

GTR'S 2012 REPORT

A NATIONAL PERSPECTIVE ON SPAIN'S BUILDING SECTOR

ACTION PLAN FOR A NEW HOUSING SECTOR



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REHABILITATION WORKING GROUP "GTR"
(Grupo de Trabajo sobre Rehabilitación)

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A national perspective on Spain's building sector

Action plan for a New Housing Sector

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Rehabilitation Working Group "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.

During 2012 GTR has worked on the second edition of its report entitled “**A NATIONAL PERSPECTIVE ON SPAIN'S BUILDING SECTOR. ACTION PLAN FOR A NEW HOUSING SECTOR.**”

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EXECUTIVE SUMMARY

The Spanish Working Group for Rehabilitation “GTR” believes that 10 million primary residences built in Spain before 2001 can and should be transformed into high efficiency, low-carbon/ low-consumption residences by 2050. This intervention would stimulate activity in the critically impacted buildings sector and can be funded through a combination of energy savings and increased Government fiscal inflows created by the activity itself. To achieve this, GTR proposes a roadmap and an action plan whose implementation will generate the order of 150,000 high quality, stable direct and indirect jobs between 2012 and 2050 through the investment of up to 10 billion euros a year in the deep rehabilitation of between 250,000 and 450,000 of Spain’s primary residences annually. Such investments can be financed through a combination of family savings, financial institutions, renovation contractors, ESCOs, energy supply companies and the State with each financing source receiving its appropriate investment returns from energy savings and emissions, improvements in the performance, comfort and quality of the building, social benefits, improved health and quality of life and productivity upgrades for commercial buildings.

This, GTR’s second report, is the result of more than two years of continuous work by a now expanded group of industry and technical experts (the GTR). The 2012 paper contains new work conducted over the last 12 months as well as a summary of 2011 activity together with input from the now extended analysis and dialogue with key Spanish industry players and government which GTR has been able to maintain.

The 2012 GTR report reinforces and provides a more detailed and critical assessment of the main conclusions of its prior published work: that the rehabilitation and upgrade of Spain’s housing stock is a feasible and economically viable task provided that there is a supportive regulatory, operational and financial framework. Also that energy efficiency is the key pillar around which the rehabilitation sector can orient its resources as this creates savings, improves the

quality of life in homes, and creates jobs in a sector badly affected by the crisis.

This report uses the same methodology and structure as GTR began in 2011, with two significant improvements:

1. GTR’s 2012 economic model introduces over eighty new parameters, and significantly deepens the technical and cost analysis in the detailed hotspot intervention menus and their creation as well as better adapting itself to the more specific segmented housing characteristics and considering more external scenarios;
2. GTR has focused on the direct incorporation of the new legislative guidelines from the European Union’s new Energy Efficiency Directive, as well as new national and international processes and developments in the field.

In 2012, GTR is also able to more confidently detail the key components of a new legislative, operational and financing framework for a New Housing Sector (“NHS”) **to save up to 390,000 million euros in energy efficiency¹ and GHG emission reductions in Spain, by 2050, and deliver an 82% reduction** in the CO₂ emissions of Spanish homes through deep renovation. These three components of the NHS framework have to be developed jointly, as the sector will not deliver the benefits that the GTR Action Plan perceives without an unprecedented level of coordination between the regulatory, financial and technical sides. The deep renovation of existing buildings requires by its very nature a significant level of coordination between different levels of government and the new and growing stakeholders in the NHS. This requires strong and clear political leadership such that the full opportunity is understood and firmly and unequivocally supported very much in line with the European legislative frame-

1 The projected cumulative energy savings and emission reductions are valued at 2012-2050 European market prices

work running up to and including the Energy Efficiency Directive adopted in November 2012.

Spain has the ability, creativity and just needs the extra push of industry players to establish the foundations of a lasting, valuable and sustainable new economic sector. By 2050, Spain can aspire to having 10 million energy efficient and fully rehabilitated low carbon homes – an upgrade of 64% of the most inefficient Spanish homes built before 2001 - reducing heating/cooling consumption by 82% and the commercial energy demand for domestic hot water by 60%. To achieve this, the right organizational framework will emerge as a result of the effective provision of a new legislative platform and new technical standards for renovation supported by public investment through a combination of initial up-front assistance, tax benefits, low cost and long-dated ICO financing and through the provision of value to household CO₂ emissions reductions through a white certificate programme.

This report provides an action plan that will generate a new, efficient and productive sector, creating jobs, saving energy and emissions and contributing decisively in meeting national CO₂ reduction targets linked to European commitments for energy and emissions reduction with horizons of 2020 and 2050. The GTR believes that the activity and the jobs created in the NHS, and their importance for Spain's transition to a sustainable economy, significantly offsets the difficulties and the work needed to create the new managerial framework which is needed by the NHS for its application and development. In fact, GTR estimates the opportunity cost for Spain by maintaining the high levels of unemployment and inactivity associated with the current inefficient energy model is approximately double the annual investment required to generate the new retrofit jobs described in the proposed Action Plan.

During a financial crisis, it is hard to identify where to obtain the needed funds to match the scale and ambition of the investments contemplated in this Plan for the transformation of Spanish properties,

especially given the tremendous pressure on family and government budgets presently. However, the issue of relative priorities is important as an investment in improving the energy efficiency of Spain's existing buildings will not only enable the fulfillment of the country's commitments to improve energy efficiency, reducing dependence on foreign energy and reducing emissions of greenhouse gases, but it has a direct positive impact on jobs and at the macro-economic level acts as an important stimulus for economic activity, increasing tax revenues and reducing costs of unemployment. GTR shows that it is more expensive in the long run to try and avoid these investments and through this evasion Spain risks delaying its recovery, poor protection from energy shocks, energy poverty increase and further damage to the buildings sector.

Finally, Spain has a unique opportunity to be a pioneer among its European peers through the establishment of a new framework for energy and emissions savings in the buildings sector and creating thousands of local jobs nationwide. The GTR remains fully convinced that Spain has the capacity and skills to deliver a clear opportunity and targets through a NHS which is well articulated to its industry and to the Spanish people. The deep renovation of Spain's building stock will be an essential tool ensuring a better quality of life for Spain's households and will allow them to better face a future characterized by continued increases in energy costs and further restrictions on the emissions of greenhouse gases.

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PRESENTATION

The Spanish Working Group for Buildings Rehabilitation (“GTR” - Grupo de Trabajo sobre Rehabilitación) is a group that was 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 10²). These conferences concluded that there was a need for change in Spain’s buildings sector as a means to resolve some of the challenges facing the Spanish economy and to meet its environmental goals. Rehabilitation and Energy Efficient Renovation will be a milestone for the buildings sector’s transformation.

The GTR builds upon the *Cambio Global 2020/2050*² report (Global Change for Spain 2020/2050), particularly especially sections related to sustainable cities and the buildings sector, where a number of GTR members participated as co-authors. The 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 Housing Sector (NHS) dedicated to the renovation, retrofit, operation and maintenance of appropriate and habitable housing, solidifying the citizens’ right to accessible housing while taking into consideration the environmental and social challenges innate in the global change, and positioning the NHS as a viable economic sector 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 re-direct the sector’s skills

and resources if the proper frameworks are in place allowing the definition of a different business model based on the renovation of existing buildings, which is more consistent with the challenges society faces today. The current situation requires a country-wide strategic vision, outlined here by GTR, which supports the restructuring of the sector. This transformation of the sector needs to take place prior to the possible reactivation of the Spanish economy and the continuance of a buildings sector with a productive model which will lead to increased environmental problems which it had previously created together with its inability to provide accessible housing to large segments of the population. The GTR published its first report in November 2011 and aims to deepen the scope of its previous Road Map with this 2012 GTR work and Action Plan to maintain and continuously revise its work in the future.

The GTR has a core of eleven members, whose CVs are presented here. They are representative of the various stakeholder groups in the Spanish buildings sector. In addition, GTR’s work is reviewed by an advisory board of domestic and international experts and while GTR raises funds from foundations and corporations its work is independent. The mission of the GTR does not end with the writing of this text. GTR will promote its work and will search for the necessary support for the implementation of its 2012 Action Plan. The activity of the GTR is coordinated by two institutions CONAMA and GBC España which encompass different actors in the sector. The co-authors, Albert Cuchí and Peter Sweatman have worked together writing both reports with the support, input and direction of the GTR core.

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- 2 Arguably the three conferences with the highest profile and influence on sustainability and the environment in Spain
 - 3 Green Building Council Spain, Asociación Sostenibilidad y Arquitectura, Centro Complutense de Estudios e Información Ambiental, & Fundación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Programa Ciudades*

WORKING GROUP FOR REHABILITATION (GTR)

Valentín Alfaya, PhD, Director of Quality and Environment at Grupo Ferrovial, promoter of the Territorial Sustainability Platform of the Spanish Sustainability Observatory. He participates in various forums and with institutions associated with sustainable construction and is the Secretary of the Executive Committee of the Green Building Council in Spain. Valentin has a PhD in Biology and holds a degree in engineering and environmental management and has worked in the buildings sector for over 15 years. Over the past seven years he has been responsible for sustainability and social corporate responsibility at Grupo Ferrovial.

Luis Álvarez-Ude, partner of AUIA (Arquitectos Urbanistas e Ingenieros Asociados), CEO of Green Building Council Spain and board member of its parent organization World Green Building Council (WGBC). Luis is one of the pioneers in applying sustainability criteria to buildings in Spain. He directed the report on buildings “*Global Change Spain 2020/2050*”.

Xavier Casanovas, professor at the Escola Politècnica Superior d'Edificació de Barcelona, and technical architect and renovation director at the Col·legi d'Aparelladors, Arquitectes Tècnics i Enginyers de l'Edificació de Barcelona. Xavier is the president of Rehabimed and has presided over the on October 2010 International Congress “Rehabilitation and Sustainability: The Future is Possible” which touched upon the future of the buildings sector within social, economic, cultural, legislative and technological frameworks. He was the rapporteur of the Conama 10 working group “Diagnosis and Objectives of Comprehensive Renovation: Scenarios, Barriers and Opportunities”.

Albert Cuchí, architect and professor at Universitat Politècnica de Catalunya. Barcelona Tech. He is the author of the report “*Global Change Spain 2020/2050*”, which was translated into English by the World Green Buildings Council to serve as a baseline report. Albert was the president of the SB10mad Congress scientific committee and was the rapporteur of the Conama 10 working group “Diagnosis and Objectives of Comprehensive Rehabilitation: Scenarios, Barriers and Opportunities”.

Enrique Jiménez Larrea, lawyer specialized in administrative law, urban planning, energy efficiency and renewable energy. He is the former Director General of IDAE. Enrique is the current director of the Executive Program on ESCOs at the Escuela de Organización Industrial in Madrid.

Francisco Javier González, associate professor in the Department of History and Urban Planning at the School of Architecture of the Universidad Europea de Madrid (UEM). He is the co-director of the Workshop on Urban Rehabilitation and Conviviality (Universidad Carlos III-EMU) and Rapporteur of the Conama 10 working group “Diagnosis and Objectives of Comprehensive Rehabilitation: Scenarios, Barriers and Opportunities”. Francisco Javier is an architect and urban planner with an expertise in social issues inherent to urban planning. Throughout his tenure as a university professor, he has collaborated with various departments and universities and has promoted graduate studies on city planning, construction and sustainability.

Fernando Prats, architect and urban planner, founding partner of the firm AUIA. Fernando has been director of sustainability strategies in Spain such as the Calvia 21 Local Agenda, the Strategy for the Lanzarote Biosphere Reserve and the Doñana Urbanism and Tourism Strategy. He has been the sustainability coordinator of the 2020 Spanish strategic plan for Tourism and for the Comprehensive Action Plan of Playa de Palma.

Fernando has also been an adviser to the Centro Complutense de Educación e Información Medioambiental (CCEIM) for its Cambio Global España 2020/50 programme and co-author of the *Cities report*. He has been a member of the steering committee on Transport, Building and Energy reports. In addition, Fernando has been a member of the Spanish Council of Biosphere Reserves, the Spanish Council of Tourism (CONESTUR) and advisor to the Program on Climate Change and Tourism in Spain. He has won various prizes and awards at the national and international level.

Juan Rubio del Val, architect and urban planner. Head of urban rehabilitation of the Zaragoza Society of Municipal Housing since 1989. Head of Residential Innovation Projects since 2003. Juan promotes urban regeneration in Zaragoza and actively participates in several European projects related to rehabilitation of traditional neighborhoods such as *Revitasud*. He also promotes energy savings and the deployment of renewable energy in buildings through the *Renaissance* program. Besides his strictly professional activity, Juan has been Chairman of the Zaragoza Delegation of the Aragon College of Architects (1990-1995), Aragon delegate of the national developer of Vallehermoso (1995-2000) and a founding member and current director of the Ecology and Development Foundation (1995).

Peter Sweatman, Chief Executive of Climate Strategy & Partners strategic consultant in Clean Energy, Clean Technology, Energy Efficiency and Climate Change Strategies. In 2010, he published a report which contrasts financial policy of the United States, Britain and Spain in terms of energy renovation of existing buildings. In 2012 he published two reports; the first report discusses financing mechanisms for the renovation of European buildings and the second report analyses challenges and funding opportunities for the energy efficiency renovation of Spanish buildings. For 5 years directly prior to this, Peter was Managing Director responsible for Iberia and Latin

America for Climate Change Capital. Peter holds a Masters degree in Engineering and Management Studies from Cambridge University and has 10 years of experience at JPMorgan, 4 years as a social entrepreneur and over 8 years working in the shift towards a low carbon economy. Peter is a visiting professor at IE University in Madrid, an active member of the Ashoka Support Network, a member of the JCI Institute for Energy Efficiency global Expert panel, lecturer at IIT-Comillas university and an advisor to the UK Trade & Industry in Spain.

Alicia Torrejo, Managing Director of the Conama Foundation, and Secretary General of the Official Spanish College of Physicists. Member of the steering committee for the *Global Change Spain 2020/2050 reports on cities* (2009) and *economy and society* (2010), Alicia is a physicist and since 2002 is the director of the National Environment Congress, which gathers over 500 institutions between governments, companies, NGOs, universities, and unions, interested in sustainability in Spain. Directed the Conama 10 sessions on rehabilitation and sustainability and coordinated the working group "Diagnosis and Objectives of Comprehensive Rehabilitation: Scenarios, Barriers and Opportunities"

Miguel Winkels, CEO of Fondo de Carbono para la Empresa Española on behalf of Banco Santander and the Instituto de Crédito Oficial. Over the past 6 years Miguel has purchased allowances for over 35 different projects in developing countries. He has previously worked in asset management in insurance companies in Germany and in the U.S., and worked for Edison Capital for 4 years in the area of high risk capital investment in Irving California. Miguel has been involved in project and corporate finance with UBS Madrid as well as UBS New York. Michael holds a degree in Economics from the Universidad Complutense de Madrid and an MBA from Babson College in Massachusetts, USA.

1. INTRODUCTION

This second report builds upon the work published by the Spanish Working Group on Rehabilitation (“GTR”) in 2011. Both GTR reports support and outline a roadmap to launch a New Housing Sector (“NHS”) in Spain whose objectives are to provide accessible housing of adequate quality to Spain’s residents, to deliver a significant reduction of its energy use and environmental footprint and to generate viable and sustainable economic activity, creating jobs and improving the national fiscal and energy balance.

The Roadmap and Action plan proposed by the GTR in 2012 focuses on the fact that the energy component of the deep retrofit of Spain’s housing stock can unlock and enable the launch of the NHS, and how this energy efficient renovation of the existing housing stock plays a decisive role. The energy efficient renovation of Spain’s existing housing stock will be economically viable in the immediate future (in certain segments and certain regions) given the appropriate regulatory, financial and organizational conditions contemplated here.

Moreover, the energy efficient intervention proposed in the Roadmap will enable Spain to generate energy and greenhouse gas emissions savings which will contribute to meeting European Energy and Climate targets for 2020 and 2050. The transformation of the buildings sector is a key component of a new national economic strategy, to enable Spain to face the challenges ahead and improving its competitive and efficient use of natural resources and the maintenance of its environmental quality.

In this context, in 2012 GTR has increased the breadth and depth of its work and has adapted the Roadmap for the New Housing Sector to current circumstances and extended its scope to also contemplate non-residential buildings. GTR has also significantly improved the quality and variety of its input data and economic model thereby updating its Action Plan to reflect that and so as to keep its assumptions and methodology under constant review and reflective of the changing domestic circumstances in Spain.

This report includes a full recap of the 2011 conclusions in its second section so that readers unfamiliar with the prior document can be quickly brought up-to-speed with the key conclusions presented.

Chapter three then follows with an overview of the new legislative framework both in Europe and the progress which has been made in Spain. The new European Energy Efficiency Directive –published in final form in November 2012 – significantly boosts the European energy efficiency agenda and increases the probabilities of meeting GHG emissions reductions in Europe’s buildings sector in 2020 and 2050. GTR sees the European energy efficiency framework for buildings as a key regulatory guideline which brings together all the key elements and mechanisms which support the efficient renovation of Member State buildings and supports its Spanish roadmap approach.

Moreover, the financial crisis in Spain has brought into distinct focus the opportunity which buildings renovation represents for the construction industry. New Spanish regulatory frameworks and strategies for renovation, urban regeneration and environmental efficiency are currently being discussed. In the last year both the European and Spanish policy frameworks have redirected -or are redirecting- their focus in support of the GTR approach and methodology for the renovation of Spain’s built environment and further details are provided in chapter three.

The fourth chapter of the 2012 GTR report outlines the development and expansion of the GTR economic and sector model, as well as its application to address specific strategic questions raised in the debate around the development of the NHS in 2012. This chapter emphasizes the improvement of the GTR model which newly incorporates some eighty parameters, a greater depth in calculating tailored actions for each hot-spot, new future energy price forecasts, four different fuel sources and the latest financial and economic market conditions. In 2012, the GTR’s model’s precision and depth has increased dramatically and the results demonstrate some very interesting sensitivities to a range of initial input conditions which are described and illustrated graphically in detail.

In 2011, GTR used the technical work prepared by WWF⁴ in 2010 as a basis for its intervention menus. This study provides a cost breakdown for the achievement of reductions of up to 80% of energy use for heating and air conditioning of existing homes. In 2012, GTR developed a detailed set of intervention menus tailored to each housing segment and built from the bottom-up using a strict merit-order intervention approach. This GTR method allows not only the targeting of an optimum economic “close to 80%” energy use reduction but also provides the accurate impact of each menu intervention stage and measure including: costs, materials demand, manufacture emissions and the direct man-hours of work required in the execution of each component of the renovation.

GTR's intervention methodology targets a deep renovation through a single intervention at the point when this intervention becomes economically viable for a segment of homes built prior to 2001. GTR believes that a single deep intervention is efficient and will build a renovation sector that delivers not only against the energy saving objectives of the home owners but also the employment and macro-economic objectives of the State. GTR believes that this base case approach is long-term socio-economically cost effective and required to deliver against national and European GHG reductions targets and will deliver a housing stock with greater energy independence.

In 2013, GTR is looking to add to its analysis homes built between 2001-2011, as a result of the publication of the new Census data. This will result in a clearer picture of the information needed to define a more precise Roadmap to 2030.

The remainder of chapter four contains a sensitivity analysis that highlights how selected financial variables can impact the roll-out of the renovation sector, in particular how selected factors can – if not in place – negatively impact the economics of deep renovation in such manner that the activity in the

NHS is delayed and the target (and indeed efficient) energy and emissions savings are not delivered. While GTR's sensitivity analysis focuses on financial variables, many of these inputs are controlled by the State (such as fiscal measures, subsidies and low cost finance). This analysis is a key input to the later sections of this report where GTR develops a series of regulation, operational and financial recommendations to provide the framework necessary for the NHS to deliver its benefits.

GTR's model has also served to help determine Spain's potential for GHG emission reductions in the residential sector –both diffuse and those generated through savings in electricity usage- assessing reduction scenarios based on various input variables. This looks from the emissions perspective and provides Spain with a policy instrument designed to deliver reductions, and assess their impact and costs over the 2012-2020 and 2030 horizons. These recommendations, when complemented with other similar instruments acting in the “diffuse sector”, will allow the articulation of a comprehensive policy for Spain to meet its energy efficiency and GHG reduction targets and commitments. This section has been elaborated with the support and assistance of the *Fundación Biodiversidad* and the Spanish Climate Change Office.

To close the fourth chapter, GTR looks at a compliance case for the European Energy Efficiency Directive as well as the potential for the introduction of a white certificate program to foster the demand for renovation for the 2014-2020 period. In rough numbers, GTR believes that the energy reduction in Spanish properties is in line with a recently suggested roadmap, which proposes a 10% reduction of GHG emissions in the diffuse sector (including buildings) by 2020.

The fifth chapter introduces for the first time non-residential buildings, which consume 35% of the energy used by Spain's buildings. In 2011, GTR did not include the tertiary sector in its roadmap and in 2012 GTR proposes a methodology for segmentation and analysis of non-residential buildings, but hopes to have the resources to develop this in the context of a national roadmap in 2013. This methodology touches upon the intervention of tertiary buildings (commercial, services and offices) taking into account their particular usage patterns and manage-

4 Martin, C. (Ed.). (2010). *Potential Energy Savings and CO₂ Emissions Reduction from Spain's existing residential buildings in 2020*. WWF Spain, WWF (2012). *Retos y oportunidades de financiación para la rehabilitación energética de viviendas en España*, Sweatman, P. R. & Tragopoulos, G

ment but taking the existing hot-spot methodology and adapting it to the specifics of a specific vertical – hospitals.

The sixth chapter contains a case study – the Basque region's Bultzatu 2025 plan. This is an initiative of the Basque government to renovate its building stock and closely aligns with the vision and interests of GTR whose methodology is complimentary to the approach adopted in Bultzatu. This section briefly describes and analyses the Basque 2025 plan from the perspective of the GTR methodology, indicating the extent to which the regional application of the national road map can work. In addition, section 6 introduces the support for foreseeable reference cases to develop the NHS and its conceptual, technical, and managerial resources.

The last chapter of the 2012 GTR report contains an update of the NHS Roadmap and provides an Action Plan. This upgrade includes the improvements to the model and updates the conclusions of the Roadmap of the 2011 report and provides updated policy recommendations. These recommendations are not just the result of the improvement of the Roadmap but also derived from the dissemination and stakeholder engagement process of the 2011 GTR Report. The 2012 stakeholder engagement process has not only served to gather feedback from the public and private sectors but also has opened the subject matter into various national and international debates, forums and with opinion leaders.

In the future, GTR intends to maintain and expand its 2012 Roadmap and update its input data to reflect the development of the market and Spanish pilot projects, the availability of new and better data and the improvement of its methodology. In essence, the GTR plans to develop its Roadmap as a dynamic instrument to evolve and grow with the sector as the buildings sector is transformed and to maintain a dual perspective – from the national and individual perspectives.

2. SUMMARY OF GTR'S 2011 REPORT

In 2011, the Spanish Rehabilitation Working Group "GTR" (*Grupo de Trabajo sobre Rehabilitación*) published its first report entitled "*A National Perspective on Spain's Buildings Sector: A Roadmap for a New Housing Sector*". In this report GTR identified the opportunity to refurbish and upgrade Spanish homes as sizeable and economically feasible - with appropriate regulatory support. In addition, GTR stated that buildings refurbishment and upgrade would 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 and social challenges which society increasingly demands ("Global Change").

In 2011, GTR estimated that 10 million Spanish primary homes built before 2001 could be transformed into low-energy, low emissions, modern housing delivering benefits to owners and occupants, and creating between 110,000 and 130,000 stable, long-term direct jobs in a vibrant New Housing Sector ("NHS") active from 2012 to 2050.

The 2011 GTR report provides the background, structure, methodology, and analysis to establish an action plan to support these objectives, and to be a key component in the transformation of the construction sector in a responsible construction sector, securing and sustaining social habitability standards needed in Spain while promoting environmental efficiency and economic viability.

A strategic National Perspective for the construction sector on Buildings Renovation would transform a key part of the Spanish economy and allow it to better face the challenges of Global Change. This national strategic perspective is embodied in the GTR roadmap which defines a "New Housing Sector" ("NHS") with an action plan to redirect the construction sector towards these new purposes.

OBJECTIVES FOR THE NEW HOUSING SECTOR

Delivering Spain's residents' access to sufficient quality housing requires that all residents can attain a socially acceptable level of habitability, maintained and renewed according to the changing demands of society. Through the stimulation of economic activity and employment: The New Housing Sector can become one of Spain's determinant economic sectors, recovering much of what has been lost from the traditional buildings sector activity. The NHS is a potential 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 which Spain's more environmentally sustainable economy will require.

GTR's 2011 framework was conceived to be sustainably compliant within Europe's 2020-2050 framework, to reduce Spain's ecological and resource footprint and protect its biodiversity: For GTR, the environmental resource efficiency of the NHS is key, not only as a priority requirement but an integral part of its direction and development, and the 2011 Road Map is a tool that will keep Spain efficient and allow the optimum mobilization of the resources activated through energy savings and domestic emissions reductions through home renovation in the most effective manner.

The NHS chose to base its work on the renovation of the existing housing stock, to reflect the needs of the Spanish population and to increase environmental efficiency together with an improvement in habitability by leveraging investment in energy efficiency and GHG emissions reductions.

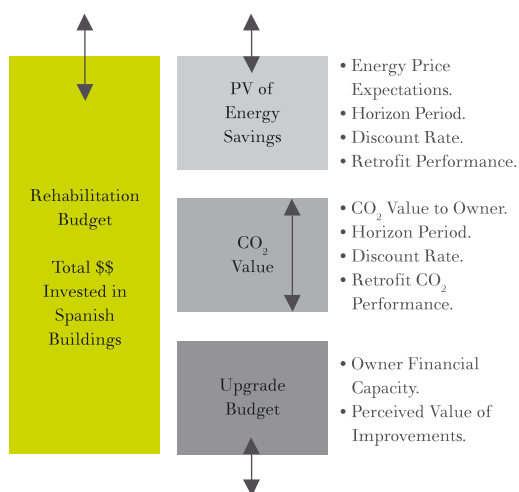
SOURCES FOR FINANCE FOR HOME RENOVATION

The roadmap proposed by GTR in 2011 showed that the deep energy-efficient renovation of Spain's existing housing stock could jumpstart a New Housing Sector. The NHS would -when in full capacity- **deploy up to Euro 10 billion invested in refurbishing 250-450,000 homes each year.** These investments can be funded through a combination of public and private finance working together to also stimulate

participation from homeowner savings, banks, refurbishment providers, ESCOs, energy companies and the State in appropriate proportions with each receiving commensurate returns delivered through the energy and CO₂ savings, macroeconomic and social benefits and modernization upgrades entailed in each individual or collective project.

The amount of capital available from each of these sources for buildings renovation will depend 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.

