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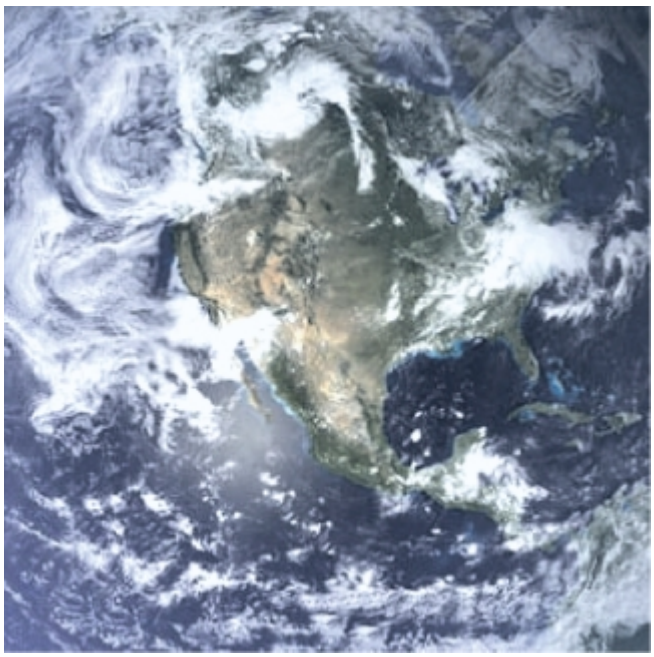

Financing Energy Efficiency Building Retrofits

International Policy and Business Model Review and Regulatory Alternatives for Spain

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Glossary of Terms

AIM – Aggregated Investments Model

buildings – all residential and commercial buildings, including homes, apartments, large and small office buildings, hotels, hospitals, and government buildings.

CERT – Carbon Emissions Reduction Target (UK)

CESP – Community Energy Saving Program (UK)

comunidad de vecinos – residential cooperative board that govern's decisions over the vast majority of Spanish residences.

CRC – Carbon Reduction Commitment (UK)

DFA – Direct Financial Assistance

EEA – Energy Efficiency Asset

EEM – Energy Efficiency Mortgage (US)

EERS – Energy Efficiency Resource Standard (US)

energy efficiency – using less energy to achieving the same level of energy services in buildings, demand management.

energy retrofit provider – any entity that provides energy efficiency retrofits. (ESCO's are just one of many possible forms that an energy retrofit provider might take.)

EPBD – Energy Performance of Buildings Directive (EU)

EPC – Energy Performance Certificate (UK)

ESCO – Energy Service Company, finances an energy efficiency retrofit and recovers invested capital based on retrofit performance and energy savings.

EU ETS – European Emissions Trading System

IBI - Impuesto sobre bienes inmuebles, i.e. property taxes (Spain)

IDAE - Instituto para la Diversificación y Ahorro de la Energía, IE. Energy Diversification and Savings Institute (Spain)

LHA – Local Housing Authority (UK)

PACE – Property Assessed Clean Energy (US)

SME – Small and Medium Enterprise

White Certificate – A certified, tradable, improvement in energy performance. (UK, Italy)

EXECUTIVE SUMMARY

A large and well documented global opportunity exists to save money and reduce greenhouse gas emission by using energy more efficiently. This report will focus on cost effective opportunities to improve the energy efficiency of the residential building and commercial building stock and in doing so, improve living quality and reduce greenhouse gas emissions. Such energy efficiency retrofits require significant up-front capital that can be paid back through lower building energy costs in the future. Engaging adequate finance together with supportive policies and broad-scale education initiatives are the keys required to unlock this largely untapped global opportunity. We hope that our recommendations will accelerate the development of this market.

Spain, the UK and the US are nations currently renewing their policy focus and activities in this area. Our analysis reviews progress to date in these countries and develops a new business model which we believe can greatly accelerate the pace of energy efficiency retrofit uptake in the residential and SME sectors. Finally, we conclude by looking forwards in the Spanish context at possible regulatory pathways which we believe will enable Spain to capture more of the value from energy savings in its buildings.

