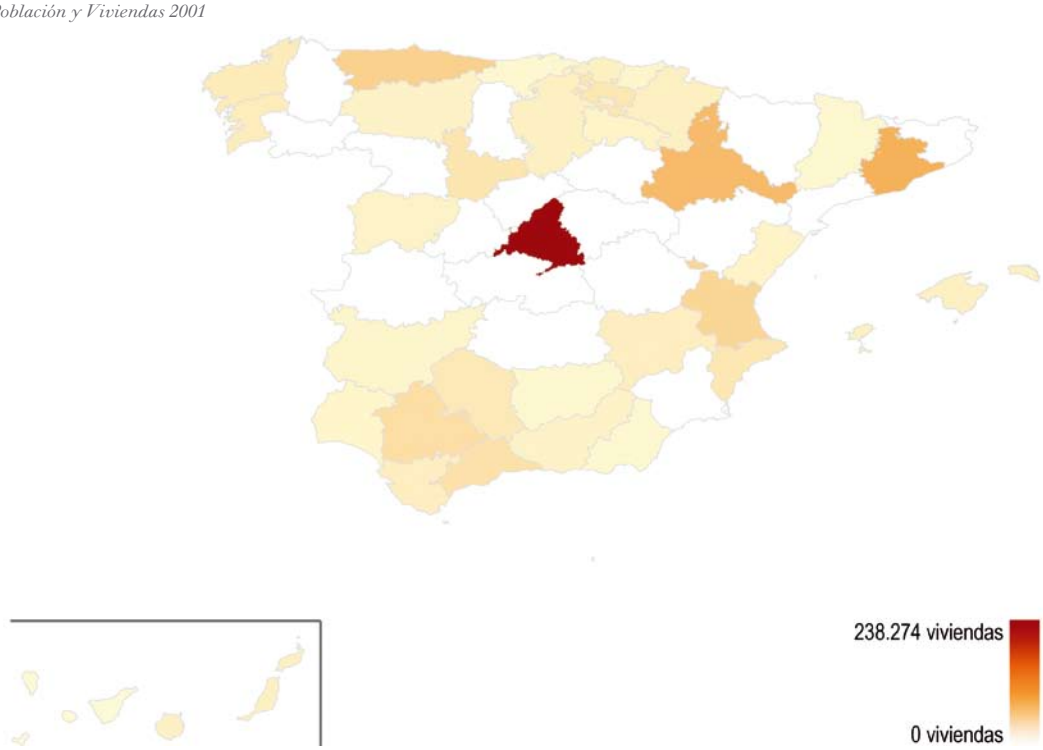
Fuente: Censo de Población y Viviendas 2001



Hotspot J

Número de viviendas principales según provincia

Fuente: Censo de Población y Viviendas 2001



"Hot-Spot" Energy Consumption

Consumo energético por calefacción en viviendas principales en edificios residenciales (MWh) según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio. Año 2001

Fuente: Censo de Población y Viviendas 2001, IDAE, WWF, Carrier, Eurostat.

		1			≥ 2			Nº de viviendas
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	Dimensión del núcleo
< 1960	1 - 3	**8.773.276**	**1.376.679**	603.863	1.019.367	461.288	372.642	**A**
	≥ 4	4.978	2.590	1.943	407.097	1.056.863	**3.562.330**	**B**
1960 - 1980	1 - 3	**5.293.488**	1.294.684	361.798	1.107.076	572.403	273.059	**C**
	≥ 4	4.763	2.728	1.836	1.230.531	**3.852.426**	**8.790.335**	**D - E - F**
1981 - 2001	1 - 3	**7.304.048**	**2.337.486**	793.868	1.221.423	661.588	267.877	**G - H**
	≥ 4	6.745	5.583	5.259	801.018	**2.094.573**	**3.087.124**	**I - J**
Año de construcción	Plantas sobre rasante							**Hotspots**