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



In 2011, GTR observed that the conditions for the financial success of the NHS in Spain were:

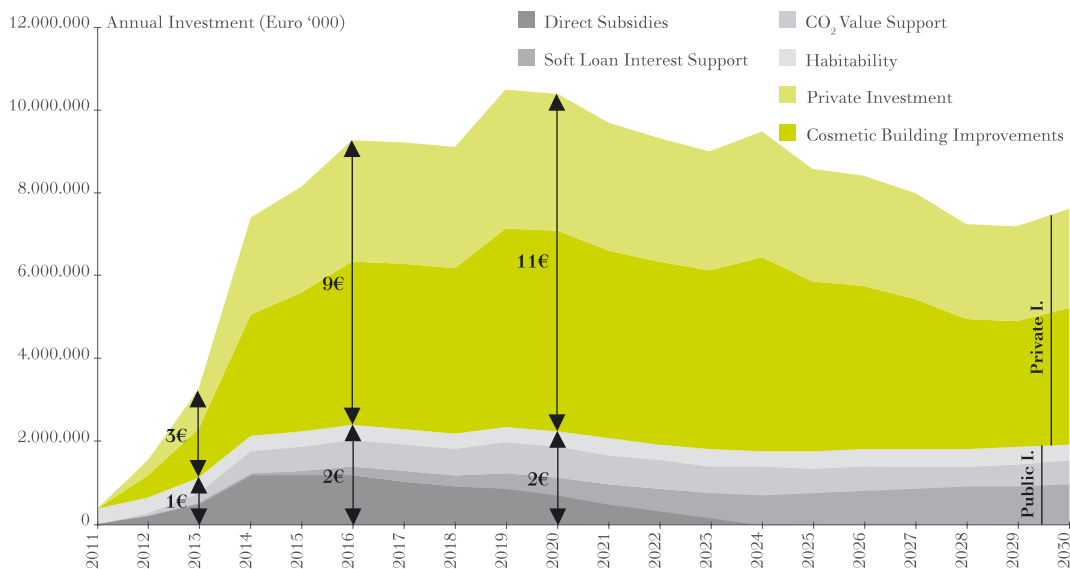
1. Maximize the national renovation budget: If the Government wishes to maximise the job creation, fiscal, social and environmental impacts inherent in a national refurbishment plan then it needs to maximise the total amount of investment capital made available for renovation and rehabilitation (including both public and private investments). This means modifying existing legislation to remove barriers and make private investments in buildings renova-

tion and refurbishment easier together with the use of new policy tools (such as white certificate programmes, fiscal benefits and “on bill” finance) to ensure the engagement and focus of powerful players such as Utilities, Banks, ESCOs and Construction firms. The maximum national renovation budget will be created by the strategic use of public finance to lever and catalyse private funding sources in combination (a 1:3 ratio initially moving to 1:5 when the NHS reaches scale).

- 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 component of value, and the associated financing streams targeting CO₂ reductions, 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. Various countries are implementing programmes and policies which place a value on the CO₂ savings from refurbishments and there exists learning on simplification and reducing transaction costs which Spain can benefit from⁵.
- 3. Reduce the risk assigned to investment returns in energy efficiency renovations:** The discount rate used by third parties to assess the present value of the future energy savings resulting from home renovations must be as low as possible to ensure maximum capital budgets. This means that the funder's evaluation 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 and can be improved with State bank support such as KfW in Germany and Green Investment Bank in the UK.

5 IEA. (2012). Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes. Retrieved from: [http://www.ieadsm.org/Files/AdminUpload/\(1\)RAP_IEADSM%20Best%20Practices%20in%20Designing%20and%20Implementing%20Energy%20Efficiency%20Obligation%20Schemes%202012%20June\(6\).pdf](http://www.ieadsm.org/Files/AdminUpload/(1)RAP_IEADSM%20Best%20Practices%20in%20Designing%20and%20Implementing%20Energy%20Efficiency%20Obligation%20Schemes%202012%20June(6).pdf)

Investment Magnitude, Public Private Model



GTR 2011 METHODOLOGY

The GTR Methodology used in 2011 can be summarised as follows:

1. **Adequately segment the existing housing stock⁶** 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.

2. **Determine "hot-spots" or quantitatively significant groups of homes with relevant homogeneous physical characteristics** with a level of consistent technical, administrative and economic parameters.

The ten "hot-spots" identified by GTR 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 (from Spain's 2001 Census).

The ten identified "hot-spots" fall in three transversal groups: single-family homes located in rural areas ("hotspots" 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.

⁶ Numerous studies and interviews suggest that segmentation is fundamental for a national action plan because working with high level averages is too blunt a tool for practical use. The GTR notes that the availability and quality of Spanish buildings data is far from ideal and that investment to improve the quality of buildings data is of paramount importance to the rehabilitation industry.

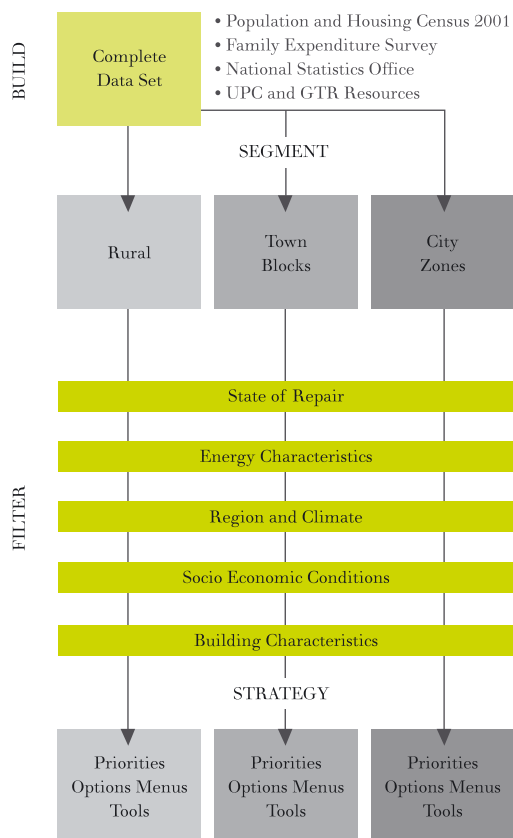
3. **Undertake a detailed assessment of these “hotspots”,** channeling primary segmentation data through a series of filters (energy consumption, building conditions, socio-economic status, geography and financial capacity of the occupants) in order to determine their habitability, energy, and social 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 a National Action Plan:** This plan needs to first address the high energy intensity segments 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 and driven down the cost of renovation, and as energy prices inevitably rise.

The GTR adopted a menu of interventions that could deliver a deep energy renovation, representing a reduction of about 80% of energy consumption and emissions of the intervened dwellings. This also reflects the need for interventions that provide an immediate macro-economic return through packaging a mix of components to fund those activities that have lower returns (longer paybacks) and that would never materialize should the renovation not be a “whole of home” global intervention in the property.

THE 2011 ACTION PLAN

Following this methodology, the GTR built a model that maps the chronological evolution of NHS and how it can become a viable economic sector delivering very significant accomplishments:



The Action Plan will be made possible if there is a clear commitment through policies that establish and maintain the following pre-conditions:

- 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;

	2020	2050	2050
Number of Homes Reformed (2012-year)	2.600.000	6.000.000	10.000.000
Aggregate Investment in Housing (€ mm)	65.000	150.000	240.000
Accumulated Energy Savings and CO ₂ from 2012 (€ mm)	8.900	62.000	300.000
% CO ₂ Emissions Reductions vs 2001 Residential Homes	27%	55%	80%
Jobs Sustained (Period Average)	150.000	140.000	110.000

- 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;
- Mandatory policies for adequate segments of the population ensuring that renovation activity reaches a minimum of 3% of remaining non-refurbished Spanish primary residences per annum.

Ultimately, the 2011 Action Plan shows what can be achieved under the necessary conditions and underscores the feasibility of launching a NHS to serve as a catalyst for a new building sector for Spain, becoming the new basis for a key part of an efficient and competitive economy.

3. NEW REGULATORY FRAMEWORK

Many countries have supported policies for energy efficiency and sustainable construction and renovation. Regulatory frameworks are being refined from those experiences. On the basis of its review of these policies and frameworks, the International Energy Agency recommends a “policy package” capable of generating an adequate and complete legislative platform for the growth of energy efficiency in buildings. The European policy framework reflects this approach as do those of leading member states.

Since the publication of GTR's first report in 2011, there have been changes made to European policy on energy efficiency and its expected impact on the buildings sector. These changes redouble the priority of energy efficiency and call for additional resources to achieve 2020 goals. Similarly, in the context of Spain, although with some delay, there has been progress in the adaptation of the instruments derived from EU directives that have an impact on energy efficiency in buildings -especially the certification of the existing building stock- as well as initiatives in buildings renovation, the stimulation of the rental markets and greater energy efficiency.

In both cases, GTR welcomes the renewed focus on the improved the political and institutional frameworks and notes that recent domestic and European legislative changes (while still not adequate to deliver Spain's rehabilitation sector as described here) are in line with its National Roadmap, GTR's approach and clearly underscore the value of the Action Plan as a tool for the implementation of the NHS.

3.1 UPDATE ON EUROPEAN ENERGY EFFICIENCY POLICIES

The European Union's recent legislative framework and commitment to the environment and energy efficiency in the construction sector started with the Energy Performance of Buildings Directive (“EPBD”) in 2002 which was developed within the context of promoting clean energy and CO₂ emission

reductions to generate a resource efficient economy which was more secure and less dependent upon external primary energy sources.

In terms of energy efficiency, the 2020 target to save 20% of primary energy consumption had been proposed in the Energy Efficiency Green Book in 2005. This goal was formally accepted by the EU heads of state in the European Council in March of 2007, but remained non-binding in character. This target was reaffirmed in the “Europe 2020” strategy, adopted in March 2010, in which the European Union set as a target for the decade of “smart, sustainable and inclusive” growth. These 2020 European targets for energy efficiency are articulated as follows:

- Reduce annual primary energy consumption by 20% by 2020, -some 368 Mtoe per year below the current trend without exceeding a total expenditure of 1,474 Mtoe in 2020. This would result in:
 - A reduction of European CO₂ emissions of 780 million tonnes⁷.
 - Savings of 100 billion Euros per year in fuel costs for EU consumers⁸.

In Europe, buildings are responsible for 40% of final energy consumption and 36% of CO₂ emissions. They are a key and necessary component to achieve the EU's goals of efficiency, CO₂ reductions and energy savings by 2020 and beyond. The inefficiency and energy performance of Europe's buildings can be improved substantially and in a profitable way using today's technologies, which can reduce it by 20% -50%⁹, depending on the building's geographic location, its type, date of construction and use. Furthermore, in Europe's roadmap towards a low carbon

7 ManagEnergy. (2010). Key Information related to energy efficiency.

8 Ibid

9 WBCSD (2009). Energy Efficiency in Buildings: Transforming the Market; 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.

economy 2050¹⁰, adopted in March 2011, the European Commission sets a target for reducing emissions in the European Union's buildings by between 88 and 91% by 2050.

The Energy Performance of Buildings Directive (EPBD - 2002/91/EC) was not transposed fully in many Member States -including Spain¹¹- (required by 2006) and as a result the European Commission proposed a legislation amendment in 2008, which was adopted in May 2010. The amended Directive (2010/31/EU) states that full implementation would reduce the total EU energy consumption by 5.6% and create 280,000 to 450,000 new jobs through required measures implemented by 2020¹². The common methodology of Directive 2010/31/EU addresses the following:

- Energy performance of buildings;
- Minimum standards for the energy performance of new buildings and major renovations;
- Systems for energy certification of buildings;
- Requirements for the regular inspections of boilers;
- Central air-conditioning systems¹³.

The new version of the EPBD (2010) urges member states to:

- Ensure all new public buildings will be “nearly zero-energy buildings” by the end of 2018¹⁴, a standard that will equally apply to all new private sector buildings from 2020.
- Benchmark national energy performance requirements against cost-optimal levels to allow easier comparison and to establish protocols for Monitoring, Verification and Evaluation (MV&E) whose requirements have been increased.
- Make energy performance certificates mandatory for the rental and sale of properties. Note however, there are no proposals to require mandatory energy performance certificates for all existing buildings.
- Elaborate national plans that encourage owners to make energy efficiency improvements in the existing housing stock.

In 2011, the European Commission recognized the need to redouble efforts to deliver energy efficiency, as it seemed that its 2020 target would not be reached, and it launched a review process that resulted in the passing of the new Energy Efficiency Directive (EED) in October of 2012.

This new policy was based around six pillars:

1. The legal obligation to establish an energy savings framework for all Member States.
2. Lead by example through the renovation of public buildings and the promotion of public procurement of highly efficient products, services and buildings.
3. Improving transparency for energy consumers and facilitate access to potential savings.
4. Provide more incentives for energy efficiency in SMEs.
5. Achieve greater efficiency in electricity generation.

10 Comisión Europea. (2011). Hoja de Ruta Hacia una Economía Hipocarbónica Competitiva en 2050. Extraído de: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0086+0+DOC+XML+V0//ES>

11 González Álvarez, G. (2010). *Implementation of EPBD Status November 2010*. Retrieved from: http://www.epbd-ca.org/Medias/Pdf/country_reports_14-04-2011/Spain.pdf

12 Elsberg, M. (2010). European Commission. *The new European Directive on Energy Performance of Buildings*. Retrieved from: http://www.wsed.at/fileadmin/redakteure/WSED/2010/download_presentations/Elsberger_NEU.pdf

13 European Commission. (2010). *Energy Efficiency in Buildings*. Retrieved from: http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm

14 The EPBD defines a “building of almost zero energy consumption” as a building with a high level of very energy efficiency, determined in accordance with Annex I. The nearly zero or very low energy required ought to be covered, largely by energy from renewable sources, including energy from renewable sources produced in situ or in the local environment”

6. Replace with a single directive the existing directives on cogeneration and energy services.

The new Energy Efficiency Directive will be implemented and transposed into national law by April 2014 and has four main areas of impact:

- Member States will impose a minimum percentage of “cumulative energy savings” on energy companies by 2020 to help its customers save energy. Such savings may not be less than 1.5% of annual power sales to industrial and domestic customers between 2014 and 2020.
- A mandatory reform of 3% of the surface area of public buildings that are “owned or occupied by the central government”;
- The obligation for each EU Member State to develop a long-term “road map” for the Buildings sector to encourage investment in the deep renovation of buildings (this includes commercial properties, public buildings and private homes);
- Additional measures regarding energy audits and energy management for large companies, cost-benefit analysis for the deployment of combined heat and power (CHP) and public procurement.

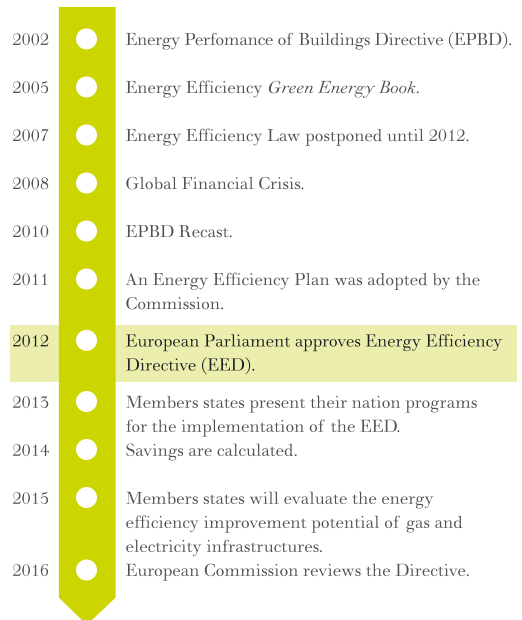
Member States have agreed to accept binding measures but the overall target for energy savings of 20% remains indicative. The national indicative targets have to be communicated to the Commission by the Member States in April 2015. In the absence of a binding target, it is estimated that the total savings, with the measures presently agreed, would be 15% in 2020, below the 20% target that the Member States set in 2007.

In order to close the gap between 15% and 20%, it is expected that efficiency measures in the transport sector such as increased use of biofuels for cars and new standards for products such as boilers, which are part of the Eco-Design Directive, could add another 2%, to reach 17%. The remaining 3% required to reach the original target is expected to be achieved as follows:

- In April 2013, Member States submit their national efficiency plans, indicate national targets and the European Commission will evaluate these and calculate what overall aggregate objective will be fulfilled;

- If the analysis of the national energy savings by the Commission shows that the EU is not in line to achieve the overall energy savings goals of 20%, additional binding policies will be added to fill the gap.
- If Member States do not apply additional measures and are not on track to meet the overall goal, the Commission will then propose legally binding targets.
- Savings will be calculated from 2014 and this will be followed by a review of the Directive in 2016.

European Energy Efficiency Legislation Timeline



A key factor for Member States transposing the Energy Efficiency Directive will be to do so taking full advantage of its socio-economic benefits. For example, energy obligations for energy companies can provide the substantial resources needed to boost and strengthen the financing mechanisms for up-front investments in energy efficiency retrofits, thereby stimulating employment and creating a new energy supply business model allowing these companies to reach more customers in longer-term relationships. With this new model, the energy companies can offer their customers a range of new services based on energy efficiency to ensure their loyalty, protecting

margins and developing new products to help clients spend less¹⁵ - as providers of mobile phone-based services do currently.

If energy companies could offer energy efficiency retrofits to their customers and include the capital repayments in their energy bills (“on bill”) –*pari passu* with energy payments– this would be even more convenient for the customer and facilitate the entry of private banks into the market. On-bill finance would lower the cost of renovation investments and thereby trigger deeper renovation with investments being able to be repaid over a longer period and avoiding the lock-in of low stimulus, low impact shallow renovation activities. The results delivered through “on-bill” finance would be a reduction in the energy component of electricity and gas bills, replaced by the capital repayments for an energy efficiency retrofit. Assuming the margins on providing retrofits are equivalent or better than plain-vanilla energy supply then the change of business model should be very attractive.

Finally, research shows that the renewal of the European building stock has the potential to create hundreds of thousands of stable, long-term local jobs with a positive return on investment of 12%¹⁶. The German public bank KfW conducted a study on the effects of its building renovation program and concluded that every Euro spent in 2010 by the German authorities in the renovation of buildings, generated between 4 to 5 euros of revenue for the State treasury that year, as a direct result of the taxation of increased activity, employment and reductions in welfare payments¹⁷. This is certainly a clear example of how Spain can boost its economy, improve its fiscal balance and renovate its built environment also

reducing its heavy dependence on foreign energy, meeting its European commitments, and taking into consideration the environment and the welfare of its citizens.

3.2 SPANISH LEGISLATIVE FRAMEWORK

Spain's Energy Efficiency policy has been traditionally coordinated and led by the resources and technical leadership of the Institute for Diversification and Energy Savings (“IDAE”), in coordination with the autonomous communities, who retain the regulatory competencies for policies affecting the housing sector. IDAE is a government agency housed by the Ministry of Industry, Energy and Tourism whose responsibilities also include Spain's overall energy policy including renewables.

IDAE has acted as the principal agent and architect of the Spanish policy framework for energy efficiency as underscored in the 2004-2012 Strategy for Energy Efficiency Savings. IDAE has further pushed for energy efficiency through two legislative vehicles: the 2008-2012 Action Plan for Energy Efficiency and the 2008-2011 Energy Efficiency Savings Activation Plan. Furthermore, there are parallel references and measures found in the Spanish Strategy for Sustainability and the proposed Sustainability Act of 2009, as well as in the law governing the National Allocation Plan for Carbon Emission Rights, which dictate the allocations and plans for emissions reductions in Spain in line with European Directives and the Kyoto Protocol.

The Spanish 2008-2012 Action Plan for Energy Efficiency sets a national energy savings target of 11% by 2012, surpassing the energy savings targets required by EU Directive 2006/32/EC of 9% for 2016¹⁸. The 2008-2011 Energy Efficiency Savings Activation Plan is, above all, a consumer awareness campaign aimed at reducing the use of an amount

15 Euractiv. (2012) Cutting energy use in Europe's old building stock: Mission impossible? Retrieved from <http://m.euractiv.com/details.php?aid=512025>

16 Renovate Europe. (2012). The Energy Efficiency Directive – Ready for Take-Off if Member States Act Decisively. Retrieved from: http://www.renovate-europe.eu/uploads/REC_Press%20Release_EED-Ready%20for%20Take%20Off%20if%20MS%20Act%20Decisively_062012.pdf

17 KfW. (2011). Impact on Public Budgets of KfW Promotional Programmes in the field of „Energy-Efficient Building and Rehabilitation“. Retrieved from: http://www.kfw.de/kfw/en/KfW_Group/Research/PDFFiles/STE_Research_Report.pdf

18 IDAE (2007), Estrategia de Ahorro y Eficiencia Energetica en España 2004 – 2012, E4. Extraído de: http://www.idae.es/index.php/mod.documentos/mem.descarga?file=/documentos_Resumen_Ejecutivo_Plan_de_Accion_2008-2012___17-07-2007_con_TABLA_PDF_ACC_362e698f.pdf

of energy equivalent to 10% of annual oil imports by 2011 mainly through the elimination of barriers¹⁹ to greater energy efficiency actions. Both programs were implemented by IDAE in collaboration with the autonomous regions that have traditionally coordinated much of the direct financial assistance available for investment in energy efficiency and related projects.

The Spanish Strategy for Climate Change and Clean Energy includes a long list of actions proposed for residential and commercial buildings and industrial plants. Many of these actions are also included in the 2008-2012 Action Plan for Energy Efficiency. In 2009, Spain devised its Sustainable Economy Act, which also included provisions for energy efficiency and mechanisms for facilitating decision making for energy efficiency building renovation²⁰.

The main driver of the Spanish energy efficiency activity to date has been based around the sectoral and regional investment of public resources through the autonomous regional governments in line with the E4 plan developed by the Spanish Strategy for Energy Efficiency and Savings framework. The government estimated that by late 2007 it had invested over 700 million Euros in this manner mainly through its investment partnerships with the regional governments. Simultaneously, IDAE has focused on removing the barriers to energy efficiency investments through information and awareness activities, providing direct support to ESCOs and the structuring and provision of direct financial assistance programs distributed through a series of credit lines, grants and soft loans offered in collaboration with the *Instituto de Crédito Oficial* (the State bank and manager of the “Sustainable Economy Fund”). Much of this assistance has been directed at large scale energy efficiency projects for commercial and industrial areas rather than at residential buildings.

In 2010, the Spanish government launched a programme to improve the energy efficiency of 330 government buildings, having presented a tender in

that year, and planned to expand the same program to some 2,000 buildings under the “Plan 2000ESE”. The 2000ESE Plan also intended to give a “boost to the energy services sector” and was to include 1,000 central government buildings and over 1,000 buildings owned or managed by the autonomous regional governments and municipalities aiming to achieve at least a 20% reduction in energy consumption. It was expected that this plan would provide a strong push to the ESCO sector in Spain.

In the buildings sector, moving in parallel with energy efficiency policies, the Spanish construction firms worked to transpose the EU Directives impacting Buildings and Construction Standards. The enactment in 2006 of the Technical Building Code (“CTE” - applicable to the construction of new buildings) defined and now regulates energy efficiency as one of the basic requirements for new buildings and CTE provided a framework for the approval of a basic procedure for the energy certification of new buildings in 2007. This was the first step moving the Spanish construction sector to embrace European mechanisms aimed at efficiency in new buildings.

The enactment of a new Regulation of Thermal Installations in Buildings in 2007 to regulate the use and management of energy systems designed primarily for air conditioning in buildings, along with IDAE’s current development of instruments for the energy performance certification of existing buildings, are the first initiatives which have a marked impact on the energy efficiency of Spain’s housing stock.

However, Building Technical Inspections (“ITEs”) for existing buildings are mandatory and must be carried out on a regular basis. Inspections for older buildings are required more frequently than for newer ones. These inspections are charged to provide a report for each building detailing its condition and physical state and thereby providing an evidence base to compel owners to comply with their conservation duty to the building. The ITE report refers to the global demands of the Spanish Technical Code (“CTE”) which include safety, waterproofing, hygiene, energy saving, etc. and all area assessed by the technician performing the ITE inspection – however, specific actions in energy efficiency which result from an ITE are presently non-binding.

19 IDAE website, 2010

20 IDAE (2010). Nueva Directiva relativa a la Eficiencia Energética de los Edificios. Retrieved from: http://www.idae.es/index.php/mod.documentos/mem.descarga?file=/documentos_1.-_Marcos_Gonzalez_12eef70d.pdf

Over the last two years the public has come to endorse the widespread belief that renovation is the only sustainable solution to the problems facing the Spanish construction industry, which has been devastated domestically by the crisis. It is this conviction which has caused the redirection of public policy towards the empowerment of renovation rather than the sole pursuit of new construction projects, which it had done previously. The latest Housing Plan -which stands the main State instrument supporting housing and through which social subsidies are channeled- ends this year in 2012. Any new plan which replaces this will have to acknowledge and embrace renovation, energy efficiency intervention and the regeneration of urban neighborhoods and it will need the financial and regulatory backing to be able to deliver against this agenda. Similarly, the Sustainable Economy Act enacted in 2011 was to give renovation a much increased and central role, but this requires the development of a specific law for the renovation of the building stock to allow and promote the transformation of the buildings sector.

Despite the gathering legislative support identified so far, there is simply not enough presently in law (or the priority of State budgets or its instruments) to support a vibrant renovation sector as is seen in other European countries, nor as targeted by GTR in this report. There are three types of barriers to the development of a new energy efficiency refurbishment industry in Spain, which are:

- **The lack of an appropriate technical regulatory framework for the renovation sector:** Today's renovation sector is governed by a framework established for new construction, which contradicts and threatens the viability of the more reasonable technical actions required by renovations to the existing housing stock, or it imposes unfeasibly high costs (through unwieldy processes and requirements);
- **The lack of an appropriate financial framework that clearly defines the areas of value creation,** their beneficiaries, identifies funding sources that can support them, and mechanisms to ensure the return on investment and payments from those who benefit from renovation, with maximum transparency and efficiency;

- **The lack of an organizational framework that define appropriate intervention strategies at scale,** objectives, benefits, etc., which would result in the sector adopting a viable business model with clearly defined and recognized responsibilities and tasks for each participant enshrined by standards and benchmark contracts.

And finally, to bring all three of the above threads together, the sector needs a politically enshrined, long-term Plan of Action to mobilize public and private resources and to jumpstart a new housing renovation sector which will progressively grow to scale.

4. DEVELOPMENT AND ENHANCEMENT OF THE GTR MODEL

The 2012 Roadmap and Action Plan proposed by the GTR for the new housing sector NHS are based on the conviction that the transformation of the building sector into a sector centered on renovation is not only necessary to provide adequate and affordable housing for Spanish residents, but is key for the Spanish economy to reach an efficiency level of that ensures its future competitiveness. Furthermore, GTR is confident that the NHS can significantly reduce the greenhouse gas emissions and environmental resources required to meet Spain's housing needs and help deliver against Spain's international commitments to Kyoto and in the context of the European Energy and Climate Change Roadmap.

GTR considers that the resources created through reductions in energy consumption and GHG emissions are a key source of value and can act as an engine for the development of the NHS. GTR is working to identify and support the establishment of the legal, regulatory, and financial conditions that will allow households to tap into the energy and emissions savings available in their homes and thereby stimulate their engagement with the NHS and identify renovation opportunities with secure returns. GTR articulates its approach through an economic model with a series of external parameters which drives a Roadmap which determines the timescale and the priority for intervention in the various sub-sectors of the housing stock.

GTR's economic model determines when an energy efficiency intervention is cost-effective for a sub-segment of Spanish homes, subject to the set of initial parameters and their expected evolution. The aggregate of the results of the activation of each of the sub-segments are combined into the Roadmap to deliver the NHS. GTR's research, interviews and opinion has helped to establish the base-case assumptions and a set of sensitivity analysis to illustrate the impact on the sector of changes to these assumptions. Aside from improvements to the economic model, GTR has also invested resources in improving the quality of its data in 2012.