Buildings represent between 40-45%[1] of our target countries' energy needs. Numerous studies indicate that buildings' energy usage can be cost-effectively reduced by some 20-50%[2], and, depending on how 2050 emissions reduction targets are met, it is likely that many countries will have to go significantly further[3]. Improving the energy efficiency of the existing building stock not only generates energy savings with attractive levels of return on investment, it improves a nation's energy security, creates jobs and makes buildings more liveable. Studies show that $60-$300 billion could be invested globally each year to fully capture the cost effective energy efficiency opportunity. Estimates vary widely because of different baselines and assumptions, but all agree that the opportunity to cost-effectively improve our energy efficiency is enormous.

While energy efficiency policy has a long history, dating back to the oil crisis of the 1970s and before, it has only in recent years returned to the full attention of Governments as the financial crisis forces an unparalleled focus on the cost efficiency of measures designed to help consumers save (in this case energy) and reduce emissions. This paper provides a useful summary of the current policy initiatives underway in the US, UK and Spain which promote investment in energy efficiency as a framework for its further analysis.

Despite the benefits energy efficiency building retrofits provide, global investments in energy efficiency building retrofits are happening at a scale many times less than the estimated amount of investment-worthy, cost effective, retrofits available each year. Our paper examines the many reasons why current business models have delivered such meagre investments in buildings in the US, UK, and Spain and we propose an improved model which can greatly accelerate up-take in the residential and SME sectors.

We analyse the three main business models that have grown in response to the energy efficiency retrofit opportunity: First, the owner financed model, in which buildings' owners design, project

[1] Pew Center on Global Climate Change (US number 43%), European Commission (EU numbers, 40%)

[2] WBCSD, *Transforming the Market*, 2009; US EPA, *National Action Plan for Energy Efficiency*, 2006; McKinsey, *Unlocking Energy Efficiency in the US Economy*, 2009; European Carbon Foundation *Roadmap 2050* 2010.

[3] WBCSD, *Transforming the Market*, 2009

manage and finance an energy efficiency retrofit to their property and take full responsibility, as well as liability, for the quality of the project and the economic returns on their investments. Second, the utility fixed repayment model, in which the up-front capital cost of an energy efficiency retrofit is organized, subsidized and at times fully provided by a utility, and this investment is repaid through monthly, fixed, non-performance related surcharges. Third, the energy performance model, in which an energy efficiency retrofit provider designs a retrofit, and finances it, and is repaid only through the energy savings, therefore assuming the responsibility for the economic success and quality of the retrofit.

Retrofit business models have multiple stakeholders to satisfy and market challenges to navigate. Stakeholders include the building's owners and occupants, financing institutions, utilities/ energy suppliers, retrofit providers and government. Each of these stakeholder's interests must be met for any business model to rapidly grow to serve the full potential scale of the market. There are also various hurdles which limit the speed and uptake of retrofits and add complexity to the market. These include structural challenges (such as a fragmented market, changes in ownership and tenancy, agent problems and regulatory distortions), financial challenges (such as cherry picking, changes in energy needs, and high hurdle rate requirements), and behavioural challenges (low information and awareness, non-economic decisions and the rebound effect). To be successful, a retrofit business model must contemplate and substantially resolve these challenges, as well as satisfying all relevant stakeholders.

Our new business model, the aggregated investments model, is designed to better meet stakeholder interests and to address the challenges in the residential and SME sector of the market and, we believe, can deliver additional wholesale and more efficient retrofit debt and equity finance at scale to this sector. The aggregated investment model has four key design features: the creation of a standardized energy efficiency asset, multi-channel origination, on-bill repayment and the potential for securitization with (or without) government credit enhancement.