España	MWh
Total:	59.014.635

Hotspots	MWh	% respecto España
A:	8.773.276	14,87%
B:	3.562.330	6,04%
C:	5.293.488	8,97%
D:	1.230.531	2,09%
E:	3.852.426	6,53%
F:	8.790.335	14,90%
G:	7.304.048	12,38%
H:	1.221.423	2,07%
I:	2.094.573	3,55%
J:	3.087.124	5,23%
Total:	45.209.553	76,61%

"Hot-Spot" CO2 Emissions

Emisiones de CO2 asociadas a la calefacción de las viviendas principales en edificios residenciales (t de CO2) según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio. Año 2001

Fuente: Censo de Población y Viviendas 2001, IDAE, WWF, Carrier, Eurostat.

		1			≥ 2			Nº de viviendas
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	Dimensión del núcleo
< 1960	1 - 3	**2.360.627**	**402.144**	168.203	300.104	139.742	109.041	**A**
	≥ 4	1.328	715	536	119.125	312.149	**1.008.835**	**B**
1960 - 1980	1 - 3	**1.474.896**	383.626	102.111	326.321	173.806	78.140	**C**
	≥ 4	1.346	780	505	358.138	**1.115.044**	**2.451.164**	**D - E - F**
1981 - 2001	1 - 3	**2.005.125**	**647.202**	206.566	342.523	188.162	71.005	**G - H**
	≥ 4	1.875	1.536	1.392	223.803	**570.887**	**791.579**	**I - J**
Año de construcción	Plantas sobre rasante							**Hotspots**

España	Toneladas de CO2
Total:	16.440.077

Hotspots	Toneladas de CO2	% respecto España
A:	2.360.627	14,36%
B:	1.008.835	6,14%
C:	1.474.896	8,97%
D:	358.138	2,18%
E:	1.115.044	6,78%
F:	2.451.164	14,91%
G:	2.005.125	12,20%
H:	342.523	2,08%
I:	570.887	3,47%
J:	791.579	4,81%
Total:	12.478.818	75,90%

"Hot-Spot" Energy Expenditure

Euros asociados a la calefacción de las viviendas principales en edificios residenciales (€) según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio. Año: consumo 2001, precio energía 2011

Fuente: Censo de Población y Viviendas 2001, IDAE, WWF, Carrier, Eurostat, Endesa, GasNatural Union Fenosa

		1			≥ 2			Nº de viviendas
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	Dimensión del núcleo
< 1960	1 - 3	**583.345.767**	**104.195.652**	42.497.814	76.141.187	36.683.592	27.996.540	**A**
	≥ 4	310.403	169.127	134.440	30.439.126	81.427.771	**255.989.251**	**B**
1960 - 1980	1 - 3	**355.460.405**	98.984.408	25.283.924	81.911.830	45.278.035	19.739.898	**C**
	≥ 4	314.618	190.411	123.423	90.046.260	**282.236.873**	**603.719.735**	**D - E - F**
1981 - 2001	1 - 3	**471.213.105**	**159.596.725**	49.433.228	85.796.616	48.483.890	17.665.430	**G - H**
	≥ 4	433.808	368.685	331.639	55.282.462	**141.266.333**	**191.684.553**	**I - J**
Año de construcción	Plantas sobre rasante							**Hotspots**

España	Euros
Total:	4.064.176.964

Hotspots	Euros	% respecto España
A:	583.345.767	14,35%
B:	255.989.251	6,30%
C:	355.460.405	8,75%
D:	90.046.260	2,22%
E:	282.236.873	6,94%
F:	603.719.735	14,85%
G:	471.213.105	11,59%
H:	85.796.616	2,11%
I:	141.266.333	3,48%
J:	191.684.553	4,72%
Total:	3.060.758.899	75,31%

Euros asociados a la calefacción de las viviendas principales en edificios residenciales (€) según año de construcción, número de viviendas en el edificio, dimensión del núcleo de población y plantas sobre rasante del edificio. Año: consumo 2001, precio energía 2020 (escenario alto)