The data that feeds the GTR model can be split into two categories: Structural and External Variables. Structural data defines the residential sector –physical building data, data on occupancy, data on resources consumed (economic and environmental) for homes in each segment- which GTR has collected from various national sources and in-house databases. Sadly, Spain has no buildings nor housing sector observatory and the structural data inputs to the GTR model are therefore collected from a series of often inconsistent and different sources updated with differing frequency and often making cross-check and collection complicated.

The key source for GTR's structural data inputs is the national population and housing census, which is collected every ten years. This provides extensive data on the physical characteristics of Spain's buildings and the distribution of the population among them. The census is also the largest and most thorough source of information among GTR's input databases. Unfortunately, the Census is updated every ten years and the GTR has had to rely on 2001 data as a basis for 2011 and 2012 analysis, nevertheless in 2013 a new census will be published.

GTR has identified one way to potentially improve its structural data by working through the autonomous communities and municipal statistics based on the mandatory statistical forms supplied to construction works, or the aggregated data of the obligatory work permits issued by the organizations of architects, contractors, and technicians collected by the Ministry of *Fomento* ("Infrastructure/Development" -previously known as Ministry of Housing)- which would allow in an approximate way test assumptions around the missing data, but having made enquiries, GTR rejected this approach based around the limited marginal returns of the extra resources required for its 2012 report.

However, GTR has been updating the information it has obtained from statistical sources and has improved its tools for Spain's forecasting housing stock changes using real case studies to calibrate its model. In 2012, GTR has been able to cross-check some of its 2011 work with partial studies related and specific papers or reports that provide additional information, although sectorial: The 2025 Bultzatu plan presented by the Basque government as roadmap for sustainable renovation in the Euskadi; and the ITeC

(Institut de Tecnologia de la Construcció de Catalunya) studies designed to generate an applicable CTE to existing buildings possess high detailed estimates on specific buildings which are representative of broader built parks.

In terms of external variables, the 2012 GTR report has updated its energy future energy price forecasts adding an extra source and includes four types of fuels for heating (gas, electricity, diesel and butane/LPG). But the really significant changes have occurred in the deepening of GTR's understanding of a sensitivity analysis of the key variables which are influenced by the policy framework and financial resources dedicated to the sector.

The sensitivity analysis of the GTR Action Plan allows a direct assessment of the output impacts on the NHS of a change to the input parameters or variables. Input parameters such as the financing interest rate, loan maturity, up-front subsidies, rebates or fiscal supports significantly modify the resulting Roadmap and the implementation and evolution of the NHS

An extremely important assumption in this Roadmap is the GTR proposal that energy renovation of homes should target as close as economically rational to an 80% energy demand reduction in heating/cooling needs. This assumption requires a global justification to ensure its technical and economic viability. Firstly, successive partial interventions will lead to economic constraints and prevent the accomplishment of ambitious targets. Partial interventions can be justified on their quick investment returns and by the same logic interventions with longer investment return periods will take place once energy prices –to be expected to rise steadily- allow reasonable return periods.

However, this reasoning does not take into account certain fundamental aspects pertaining to the introduction of energy efficiency in homes. These are: the different amortization periods of elements and systems, the complexity of operations and their relationship to the building sector, and the interdependence of the various factors that influence energy consumption in heating and air conditioning in buildings.

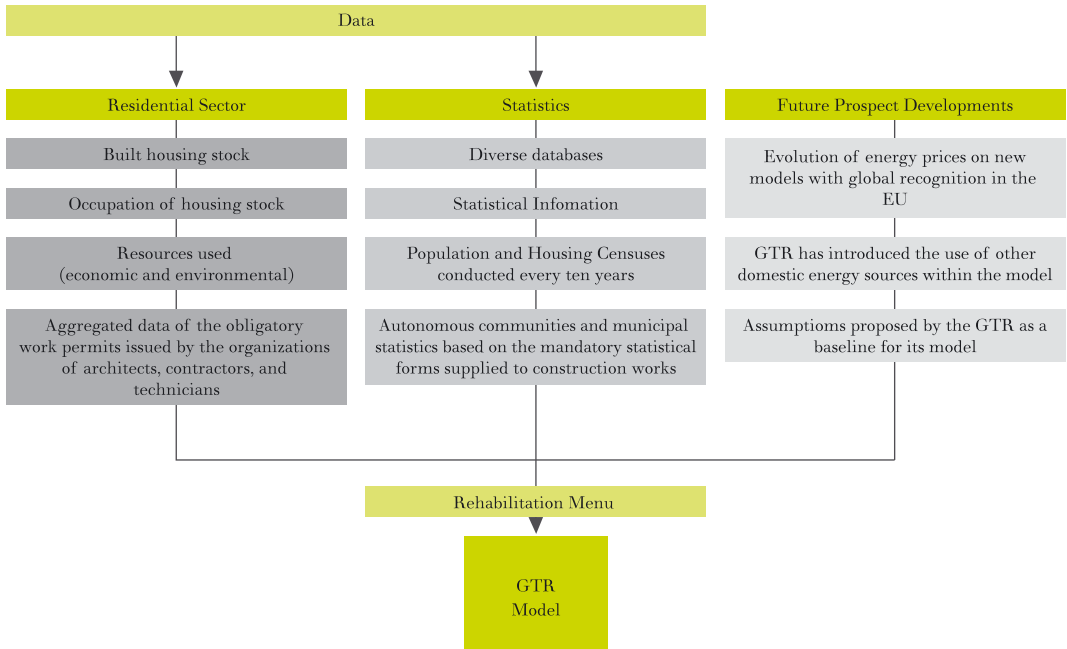
Certainly, energy efficiency investments in appliances are independent for three reasons: these devices have shorter payback periods relative to other elements and building systems; their consumption is directly proportional to their efficiency without involving any other building system (whether the source of power is renewable or grid), and their replacement does not require any intervention from other stakeholders, nor from the administration through administrative permits or specific paperwork, from a promoter, senior technician, or any sector operator, aside from a possible intervention by a plumber or electrician. GTR does not include appliances in its core model but uses a life-time replacement cycle for it base case.

The situation is different for appliances or systems which are intertwined with the rest of the building, either through their amortization periods or their involvement in the overall efficiency of the building. Their intervention commonly also requires similar resources from sector players. A clear example is the replacement of boilers for more efficient ones. The amortization period of a boiler is higher than that of an appliance -especially if it is part of multi-family or communal climate system- and its efficiency adds to or subtracts from the efficiency of other appliances and systems of the building. This replacement requires a regulatory and operational framework fully integrated with the agents of the construction sector and their organization.

The graph on p. 31 shows a summary of the GTR data sources, their typology and how they combine to form potential intervention “menus” in each “hot spot” to then be channeled through the economic model.

4.1 RENOVATION METHODOLOGY

GTR targets the deep renovation of Spanish homes to reduce heating/cooling energy consumption by 80% and to provide 60% of the energy required for hot water needs with solar energy. The GTR approach stands in stark relief against many of the proposed energy renovation policies which deem that short-term household energy savings are best made through the gradual replacement of compo-

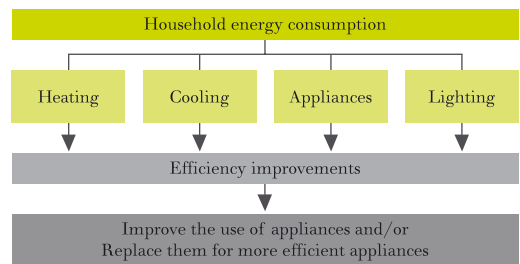


nents and appliances at the end of their natural life to ensure quick pay-back periods and short-term investments. GTR's vision is part of a long-term renovation pathway and macroeconomic stimulus where cost optimal energy efficiency is a pre-condition to competitiveness and priority economic activity.

GTR believes that new policy mechanisms are needed to facilitate, and not block, the implementation of energy and economically efficient buildings renovation, understanding that before the energy efficiency sector can enter into full force in Spain regulatory and institutional barriers have to be overcome and suitable financing sources need to be identified and working together. GTR supports a deep renovation approach to the energy efficient renovation of Spain's housing sector, when it is economically feasible, compared with shallower and less capital intense interventions because deep renovations deliver more savings, avoid lock-in to high emissions paths, by making subsequent intervention very expensive, and deliver more employment in the short term.

The energy consumption of Spanish homes is split between heating and air conditioning, hot water

(“ACS”²¹), appliance use and lighting (see 2011 GTR Report), with a 47% concentration in heating/cooling and together with ACS reaching 74% of total household energy demand. Both the use of appliances and lighting equipment generates its energy consumption in direct proportion to the hours of use of each appliance or lamp combined with the element's efficiency. Energy efficiency improvements to appliances entail their optimized use (ie. only when needed or when energy prices are lower/more renewable) and their replacement with much more efficient models when reaching the end of their useful life. In addition, the CO₂ intensity of the energy mix feeding the home will decrease the whole GHG emissions intensity of electrical loads.



21 Agua Caliente Sanitaria – lit Hot Water Supply

Replacing systems for more efficient ones when they expire is a relatively simple operation that is easy for consumers to understand and often has simple energy savings arithmetic associated. In general, many appliances may be considered to have a useful life of around 10 years, and over the last 10 years energy efficiency improvements for many household devices have been dramatic and when combined with increased energy prices this can make the early replacement economics quite appealing (plus the attraction of greater functionality etc). Ultimately, waiting for the end of an appliances' useful life will only increase the viability of their energy efficient replacement. In addition, the renewal of devices, lamps and appliances is easy²²: It takes place in a relatively short time, it does not require any complex interventions in the structure of the home and it is usually a simple matter of disconnection of the old and re-connection of the new.

Compared with this, the systems and housing elements linked to heating, cooling, HVAC, insulation and associated plumbing not only have much longer life-spans (35-40 years many passive construction elements, 30 years for centralized systems with scheduled and continuous maintenance and 20 years for mechanical installations in single family homes), they have an integral and permanent impact on the structure of the building, yet have a central role in demand reduction and efficiency which cannot be avoided when considering the whole-of-house energy efficiency.

Finally, if a building is considered to be a long-term and lasting component of a nation's infrastructure –housing its people– the overall life-span of the system should be taken into account and matched by the horizon period of the renovation strategy applied to them. If a renovation programme wishes to obtain significant reductions in heating and cooling requirements and the overall energy consumption of a home, interventions restricted to elements that produce high short-term returns will backfire in the longer term. The clearest example of this is the upgrade of a boiler, for a more efficient model, or heating fuel switching: It can be the case that the up-

grade of a 10-year old gas boiler for a new condensing boiler may deliver a 25% performance improvement. However, the home still uses more gas than it would if the intervention had previously considered passive measures – reducing the energy demand of the structure and potentially the required capacity, and likely price, of the new boiler. Passive measures considered after a boiler replacement which reduce an already reduced gas consumption, while useful, will look significantly less appealing and be significantly delayed as a result.

In order to obtain significant and economically viable energy reductions and to achieve the long-term objectives which Spain must deliver in the context of the European framework (see prior chapters) it is necessary to approach the home as a single entity and blend the returns of many retrofit components into a single and potent “whole of house” deep renovation which can then be financed with targeted financial products with maturities and rates of interest tailored to support that market (like mortgage debt). To better understand this approach, GTR considers it important to break-down and assess the key drivers that determine the main energy consumption areas in buildings.

The key drivers of energy consumption for heating and cooling in buildings are:

- The use and management of the building and its components and systems;
- Resulting energy demand net of transmission energy losses;
- The efficiency of central heating/cooling installations;
- The fuel/source of the energy supplied to the building.

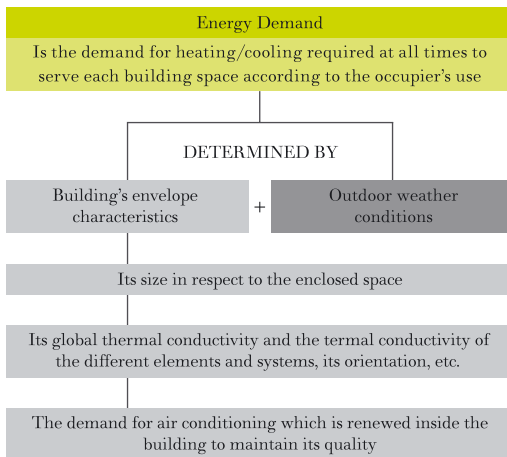
GTR defines the appropriate and efficient intervention order for a building renovation as:

1. **Rationalize the use and management of the building** as all the systems and appliances' energy consumption are defined by their specific programmes of use and management (these are also referred to as behavioural characteristics as they sit at the interface of the physical components and the human users). For instance, it makes no sense to invest in a more efficient boiler and then use it to deliver just 50% of its

22 IEA. (2011). Where should we start? [Chart]. In Energy Efficiency in the Buildings Sector Challenges and Opportunities: Saheb. Y. Retrieved from: <http://www.iea.org/media/workshops/2012/buildingefficiency/Saheb.pdf>

nominal capacity: Systems and appliances need to be sized to the buildings' needs and not the reverse.

2. **Energy Demand.** Numerous physical and structural factors impact energy demand for heating/ cooling including: The outside weather conditions, the building orientation, the characteristics of the building envelope: its size in respect to the enclosed space, its overall convection loss coefficient and the thermal conductivity of the different elements and systems that constitute it etc., as well as the heat transferred out of the building as its air is replaced. This is usually expressed as an energy intensity or total annual demand of heat and cooling required by the dwelling or by m² of area. Again, the boiler example reveals that providing a more efficient boiler to then later intervene in the building envelope decreasing the conductivity of the walls and windows will result in the boiler being oversized.



3. **The efficiency of the thermal and cooling generation equipment** clearly sized to meet the newly reduced demand load to deliver the adequate and well managed levels of comfort and deliver it to the internal locations where it is required by the buildings' users.
4. **Improving the energy and environmental efficiency of the building's energy source(s) for**

heating and cooling: Once again, it makes little sense to cover a roof with solar collectors if hot water usage is minimal and/ or size a system for the single coldest day in the year. Renewable source energy and fuels (biomass boilers) are ultimately most efficient in the context of a building system when sized after demand-side energy efficiency measures have been made and the efficiency of conversion devices is at its best.

This 2012 GTR report proposes an ordered catalog of potential actions to improve energy efficiency in existing buildings. This catalog contains the list of key intervention actions and their physical and economic conditions for application in GTR's ten different segments of the housing stock (hotspots). These intervention catalogs include each measure's energy saving potential, economic cost and the energy and emissions involved in its manufacture/ implementation. The approach to generating the catalogs follows the methodology outlined here ensuring that the most reasonable option is selected in each step, fully reflecting the efficiency impacts of the prior steps in an efficient intervention order. This is also highlighted in the IEA's own "Merit Order" approach.

While the GTR lists of actions are not intended to be exhaustive (as there are potentially an infinite number and combination of interventions), they are built from a default catalog of actions which only include currently available (tried and tested) technologies that are widely applicable to the most diverse range of households and might qualify as a reasonable minimum set of potential interventions in the factors affecting the consumption of heating and cooling for any home.

From this catalog of potential intervention actions, GTR proposes an intervention menu for each of its segments of the Spanish residential building stock (for each hotspot), tailored to their characteristics and levels of consumption and to be applied in a series of ordered actions to deliver the optimum use of heating and air conditioning. Given the number of available interventions and their flexibility and potential application, in most hotspots GTR is able to propose an economical intervention menu which is capable of delivering energy savings representing a reduction of close to 80% of current consumption. The following section details the GTR catalog of actions and intervention menus.

	1 Energy sufficiency	2 Energy efficiency	3 Renewable energy
Energy Strategy	Reduce energy needs	Reduce energy consumption	Supply with renewable energy
Policy Instrument	Land use policies Building energy codes	Building energy codes S&L policies	Land use policies Building energy codes S&L policies
Policy Measure	Bioclimatic design principles Use of passive solutions	Mandatory S&L for: - Overall building energy performance - Building elements and equipment	Mandatory share of supply from renewable energy sources Mandatory S&L for equipment

Source: IEA Sustainable Buildings Centre. (2012). Path to low energy buildings. Retrieved from: <http://www.sustainablebuildingscentre.org/pages/aboutus>

4.1.1 CATALOG OF ACTIONS

As discussed above, the overall energy consumption of a home is related to the influence of each factor on other factors and the interaction of the whole system. While each individual action is considered independently of prior actions for the catalog and menus, they need to be implemented in the order presented here. In general, the actions listed within each segment are intended to be alternatives to each other. The specific menus of selected actions which fit the characteristics of each home –in each hotspot- will determine the plan of works and home intervention execution approach.

Every action has a range of variable parameters which allow for adequate sizing and tailoring (and options where available) to best fit the segment of the housing stock they address. The structural and physical information on the hotspot in question allows the determination of the energy savings and emissions generated and the calculation of costs of execution given:

- **Barriers:** These limit the feasibility of the action and are part of the physical or structural information which is defined by the segment of the housing stock;
- **Cost:** total cost (where possible), unit cost per m² of housing (when possible), unit cost per measurement unit (m² of facade, envelope, unit, etc.);

- **Energy and / or emissions savings:** home-level savings (when possible), percentage reduction of the energy characteristics of the reference element (when possible);
- **Energy and emissions used in the manufacture of the materials required:** as an intensity figure per unit cost.

In addition, the GTR calculations indicate the hours of direct labour required to implement each of the actions in each hotspot. These can then be aggregated together with indirect labour to provide a check for the top-down calculations also undertaken by GTR for its Roadmap. The full technical lists of all of the options considered by GTR with their relevant parameters serve as an annex to this document and can be found in the GTR section of the GBCe website at www.gbce.es/es/gtr

USE AND MANAGEMENT

Use and management of each building is the first factor GTR considers in its comprehensive intervention system to reduce energy demand. This factor is the core determinant of energy demand and creates the baseline from which the other actions reduce.

Neglected by most regulation -with the exception of RITE (IDAE's Regulation on Indoor Heating/Air-conditioning Systems) which takes into account the standard and efficient use and management of systems- this factor does not affect structural ele-

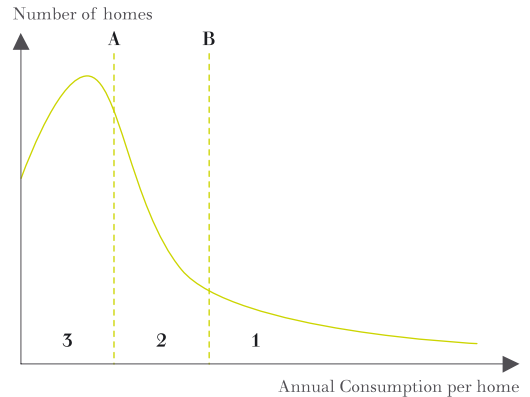
ments of the building. Therefore the tools needed to act to change a building's use and management are not specific technical systems – with the exception of “intelligent” management systems²⁵. Its reduction must be produced by stimuli that encourage the user to become an efficiency advocate which can be combined with training and sensitizing activities around energy costs and schemes which penalize excessive consumption.

The stimuli should ideally modify consumer behavior to drive energy efficient behavior by the time other measures are implemented. Users in each segment of the housing stock should aim to consume efficiently and the economic structure should compel higher energy and emissions costs for excessive use which in turn improve the returns on investments in efficiency and also subsidize the purchase of energy for those suffering energy poverty.

Additionally - although not the subject of this work - efficient strategies for the use of buildings can be developed, such as the recovery, efficient use and management strategies related to heritage buildings as adapted to specific segment needs. A specific example would be to give specific consideration to adaptive comfort at times when natural ventilation is possible, affecting a wide range of comfort temperatures and allowing for a significant reduction in cooling demand in Spain during the warmer months.

Intelligent management systems –ventilation, heating and cooling systems, blind systems, etc.- have been excluded from the GTR menus for the average home due to their high cost, but they may be considered in the future as an additional action at a time when rising energy costs and reduced technology costs make them profitable.

The dispersion of national consumption patterns fits a Gaussian distribution that is much flatter on its right-hand end as there are no restrictions to excess consumption:



The distribution can be divided into three areas 1, 2, 3 divided by line A which marks the mean consumption per household (fifty percent of households on each side of the line) and line B, which marks the point above which is 50% of all energy consumption (with fifty percent of consumption on each side of the line).

Area 1 contains all households with the highest energy consumption (large houses and very energy intensive ones) which together represent 50% of total residential consumption. Within the remaining 50% of consumption, Area 2 groups households that are above average energy consumers and Area 3 contains the 50% of households which consume less.

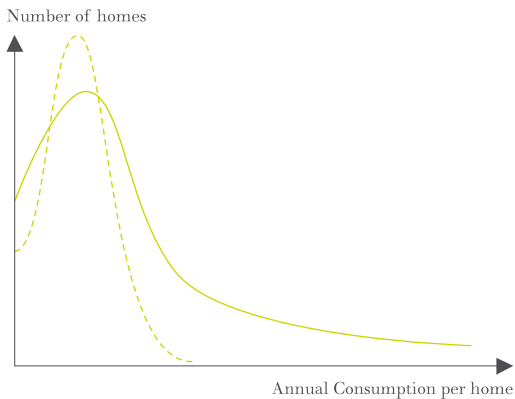
If we were to identify housing types and climatic zones in Area 3, we would see a mix of those households suffering fuel poverty, but also those which are simply located in the south of Spain. To properly identify and characterize energy poverty in Area 3 GTR would have to crosscheck energy use with family income or potentially remove households by geography.

GTR has not been able to identify a national reference study nor specific pilot homes which would allow us to generalize about the incidence and effects of improved energy management in homes. Data developed by Barcelona Tech University has looked at administrative and educational buildings, and indicates that a minimum of 10% of consumption can be reduced through improved use and management. However, this figure in some buildings can be as high as 30%; therefore GTR believes that on average 10-

²⁵ Intelligent Management Systems meaning smart, electric blinds as opposed to Smart Meters which potentially have up-stream impact and electrical per unit cost implications by “peak shifting” (ie. the re-timing of electrical loads)

20% of total energy consumption may be reduced through improved use and management of the home.

If we apply these figures in Spain's residential sector, taking into account that energy poverty affects more than 10% of Spanish households, GTR believes that there can be a level of consumption recovery and efficiency in the right hand side of the distribution and a greater energy need from the far left hand side. Depending on the compensation mechanisms which are established to deal with the social issues around energy poverty, such as recycling taxes on high consumption to help households suffering energy poverty, the graph would become narrower in a manner similar to that shown here:



This study assumes that the profits generated through improved use and management of high energy intensity buildings potentially generated through fiscal mechanisms, can be recycled to potentially further subsidize energy efficiency investments in social housing and to address energy poverty.

Despite the fact that improved use and management of buildings and their facilities can deliver significant (10-30%) savings and (ideally) should be applied prior to the sizing of and calculations related to a deep retrofit - GTR will not consider these impacts on a structural basis within the context of its modeling and analysis for 2012.

DEMAND REDUCTION FROM INTERVENTION IN THE BUILDING'S ENVELOPE

The next factor which determines a building's energy needs are its passive components, physical structure and positioning. Exact heating and cooling demand depends on the building's climate, orientation, the relationship between the amount of surface area and volume of the building and also on the air sealing of the building.

GTR has considered passive interventions, mainly through improved insulation, on the following four areas of the building's envelope:

1. **Vertical walls** -walls that separate the inside from the outside of the building- GTR's proposals look to increase thermal insulation to its maximum efficiency (ie. when marginal increases in insulation produces no significant improvement in overall losses) considering two options:

- 1.1. Interior insulation, without altering the appearance of the facade:

- 1.1.1. through a cavity insulation, applicable when there is a cavity wall and where the air chamber created may be filled with an insulating material. There are different procedures and techniques available in Spain with ample products designed to be viable for these situations;

- 1.1.2. by adding an additional insulation layer over the inside facing plane of the wall with appropriate decorative finish.

2. **Insulation attached to the building's exterior**, through an intervention in every exterior wall and transforming its initial appearance to give it continuous insulation and a new waterproof coating:

- 2.1.1. through externally attached insulation and outer finish with mortar;

- 2.1.2. by putting together a ventilated facade attached to exterior insulation, leaving a ventilated air space:

- 2.1.2.1. for facade, with greater focus on cosmetics of outer finish;
- 2.1.2.2. for shared party walls or inner walls – simpler with less cosmetics.

2.2. Windows: GTR aims to improve the thermal insulation and air sealing of windows, as well as considering solar shading. We propose two alternative actions and third as complementary. On the whole GTR considers the replacement of window units as being optimal (for performance purposes) as opposed to the re-engineering of existing units in frames:

- 2.2.1. Replacing a simple window system with a double glazed thermally divided system;
- 2.2.2. Adding to the existing window opening, a double glazed window with a thermally divided system. This is often preferable to a substitution, as it allows a significant increase in the thermal resistance of the window unit, but the building's configuration does not always allow for it;
- 2.2.3. Adding a solar shade system (additional and complementary to the two previous alternatives).

3. **Roofs:** GTR focuses on increasing the thermal efficiency to its maximum (ie. when marginal increases in insulation produces no significant improvement in overall losses) built around two options:

3.1. Sloped roofs:

- 3.1.1. when there is no ventilated chamber beneath the existing roof tiles, GTR proposes the replacement of existing waterproofing tiles and the attachment of new thermal insulation beneath and new a superior waterproofing layer above;
- 3.1.2. when there is an accessible ventilated chamber beneath the existing roof tiles, GTR proposes adding thermal insulation into the cham-

ber on the inside and around the ventilated chamber;

3.2. For flat roofs, GTR proposes the addition of a layer of thermal insulation and improved superior waterproofing protection.

4. **Flooring:** GTR proposes increasing the thermal efficiency of floors to their maximum levels considering three alternatives:

- 4.1. Attaching thermal insulation over the existing flooring together with a light finish with a total thickness of less than 7 cm.
- 4.2. Attaching thermal insulation and new rigid floor layer capable of containing-if appropriate- an under-floor heating system.
- 4.3. If there are flooring units with cavity chambers of sufficient size then through blowing insulation into the cavity.

CONTROL OF VENTILATION AND HEAT EXCHANGE

With proper use and management, and after insulation, the next defining element of home energy demand is air sealing and ventilation systems. Power consumption can be significantly decreased by high quality air sealing and controlling ventilation with a mechanical system together with a simple thermal jump which sits between the outside air temperature and interior air temperature. The heat exchange element allows for heat recovery from out-going air to pre-heat air intakes in winter and can be potentially reversed during the summer (to cool in-flowing air).

When there are large differences between inside and outside temperatures in the home, a controlled ventilation system with heat exchanger can recover around 50% of the energy which would have been lost to the outside environment through ventilation. In Spain, and in many similar climate zones, for most of the year the temperature gradient between inside and outside are small, however this is not the case at all hours of the day and night. The thermal inertia of the building's construction elements together with adequate natural ventilation together with traditional opening of windows should allow for adequate interior air conditions without air conditioning and heating systems for many months in most regions.

The ventilation control system for energy recovery is engaged when the temperature differential rises and the heating systems of the house activate.

IMPROVEMENT OF THE EFFICIENCY OF THERMAL INSTALLATIONS AND THE USE OF RENEWABLE ENERGY

The order of GTR's intervention is demand reduction first and then the re-sizing and upgrade of energy conversion devices and finally renewable energy can be included as the final step to reduce energy demand or deliver (net) near zero energy buildings. GTR considers the most reasonable, economically viable, and environmentally efficient options for each segment of the building stock combining efficient heating and cooling production systems with appropriately sized renewable or non-renewable energy sources ensuring a significant energy demand and GHG emissions reductions. Renewable energy production is the final but essential step to a sustainable housing stock and vibrant renovation market in Spain.