The aggregated investments model has the flexibility to be applied in any market, but it does rely on having a regulatory environment that enables it. In fact, our research and interviews indicate that the achievement of optimal uptake of energy efficiency retrofits requires all three groups of challenges we highlight to be addressed simultaneously: Structural, Financial and Behavioural. We believe that our model, together with an enabling policy framework, can address the structural and financial challenges, but there also needs to be significant and complimentary investment in education and information campaigns to address the behavioural hurdles which no amount of financial wizardry can remove. There are many excellent studies on the significant behavioural challenges facing energy efficiency which is a subject area that this paper does not seek to directly address.

Finally, we develop a set of ideas and regulatory pathways which we believe will increase energy efficiency retrofit activity in Spain. While the Spanish regulatory framework is presently further away from swiftly enabling on-bill finance (a key feature which improves the financial characteristics, recoverability and packaging of retrofit repayments) when compared to the US or the UK, we see no structural reasons why this cannot be contemplated in the future. Furthermore, in the short-term and with the right policy signals, we believe that pilot activity can be undertaken among Spanish banks, construction firms, ESCOs and energy companies that will underscore various of our conclusions.

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1. INTRODUCTION

Energy type, quality and cost are of strategic importance to more than 40% of the global economy[4] and the costs of securely obtaining the energy we need, the volatility of its price and associated supply risks only look set to rise. In our focus countries, Spain, the UK, and the US, buildings are responsible for around 40-45%[5] of all energy used, either directly or indirectly. Energy efficiency is the lowest cost energy resource in all three countries[6]. In the US, for example, energy efficiency costs half as much as fossil counterparts to meet the same energy needs[7].

In the US, UK and Spain studies show that energy usage in existing buildings can be cost effectively reduced by 20-50%[8]. These studies measure only the additional potential for energy efficiency improvements above and beyond what we are already doing. By 'cost effective' we refer to the energy efficiency retrofits are expected to pay back in 2-15 years through energy cost savings[9]. Energy efficiency has been a significant resource for global economies for many years, as illustrated by the fact that since 1970 three quarters of new energy demand in the US has been met with energy efficiency and only one quarter through new generation.[10] HSBC has estimated the total size of the existing energy efficiency market to be $87 billion and the potential market in 2020 to be $245 billion per year[11].

In addition to being cost effective, improving the energy efficiency of most buildings should improve a building's acoustics and liveability. Several studies and commercial real-estate owner-managers say that energy efficiency retrofits can enable higher rents and higher property re-sale value[12] (especially those helping the building attain high environmental certification). Anecdotally, many commercial retrofits which target the secondary benefits of improved working conditions and environmental certification deliver such economically material impacts on employee moral and productivity such that energy cost savings are minor in comparison. However, given that this is a relatively new market, empirical proof of increased property value and employee productivity are limited, so we do not make these assertions central to our arguments.

Present penetration of retrofits is low. This leads us to conclude that there are many millions of energy efficiency retrofits which are macro economically sensible and that make economic sense for individual stakeholders. We see the investment in these short-term, cost effective and sizeable domestic emissions reductions as uncontroversial, with no visual impact. These energy

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[4] McKinsey, *A Compelling Global Resource,* 2010

[5] Pew Center on Global Climate Change (US number 43%), European Commission (EU numbers, 40%)

[6] See levels of energy efficiency investments that are feasible at today's energy costs, WBCSD, *Transforming the Market*, 2009

[7] Duke, *Transforming Utility and Ratepayer Support for Energy Efficiency*, 2008

[8] WBCSD, *Transforming the Market*, 2009; US EPA, *National Action Plan for Energy Efficiency*, 2006; McKinsey, *Unlocking Energy Efficiency in the US Economy*, 2009; European Carbon Foundation *Roadmap 2050* 2010.

[9] Climate Strategy finding from sector interviews .