Fuente: Censo de Población y Viviendas 2001, IDAE, WWF, Carrier, Eurostat, Endesa, GasNatural Union Fenosa, Boston Consulting Group

		1			≥ 2			Nº de viviendas
		< 10.000 h	10.000 - 100.000 h	> 100.000 h	< 10.000 h	10.000 - 100.000 h	> 100.000 h	Dimensión del núcleo
< 1960	1 - 3	**892.509.938**	**159.417.725**	65.020.993	116.494.830	56.125.324	42.834.270	**A**
	≥ 4	474.911	258.761	205.691	46.571.389	124.583.221	**391.659.567**	**B**
1960 - 1980	1 - 3	**543.848.882**	151.444.603	38.684.010	125.323.825	69.274.688	30.201.737	**C**
	≥ 4	481.361	291.326	188.835	137.769.375	**431.818.020**	**923.681.791**	**D - E - F**
1981 - 2001	1 - 3	**720.948.711**	**244.180.503**	75.632.068	131.267.486	74.179.596	27.027.833	**G - H**
	≥ 4	663.719	564.082	507.402	84.581.306	**216.135.289**	**293.274.380**	**I - J**
Año de construcción	Plantas sobre rasante							**Hotspots**

España	Euros
Total:	6.218.127.450

Hotspots	Euros	% respecto España
A:	892.509.938	14,35%
B:	391.659.567	6,30%
C:	543.848.882	8,75%
D:	137.769.375	2,22%
E:	431.818.020	6,94%
F:	923.681.791	14,85%
G:	720.948.711	11,59%
H:	131.267.486	2,11%
I:	216.135.289	3,48%
J:	293.274.380	4,72%
Total:	4.682.913.440	75,31%