Once demand is reduced significantly the relative impact of increased energy conversion efficiency is relatively small, despite being one of the actions with the fastest return on investment if done first (although locking out deeper renovation actions). Certain tasks such as fuel switching, installation of efficient radiators, and even the installation of certain renewable components –such as a biomass boiler- are often not economically rational after a 70% energy demand reduction has already occurred – simply because with such a low energy demand the marginal savings are much smaller and require considerably longer periods to amortize.

The incidence of improved thermal installations and the introduction and direct use of renewable fuels will depend on: the replacement of high-cost high-emission fuels such as coal or oil. The following interventions were considered:

- Homes with natural gas heating system: replace boiler with high efficiency boiler;
- Homes with an electric heating system using night tariff: maintenance of the heating system;

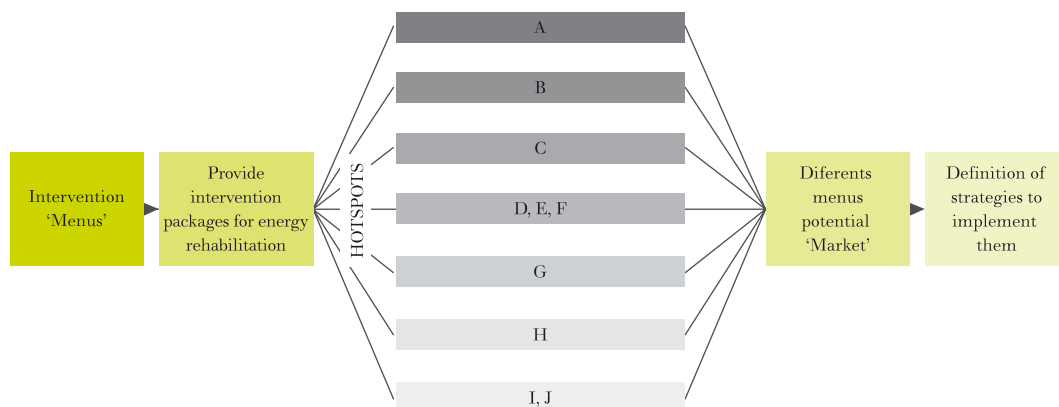
- Homes using electricity for heating through radiators and hot plates without using a night tariff: installation of an electrical heating system using a night tariff;
- Homes using oil for heating: substitution for high efficiency gas boilers upon the introduction of a natural gas network or an electrical heating system using a night tariff;
- Homes using LPG stoves heating: installation of central gas heating system with high efficiency boiler.

GTR considers that the Spanish “norm” for a multi-family residence is that there is a centralized boiler to upgrade. In all cases GTR targets solar water heating panels to cover a minimum of 60% of home ACS demand.

4.1.2 INTERVENTION MENUS

The intervention ‘menus’ provide intervention packages for deep energy renovation to be applied in the different segments of the existing housing stock (the GTR ‘hotspots’). Their purpose is to illustrate how an 80% reduction in GHG emissions from heating and cooling in households is practical, affordable and possible. GTR's intent is to demonstrate the considerable market size for such intervention so that the NHS itself will coordinate itself around their delivery. The menus consist of the specific actions which provide the orderly, efficient and logical intervention in each of the hotspots. In effect, GTR's goal is to have a reference ‘menu’ applicable to each of the ‘hotspots’.

The intervention ‘menus’ are a key contribution to the renovation sector. They offer standard package solutions for different ‘hotspots’ and thereby offer a view of the potential size of the national and local markets for these interventions. In addition, GTR believes that the focus on tailored technologies with wide implementation will stimulate the innovation and technological development in each of the intervention technologies resulting in: the decrease of prices, competition between the different materials and technologies involved; strategic alliances between the manufacturers of products, installers, construction companies, etc. The standard packages of intervention solutions should also assist in the establishment of financing ‘menus’ that become



sophisticated and produce standard contractual arrangements reflecting energy and emissions savings and secure them. The combination of intervention solution and financing menus determines the optimum size of the interventions and will contribute to the formation of a solvent market.

The intervention 'menus' are not exclusive solutions. They are the start of a process in which GTR envisages an expanded reference set of interventions, built along similar methodological lines, which will deliver well-defined and credible options, each adjusted to local conditions (typological, climate and constructive) and, as the NHS develops, build more efficient and effective locally competing solutions. GTR's 2012 proposal establishes a baseline to ensure the viability of deep renovation in the full expectation that improvements and contributions will be made from many market participants to improve and stimulate the new sector in the future.

The intervention 'menus' proposed for each of the 'hotspots' are determined based on the assumption of a base case consideration of the type of room layouts, proportions between the structural elements, surface areas, annual consumption, etc. which determine a typical Spanish home profile. GTR always proposes the implementation of actions that are considered the most energy and economically efficient:

- **Hotspot A, defined as single-family housing in rural areas built before 1960:** Buildings built with traditional solid and thick wall, predominantly with a sloping roof with a ventilated chamber and flooring in contact

with the ground. The intervention 'menu' proposes inside wall insulation –removing thermal bridges- adding tight air-sealing window units, insulation of the attic and insulation of the floor through new floor tiles plus insulation layered over existing. The installation of a ventilation system with a heat exchanger is considered in this and all hotspots. As regards energy source: The annex graphs (available on www.gbce.es/es/gtr) reveal alternatives for a gas boiler (if a connection exists) and if not then biomass may become a solution subject to future fuel costs, up-front cost reduction and availability.

- **Hotspot B, defined as multifamily buildings of over four floors located in dense urban environments and built before 1960:** These are built with solid walls, but the roof is a flat and there is usually a commercial activity developed on the ground floor. The proposed intervention menu calls for exterior "solid wall" insulation with subsequent new finish coat, adding vacuum sealed window units, insulation and protection layers for better air sealing and insulation blown into the cavity which often is found between the commercial ground floor (in its roof) and the residential sections (sometimes referred to as the "health corridor").
- **Hotspot C, rural houses built in the 1960 - 1981 period:** These usually are built with cavity walls, a sloping roof without an attic or air chamber and slab floor units. The GTR intervention menu calls for blowing insulation into the cavity wall (correcting thermal bridges),

adding vacuum sealed window units, replacing the roof installing thermal insulation under new tiles and adding insulation in the floor cavities.

- **Hotspots D, E and F, defined as multifamily dwellings in detached buildings either in rural or urban areas, built between 1960 and 1980,** considered to be built with cavity walls, flat roofs and slab floor units. The GTR intervention menu proposes blowing insulation into the cavities (wall and floor), adding vacuum sealed window units with insulation and protection layers for better air sealing and extra insulation above the commercial units (where they exist).
- **Hotspot G single-family homes built in rural areas from 1980 to 2001, after the introduction of Spain's first mandatory thermal regulations.** These homes were built with solid walls with integrated insulation, sloping roofs without air chambers and slab floor units. GTR does not propose further insulation of the solid walls, but to add vacuum sealed window units, replacing the roof installing thermal insulation under the new tiles and blowing insulation into the floor cavities.
- **Hotspot H, low-rise multi-family housing located in rural towns and built between 1980**

and 2001. These homes were built with thermal insulation, flat roofs and slab floor units. Intervention in this hotspot requires adding vacuum sealed window units with insulation and protection layers for better air sealing and insulation in the floor cavities and roof of commercial units (where they exist).

- **Hotspots I, J, multi-family housing in urban areas built between 1980 and 2001.** These were built with solid walls with insulation, flat roofs and slab floor units. GTR proposes adding vacuum sealed window units with insulation and protection layers for better air sealing and insulation in the floor cavities and roof of commercial units (where they exist).

To ensure that GTR's proposed menu for each 'hotspot' reduces home energy consumption by close to 80%, the model first describes current consumption based on two determining factors: the transfer of heat through the building envelope and its ventilation losses.

Ventilation losses are an important (and often overlooked) factor in Spain's existing buildings as vacuum sealing carpentry is a very recent development in Spain's construction methods. As a result, most of the housing stock lacks the benefits of vacuum sealed windows. However, these losses are hard to quantify for each dwelling. All GTR intervention

Heating		Current data				
		Characteristics		W/Km ² home surface	kWh/m ² home surface per year	
Elements that determine consumption		Values	Units			
Losses	Transmission	walls	1,9	W/m ² K	1,64	57,5
		windows	5,7	W/m ² K	0,77	27,0
		roof	1,8	W/m ² K	1,27	44,4
		floors	2,5	W/m ² K	0,87	30,6
		Total			4,55	159,4
	Ventilation	1	renov hour	0,86	30,1	
	Total			5,41	189,5	
Gains	Appliances Radiators	9	kWh/m ² (1) not considered			
Heating demand (losses + gains)					189,5	
CONSUMPTION, Heating					180,5	
% CONSUMPTION, Heating - after each action					100	
% REDUCTION IN CONSUMPTION - after each action					0	

menus dramatically improve the sealing of windows and provide a ventilation system with a heat exchanger allowing absolute control of ventilation losses and helping to achieve the CTE standards. It would be easy to exaggerate the benefits of insulation (or to lose them) by assuming an initial state of air ventilation which is dramatically different from that which is actually occurring. For this reason GTR assumes that there is a single full air replacement within the home each hour – both before and after the programmed intervention, so as not to skew the study. This measure is conservative and provides upside to consumer energy savings proposed by GTR.

Heating consumption in homes is smaller than the theoretical demand due to internal heat loads (eg. Lamps which give off heat and people living inside) and sunlight, which both contribute to a reduced home energy need. The impact of the occupants is de facto considered as GTR assumes the same occupation before and after intervention and sunlight heating is discounted in some locations to avoid over sizing insulation. GTR also considers the contribution of heat from appliances as during the delivery of the roadmap these appliances (and lighting) will become more efficient and therefore radiate less waste heat and households will tend to buy more efficient devices for economic reasons and resulting from increased awareness. In effect, this reducing internal secondary heat source works to increase the economic case for

passive measures and marginally strengthens GTR's intervention approach.

Thermal conduction losses are distributed around the home and depend on the distribution of room space, structural elements' thermal conductivity and their surface areas exposed to thermal gradients. GTR has calculated the following distribution of home heating energy consumption.

To calculate the changes in consumption generated through the implementation of GTR's intervention menus we apply a reduction in each kWh/m² coefficient ("U value") for each housing surface per year for each element to generate a change in the required energy consumption listed in each row of the chart on p. 40 and summing to give a total for the property ("losses" section in the chart).

Then GTR assess the savings due to the heat recovery in the new ventilation system ("Ventilation row"). This benefit is in addition to any "gap sealing" or draft prevention benefits which new windows and a general renovation may bring. As mentioned these "co-benefits" of better general air sealing are a balancing factor against rebound and other considerations. Yet, the recovery of heat does reduce the heat consumption needed to heat external air to renew exhausted air.

Rehabilitation data					HOTSPOT A			
2. DEMAND					3. VENTILATION		4. INSTALLATIONS	
Characteristics		Wh/m ² home surface	Heterogeneity coefficient	kWh/m ² home surface per year	Heat recovery savings (%)	kWh/m ² home surface	Savings action (%)	kWh/m ² home surface
Values	Units							
0,4	W/m ² K	0,58	1,20	16,1				
1,7	W/m ² K	0,25		8,0				
0,5	W/m ² K	0,19		6,8				
0,4	W/m ² K	0,14		5,0				
		0,95		33,9		35,9		
1	renov hour	0,86		30,1	56,9	12,95		
		1,81		66,0		48,9		48,9
5,6	kWh/m ² (2)							
	not considered							
				66,0		48,9		48,9
				60,4		43,3	25,0	52,47
				33,5		24,0		18,0
				66,5		76,0		82,0

Finally, we consider the efficiency improvements in heating and air conditioning systems –in this case, the boiler efficiency in the production of heat is assessed according to the type of fuel used and its impacts on household consumption.

The intervention ‘menus’ proposed by the GTR model not only ensure reductions in consumption to more efficient levels, they enable an evaluation of the costs of intervention by household, by ‘hotspot’ and distribution area (1, 2 or 3) as well as calculate derived economic costs such those resulting from GHG emissions reductions and the direct labour work hours required for each component of the intervention. An example of these calculations and results can be seen in the table above.

GTR’s cost calculations and assessments, which are included in its Roadmap, are guidelines based upon industry reference levels and include relevant taxes and margins. However, these numbers are designed to kick-start a conversation and development process whereby the renovation industry engages to develop improved menus and lower costs. The materials supplied by the construction supply chains and systems are based around today’s pricing and then forecast as the NHS grows.

The GTR intervention ‘menus’ are to be considered as base cases from which tailored local solutions can be developed. Their mission is to demonstrate the feasibility of the NHS and to showcase the benefits that could be gained from its inception.

The quality and granularity of the information on the housing stock itself is a constraint when conducting narrower segmentations to put together better quality menus that more closely resemble the current state of edification. The GTR model is flexible and can easily adapt to improved data quality adjusting its calculations and conclusions – in fact in 2013 with new census data GTR plans to do exactly that. As a final annex to this section, the complete tables of the menus’ incidence on Area 1 (Spain’s most energy consuming homes) for each of the ‘hotspots’ is also attached to the website www.gbce.es/es/gtr.

4.2 FINANCIAL VARIABLES WITH GREATEST IMPACT ON RENOVATION

With the renewal and enhancement of the GTR data in 2012, it is important to summarize the changes that have occurred in the model prior to seeing the sensitivity analysis of the results by changing several of its key financial variables. The introduction of intervention menus for each hotspot, which now take into account four different fuel sources for heating, as well as the consideration of two system life spans one designed for no further investment in 20 years and the other for 30 years, has expanded the level of detail in the analysis from the 2011 report eighty times. In addition, the 2012 data includes an additional energy price evolution based around the EU Prometheus model and updated interest rates, CO₂ prices and actual energy price and tax fluctuations in the last 12 months.

The following table provides a summary of the significant changes in the data architecture of the GTR Model between 2011 and 2012 reports.

Despite the improved data, the GTR’s core model methodology remains the same: GTR’s method assumes that the renovation of a dwelling will be performed only when the net present value of future energy savings -including any value attributed to CO₂ savings, such as through white certificates- is equal to or greater than the net cost of renovation after deducting all available subsidies and/or tax breaks. Some of the most important parameters within the model are therefore the availability, cost and financing term, future evolution of energy prices, inflation, the price of the renovation project and its future evolution and the value of CO₂ savings.

The chart on p. 43 compare the GTR 2011 base case with the new GTR 2012 model (with the same assumptions) and this illustrates that the size and evolution of the NHS sector forecasted by both models is similar and hence notwithstanding the 2012 model’s increased complexity, it’s results are broadly in line with 2011’s higher level analysis. With the same size and evolution, however, the introduction of the details of the different heating fuels triggers the indus-

Description	GTR 2011	GTR 2012
Information on the physical characteristics of buildings	INE (Census 2001) supplemented by UPC Barcelona Tech	INE (Census 2001) supplemented by UPC Barcelona Tech
Renovation Costs	WWF 2010 complemented by UPC Barcelona Tech and GTR	ITeC prices combined in menus by UPC adjusted for each hotspot
Number of Menus Considered	10	80
Energy Use Reduction	WWF 2010	Direct Calculations based on the intervention menu for each hotspot (UPC)
Basis for the selection of menu	Get 80% reduction in energy use in all homes	Obtain a deep (65-82%) reduction in energy use, subject to economically rational component decisions
Number of energy sources considered	1 (Gas)	4 (Gas, Oil, LNG and Electricity)
Number of future energy scenarios addressed	2 (IDAE/ BCG "high" y "base")	3 (new IDAE/ BCG "high" y "base" y EU Prometheus)
Additional variable parameters (financial, etc)	9	10

try start-up somewhat earlier and even begins to rehabilitate the lessor energy intense houses which use the most expensive fuels for heating prior to some energy intense but cheaper fueled homes (this may also lead to some fuel switching where available). In both cases this effect is caused by the introduction of fuels that are more expensive than natural gas. The other impact is a more gradual start-up between 2012 and 2020, without a steep ramp up in 2014.

4.2.1 SENSITIVITY ANALYSIS

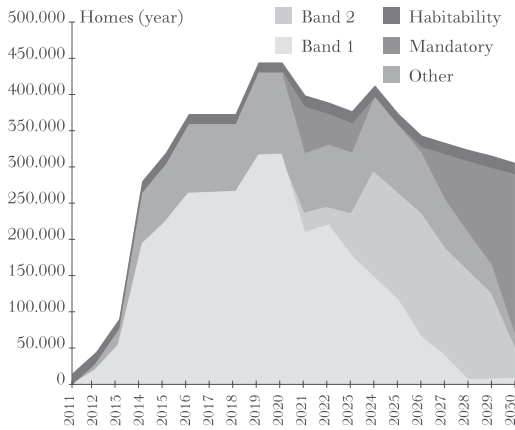
This section contains a sensitivity analysis of the 2012 GTR model showing how its results (and therefore the likely evolution of the NHS in Spain) are impacted by changes in the key input driver parameters. This sensitivity analysis is specifically directed at policy makers for their better understanding of the dynamics of the renovation sector and the relative importance of each of the driving factors. The parameters with the greatest impact on the evolution of the sector are:

- Current levels and future projections of energy prices;
- Renovation costs taking into account up-front subsidies and any fiscal benefits, ie. net investments required from the homeowners;
- The value of generated GHG reductions;
- Renovation finance availability and its specific terms and conditions.

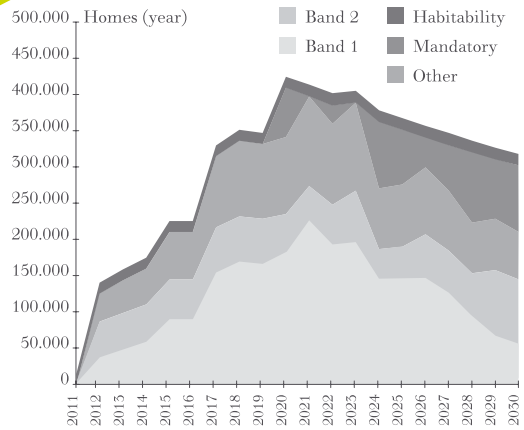
Each sub-section of this chapter deals with a single variable and concludes with an assessment of the impacts of changes to that variable alone (keeping all other parameters the same as the base case) and finally at the end of the section GTR summarizes the overall aggregate conclusions for the 2012 action plan.

1. **Updated Gas Prices.** In GTR's 2011 report the domestic gas price was obtained from Eurostat, which in turn corresponds to Spain's *Tarifa de Ultimo Recurso* (TUR – general retail customer rate) published in the State's Official Bulletin ("BOE") on 30th June 2011. In addition, future gas price forecasts were estimated using data from a Boston Consulting Group / IDAE study forecasting gas import prices for Spain from 2012 which provides both a "base" and a "high" case. In 2011, GTR had estimated a 2011-12 gas price increase of 16% which in reality (adding

Original GTR 2011 Plan



GTR 2012 Base Case



the BOE 29th June 2012 TUR together with a 1st Sept VAT increase) turns out to have been 12.4% for the TUR (although for many customers maybe more as the TUR rate protection is going to be removed). Aside from an update of prices for 2012, GTR was provided by the Spanish Climate Change office a new set of energy (oil & gas) price forecasts sourced from the European model Prometheus²⁴. The following sensitivity analysis shows the impact on the GTR action plan of the different forecasts of future fossil fuel prices based on these new assumptions:

- a. **Impact of using the EU Prometheus forecasts in place of the 'high' BCG/IDAE price evolution:** If the prices of gas, and other fossil fuels, do not rise (for domestic consumers) as fast as in the IDEA / BCG "high" scenario, the renovation sector will maintain low levels of activity (c. 100,000 units per year) until 2020. This can also be seen as a delay of 3 years of the entry of homes served by gas central heating - instead of a steady ramp-up between 2014 to 2017 in the base case, the homes served by mains gas are

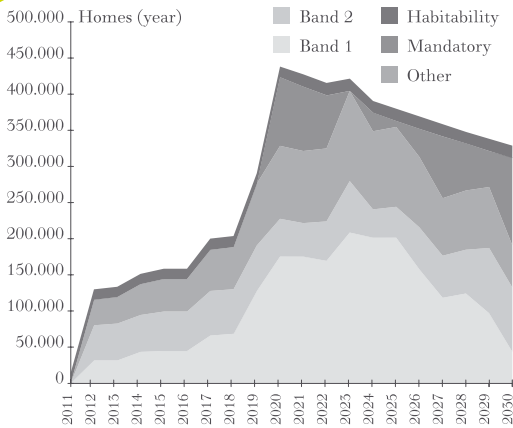
not active in most hotspots until the 2018-2020 timeframe. This effect can be seen in the charts on p. 45.

- b. **Sensitivity to a "flat" energy prices future:** An evolution of low gas prices (an annual increase of 1.5% versus a 4.7% between 2012-2020) would delay the ramp-up of the NHS in Spain until after 2020 and require the implementation of mandatory policies that demand energy efficiency by 2020 to stimulate any level of activity comparable to the base case (seen in the charts below). This sensitivity highlights the fact that if homeowners have a view that recent energy price rises are a "temporary peak" and expect them to come down, they will be more reluctant to engage.

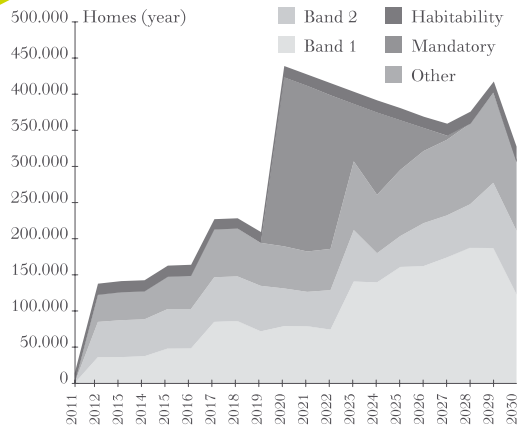
Gas Price Sensitivity Conclusion: The GTR model shows that the renovation sector in Spain is sensitive to fuel prices and their future evolution. Although it is rare to find Spanish households that believe energy prices will fall in the future, it is clear that a policy of subsidized energy prices for households will work against the renovation sector. It is also worth noting that the evolution of fuel prices considered in the GTR model does not include increases in domestic taxes, VAT, recent "green cent" added to gas imports or any future carbon taxes nor does it include the repayment of the nation's energy tariff deficit. GTR is confident in its repeated selection of the high BCG/

24 European Environmental Agency. (2010). Prometheus. Workshop on Global megatrends and Environment Security 7-8 December 2010. Retrieved from: <http://scenarios.ew.eea.europa.eu/fo1079729/online-model-inventory/prometheus>

GTR 2012 with Prometheus Prices



GTR 2012 with "Low" Gas Evolution



IDAIE scenario for its 2012 base case as this was the best predictor of 2012 prices and the Spanish national budget situation appears to require further step energy price increases in the short term and GTR sees no balancing factors in Europe to the positive. As mentioned, future consumer expectations regarding the rate of increase retail energy prices are the key to accelerating retrofits and the NHS activity. Without sending appropriate signals about the likely price evolution (ie. materially faster than inflation), deep renovation is less likely to take place in a large segment of households in the short-term.

2. Renovation costs and direct subsidies: For its 2011 report, GTR used data for the cost of executing a deep renovation²⁵ (to achieve an 80% energy reduction) from the technical work undertaken for a 2010 study published by WWF²⁶ subject to GTR's practitioner review and debate. As outlined at the start of this section, in 2012 GTR has newly developed its own cost calculations which are tailored to each hot-spot and built from the bottom-up considering only cost effective energy reduction measures in combination to attain as close to 80% overall energy

reduction as possible. The following table shows the results of this new approach²⁷ (compared with 2011 assumptions) and gives an approximate total cost (including margin and taxes) for the median deep renovation in each hot-spot together with the actual predicted heating and ACS-linked energy reductions which result. A combination of tax increases, 2012 prices and new rigour has tended to increase costs for multi-dwelling apartment blocks while marginally reducing them for single family dwellings in rural settings.

In order for the renovation sector to materially ramp-up in the short-term (ie. by 2014) a direct public subsidy of 25%²⁸ of the cost of deep renovation is required. Although this subsidy should reduce year

²⁵ Achieving an 80% reduction in heating costs.

²⁶ WWF (2012). *Retos y oportunidades de financiación para la rehabilitación energética de viviendas en España*, Sweatman, P. R. & Tragopoulos, G. Extraído de: awsassets.wwf.es/downloads/financiacion_rehab_edif.pdf

²⁷ These costs and reductions are the result from models based on theoretical yields. Although the assumptions of the GTR model are intentionally conservative, a rebound effect has not been considered -which, as indicated, it should be determined by actions on the use and management of the building-nor were considered proposed actions whose success may be hampered by particular situations.

²⁸ Interestingly, the German KfW program provides non-repayable grant for deep renovation of up to 20% or 15,000 Euros. Intelligent Energy Europe. (2012). Build Up: Refurbishment into a "KfW Efficiency House". Retrieved from: <http://www.buildup.eu/financing-schemes/24906>

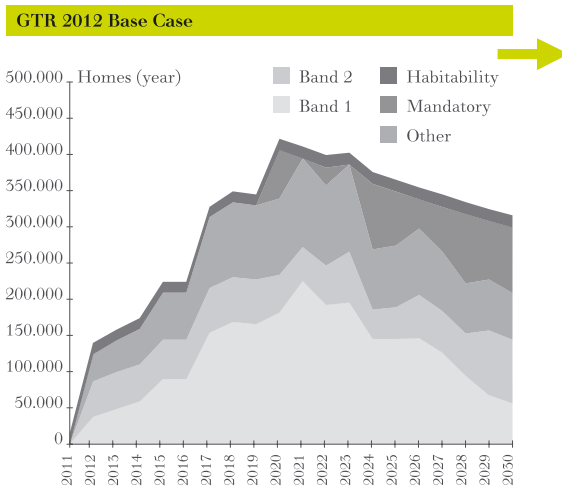
	GTR 2011		GTR 2012	
	Cost	Reduction	Cost	Reduction
Hotspot A	25,586 €	80.0%	24,696 €	82.0%
Hotspot B	12,510 €	80.0%	18,003 €	81.1%
Hotspot C	25,586 €	80.0%	26,230 €	79.6%
Hotspot D	12,510 €	80.0%	14,916 €	81.8%
Hotspot E	12,510 €	80.0%	14,916 €	81.8%
Hotspot F	12,510 €	80.0%	14,916 €	81.8%
Hotspot G	25,586 €	80.0%	25,275 €	78.3%
Hotspot H	17,985 €	80.0%	18,453 €	78.3%
Hotspot I	12,510 €	80.0%	14,524 €	75.6%
Hotspot J	12,510 €	80.0%	14,524 €	75.6%

after year as the sector drives economies of scale and the energy price goes up –GTR projects that it reaches zero within a decade- it is necessary initially for renovation to start-up especially in hotspots covering households in major cities or in shared apartment blocks.

It is worth noting here that GTR believes that a public up-front subsidy –along with other tax related assistance for renovation and support to reduce the interest rate on energy efficiency finance- will be recovered through increased government tax revenues, and reduced social security costs of unemployment, generated by the macroeconomic simulative effect of the NHS activity and new employment that it creates. Thus, GTR fully endorses an up-front subsidy package together with an ICO renovation credit-line program as a public investment to create economic activity, which will quickly allow the government to recover its fiscal investment²⁹.