[10] Ehrhardt-Martinez and Laitner, *The Size of the US Energy Efficiency Market: Generating a More Complete Picture,* 2008

[11] HSBC, *Sizing the Climate Economy,* 2010

[12] Initial studies indicate that there is a connection between building energy efficiency and increased rental and/or capital value, though few empirical studies exist today. RICS, *Is sustainability reflected in commercial property prices: a review of existing evidence.*, January 2010.

efficiency investments will play an essential role in enabling the transition to a low carbon economy for these countries.

$60-300 billion per year could be invested globally to fully capture the cost effective energy efficiency opportunities in buildings[13]. Estimates vary widely because they are based on different expected baselines and different assumptions. Despite their attractive returns and the improvements in liveability that they create, the market penetration for energy efficiency retrofits to buildings continues to be low. Only a small portion of clean energy investments in 2009 were directed at energy efficiency[14]. Energy efficiency retrofit investments could offer attractive risk-weighted returns when compared with other investments[15], however the market size is currently limited by a lack of investor track record, experience in the asset-class and limited availability at scale.

Energy efficiency investments should be cost compared with the marginal cost of construction of new energy generation infrastructure. In the US, investor owned utilities estimated that they would spend approximately $30 billion on new generation capacity in 2008,[16] while the US Department of Energy reported annual investments in energy efficiency of only about $2.5 billion for all US utilities.[17] Capturing the full value of cost effective energy efficiency opportunities in the US could require investing $50 billion more per year.[18] While there is much debate around exactly how much balance sheet electric and gas utilities, and other operators in retrofitting, have "available" to hold energy efficiency investments[19]; we argue that retrofits should be economically attractive to justify their share of balance sheet and that securitization (using our new model) opens a new avenue of direct liquidity for these energy efficiency assets that lower their required holding period and hence enhance their appeal.

Energy efficiency also creates jobs.[20] Some studies estimate that energy efficiency retrofits create about 5.4 jobs for every $1 million of sales of energy efficiency projects[21]. While estimates vary, our research concludes that significant business activity and employment is created by energy efficiency retrofit programmes[22], and that in times of economic stimulus retrofit activity certainly is superior to Keynesian monies paid "to dig holes in the ground". More than 1/3 of $180 billion 'green stimulus' measures, passed by governments around the world in response to the economic crisis, was directed into energy efficiency, though only a small portion of the total

[13] $300 billion per year could be invested globally in energy efficiency with a 10 year payback according to WBCSD, *Transforming the Market*, 2009; $60 billion per year could be invested globally with a 17% average IRR according to McKinsey, *How the world should invest in energy efficiency,* 2008.

[14] UNEP and New Energy Finance, *Global Trends In Sustainable Energy Investment,* 2010; HSBC, *Sizing the Climate Economy,* 2010

[15] ACEEE, *The American Energy Efficiency Investments Market,* 2007

[16] Duke University, *Transforming Utility and Ratepayer support for Energy Efficiency,* 2009

[17] US Department of Energy, Energy Information Administration, *Table 8.3 Electric Utility Demand Side Management Programs,* 2007 (the latest year for which data has been published).

[18] McKinsey, Unlocking Energy Efficiency in the US Economy, 2009

[19] Utilities often have access to wholesale finance, but to date a relatively small share of most utility balance sheet s are dedicated to energy efficiency.

[20] New Economics Foundation, *A Green New Deal,* 2008; Barbier et al, *A Global Green New Deal,* 2009Citibank, *Citi Energy Efficiency Finance Initiative Presentation*2009

[21] ACEEE, *The Size of the U.S. Energy Efficiency Market,,* 2008

[22] German state-bank KfW has committed Euro 31 billion since 2001 in subsidized loans to 1.5 million energy efficiency housing retrofits. Recent macro-economic analysis of this programme concludes that it has saved 3.9 million tCO2 emissions and safeguarded or created 200,000 jobs per year.

[23] UNEP and New Energy Finance, *Global Trends In Sustainable Energy Investment,* 2010

funding has been deployed so far.[23] The challenge still lies in selecting the most effective policies and creating unequivocal market signals to support demand side energy use reduction policies.