Breakdown of Cost Components for Energy Efficiency Upgrade

Nº de viviendas en el edificio	1		≥ 2			TOTAL ESPAÑA	
Nº de plantas del edificio	1 - 3	≥ 4	1 - 3	≥ 4			
Datos generales							
Viviendas principales	4.382.027	7.033	2.017.580	7.719.208	2	14.125.848	viviendas principales
Sup. útil media viv. prin.	109,25	96,84	92,80	84,35	2	93,29	m2 vivienda
Sup. útil viv. prin. total	478.727	681	187.228	651.106		1.317.742	miles m2
Coef. cubierta-planta	0,693	0,226	0,504	0,181	1	0,413	m2 cub/m2 planta
Sup. cubierta media viv. prin.	75,73	21,92	46,73	15,28	1	38,53	m2 cubierta/viv
Sup. cubierta total	331.846	154	94.274	117.963		544.237	miles m2
Coef. fachada-planta	1,008	0,987	0,756	0,599	1	0,770	m2 fach/m2 planta
Sup. fachada media viv. prin.	110,14	95,55	70,11	50,56	1	71,86	m2 fachada/viv
Sup. fachada total	482.648	672	141.457	390.268		1.015.045	miles m2
Coef. suelo-planta	0,137	0,155	0,022	0,024	3	0,065	m2 suelo/m2 planta
Sup. suelo media viv. prin.	15,00	15,00	2,00	2,00	3	6,04	m2 suelo/viv
Sup. suelo total	65.730	105	4.035	15.438		85.309	miles m2
Costes económicos							
Coste ais. cubierta	105,92	105,92	105,92	105,92	4	105,92	euros/m2 cubierta
Coste ais. cubierta / m2 planta	73,42	23,98	53,33	19,19		43,75	euros/m2 planta
Coste ais. cubierta / viv	8.021,21	2.322,05	4.949,23	1.618,64		4.080,86	euros/viv
Coste total ais. cubierta	35.149	16	9.985	12.495		57.646	millones euros
Coste ais. fachada	94,63	94,63	94,63	94,63	4	94,63	euros/m2 fachada
Coste ais. fachada / m2 planta	95,41	93,37	71,50	56,72		72,89	euros/m2 planta
Coste ais. fachada / viv	10.422,79	9.042,12	6.634,74	4.784,31		6.799,85	euros/viv
Coste total ais. fachada	45.673	64	13.386	36.931		96.054	millones euros
Coste ais. suelo	13,03	13,03	13,03	13,03	3	13,03	euros/m2 suelo
Coste ais. suelo / m2 planta	1,79	2,02	0,28	0,31		0,84	euros/m2 planta
Coste ais. suelo / viv	195,45	195,45	26,06	26,06		78,69	euros/viv
Coste total ais. suelo	856	1	53	201		1.112	millones euros
Coste huecos / m2 planta	34,76	34,76	34,76	34,76	4	34,76	euros/m2 planta
Coste huecos / viv	3.797,45	3.366,12	3.225,67	2.931,96		3.242,62	euros/viv
Coste total huecos	16.641	24	6.508	22.632		45.805	millones euros
Coste recuperador / m2 planta	10,11	11,41	11,91	13,10		11,85	euros/m2 planta
Coste recuperador / viv	1.105,00	1.105,00	1.105,00	1.105,00	3	1.105,00	euros/viv
Coste total recuperador	4.842	8	2.229	8.530		15.609	millones euros
Coste caldera / m2 planta	18,71	21,11	22,03	24,23		21,91	euros/m2 planta
Coste caldera / viv	2.044,00	2.044,00	2.044,00	2.044,00	3	2.044,00	euros/viv
Coste total caldera	8.957	14	4.124	15.778		28.873	millones euros
Coste aislamiento / m2 planta	205,38	154,13	159,87	110,98		152,24	euros/m2 planta
Coste aislamiento / viv	22.436,90	14.925,73	14.835,70	9.360,97		14.202,02	euros/viv
Coste total aislamiento	98.319	105	29.932	72.259		200.616	millones euros
Coste E6cal / m2 planta	234,20	186,65	193,80	148,31		186,00	euros/m2 planta
Coste E6cal / viv	25.585,90	18.074,73	17.984,70	12.509,97		17.351,02	euros/viv
Coste total E6cal	112.118	127	36.286	96.567		245.098	millones euros

Cost estimates for the installation of solar termal hot water supply for 60% of home needs against each *"Hot-spot"*

A

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	309.007	107,7	20,63 €	2.222,94 €	687
2	339.282	101,6	21,77 €	2.212,02 €	750
3	608.731	100,3	23,44 €	2.351,43 €	1431
TOTAL	1.257.020	102,5	22,27 €	2.282,22 €	2.869

B

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	66.118	84,3	14,56 €	1.227,17 €	81
2	482.615	79,8	16,29 €	1.299,05 €	627
3	565.415	81,4	16,28 €	1.324,64 €	749
TOTAL	1.114.148	80,8	16,18 €	1.307,77 €	1.457

C

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	188.350	108,0	21,92 €	2.367,45 €	446
2	227.166	106,2	20,40 €	2.166,88 €	492
3	418.842	104,0	24,82 €	2.581,62 €	1081
TOTAL	834.358	105,5	22,94 €	2.420,35 €	2.019

D

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	100.175	86,8	15,27 €	1.324,75 €	133
2	92.225	82,3	13,54 €	1.113,35 €	103
3	213.682	88,4	17,24 €	1.523,80 €	326
TOTAL	406.082	86,6	15,95 €	1.381,48 €	561

E

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	329.440	85,6	15,97 €	1.367,40 €	450
2	279.165	85,1	14,41 €	1.226,02 €	342
3	673.134	85,3	17,02 €	1.452,07 €	977
TOTAL	1.281.739	85,3	16,19 €	1.381,07 €	1.770