GTR is also aware that there are many ways to for the administration to potentially provide a 25% subsidy or reduction in renovation costs (tax deductibility, grant & loan programme, differentiated IBI taxes

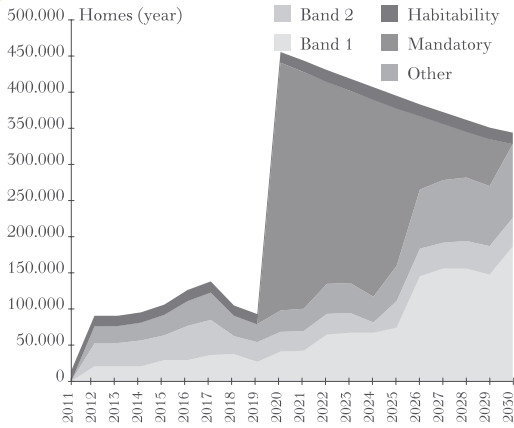
29 KfW. (2011). Impact on Public Budgets of KfW Promotional Programmes in the field of „Energy-Efficient Building and Rehabilitation“. Retrieved from: http://www.kfw.de/kfw/en/KfW_Group/Research/PDF-Files/STE_Research_Report.pdf



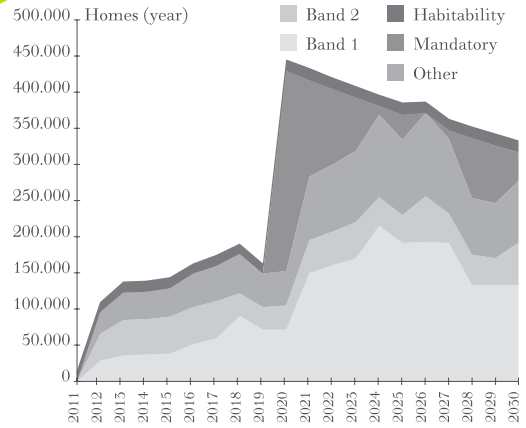
etc.) and recover its investment. The important thing is that there is this 25% cost reduction element available to stimulate the deep renovation market – delivering the bulk of the jobs and avoiding the lock-in of shallow measures. The following sensitivity analysis illustrates the impact of reducing -or removing- the 25% of up-front direct subsidy:

- a. **Sensitivity to the absence of up-front direct subsidy or an increase cost of 25%:** The impact of a 25% increase in the cost of deep renovation, or the removal of the base case 25% of up-front direct subsidies currently included in the GTR model, would be to delay for over a decade most of the renovation sector activity generated through energy efficiency in Spain. In this scenario the homes deeply renovated before 2026 are those that use oil or “expensive” electricity paying full tariff (and not the night-time rate) as illustrated in the charts on p. 47.
- b. **Sensitivity to a marginal Renovation Cost Increase of 10% / Up-front Subsidy Decrease to 15% (from 25%):** The impact of a 10% increase in renovation costs or the reduction of the up-front subsidy to 15% (from the 25% recommended in the base case), would delay the ramp up the critical gas heated component of the market by about 4 years from 2017 until 2021 leaving deep renovation activity just in “expensive fuels”. The superior shaded area prominent

GTR 2012 without Up-front Subsidies



GTR with -10% Up-front Subsidies vs. 2012



in 2020 in the above graphs related to a GTR modeled impact of a mandatory 3% policy target of non-rehabilitated homes per year after 2020 – while this has little impact on the results for the base case, and slightly more for the 15% subsidy case, in 2020 it is almost the prime motivator of the NHS in the case of zero subsidies as seen in the graphs on p. 48.

Conclusion on Costs and Subsidies: The competitive cost of deep renovation is one of the main drivers generating activity in NHS sector and GTR has identified a “cost gap” of around 25% between 2012 deep renovation prices in Spain and the net present value of energy savings (including a value for CO₂ savings). This gap needs to be filled or subsidized to boost the sector and stimulate levels of activity which will in turn deliver the meaningful new jobs and future cost reductions. Filling the 25% cost-gap can be achieved in various ways being implemented in other European countries, including any or a combination of:

- Direct subsidies;
- Income tax deductibility of the first Euro 10,000 of household investment in deep renovation;
- Property tax rates (IBI) that decrease with improved home energy performance;
- White certificate programs;
- Increased taxes on energy inefficiency.

As described previously, GTR is convinced that the direct or indirect public investment through the provision of a subsidy of 25% of the costs of the energy efficiency components of a deep renovation will be more than compensated by the extra net revenue (more taxes and less unemployment benefits) collected by the government through the creation of 130-170,000 jobs and the direct and indirect economic activity generated in the supply chains to the renovation sector and the taxes thereon etc., as demonstrated in Germany³⁰ and in the Czech Republic³¹.

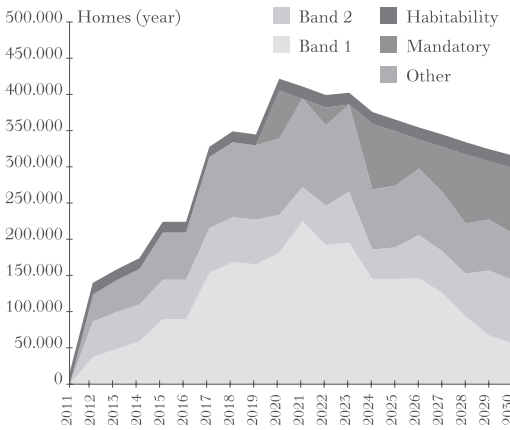
3. CO₂ prices: In its 2012 analysis, GTR used an updated forecast of future CO₂ prices of 17 € per tonne in 2020, 37 euros per tonne in 2050 and 50 € per tonne in 2050 to calculate the CO₂ value component of the economic returns of its 2012 Action Plan for Spain³². The GTR base case continues to assume that families and building owners undergoing a deep renovation of their property will receive a “Saved CO₂ value” equivalent

30 KfW. (2011). Impact on Public Budgets of KfW Promotional Programmes in the field of “Energy-Efficient Building and Rehabilitation“. Retrieved from: http://www.kfw.de/kfw/en/KfW_Group/Research/PDF-Files/STE_Research_Report.pdf

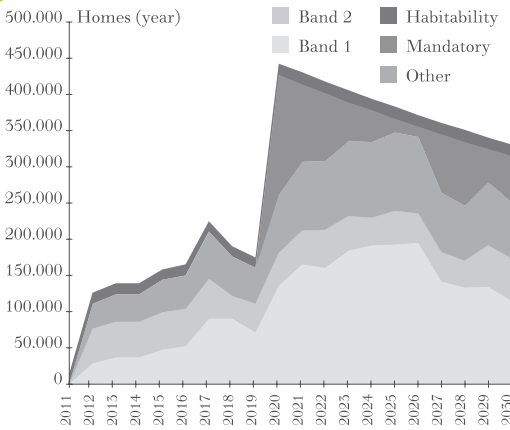
31 Zámečník, M. & Lhoták, T. (2012). Sance Pro Budovy: Should the government invest in energy efficiency of buildings? Macroeconomic impact assessment.

32 Forecast provided by the Spanish Climate Change Office.

GTR 2012 Base Case



GTR 2012 without "CO₂ Value"



to around 15% of its energy savings. In rough numbers this is equivalent to a CO₂ or “white certificate” value of between Euro 50 and 120 per home per year, with the range depending on the home’s size and pre-renovation energy intensity. As of 2012, European carbon prices are at historically low levels –between 6-8 euros per tonne- however, with the potential for European governments to delay supply and with the entry into Phase 3 of the EU ETS, GTR expects prices to rise as European countries become yet more rigorous and certificates become more scarce. Considering the European Energy Efficiency Directive³⁵, Spanish energy companies are obliged to help their customers become more efficient and reduce their net energy consumption by 1.5% per year from 2014-2020. An easy and transparent way to accomplish this would be through the introduction of a white certificates³⁴

system and GTR believes that white certificates can offer the “saved CO₂ value” to homeowners and help reduce the 25% cost gap between deep renovation costs and energy savings identified in this report. The following sensitivity analysis shows the impact on the sector of the changes in the CO₂ value to renovation perceived by the homeowner:

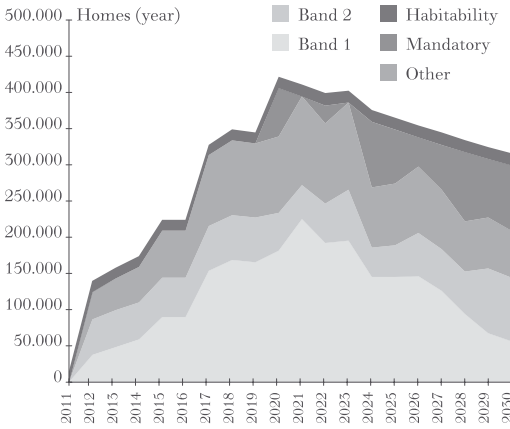
- a. **Sensitivity with no “CO₂ value”:** The impact of the elimination of any “CO₂ value” delays the boost of the sector by 3-5 years (2015-17 to after 2020) as shown in the charts above.

CO₂ Conclusions: While “CO₂ Value” by itself (or the CO₂ price for deep renovation) is not a very strong driving force of renovation alone (and clearly not as important as increasing energy price increases or closing the 25% cost-gap), it is still an important factor without which (or an economic equivalent such as a white certificate scheme) the jumpstart of energy renovation in Spain would be delayed by 3 to 5 years. With the base case “CO₂ Value” ascribed by the GTR to each home-owner being Euro 50-120 per annum (for 20 years) which has a present value (using GTR’s 5% discount rate) of Euro 600-1,500 – a range not inconsistent with the amounts being invested by UK energy companies per household in activities to comply with CERT or ECO regulatory requirements through retrofits.

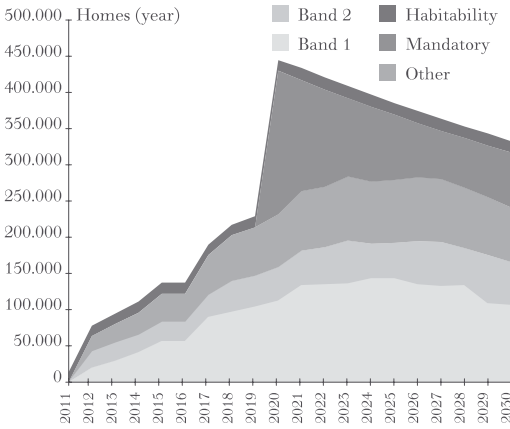
35 Energy Efficiency Directive approved on September 11, 2012 for implementation in the Member States before April 2013. European Parliament. (2012). September 11, 2012 European Parliament legislative resolution of the proposal for a Directive of the European Parliament and of the Council on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC. Retrieved from: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0306+0+DOC+XML+V0//ES>

34 Used in Italy, France and the United Kingdom among other countries.

GTR 2012 Base Case



GTR 2012 with Constrained Finance



4. Retrofit Finance Availability, Cost and Term:

GTR models retrofit finance in Spain using the German model where Germany's State bank KfW provides low cost, long-term (20 years) finance for home renovation with interest rates of 1% to 2.75%. In its 2011 work, GTR assumed that Spain's ICO could provide 20 year finance at a fixed rate of 5%³⁵ to fund the energy efficiency components of deep renovation for Spanish homes. Recently with the more severe impact on Spanish Government bond yields of rising spreads –and increase credit margins offered by private Spanish banks – this may require increased interest rate subsidies (the exact amounts change with Spanish borrowing costs) but GTR deems that this is a necessary pre-condition for the renovation sector to gain a footing and homeowners need a way to tap into long-term savings at a reasonable rate, isolated from such volatility.

There are three key parameters which define the finance available to the renovation sector:

- the availability of financing (the absolute amount deployed);
- its cost (interest rate), and
- its maturity (term)

35 Currently ICO has finance lines for rehabilitation at a rate of 8.5% for 20 years.

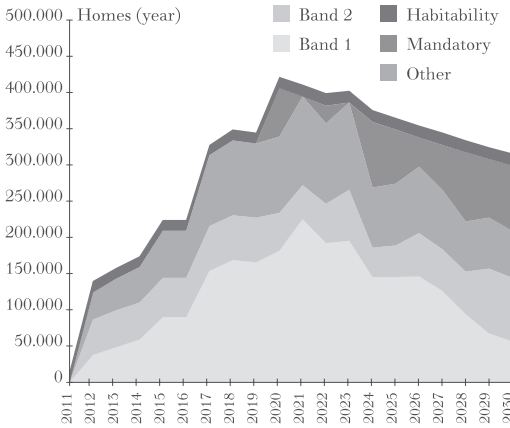
The following sensitivity analysis shows the potential impacts to the NHS in Spain with changes to the availability, cost and maturity of energy efficiency funding:

a. Sensitivity to Constrained Access to Finance:

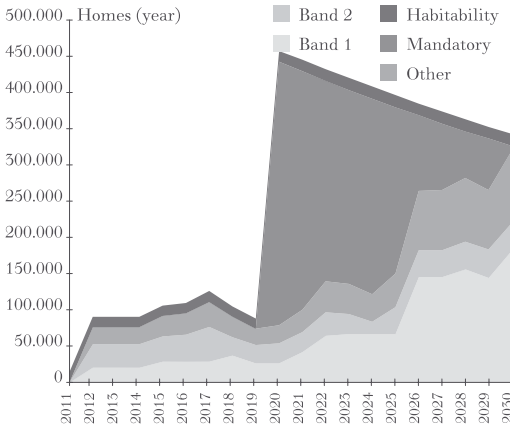
To model the impacts of constraining the amounts of financing available (without changing the finance's term or interest rate), GTR has run a scenario where we assume that ICO funds are approximately halved from the 2012 base case³⁶. In rough numbers, under this sensitivity, ICO provides only 2 billion euros a year instead of the 4 billion Euros required (on average per annum 2012-2020) to kick-start the sector initially in the base case. The effect of the imposition of this "availability constraint" is to roughly halve the gas-related steep ramp-up in the base case from 2014 to 2020 and spread it out after 2020. This is illustrated by the smoothed profile seen in the "Constrained Finance" sensitivity chart above (ignoring the mandatory component).

36 The GTR denotes that each active hotspot (ie. when energy returns and CO₂ savings justify investment in rehabilitation) takes twice as long to complete (ie. only half of households obtain funding in any year provided the conditioned mentioned above is met).

GTR 2012 Base Case



GTR 2012 with 8.5% Cost Finance



b. Sensitivity to Cost of Finance: GTR analysis suggests that each 1% increase in the cost of renovation finance has the potential to delay the sector’s ramp-up by up to 3 years. The above graphs illustrate the impact of raising the cost of renovation finance from 5% to 8.5% (the current 2012 ICO 20 year interest rate offered for renovation credit lines³⁷). Without taking into account the superior part of the graph –mandatory renovations- the “natural” component of the sector is delayed by over a decade only ramping-up after 2025.

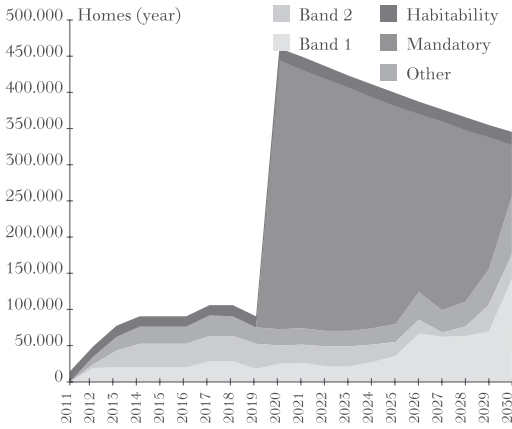
c. Sensitivity to Reduced Finance Term/ Maturity: GTR analysis suggests that each year shorter the term of finance available to energy efficiency renovations can delay the sector’s ramp-up by a year and a half. The graphs on p. 51 illustrate the impact of shortening the available finance from a base case of 20 years to 10 years. The shortening of the energy efficiency finance term almost has a worse impact than a doubling the interest rate. With only 10 year finance available, and outside of the mandatory renovations, the ramp-up of the sector is delayed by over a decade to pick-up as late as 2028-30.

d. Sensitivity to Increased Finance Term/ Maturity: GTR analysis suggests that the provision of 30-year debt at 5% could significantly boost the sector and reduce the size of the cost-gap and hence reduce the amounts of direct public financial support required to kick-start the NHS. The graphs on p. 51 show the effect that extending the maturity of the funding available from 20 to 30 years has on the model. The availability of 30 year 5% energy efficiency finance from ICO could cause the renovation sector to kick-start almost immediately and / or reduce the amount of public subsidy initially required.

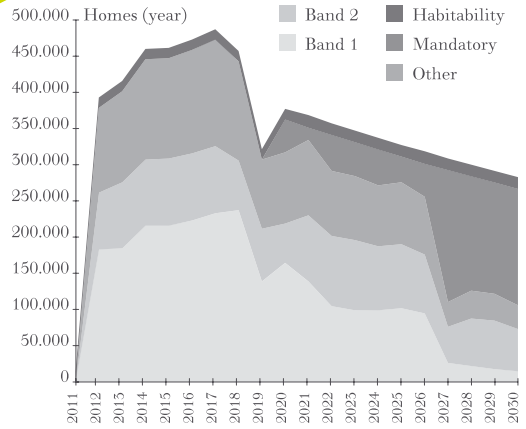
Finance Sensitivity Analysis Conclusions: The availability and appropriate term and cost of renovation finance are critical for the ramp-up and health of Spain’s renovation sector. While restriction of the availability of credit acts as an overall limiter of the sector’s activity, extending the time taken to execute each hotspot, changes to the cost and term of finance have more immediate and serious impacts. Undoubtedly, providing “standard” short-term (<10 years) financing to homeowners at 8.5% interest rates will not be sufficient to allow rational homeowners to carry out deep renovations. An ICO program designed and tailored specifically to promote deep renovation with characteristics to meet the needs of homeowners –that is, low cost and maturity of 20-30 years- falls more into line with the risk profile of the

37 ICO. (2012). Rehabilitación de Viviendas 2012. Retrieved from: http://www.ico.es/webcomercial/porta/destino/Sectores/colaboradoras/index.html?prod=/destino/Sectores/colaboradoras/producto_0039

GTR 2012 with 10 year Finance



GTR 2012 with 30 year Finance



asset (essentially: a low risk, long term house renovation loan).

Interestingly, the sensitivity analysis conducted using 30 year debt almost fills the 25% “cost gap” meaning that if ICO’s lines were available for up to 30 years at 5% cost then homeowners willing to take a 30 year view could commission deep renovations in the short term without the need for up-front subsidies, as long as there were white certificates –to deliver the CO₂ value- and the owners recognize that their energy reform has to be amortized over 30 years.

4.2.2 SENSITIVITY ANALYSIS CONCLUSIONS

Sensitivity analysis of GTR’s 2012 model clearly shows that the pace of development of the renovation sector in Spain is very sensitive to a series of external financial and market parameters. In essence, the analysis suggests that without certain pre-conditions, the renovation sector in Spain will be limited to fewer homes, with measures on the building’s envelope restricted to households using electric heating systems –without night tariff- and oil heating, and shallow renovations (such as the change of light bulbs and improved boilers – which is likely to deliver a lock-in against future deep renovations). Understandably, a sector with only a little and shallow activity will not have the positive impacts expected

by the NHS on employment, will not transform the construction sector and will not deliver the energy savings nor GHG reductions forecast in the GTR base case. Furthermore, this could harm the future growth of the NHS sector as the partial renovation of a few homes will worsen or at least delay the economic balance of a future renovation without driving deep renovations down the cost curve.

The GTR model requires the present value of energy savings and CO₂ Value (if available) to exceed the net refurbishment cost prior to the activation of each of GTR’s ten hot-spots containing 75% of over 16 million Spanish homes constructed before 2001. These economic conditions are met in a base case which assumes rising energy prices (a “high” case according to IDAE), CO₂ savings value for the owner (at least a white certificate programme) and an average of Euro 4 billion of ICO financing (2012-2020) at an reduced interest rate (5%) and a sufficiently long dated to collect all savings (20 years +) supported by a declining 25% up-front public subsidy potentially part provided as a tax relief or through a white certificate scheme.

The model’s sensitivity analysis overwhelming demonstrates that the economic optimal conditions for the renovation sector key to delivering national scale and for the decisions of each of the owners to be clear and easily made. The model also sheds light on the relative importance of each of the factors: a

future change in the price of gas from high-IDAE to an EU-Prometheus base does not delay the sector as much as not having access to 20 years finance, 8.5% rates or the lack of 25% up-front assistance. Moreover, the model can also show that a limitation on the amount of funding has considerably less impact than the financing terms and conditions themselves (5% for 20+ years) – fairly different from alternatives available today. Finally, the model also shows the sensitivity of the sector to relatively small changes in the optimal economic conditions which can have a surprisingly significant impact on the timing of the ramp-up of the sector.

Finally, importantly and in order to accelerate the renovation industry nationwide over the next 2-3 years, the Spanish government will have to resolve an initial “cost gap” of 25-35% (depending on the existence of a white certificate program to provide value to GHG reductions). However, GTR remains optimistic that the key conditions for a massive and national scale renovation sector can exist in Spain, even in the teeth of a financial crisis. This optimism is based on the macroeconomic case for subsidies and support as the extra revenue obtained from increased taxes and reduced unemployment payments delivered by an active refurbishment sector (not to mention overall positive sentiment through the creation of 130-170,000 new jobs) which will more than compensate for the up-front subsidies required as forecasted by GTR. The committed engagement of the Spanish energy companies (following transposition of the EU Energy Efficiency Directive) and the increased allocation and engagement to energy efficiency from European institutions through the provision of funds and support will also enable the development of a timely and optimal renovation sector in Spain in the context of the next EU Multi-annual Financial Framework (2014-2020).

4.3 DETERMINATION OF GREENHOUSE GAS GHG REDUCTION TARGETS FOR THE DOMESTIC SECTOR

In the context of the European burden sharing framework, Spain has a target to reduce its national GHG emissions to not more than 15% above the 1990 reference year during the first compliance period of the Kyoto protocol 2008-2012. Since the launch of the Kyoto Protocol in February 2005, Spain has developed its National Allocation Plan (“NAP”) for GHG allowances serving as the key national policy instrument which defines its emissions reduction objectives -in accordance with European Directive 2003/87/EC and its subsequent recasts- and establishes the distribution of the European Allowance Units for carbon emissions to the different sectors of the economy.

The national allocation plan established limitations on productive sectors and companies expressly covered by the EU Directive -commonly referred to as the “regulated sector”- for whom the economic case to reduce emissions through changes to production, fuel use, efficiency and the import of CDM credits was clear. However, the aggregate emissions from companies regulated by the European Directive only accounted for some 45% of the national emissions attributable in Spain at that time. The real challenge still facing Spain is to meet its commitment, within the European context of the Kyoto Protocol, to make emissions reductions in the “diffuse sectors” – those from firms and activities not regulated by EU ETS and representing around 55% of national emissions. The “diffuse sectors” include: SMEs and companies with lower concentration emissions, transportation, agriculture, waste management, domestic appliances and residential construction and services.

The European allowance mechanism fosters economic efficiency in the regulated industries driving companies to reduce their emissions intensity per product unit value. However, in the “diffuse sectors”, companies are more fragmented and the costs of measurement, containment and mitigation strategies are more significant as a proportion of total

business flow; efforts are more spread-out and a different and more complex policy matrix is required.

In Spain, the choice was made to reduce emissions in the diffuse sector through major strategic policies, which support biofuels, energy and fuel savings and efficiency, with defined targets and approaches to attain them. Given Spain's national target covers the whole economy, a reduction of GHG emissions in the diffuse sector reduces the need and cost of the reduction in the regulated sector or the cost of the Government buying additional allowances from abroad.

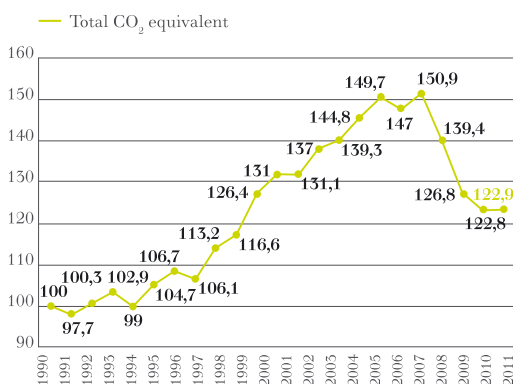
The Spanish Energy Saving and Efficiency Strategy "E4" enacted in 2003 outlined the objectives and basic guidelines for the building sector to reduce energy demand, considering both the intervention in the existing buildings and new construction. Key mechanisms for renovation of existing buildings supported by E4 were the improvement of the efficiency of heating and lighting systems and it also contemplated the need for a new Technical Buildings Code (which eventually was enacted in the form of the CTE 2006 –in line with the EPBD 2002 for new build). Similarly, the E4 strategy, and its successive versions, considered improving the efficiency of the equipment and appliances being installed and used in both the residential and tertiary sectors.

The policies defined by the NAP, and its subsequent redrafts, were supplemented by the Spanish Strategy for Climate Change and Clean Energy of 2007, which responded to the rising levels of national emissions and to the new European Energy and Climate Change targets defined for the 2020 horizon and beyond. The resulting evolution of GHG emissions in Spain, expressed in percentage of the reference year 1990, are shown in the graph- and it is clear that the continuous rise in emissions was not stabilized until 2005 and since 2007 emissions have begun to decrease significantly.

The reduction of GHG emissions in Spain results from a combination of factors including the improvements in efficiency in industry and the greater share of renewable energy in the electricity mix of Spain – however the major factor seems to be the result of the lower industrial activity resulting from the 2008 financial crisis. Notwithstanding this inadvertent intervention, whose impact has been to reduce the absolute levels of emissions to within reach of Spain's targets, investment in energy efficiency remains a necessary and low cost measure to reduce emissions further across all sectors (especially in buildings) and improve the competitiveness of Spanish industry and resource efficiency.

One of the key areas where emissions reductions come at a low or negative cost is the residential sector. The construction boom which occurred during the last decade and ended in 2009 not only increased Spain's building stock but and it also triggered lots of extra emissions within the supply chain of the construction companies (manufacturing, materials etc) and resulted in an increase in the average energy consumption of the residential and tertiary buildings sectors. Spain's buildings' energy intensity, measured as the use of electricity per square meter, has increased continuously by a total of 151% between 1990 and 2005, 131% if we consider the residential sector alone³⁸. The total GHG emissions associated with energy use in the construction sector -including both the emissions from buildings use and those generated by the electrical energy used in their con-

Evolution of CO₂ emissions



Source: Ministerio de Agricultura, Alimentación y Medio Ambiente (2011). *Avance de la estimación de emisiones GEI 2011*.

38 Cuchi, 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)

struction- increased by 200% between those years, while the surface area of the existing housing park increased at the slightly lower rate of 150%³⁹.

Therefore in 2005, about 20% of Spain's national GHG emissions were attributable to energy use in buildings. The construction sector at that time was undergoing explosive growth and if we sum the emissions generated by the production of materials it needed from its supply chains, one third of the total national emissions were generated by the building sector⁴⁰ – in use plus in construction.

With the onset of the financial crisis activity in the construction materials sector has collapsed, even so there has also been a reduction of emissions from energy use in buildings – but this relates more to the increasing share of renewables in the energy mix than to demand reduction policies and/ or measures beyond the very shallow efficiency improvements of appliances and lightning. An overall reduction in energy consumption in buildings, if not produced through efficiency increases, can only be the result of worsening local housing comfort conditions and energy poverty -which already affects around 10% of Spanish households⁴¹- and this is not an acceptable situation.