The current policy mix and customer response has not delivered the scale of buildings transformation which is required nor optimal – given the scale of the opportunity. This is because today's business models and regulatory environment do not sufficiently align the key stakeholders' economic interests nor do they reduce the hurdles to action enough to engage wholesale finance (the key ingredient we postulate would act like an accelerator pedal to the system). However, sufficient models and policies have been tested and market research done, such that solutions are available to spark the massive transformations required in the coming years.

This paper seeks to unravel the successes and failures in policy and practice in the US and the UK through an analysis of the relative successes of, and enhancements to, the key business models delivering the retrofits, and finally to develop a set of ideas and regulatory pathways which we believe can unleash the energy efficiency retrofit opportunity in Spain.

Guidelines for the typical returns for common components of energy efficiency retrofits in buildings are provided below:

Energy Efficiency Building Retrofits – Component Economics

Whole building retrofits can be sub-divided into nine components, six improve the building's usage of electricity and natural gas, making it more efficient, and three generate onsite heat and/or power. Retrofits should be able to reduce a building's gross energy bill, on average, by 20-50%, the net energy bill is highly dependent on the situation and segment of the market, but net energy savings should be possible post-retrofit in most situations. Retrofit providers have indicated that retrofits are only cost effective under a certain cost per square meter, a correlation which makes sense given that energy usage tends to be directly correlated with size of a space.

For any building some activities will be more profitable than others, making a comprehensive (or packaged) approach the best way to maximize the aggregate energy efficiency gains for a country while optimizing the risk-reward and friction costs for each individual building. This chart provides a very rough guide to relative capex and returns for each component:

	Type of Retrofit	Practical Difficulty	Capital Cost	Pay Back (years)	IRR	Overall Difficulty
Energy Efficiency	**Efficient Lighting**	Low	Low	1-2	High	
	New Boiler/Air-conditioner	Low	Medium	2-7	Medium	
	Usage/Energy Management (ex. Smart Thermostast)	High	Low	0-1	High	
	New Efficient Appliances (ex. Refrigerator)	Medium	Medium	3-10	Medium	
	Insulation	Medium	Medium	3-15	Medium	
	Fittings/Windows	Medium	Medium	8-15	Low	
Micro-gen	**Solar Thermal/Geothermal**	Medium	Medium	5-10	Medium	
	Co-generation	High	High	5-9	Medium	
	Micro-generation	Medium	High	10-25	Low	

2. Methodology

Our analysis begins by comparing the current status of residential building and commercial building energy efficiency policies and practice in the US, the UK, and Spain. We have chosen to focus on these three countries because they share similarly inefficient building suck and all three are currently experimenting with ways to improve building energy efficiency. The US and UK are slightly ahead in their energy efficiency building retrofit market development, making them particularly interesting examples to examine in the Spanish context as Spain begins to move in a bigger way into this area in order to meet its emission reduction goals. We then identify the common themes in the market's response to these policies and practices and their relative successes in delivering against our target outcome: The timely delivery of the optimal regional buildings retrofit transformation at a scale to match the opportunity.

We look in detail at three template business models, which describe the bulk of the private sector policy response and retrofit activity. We evaluate how well these business models address the interests of key stakeholders and how they may meet the many challenges in the energy efficiency building retrofit marketplace for the future. We also analyze the type of policies that governments have tried to improve energy demand management. To date, the majority of energy policies have focused on the 'supply side' in our three target countries, but the US, UK and to some extent Spain have begun to experiment with 'demand-side' policies.

Finally, we propose a new hybrid business model targeted at the residential, multi-unit and small and medium enterprise (SME) sub-sectors which we believe builds on the strengths of the existing models and addresses some of their weaknesses with regards to these sub-sectors. We use this new model together with our analytical framework to help target areas of focus in Spain and generate ideas as to how these could be rolled out in the Spanish institutional framework and business context[24].