F

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	277.836	86,8	15,20 €	1.319,46 €	367
2	1.002.098	79,7	16,80 €	1.338,73 €	1342
3	1.297.785	83,4	16,58 €	1.382,41 €	1794
TOTAL	2.577.719	82,3	16,50 €	1.358,65 €	3.502

G

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	243.947	126,4	21,72 €	2.746,45 €	670
2	306.404	122,2	20,79 €	2.541,43 €	779
3	573.230	111,4	24,63 €	2.744,28 €	1573
TOTAL	1.123.581	117,6	22,87 €	2.689,44 €	3.022

H

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	90.745	101,1	15,95 €	1.612,79 €	146
2	109.786	100,4	16,11 €	1.618,15 €	178
3	201.750	97,2	18,20 €	1.769,84 €	357
TOTAL	402.281	99,0	17,10 €	1.693,02 €	681

I

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	182.133	90,7	16,07 €	1.457,59 €	265
2	140.222	90,3	15,72 €	1.420,40 €	199
3	345.970	89,0	16,98 €	1.511,14 €	523
TOTAL	668.325	89,7	16,46 €	1.477,51 €	987

J

franja	viviendas	m2/viv	€/m2	€/viv	M €
1	129.327	88,0	15,53 €	1.365,93 €	177
2	245.868	85,7	16,95 €	1.453,37 €	357
3	493.971	88,0	16,76 €	1.475,27 €	729
TOTAL	869.166	87,4	16,63 €	1.452,80 €	1.263

Breakdown of Cost Components for Energy Efficiency Upgrade

	Source	Amount Invested	Jobs
1	ACE Research	UK£ 1 million	10-30 (number could reach 60 if training programs are sufficiently implemented)
2	UNEP	US$ 1 million	10-14 direct jobs and 3-4 indirect jobs
3	Fundación Conde del Valle de Salazar	€ 1 million	8.3
4	Centro Complutense de Estudios e Información Medioambiental	€ 1 million	25 direct jobs and 38 indirect jobs
5	EuroACE	€ 25,000 - € 30,000	1
6	Home Performance Resource Center	US$ 1 million	12-13
7	Columbia Institute	US$ 1 million	13-16
8	City of Toronto	C$ 1 million	7
9	Impetus Consulting	€ 1 million	8-14
10	Center for American Progress	US$ 1 million	12.5
11	The Center on Wisconsin Strategy	US$ 1 million	12.5
12	The Political Economy Research Institute at the University of Massachusetts at Amherst	US$ 1 million	13.6
13	NRDC	US$ 1 million	13.6
14	U.S. Green Building Council	US$ 1 million	13.6
15	The Real Estate Roundtable	US$ 1 million	13.6

Data found in database

1	15-ECF Ecofys Fraunhoff EnergySavings2020-FullReport.pdf	P. 16
2	37-UNEP Green Economy Report Ch on Bldgs.pdf	P. 353
3	96-la_generacion_de_empleo_en_la_rehabilitacion_y_modernizacion_energetica.pdf	P. 123
4	101-Fundación IDEAS_1 DD 07 la rehabilitación_una oportunidad para la reconversión del sector de la edificación_2011.pdf	P. 29
5	23-EuroACE - Making Money Work For Buildings - September 2010.pdf	P. 40
6	108-green_jobs_in_the_residential_energy_efficiency_industry.pdf	p. 10
7	109-This_Green_House_May25.pdf	p. 10
8	110-homeenergyretrofit_challengesopportunities.pdf	P. 2
9	111-EE_fiscal_stimulus_Impetus_Report.pdf	P. 3
10	112-RebuildingAmerica_Vision_Statement_FINAL.pdf	P.1
11	112-RebuildingAmerica_Vision_Statement_FINAL.pdf	P.1
12	114-A_New_Retrofit_Industry_2011.pdf	P. 7
13	114-A_New_Retrofit_Industry_2011.pdf	P. 7
14	114-A_New_Retrofit_Industry_2011.pdf	P. 7
15	114-A_New_Retrofit_Industry_2011.pdf	P. 7

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