In order to achieve Europe's Strategy 20/20/20 three goals of energy efficiency, emissions reduction and renewable energy production by 2020, and to establish the foundations for a competitive low carbon economy after the current crisis, Spain needs to assess and re-prioritise its investment in the diffuse sectors and increase its effectiveness.

Having a detailed understanding of the cost of emissions reductions for each sector is critical to devise the appropriate policy response to realize pledged objectives in the most economically efficient manner and to deliver an economic framework which is productive, competitive and creates jobs.

European directives mandate that the energy consumption of new buildings will be close to or nearly

zero emissions by 2020. Therefore the only material manner to intervene to reduce emissions and energy use in buildings is through the renovation of the existing building stock. The three ways to improve the efficiency of the existing building stock and reduce its GHG emissions are: increased renewable production (electrical, heat and ACS), improving the efficiency of appliances and lighting and through demand reduction via insulation and improved heating and air-conditioning systems and controls.

Against this backdrop, GTR began to work in a project financed and promoted by Spain's Biodiversity Foundation with the assistance and guidance of the Spanish Climate Change Office (*Oficina Española de Cambio Climático* - OECC). In this context, GTR has developed a project, entitled "Stages of reducing greenhouse gas emissions for the residential sector in Spain", which is intended as a base resource to help define CO₂ emissions reduction actions for the residential sector and, more generally, to assist in the definition of the Spanish strategy to reduce emissions from the "diffuse sectors" to meet 2020 targets.

The project uses the GTR model to analyze the capacity and feasibility for residential emissions reduction over the horizon period and provides policy priorities for intervention in the residential park, following the GTR methodology. The resulting roadmap is adjusted depending on the scenarios that are considered most relevant to the project participants, who have repeatedly refined the input variables to determine the implementation and evolution of the New Housing Sector funded mainly through the returns provided by energy and emissions savings.

The GTR model determines the present value of the energy and emissions savings discounted at the cost of available finance amortized over its life and compare this with the investment needed to conduct deep renovation (c. 80% GHG reduction) in a home through the successive implementation of components from the intervention menus (detailed in section 4.1 of this report). The model is able therefore to provide a roadmap of the aggregate amount of investment needed, the number of homes intervened in each year and the aggregate energy and emissions savings resulting and turn these outputs into new jobs created and economic stimulus.

39 Ibid.

40 Ibid.

41 Asociación de Ciencias Ambientales. (2012). Estudio de Pobreza Energética: Potencial de generación de empleo derivado de la rehabilitación energética de viviendas.

The key variables considered in the context of this emissions reduction sub-project are:

- The evolution of future retail energy costs. Increasing energy costs is a key factor that activates energy renovation as it adds greater economic viability and faster recovery of the up-front investment needed to fund renovation through energy savings. In the context of the OECC project GTR considered three scenarios: the BCG/ IDAE high scenario, the same study's base scenario and an EU base case (provided by the EU Prometheus/ PRIMES model).
- Cost of finance. The second factor that determines the evolution of home renovation in Spain is the cost of finance for households. The GTR-OECC study considers four different costs of 20 year retail finance of 4%, 5%, 6% and 8%.
- Investment return period. While GTR's model contemplates investments with a 30 year life as well as those with a 20 year life; the 20 year maturity was selected for this project as this matches more closely some existing finance facilities presently being offered by ICO for the purpose of renovation. GTR notes that the actual life of a deep renovation is likely over 40 years.
- A Spanish inflation rate of 2% over the long-term together with an average annual reduction of 3% for deep renovation costs with efficiencies and economies of scale generated by the strong increase in market activity and scale which would result from the actions envisaged in the plan, and which multiplies the current market for renovation and thereby catalyze significant improvements in process and the overall productivity of the sector.
- Public investments. The GTR model allows project participants to see how the amount and type of government subsidies for buildings renovations impact the achievement of national objectives. The up-front subsidies available when there is a cost-gap between the present value of energy and CO₂ emissions savings or equivalent tax breaks or investment allowances are pre-conditions for the quick start for residential renovation activity. GTR believes that this public co-investment will be recovered with good returns in the very short term through the increase in VAT, of direct employment taxes and direct taxes on the increased industrial activity

and savings in the social cost of maintaining less unemployed resulting from NHS activity. The study considers four up-front subsidy levels 0%, 10%, 25% and 35%.

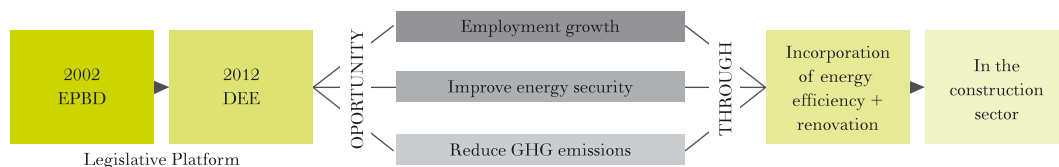
GTR's results show a number of scenarios which can achieve reductions of between 5% and 20% in the energy used in 2020 for heating, air conditioning and hot water; and of between 10 and 30% for a 2050 horizon all provided with cost effective long-term investments according to the GTR methodology (with the result range being the impact of the external parameters observed or provided as input). Clearly, GTR's model could support a reduction of GHGs in the residential buildings sector of around 10% by 2020 - that recently cited by Spain's secretary of state for environment and climate change - as long as the pre-conditions to spur the NHS are in place as described in section 7 of this report.

Similarly, additional results of the study show that the potential for the creation of employment in the sector for the period 2013-2020 and in the next 2020-2050 is substantial as well as the induced demand for building materials to the industry which will produce the elements and precise systems for renovation. These estimates also allow for the calculation of the returns on public investment resulting from the increased economic activity, mainly resulting from reduced outflows to unemployment, and increased in-flows from direct (VAT) and indirect taxes, income tax, etc. not to mention the benefit to Spain of greater energy independence.

The GTR model will allow for the tracking and monitoring of policies developed in this framework as well as the ability to evaluate and choose the best options to correct the paths that are impacted by changes in the external variables which impact the sector and are contemplated in the model.

4.4 EU COMPLIANCE CASE

The Spanish Rehabilitation Working Group (GTR) believes that the platform of European legislation which has been created since the EPBD was adopted in 2002 and including this year's Energy Efficiency Directive provides Spain with a clear and positive pathway towards greater sustainability and resource efficiency.



In its 2011 report “25 Energy Efficiency Policy Recommendations – 2011 Update”⁴², the IEA recommends a “package of policies” to generate the right legislative platform for growth in energy efficiency in Buildings. The report affirms that energy efficiency in buildings will provide 25% of all energy efficiency improvements in member countries. The complimentary components of this policy package are:

1. Require all new buildings, as well as buildings undergoing renovation, to meet energy codes and minimum energy performance standards (MEPS).
2. Support and encourage the construction of buildings with net-zero energy consumption.
3. Implement policies to improve the energy efficiency of existing buildings with emphasis on significant improvements to building envelopes and systems during those renovations.
4. Require building energy performance labels or certificates that provide information to owners, buyers and renters.
5. Establish policies to improve the energy efficiency performance of critical building components in order to improve the overall energy performance of new and existing buildings.

This five component policy package is well reflected in European legislation and has begun to be implemented in Spain as follows:

1. The Technical Buildings Code (“CTE” - *Código Técnico de la Edificación*) was implemented for new buildings in April 2009 - just as Spain’s new-building boom ended. In Section DB HE1, the CTE provides a series of guidelines to limit

energy use to a rational level depending upon geographical area and it requires the use of solar energy, among other things, for Spain’s new buildings and those under-going substantial renovations (>25% of the floor area).

2. Spain has begun to build near-Zero Energy Buildings. IDAE, together with the more active Regional Governments, and Ciemat are promoting the concept and there are a few pilots projects completed, or underway, such as Ciemat’s own Project ARFRISOL, the new CIRCE offices in Zaragoza and residential prototypes in LIMA Cataluña.
3. GTR believes that a plan to improve the energy efficiency of existing buildings is the policy area which is weakest in Spain and concludes this report with its own recommendations on how Spain can address this. Presently, there are few existing policies working to create an active renovation market.
4. The issue of Energy Performance Certificates in Spain is partially implemented in line with the first version of the EPBD passed in 2002. However, On 9th February 2012 the European Commission brought Case C-67/12 against Spain for failing to adopt all the laws, regulations and administrative provisions necessary to comply with Articles 3, 7 and 8 of the EPBD Directive 2002/91/EC on the energy performance of buildings (or in any event, by failing to communicate them to the Commission). While the outcome of this case is unknown as this report goes to press, GTR members believe that a renewed push to certify existing buildings in Spain will certainly improve awareness and is part of the necessary conditions for a strong and vibrant renovation sector. GTR understands that the Ministry of Industry and Energy and Tourism is working on a Royal Decree to implement mandatory energy certification using the common methodology of Direc-

42 IEA. (2011). 25 Energy Efficiency Policy Recommendations: 2011 Update. Retrieved from: www.iea.org/publications/freepublications/publication/25recom_2011.pdf

tive 2010/31/EU for property rentals and sales from January 1st 2013⁴⁵.

5. The issue of Minimum Energy Performance of critical components for buildings, such as windows or HVAC systems, is covered at a pan-European level through the Ecodesign Directive (2005/32/EC and recast 2009/125/EC) on Energy Related Products which aims to set minimum energy efficiency requirements for products sold in the European market and the Energy Labeling Directive (92/75/EEC and recast 2010/30/EU) which aims to set uniform labels for products of the same type. Many manufacturers of buildings components are pan-European in nature and are therefore impacted by the overall speed at which these Directives are implemented and transposed. At present this area is moving forwards across various product areas in Europe step-by-step and inevitably this affects Spain at the same rate as other countries.

In addition to the above, Spain, and other member states, will have a year and a half (until May/June 2014) to transpose the Energy Efficiency Directive's provisions into national law and start the really important phase of its implementation. Under the new Directive, Member States have to report their national indicative energy efficiency targets by 30th April 2013 and must report on the implementation of energy efficiency obligation schemes or alternative policy measures in just one year's time (November 2013 - a year after the entry into force of the Directive).

GTR sees the Energy Efficiency Directive together with the potential for the introduction of a white certificate programme as an ideal way to provide a structured and measurable set of incentives to ensure national compliance with the anticipated 1.5% reduction of net customer demand anticipated by the Directive for the period 2014-2020. In rough numbers, this might be seen as approximately a 10% reduction in net energy demand from buildings which also fall closely into line with recent

comments made by Spain's secretary of state for Environment⁴⁴ indicating that Spain will publish a new road-map for emissions reduction of 10% in the diffuse sector (including buildings) by 2020.

The GTR believes there are three areas which Spain can work on to help deliver against European objectives for energy efficiency:

1. Provide a technical regulatory framework which allows, facilitates and supports the renovation of existing buildings. This requires adaptation of a network of laws originally conceived for the promotion and occupation of newly constructed buildings together with a development path for the current CTE, to be adapted and implemented in a practical way for the renovation of existing buildings (today's CTE is inflexible and unsuitable for application in retrofits). Finally, this should be backed-up and supported by a comprehensive, ambitious and immediate transposition of EPBD 2010/31/EU;
2. Provide for an appropriate financial framework that defines the areas of value creation (energy, improvements and emissions reductions), their beneficiaries and ensures an offer of long-term, low cost finance and mechanisms which ensure that returns flow unimpeded to those investing capital. Initially fiscal or direct subsidy support is required for some areas, homes and segments of society and will boost uptake in the sector. In addition, clarity and guidelines for ESCO finance and support for standard procedures of verification and contracts.
3. Execute an action plan to mobilize resources and to jumpstart the renovation sector which will progressively build to scale and support the development of an organizational framework defining its own intervention strategies, goals, benefits, etc. The action plan should espouse a viable business model with well-defined responsibilities and tasks for each stakeholder and actor.

45 ABC. (2012). Medio Ambiente busca reducir un 10% las emisiones de sectores difusos para 2020. Retrieved from: <http://www.abc.es/20121025/natural-cambioclimatico/abci-emisiones-sectores-kioto-201210251347.html>

44 "The Ministry of Environment is working on developing a roadmap to reduce pollutant emissions by 10% by 2020 from diffuse sources, pollution sources such as transport, waste or households, as agreed with the European Union." Hearing before the Congress Committee of Climate Change. Europa Press. (2012).

GTR believes that Spain is capable of creating a strong and productive renovation sector that will allow the country not only to meet its European commitments on energy efficiency, but to add value to Spanish buildings and the firms active in the sector while also improving comfort conditions in buildings and creating healthy and more productive environments. As shown in this report, GTR's economic models suggests that for Spain to deliver against an action plan reducing by 10% the net energy demand from the housing sector by 2020 it will be necessary to identify approximately Euro 4 billion annual financing at 5% (or less) interest rates with a maturity of 20+ years.

5. NON-RESIDENTIAL BUILDINGS

In 2011, GTR devoted its focus and resources into the development of a “Roadmap for a New Housing Sector” in Spain. The residential sector is the largest consumer of energy and had previously received much less attention than the non-residential or commercial buildings in the tertiary sector (services, commercial and public). At a national level, 65% of Spanish non-industrial energy supplied to buildings goes to the residential sector and 35% to the non-residential or tertiary sector. Following the launch of the 2011 study, and during the development of the new 2012 Action Plan, GTR decided to maintain the majority of its focus on the important opportunity posed by the renovation of the residential sector in Spain. However, an analysis of buildings in Spain, within the European context and from an energy perspective, GTR felt that its 2012 report would not be complete without assessing the tertiary sector in Spain and its important role in the context of a national plan for the building sector.

For its 2012 report, GTR decided to carry out a review of reports, data and activity in the tertiary sector in Spain to provide a complete picture of the Spanish buildings sector and as a compliment to its deeper work on the residential sector. In this section, GTR offers an overview of and introduction to the tertiary buildings sector in Spain, and provides a first level of segmentation to establish a methodology to evaluate the potential of each segment and draw some initial policy conclusions to complement its national Renovation

Roadmap for buildings. It is worth noting that as of 2012, GTR has not developed detailed models of the non-residential sector segments – as it has for the residential sector. Nevertheless, the GTR hopes to expand its reach and resources to make progress in this area in 2015.

5.1 INTRODUCTION AND SCOPE

In Europe buildings use about 40% of final energy consumption, which is divided between households (64%) and commercial or tertiary buildings (36%). While the proportion of total energy use in commercial buildings is lower than in residential buildings, the number of buildings is also much smaller and the energy intensity in many of its buildings is much higher. 2020 Studies from the European Commission suggest that the energy saving potential in Europe in the short term from commercial buildings is slightly higher than in the residential sector:

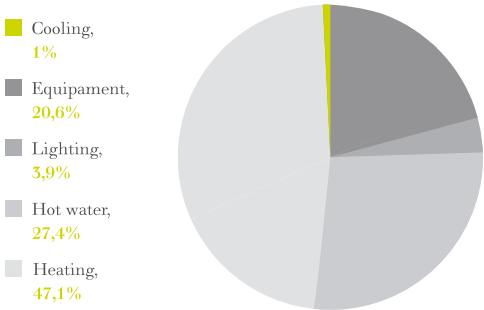
Energy consumption in Spain is split between residential and tertiary buildings in very similar proportions as in the rest of Europe, and GTR sees a significant potential for energy savings in Spanish tertiary buildings for three reasons:

1. Tertiary buildings have a relatively higher demand for lighting (22% vs 4%), and traditionally the energy savings obtained from a shift to more efficient lighting is very cost effective and can be repaid within a relatively short period of time;

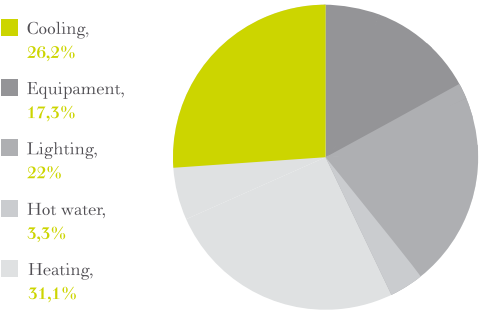
Estimates of potential energy savings in end-use sectors in Europe.	Energy Consumption (Mtoe) 2005 (EE Scenario)	Energy Consumption (Mtoe) 2005 (Business as usual)	Potential 2020 Energy Savings (%)
Homes (Residential)	280	338	27%
Commercial Buildings (Tertiary)	157	211	30%
Transport	332	405	26%
Manufacturing Industry	297	382	25%

Source: European Commission EU-25 baseline Scenario and Wuppertal Institute 2005.

**Distribution of final energy consumption
Domestic buildings sector (2010)**



**Distribution of final energy consumption
Tertiary buildings sector (2010)**



Graphs by the GTR. Source: IDAE (2010). Plan de acción de ahorro y eficiencia energética.

Percentage of power devoted to lighting applications

Use	% Power dedicated to lighting
Offices	50%
Hospitals	20-30%
Schools	10-15%
Shops	15-70%
Hotels	25-50%

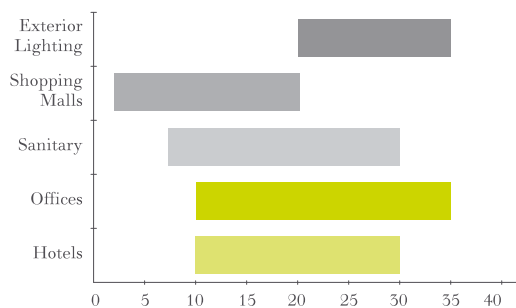
Source: Fenercom. (2012). Guía Técnica de Iluminación Eficiente: Sector Residencial y Terciario. Retrieved from: <http://www.fenercom.com/pdf/publicaciones/guia-tecnica-de-iluminacion-eficiente-sector-residencial-y-terciario-fenercom.pdf>

2. Tertiary buildings are larger users of energy with greater intensity and often have large climate control systems (HVAC etc) that produce heating and cooling (31% and 26% of total energy consumption in commercial buildings respectively) where there have been significant technology improvements in efficiency and in their smart operation (new smart control systems, etc). In recent years, with the increase in the cost of electricity, further possibilities have emerged such as the implementation of cogeneration/tri-generation strategies, especially for large buildings or complexes (eg. Shopping malls) positioned next to industrial heat sources or areas with plentiful supply of biomass;
3. Projects to rehabilitate commercial buildings are larger and can be more easily replicated within a sector (eg. hotel chains, retirement residences with same owner) becoming more appealing to aggregators and thus more easily attracting external funding and Energy Service Companies (ESCOs).

Several studies⁴⁵ have shown that Spain can achieve energy efficiency of at least 20% in the tertiary sector in the short term even with relatively low ambition. The graph on p. 61 shows the potential energy

45 A3e. (2011). Estudio sobre el Mercado de la Eficiencia Energética en España.

Potential Energy Savings in % in each area of energy use in the tertiary sector



Source: Gas Natural Fenosa (2011)

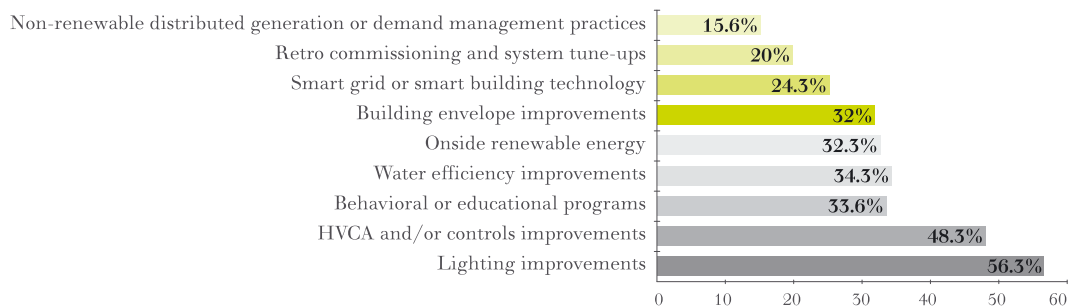
savings in several service sectors with data from audits provided by Gas Natural Fenosa in 2010:

In general, owners and managers of tertiary buildings are more sensitive to the maintenance and operational costs of their buildings as energy bills represent a higher proportion of their budgets (30% of the annual budget⁴⁶ in tertiary buildings) than for a typical Spanish family (5-8% of the household budget⁴⁷).

A 2012 Johnson Controls survey⁴⁸ of 944 managers and people in charge of commercial buildings, indicated that over 80% said that energy management was important to them and 50% said they had invested in energy efficiency in the last year. Lighting and HVAC systems were the main focus of the energy efficiency investment found in the JCI Institute on Buildings Efficiency Survey and the improvements in the building envelope occurred in only 30% of cases, just above smart/ intelligent technologies for energy supply management:

Nonetheless, the study notes that there are three main obstacles that prevent a greater investment in energy efficiency, and they are all of a financial character (insufficient funds, insufficient and/or uncertain returns). Those responsible for European buildings had a repayment period target for its energy efficiency measures of 3-4 years; this explains why most of the renovation works are directed at lighting and air conditioning, and not in the building's envelope or a deep retrofit.

Interestingly, however, the reasons preventing further, and deeper, renovation of tertiary buildings are very similar to those explaining the lack of ac-



Graph data Source: Johnson Controls. (2012). *Energy Efficiency Indicator Survey: European Results*.

46 Energy Star. (2012). Commercial Real Estate. Retrieved from: http://www.energystar.gov/index.cfm?c=comm_real_estate.bus_comm_realestate

47 Asociación de Ciencias Ambientales. (2012). Estudio de Pobreza Energética. Potencial de generación de empleo derivado de la rehabilitación energética de viviendas.

48 Johnson Controls. (2012). Energy Efficiency Indicator Survey: European Results. Retrieved from: <http://www.institutebe.com/Energy-Efficiency-Indicator/2012-EEI-European-Results.aspx?lang=en-US>

tivity in the residential sector. These are described in several comprehensive reports and are well summarized in the following table arranged in five main categories.

While GTR believes that in Spain many of the barriers that prevent the renovation of tertiary buildings are also similar to those that prevent renovation in the residential sector, there are specific barriers - such as how annual investments in public schools

and hospitals are decided and accounted for - that need to be addressed in different ways in each of the segments of the tertiary market. Given the higher energy intensity of commercial buildings and the increasing awareness of energy efficiency as a way to reduce operating costs, GTR believes that there are reasons to develop an effective market segmentation in the tertiary sector in Spain and thus determine whether there are opportunities and economies of scale in some of these segments.

Market	<ul style="list-style-type: none"> • Price distortions prevent consumers and investors from valuing energy efficiency. • Split incentives – transactions where economic benefits of energy savings do not accrue to those who invest in energy efficiency, as when building owners pay for investments in energy efficiency, but occupants pay the energy bills. • High transaction costs. • Externalities associated with fossil fuel consumption are not priced; imperfect competition. • Dispersed and diffuse market structure with multiple locations and small end users. Multiple industries – construction, efficiency, energy industries – are involved in building efficiency, posing a multi-sectoral challenge. • Energy tariffs discourage energy-efficient investments.
Financial	<ul style="list-style-type: none"> • Organizations rely on constrained internal capital and operational budgets. • High up-front costs and dispersed operational benefits discourage investors. • Perception that energy efficiency investments are complicated and risky. • Financial institutions lack awareness of financial benefits. Perception remains that financial benefits from energy efficiency are non-existent or exaggerated. • For building owners, a lack of external finance. • For financial institutions, small transaction sizes may require bundling of buildings or improvement measures to make them suitable for financing.
Technical	<ul style="list-style-type: none"> • Lack of affordable energy efficiency technologies (or know-how) suitable to local condition. • Insufficient capacity to identify, develop, implement, and maintain energy efficiency investments. • Lack of firms that can aggregate multiple projects; lack of implementation firms that can deliver cost-optimal energy efficiency project.
Awareness	<ul style="list-style-type: none"> • Lack of sufficient information and understanding on the part of consumers/tenants/building owners to make rational consumption and investment decisions. • Lack of information about the performance of buildings. • Energy information may not be provided or analyzed by end users, energy providers, or other implementing agencies. • Benchmarks for performance may not exist. • Perception that energy efficiency measures make buildings more expensive.
Institution	<ul style="list-style-type: none"> • Governments, especially in developing countries, have limited technical capacity to design and implement energy efficiency policies, programs, building codes and standards. • Inter-agency coordination to ensure policy coherence (at different levels of government, between various energy policy goals, or across scattered energy efficiency initiatives) is limited. • Regulators pay limited attention to demand-side measures. Traditionally, policy packages rely on supply-side interventions. • Energy providers are compensated by selling energy, instead of by delivering energy efficiency. • Government and the private sector rarely work through partnerships that tackle energy efficiency in a collaborative manner.

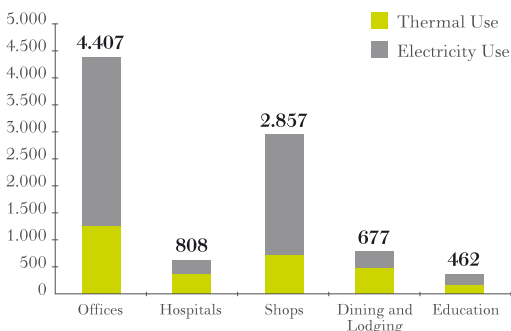
Sources: Elaborated by the Institute for Building Efficiency. (2011), based on: IEA Energy Efficiency Governance (2010) EEI Survey, Institute for Building Efficiency (2011) Christiana Figueres, Executive Secretary, United Nations Framework Convention on Climate Change (2011)

5.2 SEGMENTATION AND “SECTOR STRATEGIES”

Unlike residential buildings, the physical characteristics of a commercial building are just a guide to determining its energy requirements, as they are largely determined by the use for which the building is intended. To better define energy saving and renovation strategies for tertiary buildings in Spain, GTR believes that a sub-segmentation of buildings by their use and ownership makes sense. For example school buildings not only share similar physical characteristics among them, they also share energy use patterns, legal framework and decision-making processes that are also quite different with respect to other buildings (eg. private hotels or government offices).

The total energy demand for Spanish tertiary buildings has remained relatively constant since 2004, while its energy intensity has improved gradually since its historical peak in 2005. Trends in total energy use (electricity and heat) do not tell the full story because electricity use has grown substantially, as well as the electric intensity of tertiary buildings which grew steadily for two decades before its peak in 2008.

The distribution between the thermal and electrical requirements for sub-sectors of tertiary buildings in Spain is very different in the different segments:



Source: IDAE (2010).

GTR believes that to promote buildings renovation and energy efficiency activity in the tertiary sector in Spain a national plan requires specific “sector strategies” which lever the similar characteristics among buildings in each sub-sector (or segment) and develop practical and workable frameworks to promote resource efficiency at scale in each sector. To a certain degree this approach had been initiated in the Plan2000ESE launched by the Ministry of Industry (“MyTIC”) in July 2010:

The 2000 ESE Plan was launched to support the Spanish ESCO market, to create jobs and to introduce a culture of energy efficiency in state buildings. 2,000 public buildings were to be identified at first, which were then to be converted into energy efficiency projects; 1,000 belonging to the Autonomous and Local Administration and another 1,000 to the Central Government. Each autonomous regional authority would establish a line of support/subsidy for a maximum of 20% of the required investment, which would be covered with a 15% charge against the unused budget of the National Savings and Energy Efficiency Plan, and supplemented by an additional 5% with resources from the autonomous community. Unfortunately, the complexity of the tender process and contracts, the financial crisis and the general loss of momentum and the reduced priority of this project resulted in only a handful of the 2,000 buildings undergoing renovation works. Most of the activity in these renovated buildings was implemented through active measures (lighting, HVAC and controls) and not passive measures (building envelope).