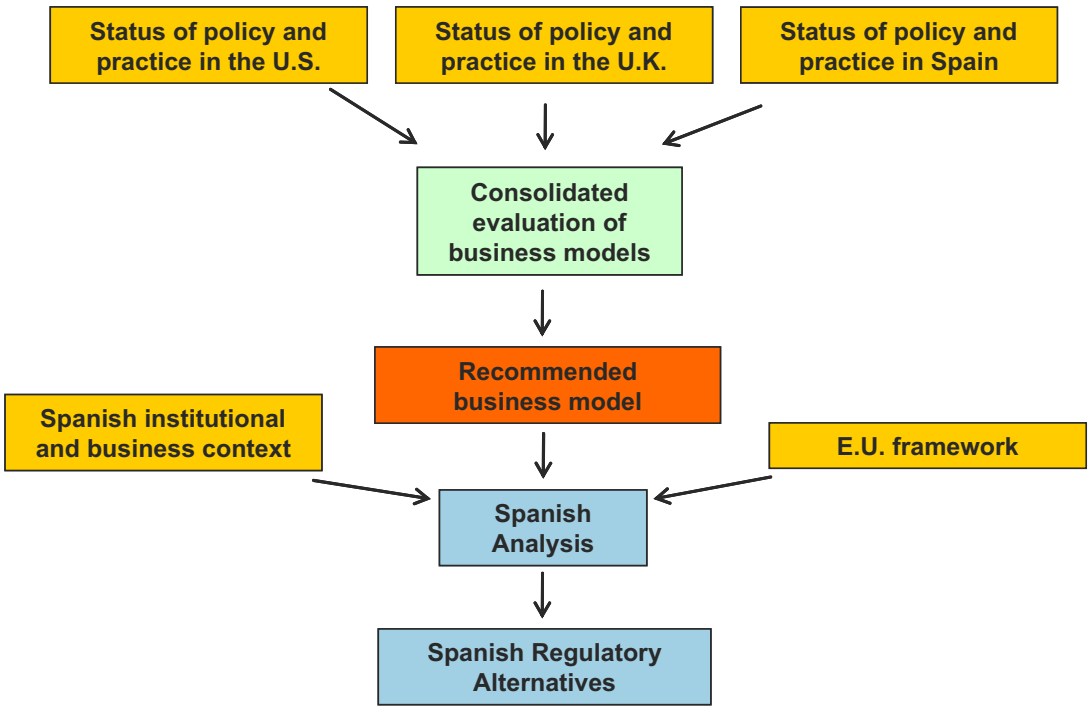

Figure 1 Methodology

2.1 Limitations to the Scope

This paper does not seek to extend beyond energy efficiency retrofits in existing buildings. While the energy efficiency of new buildings, efficient transportation, industrial efficiency, distributed electricity generation are convergent, parallel and occasionally overlapping areas, we do not seek to extensively cover them here. Our analysis extends to them only to the extent that any of the broader energy efficiency policies impacting several of the subsectors, including existing buildings, may impact retrofits and the business models required to finance and deliver them alongside further change.

[24] While targeted into the Spanish context, we believe that our analysis and business model proposal applies to any market with appropriate policy support.

We try to make the clear separation of energy efficiency retrofit (as a demand reduction mechanism) from onsite generation (as a distributed means of production of local heat or power, whose primary energy efficiency is derived from reduced transportation losses) and from power shifting (the more efficient distribution of power load during the day/ year). In broad terms, we think that policies directed at all three of these areas will bear fruit at different speeds and in different regions depending on many independent variables. To be clear, this paper will focus on the business and policies required to deliver demand reduction at scale through the stimulation of optimal buildings retrofits.