Some of the barriers to greater refurbishment activity in the tertiary sector can be addressed in a similar fashion to the residential sector and across all sub-segments, such as raising awareness, mandatory building energy certification, white certificate schemes, availability of low-cost and long-term energy efficiency finance, the inclusion of energy efficiency repayments within energy bills and the provision of fiscal benefits for energy efficiency. However, there are issues which cut across all of the tertiary sector such as the impact of commercial activity on building use/occupancy (ie. offices are less occupied when economic growth slows, banks close branches, vacant periods increase etc.) or the availability of investment budgets in the public administration and private tenants during a crisis.

GTR believes that one way to simplify and confront the energy challenge in the tertiary sector is through “sector strategies” designed and tailored specifically to treat certain segments facing similar challenges. “Sector strategies” can be considered the tertiary sector equivalent of the “hot spots” in the GTR methodology for its Roadmap for a New Housing Sector in Spain. The idea is that while all schools are different, there will be a distribution of energy intensity among schools across the country as defined by their location, age of structure, design, occupation and so on. Some of the criteria for the definition of a sector strategy will necessarily change between sub-sector (schools may have energy intensity by pupil as a guide and hospitals may measure by patient and hotels by guest or bed as well as per m² etc.) and some will be similar such as geographical location and building orientation. GTR’s “sector strategy” approach promotes a sub-sectoral methodology of overlaying a template or menu of potential buildings refurbishments tailored specifically for the sector onto a distribution of its actual buildings ordered by energy intensity (against a selected sub-sector intensity measure –m², bed, guest). The resulting cross-section provides the basis for a sector strategy and the aggregate of which will provide a complete national

action plan with indicative results for the tertiary sector as a whole in Spain.

GTR has identified the following segments of the tertiary sector which each require a “sector strategy” to create a national action plan for commercial buildings: hospitals, universities, schools, sports centers, retirement homes, hotels, shopping centers and offices (sub-divided into the following classes: public administration offices, large single-tenant private buildings, multi-tenant facilities and SMEs/ smaller buildings).

The “sector strategy” for each segment will be defined by the combination of the physical characteristics (such as use, geographic location, age, etc.) with energy intensities and a menu of possible interventions designed for that segment according to best practices and pilot experiences (in Spain and abroad). In each segment there will be a group of high energy intensity buildings, which would constitute the first band for priority reforms followed by buildings which represent 50% of all of the energy consumption of each segment. The following table shows some of the key segments, their number and some of the likely approaches of the intervention menus.

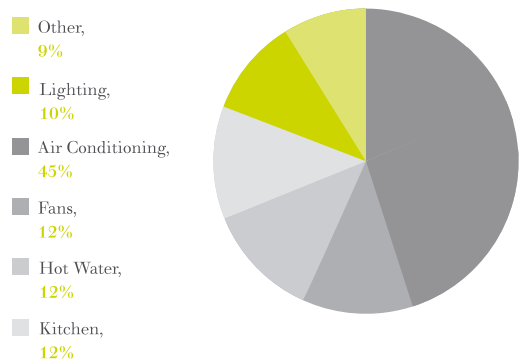
Sector	Number	Priority Focus (Intervention 'menu')
Hospitals	350 Public 350 Private	Use and management, lighting, cogeneration, insulation, solar water heating and intelligent controls.
Universities	50 Public 27 Private 236 Campuses	Use and Management / Education, lighting, insulation, cogeneration, "District Heating" and HVAC, intelligent controls.
Hotels	8,300	Lighting & Intelligent Controls, HVAC / Boilers, Insulation and Solar (PV ACS).
Retirement Homes	950 Public 2,850 Private	Lighting, Insulation and Solar (PV ACS).
Shopping Centers	510	Cogeneration, tri-generation, intelligent systems and renewable energy.
Sport Centers	5,000+	Lighting, Insulation and Solar (PV ACS).
Offices (public administration)	2,000+	Education, procedures, lighting, insulation and smart controls.
Offices (large buildings)	2,000+	Education, procedures, lighting, insulation and smart controls.
SMEs	3,000,000	Awareness, lighting, insulation and controls.

There is much anecdotal evidence that GTR has identified globally which indicates that the “sector strategy” approach is appropriate to assess, identify and prioritize the refurbishment opportunity in Spain in the tertiary sector. However, during 2012 GTR has not had the resource and time necessary to build an entire national plan for the tertiary sector with the same degree of rigour and analysis as it has been able to do for residential buildings. Therefore what follows are a series of example sector strategies⁴⁹ which GTR has identified for certain of Spain's tertiary sub-sectors from its research during 2012 which it hopes to be able to develop and complete in 2013:

CASE STUDY: STRATEGY FOR THE SMART USE OF HEAT, LIGHT AND AWARENESS IN HOSPITALS

There are over 700 hospitals in Spain which consume approximately 2% of Spain's energy⁵⁰, half are in public ownership and the other half are privately owned. Sources suggest that up to Euro 180 million per annum⁵¹ can be saved from hospital energy bills cost effectively. Public hospitals are larger buildings, on average, with 3x the number of beds of private hospitals. While many hospitals are managed as “single site” operations there are several private owners of between 2 and 16 hospital sites each.

Hospitals are heavy users of heat and electricity; they demand significant electrical loads for lighting and equipment, they occupy both very old and new buildings (however, nearly all were built before CTE requirements were introduced) and they have complex demand patterns suited to smart control systems (some strict requirements for uninterruptable power and other occasional down-cycles, eg. temporarily unoccupied specialist wards). In summary, Spain's hospitals are an ideal sector for a GTR “sector strategy” approach and have an energy expenditure breakdown as follows:



Source: IPSOM. (2012). Hospitales: Consumo Energético. Retrieved from <http://www.ipsom.com/clientes/eficiencia-energetica-hospitales/>

In the UK, the National Health Service (UK's State run Public Health Service) manages around 350 hospitals each structured as a Trust with similar number, “single site” and budget/ operating difficulties as those in Spain.

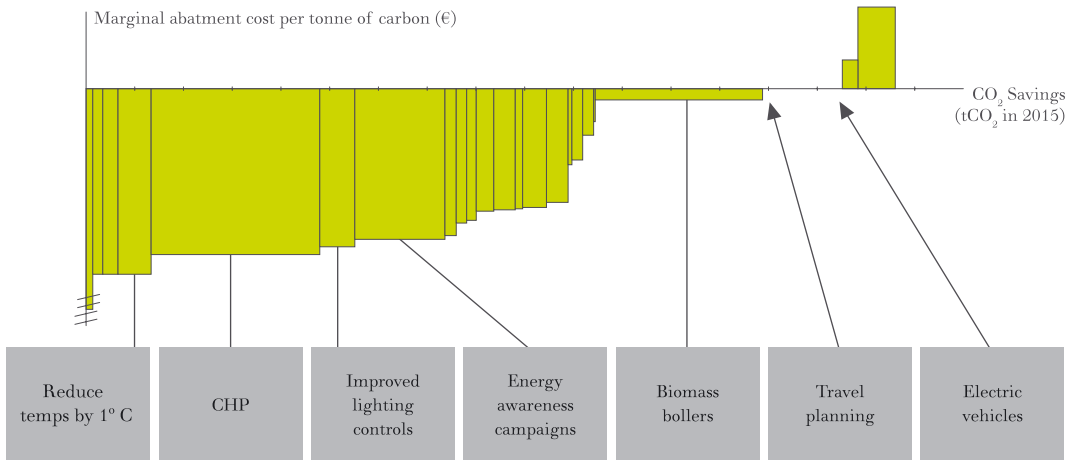
In 2010, the sustainable development unit of the NHS completed a detailed survey of CO₂ reduction possibilities and the potential for energy efficiency measures in hospitals of different size and different location. The results were dramatic: The NHS could save £49 million per year through installation of CHP, it could save over £5 million through an awareness campaign and plenty more in individual hospitals through insulation, smart lighting controls, temperature reduction and even the use of biomass boilers.

49 The GTR highlights that a strategy report could be written for each commercial buildings sub-sector. The GTR intends to increase and improve its work in the 2013 GTR report.

50 IPSOM. (2012). Hospitales: Consumo Energético. Retrieved from: <http://www.ipsom.com/clientes/eficiencia-energetica-hospitales/>

51 Econoticias. (2012). Los hospitales de España ahorrarían unos 178,8 millones anuales con un control de sus consumos energéticos. Retrieved from: <http://www.ecoticias.com/sostenibilidad/63685/afirma-energia-solar-colaborara-con-la-upm-para-el-desarrollo-de-una-casa-solar-energias-renovables-verdes-limpias-sostenibles-alternativas>

Examples Measures in NHS MAC Curve



Source: NHS England. (2012). A Marginal Abatement Cost Curve. Retrieved from: <http://www.sdu.nhs.uk/publications-resources/10/MAC-Curves/>

US hospitals spend US\$ 8.8 billion⁵² on energy each year and they have discovered that every \$1 saved in energy expense is the equivalent of \$20 increased general revenues⁵³. Hospitals in the USA have started to recognize the potential cost savings available through energy efficiency and the reputation gains and productivity improvements deliverable with a strong sustainability and environmental policy. The EPA manages an energy efficiency incentive programme⁵⁴, through Energy Star, targeted at US hospitals which indicates that the most energy efficient hospitals use 30% less energy than the least efficient ones. A number of hospital benchmarking tools have been made available by Energy Star to help hospitals assess their energy intensity (per m²) and potential

for savings and the results are clear for both private and not-for-profit US hospitals.

In Spain, a number of studies and technical guides have been produced for hospitals by IDAE, Comunidad de Madrid, Xunta de Galicia and various energy companies and ESCOs. The consensus of these studies suggests that energy efficiency is an important source of cost savings in Spanish hospitals and that they can be achieved with good returns and at affordable costs. However, we believe that hospitals that have considered energy efficiency measures have carried out work that represents only 20-30% of their potential energy savings to date, with most energy efficiency measures having been in the area of lighting and with very short pay-backs (ie. 1-3 years).

A good example is the Xunta de Galicia's 14 hospitals⁵⁵ which spend Euro 20 million a year on energy, 50% of the Xunta's entire energy bill. Together with 700 primary day-care centers, Xunta believes that 10-40% of energy consumption in these buildings

52 EIA, CBECS 2003, Adjusted for inflation to 2008 dollars

53 Energy Star. (2004). Environmental Leadership Adds Value to Your Bottom Line and Corporate Reputation. Retrieved from: http://www.energystar.gov/index.cfm?c=healthcare.bus_healthcare

54 Energy Star. (2005). The Business Case for Energy Performance Upgrades. Retrieved from: http://www.energystar.gov/ia/business/healthcare/ashe_jan_feb_2005.pdf?6a56-21c1

55 Xunta de Galicia. (2012). La Figura del Gestor Experto, Clave para Pasar a la Acción en Eficiencia Energética: Primeras iniciativas en la sanidad gallega.

can be cost effectively saved and has launched a Euro 13.5 million energy efficiency investment strategy⁵⁶ in 5 pilots to prove this.

As in the UK, there is evidence showing that many Spanish hospitals can benefit from cogeneration, more efficient lighting, smart buildings controls, motion sensors, improved insulation and better overall awareness to prevent energy waste. GTR believes that what isn't measured transparently and clearly will not be a priority for hospitals and that, as well as specific tools and technical support, a publicly available ranking of energy intensity, data gathering and transparency exercise in the hospital sector would enable, catalyze and create significant energy savings and improve patient comfort and the productivity of Spanish hospitals.

56 Brant, M. (2012). 17 Congreso Nacional Hospitales: La figura del gestor experto, clave para pasar a la acción en eficiencia energética. Retrieved from:// www.17congresohospitales.org/Ponencias/dia28/Mesa_20/Maria_Luisa_Brant.pdf

6. CASE STUDY: SUSTAINABLE BUILDING PLAN IN THE BASQUE REGION

Launched in 2012, the Roadmap for Sustainable Buildings in the Basque Country: *Bultzatu 2025 (Hoja de Ruta de Edificación Sostenible del País Vasco: Bultzatu 2025)* stands as a support instrument for the strategic planning and implementation of long term goals for the Basque housing stock. Bultzatu plans for the Basque housing stock to deliver better services to its customers, to uphold higher environmental standards, to serve as an engine for economic activity through the demand of advanced products and services that contribute to the transformation of the building sector in the Basque Country.

Bultzatu's purpose is to align the objectives set by the EU, the State and the Basque Government linked to sustainable building until 2025, and to prioritize and plan major actions to be developed for its realization in an efficient and coordinated manner.

Furthermore, Bultzatu aims to become a pivotal instrument for Euskadi to position itself as a European model in the area of sustainable building in 2025.

BASQUE COUNTRY HOUSING STOCK, CHARACTERISTICS:

Bultzatu 2025 focuses on the existing building stock as its primary axis for intervention in the residential sector. The Basque housing stock has certain key characteristics that define its needs and the patterns for its intervention:

- The Basque has a housing stock comprised of 1,004,740 units. Its occupation rate is approximately two individuals per unit.
- Its average age is over 39 years, making it the second oldest housing stock in Europe after the UK.

- It has a “Mediterranean” tenure regime⁵⁷ (ie owner-occupier) which covers 93% of households, making it difficult for integral interventions in residential buildings due to the absence of aggregators such as large landowners, unlike other European countries and regions.
- There are a relatively small percentage of unoccupied housing units representing just 4.6% of the total number of homes (a much lower figure than for all of Spain).

BUILDINGS AND THE BASQUE ECONOMY

Even though its contribution to GDP has declined, the construction sector is still an important part of the Basque economy. Construction represents 7% of the Basque Country's GDP, however, due to the economic and financial crisis there are now 14% fewer construction companies operating in the region. The construction sector is therefore an important and mobilizing component of the economy, which has been heavily impacted by the crisis.

TRANSFORMATION TOWARDS SUSTAINABLE BUILDINGS

Primary Drivers:

- The Basque housing stock is old and is therefore inefficient. A renovation plan offers an opportunity to foster energy efficiency as well as the set of improvements that would allow for the renovation of the housing stock.
- Basque society is aging and is moving towards a home based service delivery model with evolving needs, which entails also addressing stringent accessibility requirements from households.

57 Characterized by ownership of property. IREKIA. (2012). Aprobado el programa REVIVE dirigido a comunidades de propietarios para rehabilitar conjunto de edificios (Acuerdo del Consejo de Gobierno del 17-07-2012). Retrieved from: <http://www.irekia.euskadi.net/es/news/11768-aprobado-programa-revive-dirigido-comunidades-propietarios-para-rehabilitar-conjunto-edificios-acuerdo-del-consejo-gobierno-del-2012>

2020 Objectives	Europe	Spain	Basque Country
Reduction of GHG emissions.	- 20% (1990 base)	- 14% global (2005 base) - 10% residential sector (2005 base)	Pending execution of 2nd Basque Climate Change Plan.
Renewable Energy (% of consumption from renewable energies).	20%	20%	- 14% global - 6,9% residential sector
Energy Efficiency (reduction of primary energy consumption regarding trend forecasts).	-20%	- 20% global (Residential sector has a marginal contribution of 1,2% of the global energy savings).	- 17% global - 8,7% residential sector

Source: Gobierno Vasco. (2011). Hoja de Ruta de Edificación Sostenible del País: *Vasco Bultzatu 2025*.

- The Basque construction sector needs to evolve into a more sustainable business model that is primarily based on renovation.
- The emergence of new public-private business partnerships, which should allow for new investments in the existing housing stock.

Barriers to Overcome:

- From an economic, social and environmental perspective, Basque society is not sufficiently familiar with the importance of an integral, deep and profitable retrofit of its homes and buildings.
- The Basque administration's complex nature makes coordination among its institutions difficult. Although *Bultzatu 2025* was launched as a collaborative initiative among regional Ministries, there is still a long way to go.
- The current regulation does not effectively cover all expected construction activity, especially renovation, thus slowing the business model transformation of the construction sector.
- The lack of large landlords results in a fragmented state of Basque housing stock ownership, which makes decision-making difficult, slow and can potentially discourage the renovation of buildings.
- The current system of support and counseling for owners and landlords is fragmented and dispersed. Its limited reach needs to be upgraded and re-activated.

- Maintenance intervention patterns are not exploited as opportunities to undertake more comprehensive energy efficiency upgrades and renovations of greater impact.
- The construction sector, and its supply chain, show limited innovation in this area.
- The present economic situation and lack of available financial investment resources deters all housing intervention.
- Other considerations need to be incorporated into the rationale for intervention addition to energy savings. These complementary considerations (or ancillary benefits) can serve as an incentive and encourage the investment to be undertaken by the home owner and can boost the deep retrofit of housing units.

RENOVATION, SOCIO ECONOMIC BENEFITS AND JOBS

- Retrofits can enable immediate and future housing needs to be met at a minimum cost.
- 31% of the Basque population lives in areas with high or very high housing vulnerability.
- Over 15% of the buildings require urgent intervention. Retrofitting of these homes should be a priority due to its social impact.
- Energy efficiency interventions that take place in parallel with other interventions in buildings are two to three times more cost efficient.

- Improving accessibility and comfort in the housing stock can avoid future health care costs by improving the care and quality of life of the elderly and their dependents.

MAJOR SOURCE FOR EMPLOYMENT:

The renovation of buildings is very labor intensive (eg. Renovation has 5x more job creation capacity than the same investment in transport infrastructures⁵⁸).

- **The energy retrofit of buildings has the ability to create between 8 and 14 direct jobs per million euros invested⁵⁹.**
- Most of the jobs are local, distributed homogeneously throughout the territory and developed by SMEs and other professionals.
- **A significant investment with tax returns and opportunities for funding: for every Euro of aid, 6.9 € are mobilized in direct investment (16.3 € in total considering induced effects), resulting in a tax return of 1.37 € (with 0.55 € recovered by the Basque Government).⁶⁰**

2025 FORECASTS AND TRENDS

Bultzazu 2025 aims to attain a comprehensive renovation rate of at least 65% of existing homes by 2025. In addition, 68% of new construction is expected to surpass the requirements of the current Construction Technical Code (*Código Técnico de Edificación Actual (CTE)*).

Undertaking the number of planned interventions will require an **average annual investment of 1,328 million euros**. Around 1.8% of 2011 Basque GDP, aiming at:

- Sustaining 10,818 jobs per year
- Achieving average annual savings on energy bills of households of 49 million euros
- Generating an annual tax revenue of 161 million euros related to the direct activity

The additional investment required to meet the CAPV (*Comunidad Autónoma del País Vasco*) targets is 569 million euros a year until 2025. 481 million euros would be related to energy bill savings. While the rest of additional investment would be allocated to other measures such as accessibility, repairs, upgrades, etc. Based on the references above, the strictly energy-related ROI/ payback is estimated, on average, as 8.9 years⁶¹.

CAPV 2025 Residential Sector Performance indicators.	Trend Development	2025 Target
Average Annual Investment	731	1.328
Jobs Created (per year)	5.957	10.818
Yearly Energy on Bill Savings Trend (MME / ?)		49 (8,4%)
Yearly Tax Revenue (MME)	89	161

Source: Gobierno Vasco. (2011). Hoja de Ruta de Edificación Sostenible del País: *Vasco Bultzatu 2025*.

Bultzazu 2025 is committed to reach the goals of the Euskadi 2020 Energy Strategy, 3E2020 (*Estrategia Energética de Euskadi 2020: Euskadi 2020 Energy Strategy*). Hence, Bultzazu 2025 actions intend to reduce energy consumption by 8.7% taking into account the 2020 baseline scenario, and to achieve of 6.9% of energy consumption from renewable sources.

In addition, the reduction of CO₂ emissions compared to the business as usual scenario is expected to reach 9.6% by 2020.

58 Gobierno Vasco. (2011). Hoja de Ruta de Edificación Sostenible del País: *Vasco Bultzatu 2025*.

59 Fundación CONAMA

60 BREV Project

61 The ROI is calculated from the ratio between the “energy investment” of 481 million euros and the annual savings on energy bills of 49 million euros.

CAPV 2025 Residential Sector Performance indicators.	2010	2020 Target
Energy Consumption (tep)	625.500	605.108
Reduction of Energy Consumption, baseline scenario (%) (3E2020 target = 8,7%)	50.400	8,7%
Energy Generation, Renewable sources (tep) (3E2020 target = 45.600 tep)	4,9%	41.258
Generación renovable sobre Renewables Generation, Energy Consumption, (3E2020 target = 6,9%)	865.069	6,9%
CO ₂ Emissions (CO ₂ Tons)		821,849
Reduction of CO ₂ Emissions, baseline scenario (%)		9,6%

Source: Gobierno Vasco. (2011). Hoja de Ruta de Edificación Sostenible del País: *Vasco Bultzatu 2025*.

BULTZAZU 2025 & GTR

Bultzazu 2025 is at the forefront of energy efficiency policy-making among Spanish regions which illustrates many of the benefits and barriers highlighted by the GTR. Using a similar approach to GTR, Bultzazu's 2025 vision, plan of action and goals focus on a cost-optimal economic boost for the region by addressing 21st century energy issues, fostering long term job creation, and reducing CO₂ emissions. The transformation of its buildings sector stands as a great and ambitious step in the right direction which GTR deems appropriate to face the current economic stagnation in the Basque region and much of Spain, while simultaneously delivering social, environmental and economic goals.

One of the issues which was highlighted in the context of this regional analysis, it that the legal framework governing property in Spain has its origin in the nineteenth century and is intended primarily to regulate the rights and duties of individuals in the process of urban development (expansive growth from urban centers). The law maintains formulations which link concepts of profitable use (maximum allowable construction area, maximum ceiling

area or equivalent maximum parameters set out in the various regional regulations) and the right and obligations of owners to develop those rights.

This urbanism ethos and rights focus is incompatible with the principles governing the concept of sustainable building. The adoption of passive measures that would allow owners to effectively attain energy performance standards which would lead to significant reductions in consumption, or the development of measures that would allow for the improvement of accessibility and habitability conditions generally involve an increase in edificability (floor area or profitable use) of buildings. This results in a loss of rights or benefits which the traditional law grants the owner, making the administrative process of renovation overly complex.

Bultzatu 2025 is built from a systematic analysis of the existing housing stock in the Basque Country -with a level of local information which is more detailed than that available to GTR at a national scale- and follows a sub-segmentation of the housing stock using intervention menus based on selected pilot test cases for each of the segments to serve as reference points.

Whereas the Basque plan is defined by certain short-term objectives related to the adequacy of the housing park to the current and future situation and the immediate circumstances of Basque households, energy efficiency, and the reduction of emissions, is an important goal yet it is not the driving force of the plan. Perhaps the most significant difference with respect to the GTR's proposed methodology is the lower priority given to the capacity of energy renovation to serve as an economic engine to drive resources into the plan, and the greater emphasis given to social rates of return. The improvement in living conditions of household members will require public and private support, and yet the improvement of energy efficiency is viewed more as an integrated goal of the Basque plan and a requirement of global environmental politics than as a primary funding mechanism for the renovation itself.

Consequently, the objectives proposed in Bultzatu 2025 for energy renovation are not as deep as those proposed by the GTR and in this manner Bultzatu diverges from the GTR methodology. The GTR model targets the cost-optimal deep renovation of

the current housing park such that Spain is set on course for 2050 goals as well as 2020. It also calls for the adoption of precise financial, regulatory and organizational measures to ensure that deep renovation happens as a priority once energy prices make it economically viable. The GTR model activates the deep intervention of a building when the present value of the energy savings covers the net size of the required investment. When a deep retrofit is economically practical then GTR's model allows for further owner-financed non-energy upgrades and habitability or social investments to be executed simultaneously.

Although Bultzatu 2025 provides a detailed assessment of the old and energy inefficient Basque housing stock, it has a broad renovation focus and does not use energy intensity as a guide to priority intervention nor does it target energy reduction as a primary economic resource. The GTR methodology might define an intervention order that would need an additional social context to meet the plan's priorities of adapting the housing park to improvement demands or household needs. As a result, the Bultzatu 2025 plan requires more public aid and private investment than would be required under the GTR model, and if not recovered by other means, would result in a higher overall cost. In any case, without a detailed comparison, this discussion remains open and a modification to the target depth of renovation and approximation to the needs of the Basque homeowners is possible from both sides as Bultzatu moves into its execution phase and the scope and depth of the plan can be trialed in practice and the availability of public and private finance is better defined.

Notwithstanding these marginal differences in focus, Bultzatu 2025 is a plan which GTR fully supports and is largely in line with a regional version of GTR's New Housing Sector. The plan highlights the key drivers of renovation: Accessibility, habitability, energy efficiency and macro-economic stimulus and underlines the same legal and regulatory barriers to its successful implementation, which GTR also underscores. The unraveling of the local and national challenges to housing stock renovation are welcomed at a regional and national level and GTR members are keen to see, and hope to work to make Bultzatu 2025 succeed.

7. UPDATE OF THE FINDINGS OF GTR 2012

This final chapter consolidates the latest technical, operational and financial findings from GTR's work during 2012. The new GTR model has considerably improved and enhanced the 2012 Action Plan without causing any material departure from the direction established in the 2011 Roadmap. Finally, GTR closes with more detailed legislative and operational conclusions for Spain which are drawn from its 2012 work. These appear in the second part of this section.

The 2012 Action Plan proposed by the GTR (as in 2011) contemplates the energy efficient intervention of 10 million primary homes in Spain by 2050 ordered by energy intensity starting with the most intensive users of heating and cooling. The GTR Action Plan targets the refurbishment of 75% of all Spanish primary residences built before 2001 by 2050. Intervention targets a reduction of as close to 80% of the heating/ cooling requirements of the rehabilitated units as the economic model allows and also targets a 60% reduction in energy needs for ACS in each renovated dwelling.

7.1 ACTION PLAN

The following table summarises the key results and outputs of GTR's 2012 Action Plan with 2020 and 2050 outcomes and interim objectives for 2030.

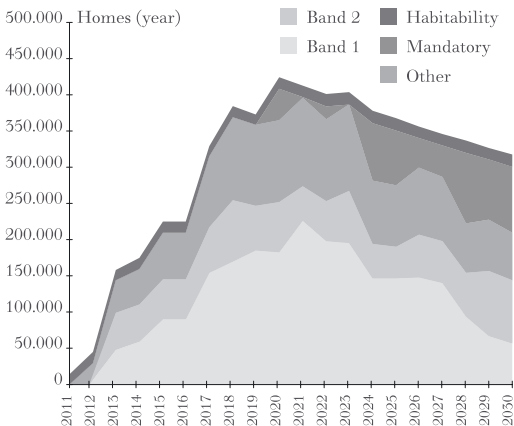
While both the 2011 and 2012 Action Plans are highly comparable and materially similar in their conclusions, there are some minor changes of note including: while the total investments in the sector are the same by 2020, the new model only retrofits 2.2 million homes (compared to 2.4 million in 2011) – this is a direct result of the use of the new intervention menus (as described fully in Section 4). Energy savings and CO₂ emissions reductions are also reduced by the same factors in 2012 as a result of around 10% fewer renovations by 2020. Activity picks up after 2020 and is more concentrated in the decade between 2020-2030, than in the Roadmap 2011, and therefore the number of jobs created by the NHS between 2020-2030 is higher than previously forecast as a result together with higher investment needs in the 2030-2050 decade. Finally, and also as a result of the re-pricing of the more detailed intervention menus, the average amount of subsidy required per job created for the 2012-2020 and 2020-2030 period has increased from € 12,000 to around € 14,000.