Although we describe all the challenges the energy efficiency market faces (structural, financial and behavioural), our focus here is on solving the structural and financial challenges. We recognise that the behavioural challenges are also incredibly important to overcome to bring the energy efficiency market to scale, and that they require a different, yet complimentary, set of actions than the resolution of the structural and financial challenges. We believe that our proposals will help the sector overcome some of the behavioural challenges, but it is in no way intended to be a complete solution to these challenges.

We draw attention to the fact that different structural and financial solutions are appropriate for different sub-sectors of the buildings market. We have considered various ways to segment this market: Residential or commercial, by building size, by use, multi-unit or single family, by investment size, by required investment per unit area, by owner motivation (as examples: "green", "cost conscious", "peer pressured", "non-economic"), by access to finance (with savings or without) and others. In general, our business model analysis focuses on residential, SME and multi-unit housing. While our work has considered larger commercial and municipal-scale projects-by-neighbourhood, our business model and subsequent policy discussion is focused on smaller, non-pre-aggregated projects. We have been unable to find consistent motivational characterizations across the research or good data sets with which to work (and we suspect motivational factors will also differ greatly by geography) and so we have left a rigorous intra-regional sub-segment approach also outside our current scope.

We have drawn together initial policy and practice analysis from a literary review of over 120 academic papers and journal articles[25]. In the US alone, over one thousand papers have been written on the subject of energy conservation and efficiency policy and practice.[26] In such a complex area, we also recognise that our wish to gain traction with a broad readership risks the over-simplification of policies and practice and necessary avoidance of in-depth analysis in certain areas. Our approach to resolving this, with limited resources, has been to complement our literary review with interviews and engagement with 34 expert reviewers in our key geographies, and trust our judgement.

3. BUILDING COMPARISON: US, UK AND SPAIN

Despite some technological changes and improvements in standards for the energy efficiency of homes and appliances since the 1980s, changes in lifestyle that increase the heating, lighting and general energy demands on buildings have resulted in a steady increase in the energy intensity of buildings in the US, UK and Spain. The present rate of construction of new buildings in all

[25] Please see the References Appendix for the full list of works cited, full archive of papers available on request.

[26] Vine, E., *Breaking down the silos: the integration of energy efficiency, renewable energy, demand response and climate change*, 2008

three countries is now less than 2% per year, so in order to rapidly improve the efficiency of the building stock, retrofits of existing buildings are necessary at a large scale. For a comparison of the climate zones present in the three target countries see endnotes.[i]

Detailed data comparing the existing building stock is only available for residential buildings. In all three countries, 60% of the residential building stock was constructed before 1980; in fact in the UK the figure is nearly 80%. Ownership turnover is around 18 years in the US and the UK, but closer to 30 years in Spain, making Spain an easier place potentially to implement longer-term payback retrofits, but in all cases giving margin for 15 year paybacks. Multi-unit housing is much more common in Spain, at 71% of all housing, than in the US and UK, making retrofit decisions potentially a slower and more difficult group process for the majority of the Spanish multi-unit residences ("*communidad de vecinos*") and their residents' boards are key clients for residential retrofit providers in Spain.

	US	UK	Spain
Multi-unit residences	25%	12%	71%
Residence owner occupied	67%	68%	89%
Average Residence Ownership Period	18 years	18 years	29 years
Residences constructed before 1980	59%	79%	58%
Number of Residences (millions)	128	22	25

Figure 2 Residential Building Comparison, US, UK, Spain[ii]

Commercial building stock in Spain and the UK is also quite old with more than 60% built before 1975, and over half of commercial buildings are small buildings, making this white paper's proposals particularly relevant.[27]

	constructed before 1975	constructed 1976-2004	small buildings	large buildings
Spain – commercial buildings	61%	39%	53%	47%
UK – commercial buildings	60%	40%	55%	45%

Figure 3 Commercial Building Comparison, UK, Spain

[27] Fraunhaufer, *Study on the Energy Savings Potentials in EU Member States*, Candidate Countries and EEA Countries, 2009;