	2020	2030	2050
Number of Homes Reformed (2012-year)	2,200,000	5,700,000	10,000,000
<i>(% of 2001 Primary Residential Homes)</i>	14%	35%	62%
Aggregate Investment in Housing (€ mm)	64,000 €	160,000 €	260,000 €
<i>Cumulative Investment only in Energy Efficiency</i>	42,667 €	106,667 €	173,333 €
Energy Saved in Year (GWhr)	21,000	47,000	68,000
<i>Cumulative Energy Savings since 2012 (GWh)</i>	77,000	440,000	1,670,000
CO ₂ Saved in Year ('000 Tons)	4,600	8,500	8,600
<i>(% Reduc. vs 2001 Residential Homes (inc. other measures))</i>	24%	49%	82%
<i>Cumulative CO₂ savings from 2012 ('000 Tons)</i>	19,000	89,000	26,000
Accumulated Savings Energy and CO ₂ from 2012 (€ mm)	11,000 €	81,000 €	390,000 €
Jobs Sustained (Period Average)	150,000	170,000	120,000
<i>Subsidy Cost per Job (average over period)</i>	13,694 €	14,144 €	n/a

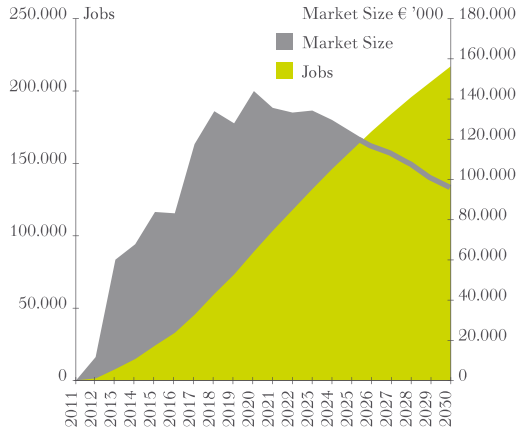
The current legislative, operational and financial framework remain insufficient to deliver these outcomes and for the NHS to become an economically viable sector, the key financing pre-conditions remain the same as recommended in 2011:

- Low cost, long-term financing for deep renovation – at least 20 years at rates of 5% or less;
- A clear system to place a value on CO₂ emissions reductions and allow that value to be realized by the homeowner or occupant or count towards the financing of a deep retrofit (such as a white certificate program promoted within the context of the new European Directive on energy efficiency);
- Up to 25% kick-start subsidies paid up-front during the initial stages of each “hot-spot” to stimulate the deep renovation market or an equivalent fiscal rebate or cost reduction (this forms part of the needed public stimulus investment and will be recovered through the collection of more taxes –VAT, Income Tax- and the reduction in unemployment payments);
- Mandatory policies introduced after 2020 for specific energy profligate segments of the building sector ensuring that renovation activity reaches a minimum of net 3% of unrenovated Spanish primary residences per annum;

With the above stimulus framework, the new profile of the home renovation delivered through the GTR 2012 Action Plan is summarized in the following graph:



The 2012 Action Plan creates a home renovation market with an aggregate value of up to Euro 160 billion⁶² by 2030 and is capable of creating and sustaining 130-170,000 new jobs for individuals within the New Housing Sector as illustrated in the following graph:



7.1.1 KEY DRIVERS OF GTR'S ACTION PLAN

Given little regulatory or sectoral development since GTR published its 2011 report, the key drivers of the 2012 Action Plan remain similar to those described in 2011 and are those which if implemented in 2013 will allow Spain to develop the outcomes summarized here. Several key parameters continue to have a significant impact on the results, and are still largely absent from current policies in Spain and are necessary for the NHS to be launched in a credible and durable manner:

- **“Deep Renovation” interventions are targeted which deliver close-to 80%⁶³ reductions in energy needs of buildings over the long**

62 For each Euro invested in energy efficiency, 0.5 Euro is invested in non-energy related improvements (eg. Cosmetic, accessibility, etc.).

63 In line with the scenario E6 of the WWF white paper (December 2010) and the scenarios contemplated in the recent BPIE “Renovate Europe” campaign.

term, in line with the European 2050⁶⁴ Roadmap for a Low Carbon Economy, adopted in March 2011. The GTR Action Plan is built upon the premise that the intervention of homes must be carried out once in a single intervention (a “deep renovation”) to avoid lock-in and without successive interventions over time. This requires a willingness to maximize cost effective renovation using a whole-of-house approach and striving to attain the highest standards of insulation, consumption measurement and control systems and efficiency technologies available in Europe. The Action Plan contemplates a series of financial measures which provide significant risk sharing between owner, utility and State and offers low cost finance enabling households to take a long-term view to reduce annual repayments to levels which can be covered by savings.

- **Lines of finance tailored for the renovation risk and term.** GTR recognizes that the crisis has worsened financial conditions in Spain considerably. However, the GTR believes that energy efficient renovation –precisely because it creates jobs and produces economic savings both for the state and for the occupant of the building- can attract such tailored financing modeled following the success of similar facilities in other European countries. GTR remains convinced that -even in times of crisis- new, low cost, long-term ICO credit lines targeted at the deep renovation of Spanish homes at a 5% fixed rate for 20 years or more distributed through private bank networks are the right solution. These new lines may also attract some central EU financing support from 2014-2020 to ensure financial resources required to deliver on Spain's National Energy Efficiency Action Plan, target 2020 GHG emissions reductions in the domestic sector and its energy efficiency targets.
- **Formulas to subsidize or fill a gap of 25% which exists between the cost of deep renovation and the present value of the expected energy savings in the form of a direct subsidy or tax relief.** This gap is expected to close over the first 10 years of activity of the NHS, as

economies of scale drive down the cost of refurbishment and as energy prices rise.

- **“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.** These real cost reductions can be delivered through economies of scale, city-block size projects, 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 subject⁶⁵.
- **Additional Renovation Spending Knock-on Effects of Deep Energy Efficiency Renovation on Non-Energy/ Cosmetic areas of 0.5 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, car-park additions 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 0.5:1 ratio for its Spanish base case (ie 50% of the German case).
- **CO₂ savings are assigned an economic value equal to 15% of the value of the energy saved.** Energy efficiency renovations of households will certainly impact Spain's national CO₂ emissions (in diffuse sector and EU ETS emissions). The 2012 GTR Action Plan contemplates a contribution of “CO₂ value” in the order of 50 to 120 euros for the energy renovation of

64 Roadmap for a competitive low carbon economy in 2050, European Commission, March 2011.

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

each home and per year during the amortization period of the retrofit finance (ie. between 20 and 30 years). GTR acknowledges that this “extra value” is more than would be suggested with the current low EU ETS price of between 6-10 euros / ton. However, given the lifetime of a retrofit is 20+ years and the price volatility of EU ETS prices has been high in Phase 2, GTR believes that prices will recover to 2020 to support its assumptions⁶⁶. Finally, GTR recognizes that domestic GHG reductions in Spain will always be more expensive to obtain than purchasing credits between sovereign nations with excess or in a European system whose price has been reduced by the crisis and oversupply. GTR believes that a domestic system of energy efficiency white certificates linked to energy suppliers' compliance with the new energy efficiency directive, would be a very promising solution to these issues.

- **GTR assumes that for every Euro 1 million invested in deep renovations there are 18 sustainable Jobs created.** A summary of studies of the impacts of the renovation of buildings in with a focus on jobs carried out in 15 countries allows us, using the arithmetic mean of these reports, to come up with an estimate on job creation of about 18 stable, quality, long-term jobs for every million euros invested in the NHS. This figure is consistent with assessments made by other studies in Spain and is the same assumption GTR used in its 2011 report. In 2012, the GTR made direct and complementary estimates with its manpower models for each hotspot and across each menu for intervention and these more detailed calculations also support this high-level approach.

Overall, the deep retrofit of dwellings proposed by the GTR must combine interventions within the envelope of the building and its air circulation -which directly reduce the costs for heating and air-conditioning- with efficiency improvements in lighting, appliances, and management control systems, acting in parallel and as an additional set of measures.

These additional measures are these, and GTR's assumptions did not change in these areas in 2012:

2. **Improved Efficiency of Home Appliances, which can reduce the 23% of energy required for this segment of home use by 80% by 2050.** This will entail the progressive change and renewal of home appliances and lighting systems for those that are more efficient and that follow similar lines already developed in Spain's national plans for energy efficiency and industrial development. GTR anticipates that by 2020 lighting emissions can be reduced by 20%, by 40% in 2030, and by 60% in 2050.
3. **Smart Control systems and the reduced use of inefficient cooling systems.** Today, a key factor behind the rise in home energy demand is the cheaper sale of inefficient appliances (especially electrical heaters and air conditioners) and the lack of basic thermostatic and simple energy efficient control systems in homes. Preventive incentive policies -commercial and industrial - are the recommended option to halt the spread of inefficient refrigeration systems in 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.
4. **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 2050⁶⁷ where the penetration of renewable energy and other zero emissions technologies in Spain reaches 40% by 2020, 60% by 2030 and 80% by 2050.
5. **FuelSwitching for Heating and Hot-Water:** In 2012, GTR's new model divides Spanish homes by major fuel type, as many Spanish house-

⁶⁶ In recent years the price of CO₂ in Europe has risen to more than Euro 30 and has been often bound in the € 15-20/t range.

⁶⁷ GBCe, Asociación Sostenibilidad y Arquitectura, Centro Complutense de Estudios e Informacion Ambiental, & Fundación Caja Madrid. (Eds.). (2010). *Cambio Global España 2020/50 Sector Edificación*

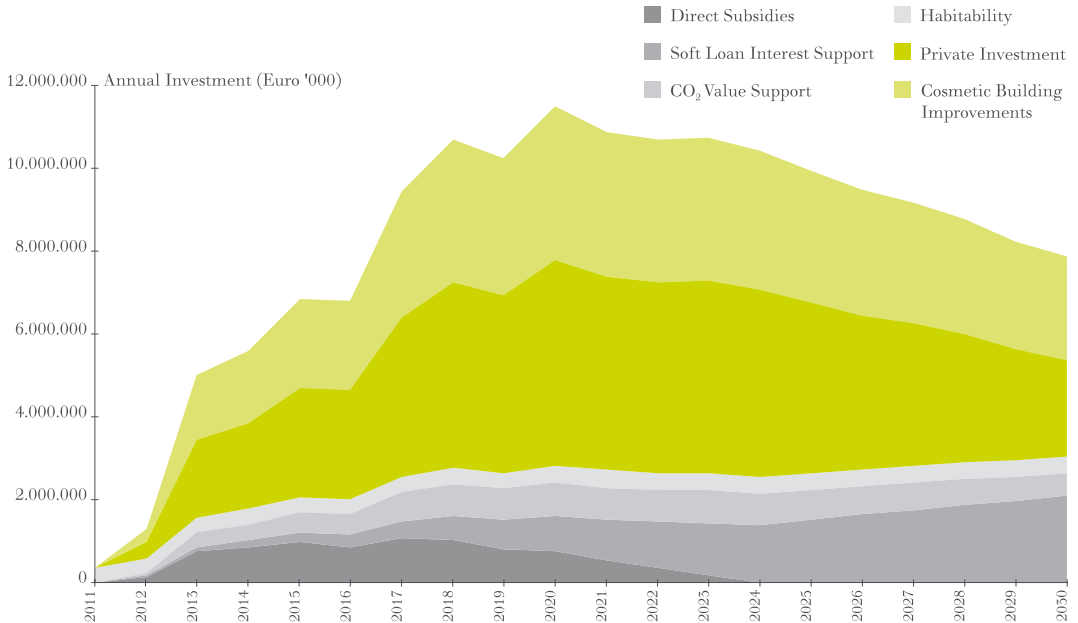
holds still rely on the direct burning of coal and fuel oil to generate heat. Changing these practices for biomass, ground-source heat pumps or other cleaner energy sources would significantly reduce emissions from these homes. GTR believes that this likely impacts of this increasing trend of fuel switching, 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 complimentary actions at 5% by 2020, 20% by 2030 and 60% by 2050.

When considered together with these complimentary actions, the GTR Action Plan provides a clear calculation of how a successful and vibrant NHS can substantially decarbonize Spain's housing stock producing overall emissions reductions of 24% by 2020, 49% by 2030 and 82% by 2050.

7.1.2 PHASES AND SCOPE OF THE ACTION PLAN

The Action Plan proposed in this report begins in 2012 and extends until 2050 - ensuring a trajectory in line with Europe's 2020 targets and the 2050 Low Carbon Roadmap. The plan targets the retrofit of an annual average of 200,000 houses in the 2012-2020 period and on around 360,000 houses annually in the 2020-2050 period with a “long-tail” of around 250,000 retrofits per year until 2050.

The Action Plan anticipates a total investment of 260,000 M€ (of which 170,000 M€ are invested to produce energy and CO₂ savings, and Euro 87,000 M€ into non-energy related renovations) over 38 years until 2050. This total investment amount is almost identical to the 240,000 M€ unanimously approved by the Spanish Parliament for the Strategic Infrastructure and Transport Plan in Spain for the 2005-2020 period⁶⁸. The investment period for stra-



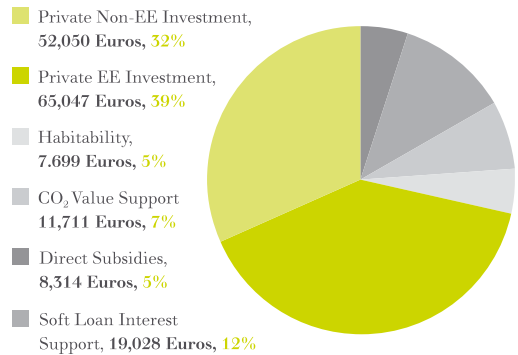
68 CCOO. (2005). Plan Estratégico de Infraestructura y Transporte 2005 – 2020: *Consideraciones de la Confederación Sindical de Comisiones Obreras*.

tegric infrastructure and transport is shorter (in fact it is 15 years, under half the 38 year investment time-frame for the NHS) and the returns to infrastructure investment are not supported by energy and CO₂ savings, usually, nor will they so directly impact Spanish families' home quality. GTR believes that when the costs and benefits of the public support for an energy efficient refurbishment sector are assessed and compared alongside other decisions of similar magnitude, the NHS will stand-out for its public returns, social and environmental results.

At its peak, the 2012 GTR Action Plan envisages the investment of over 10,000 M€ per year (€9 billion average over the 2012-2030 period) in Spanish homes, with the annual evolution of the public and private finance sources as shown in the chart on p. 77.

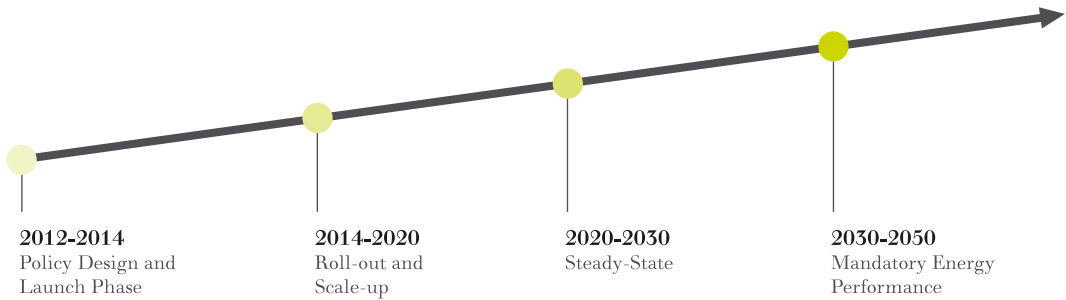
In "steady-state" between 2020 and 2030, GTR believes that the level of policy support through direct subsidies, fiscal measures, soft loans, CO₂ value recognition and habitability improvements will represent just below 30% of the total investments of the Action Plan, as shown in the pie chart. It should be noted that in "steady-state" the largest part of the subsidy is channeled via the reduced interest rate (12%) and with a white certificate programme providing CO₂ Value, the direct annual public finance contribution is reduced to just 10% (5% direct and 5% habitability for social purposes).

The 2012 GTR Action Plan anticipates the delivery of energy savings totaling 1,600,000 GWh and emissions reductions of 260 million tCO₂e, which GTR believes will represent an accumulated value of up to Euro 390.000 M€ over the full 2012-2050 period. By 2050, the accumulated energy and CO₂ returns are considerably higher than the 170,000 M€ which has been invested over the period to deliver them. In 2012, GTR reflected an updated CO₂ price forecast in this calculation (kindly provided by the Spanish Climate Change office) showing a CO₂ price forecast of Euro 17 by 2020; Euro 37 by 230 and Euro 50 by 2050. The emissions savings generated by GTR's Action Plan represent a 52% reduction in heating and ACS related emissions for the household sector by 2050 which when combined with the additional emissions impacts of the complimentary actions in appliances and lighting would allow the NHS to reduce 82% of its annual emissions by 2050 from all homes built prior to 2001.



To deliver GTR's 2012 Action Plan the NHS would create 130,000 new jobs on average in its first period until 2020, and would then grow to sustain around 170.000 jobs for its second period from 2020 to 2030; and GTR anticipates that the long-term trend would be above 120,000 jobs sustained from 2030 onwards. GTR estimates that the total public subsidy required to support these jobs is in the order of Euro 13,500 to 14,500 - reducing over time as the plan evolves and the amount of public subsidy declines.

The GTR Action Plan will be rolled in four phases: From 2012-2014 the legal and regulatory framework must be put in place and the sector needs to organize itself around the National Energy Efficiency Action Plan and accompanying long-term buildings roadmaps. Once the NHS is launched, GTR anticipates a growth phase from 2014-2020 in which activity attracts new players into the sector, costs come down, methods and processes improve and awareness rises as the intervention rhythm reaches 350,000 homes per year tackling the most energy intensive homes. From 2020, GTR believes that home retrofit should be common-place in Spain and that some 300,000+ homes a year are being renovated to high energy performance standards. In its models GTR uses a mandatory 3% renovation policy tool (of non-renovated properties) from 2020 which is only significantly required when energy prices move unexpectedly or low cost finance is removed etc. Beyond 2030-2050 GTR anticipates a combination of meeting new buildings standards, including energy performance, combined with retrofit price reductions and energy price rises will deliver a 250,000 area annual renovation activity and set the NHS on course to meet the 2050 Energy and Climate Change Roadmap projection for emissions from the household sector.



To be viable, the GTR Action Plan requires decisive and effective actions to be taken in Spain in the detection and removal of legal, regulatory, operational and financial barriers facing the creation of a new renovation sector of residential and tertiary buildings. The first phase, 2012-2014, will also require the execution of large scale pilots which will validate in practice the GTR models and establish the necessary managerial and operational foundations of the NHS. These pilots should be providing feedback to the policy community and also to the financial and operational community so that once the roadmaps are in place and the roll-out phase from 2014 begins the largest number of hurdles have already been identified and overcome. The financial framework should clearly denote distribution of risk and seniority of claims over the resulting cash flows and investments and which party bears responsibility for what outcome etc. And this can be reflected into the standard contracting procedure as the sector ramps up.

The following section develops GTR's recommended regulatory-financial-operational framework in the context of the need to deliver the Action Plan and NHS on the time-frames described.

7.2 KEY POLICY RECOMMENDATIONS FOR THE SECTOR

In over two years of work and engagement with networks of local experts in a growing consensus, in 2012 GTR re-affirms its unambiguous message that the energy efficient renovation of Spanish buildings is a unique opportunity for the country, and for its

economy to shift towards a more resource efficient, secure and competitive model. Moreover, the European legislative framework is a well ordered and powerful foundation from which to build and launch a New Housing Sector based on a deep renovation model tailored for Spain. This NHS has the potential to provide between 150,000 and 170,000 new jobs, reduce Spain's energy dependence and generate positive financial returns both at a government level and at the household, building owner and tenant levels.

To deliver the multiple benefits of the NHS there needs to be simultaneous and coordinated work in three areas:

1. **Political Leadership and Coordination among Public Institutions:** A country, its citizens, and its public and private institutions have to witness and feel the level of commitment, leadership and political priority for energy efficiency. This support should be expressed in unambiguous actions and policy priorities where energy efficiency should increasingly appear as one of the key "anti-crisis" measures providing benefit to the country's economy and to the welfare of its citizens.

Political leadership would take the form of a high-level narrative which communicates the fundamental political-economic logic and espouses an ambitious Spanish action plan aligned with EU 2020 goals on energy efficiency with transparent, firm and easily measured objectives in each of the sectors involved. In addition, Spain's political leadership can use the opportunity created to stimulate the construction sector through the long-term roadmap for

its buildings to lay the foundations for a transformation to a low carbon housing sector which delivers higher quality units with lower energy running costs eventually achieving reductions of GHG emissions in buildings of in the order of 88-91 % by 2050. With a clear and coherent strategy and the right high-level messaging resonating through all levels of government (central and regional), Spain's citizens and public and private institutions could engage more fully in understanding the benefits of energy efficiency and the potential in renovation to drive the need and urgent demands for the necessary legislative and operational changes required to jumpstart the NHS.

Energy efficiency as a theme requires a high level of coordination among Ministries and between the central government and towns and regions. National plans, roadmaps and vision will require a deep level of collaboration between Ministries (especially Infrastructure/Development, Industry, Economy and Environment) and between the central government and the autonomous communities and municipalities. Furthermore, the administration must seek to be consistent in its proposals and demonstrate its commitment and leadership with the urgent renovation of all public buildings owned or occupied by the central government (at a minimum) and requiring as a priority the examination and scoping of all cost-effective energy renovation works in every building that the administration controls, operates and / or manages (eg. hospitals, offices, schools, universities etc.).

2. New Legislative and Operational Framework:

Clear political leadership and inter-ministerial coordination, would create the political space and mandate to allow for and expedite the legislative changes needed to launch the NHS. Following the framework proposed for Europe, and as supported by the analysis of the International Energy Agency, GTR recommends Spain quickly implement the following steps: Implement a Technical Building Code designed for the renovation of existing buildings; fully transpose the May 2010 re-cast EPBD (in particular in the area of energy labeling, buildings with almost zero energy consumption and the

promotion of the energy efficiency culture in buildings) as well as a series of more detailed cross-cutting legislative changes to facilitate the removal of typical organizational-financial barriers preventing the implementation of energy efficiency renovation at the project/ household-level. In addition, the NHS will require the government's support in jointly developing an operational framework with high quality processes and standards that will instill confidence among citizens and foster the efficient organization of the sector's resources. Mechanisms to facilitate large-scale renovation (ie. buildings and/or neighborhoods within large cities) should be considered within this framework in addition to the development of tools to facilitate the renovation of single family homes. Finally, the NHS will require the commitment of large and small firms and the Government can help coordinate standards, training and communication so that the quality of project execution rises.

3. Engagement and Coordination of Public and Private Resources:

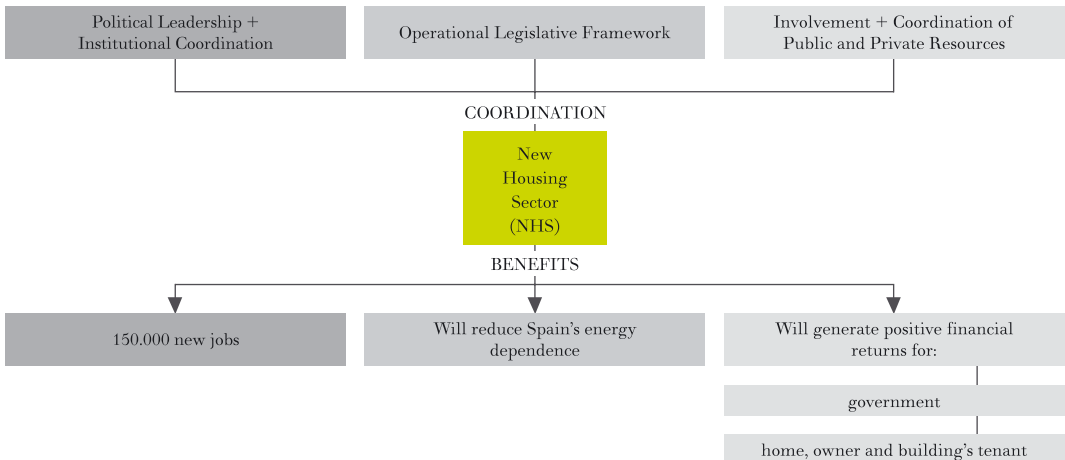
The NHS will not start, nor reach its critical mass, with political leadership and regulatory coordination alone. The NHS requires the coordinated backing of public and private resources working to deliver high quality renovation projects and aligned goals. GTR estimates that the present value (at 5% discount rate) of the energy savings alone received by Spanish building occupants (over 20+ years) could cover up to 75% of the 2012 deep renovation costs⁶⁹ – subject to availability of 20 year finance at 5% fixed rate. In the future, due to the rising price of energy and the benefits of economies of scale, new technologies and the learning curve, GTR is confident that the need for public subsidies for energy renovation will reduce to zero within a decade. Yet, until the number of homes rehabilitated annually is over 200,000 and we see the same pace of renovation growth in the tertiary sector, it will be necessary to have direct investment from public resources or an equivalent fiscal stimulus. ICO lines are available for renewal energy and energy efficiency renovation and currently have

69 A deep rehabilitation has minimum energy savings of 75%.

a fixed rate of 8.5% for 20 years. In addition, GTR believes that the German model where KfW pays distribution fees to private banks for their successful promotion of the home renovation programme could be replicated. Private banks should be incentivized to offer renovation facilities linked to customers with creditworthy mortgages and energy inefficient homes. Finally, Spanish energy companies need to have their interests aligned with the nation's energy efficiency goals and those of the NHS. Fortunately, the Energy Efficiency Directive provides for an energy supplier obligation, in Article 7, requiring Spain's energy companies to assist their customers to reduce their energy expenditure by 1.5% per annum based upon net sales 2014-2020. Energy companies can provide energy data, distribution networks, considerable financial resources and technical support to the renovation project. GTR is confident that the introduction of a white certificate program by which specific energy efficiency actions are credited and verified within the premises or homes of energy customers would be a good step forward to motivate and align private and public resources. Finally, the GTR believes that the government should consider the potential of using fiscal measures to promote energy conservation: For example, offering a tax relief for the first €10,000 invested in deep energy efficiency renovations or considering the introduction of different IBI tax bands according to the building's energy performance certification.

GTR is convinced that Spain has the opportunity to recycle a lot of knowledge, skills and resources from the current buildings sector and its largely domestic supply chains to develop a new powerful economic sector aimed at renovating its housing stock. Taking advantage of this opportunity through the resolution of organizational, functional, financial and cultural challenges is a productive use of political capital and now is the right time for Spain to mine the public and private benefits which can be gained from overcoming these challenges.

In conclusion, GTR is more confident than ever in 2012 that Spain is well placed among its European peers to be an exemplary case and deliver an energy efficient and fully transformed low carbon, sustainable buildings sector. Spain has the raw materials –strong construction sector and inefficient, old buildings- and the necessary tools -people and companies with the necessary skills- to propel a New Housing Sector based on the deep energy efficient renovation of its homes to generate energy savings for households and businesses and to stimulate economic activity and financial savings for the state.



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