4. ENERGY EFFICIENCY POLICY FRAMEWORK

This section summarises and categorizes twenty-two policy-types which either stimulate or stunt the accelerated implementation of residential and commercial buildings retrofits. Each of these policies, of course, complements an underlying and complex regulatory framework governing the local energy markets. The relative success of policies promoting energy efficiency against an energy background of vertically integrated, regulated utilities with captive clients (many US States) will differ from those in fully segmented and liberalized markets (eg. UK) or those where the majority of the household sector (<10kW) receive a regulated tariff (Spain). Interestingly, and notwithstanding these dramatic differences in regulatory framework, the actual policies used to promote energy efficiency can be grouped and compared across regions. Policies fall into just four categories:

1. **Standards:** Regulated mandates applied to buildings, retrofit providers, city-regions, electric and gas utilities or that prescribe minimum standards, standard approaches or legal compliance requirements for energy market participants;
2. **Direct Financial Assistance:** Government or policy-led provision of direct financial assistance which directly impacts the economics of the energy efficiency retrofit investment. Examples include: Capital expenditure financing, soft loans or part-contribution to the cost of the retrofit, the provision of risk underwriting, first loss absorption, insurance provision and/ or Government wrap/ credit enhancement to subsidize financing costs or provide otherwise unobtainable access to the capital markets;
3. **Market Based:** The creation of a market-mechanism (white certificate or tradable obligation) or the adaptation of fiscal code as relates to building stock (annual property tax) or the fiscal treatment of the rent or sale of the retrofit building (both an accretion of value to the building through the adjustment of the economics of an uncorrelated "market event" to the retrofit itself);
4. **Removing Hurdles:** This covers all policies directed specifically at the removal or reduction of specifically identified hurdles to greater retrofit market penetration. Examples include: Provision of information, education, buildings labelling, decoupling of amount of power sold from total energy-cost billed by electric and gas utilities, or enabling the use of the utility billing channel to various retrofit finance providers;

Figure 4 summarises the sixteen types of policies we identify as having been used in the US, UK and Spain to promote energy efficiency retrofits:

	Policy Category	Description
Standards	Strong Building Codes	Energy efficiency requirements for new buildings and/or building retrofits.
	Labeling or Retrofit requirements at Time of Sale/Rental	Requirements for buildings to have an energy rating label (Energy Perfomance Certificate) in order to be sold or rented, may include required levels of retrofit at the time of sale.
	Retrofit Provider Accreditation	Accreditation of energy efficiency building retrofit providers, including technical warranties, reduces both customer and lender risk.
	City-wide Opt-out Policy	Governments automatically enroll whole areas in energy efficiency programs individuals have the right to opt-out if they don't want to be included.
	Utility Minimum Spending Requirement	Utilities are required to spend a certain percent of their profits or a certain dollar amount on energy efficiency retrofits for their customers.
	Utility Energy Efficiency Priority Resource Requirement	Requires electric and gas utilities to implement all energy efficiency opportunities that cost less than new energy supply as the first priority energy resource.
	Appliance Standards	Energy efficiency requirements for new appliances, such as refrigerators.
Direct Financial	Direct Government Subsudy unlimited	Any type of direct financial assistance from the goverment, rebates, interest rates below treasury bond rates, etc.
	Government Risk Insurance	Loans below market rates and/or government loan guarantees.
	Property/Tax Financing (PACE)	Municipalities offer loans for energy efficiency retrofit's that are repaid through an annual surcharge on annual property taxes.
Market Based	Certificate Programs [CERT/EERS]	Requires that utilities improve the energy efficiency of their customers by targeted amounts, often with flexibility to achieve the target through a market-based trading system.
	Fiscal Incentives, e.g. stamp tax	Tax incentives for improvements in energy efficiency and/or penalties for inefficiency.
Removing Hurdles	Building Energy Label Requirement	Requires that a building's energy perfomance rating be provided when the building is constructed, sold or rented out.
	Education	Any program to improve knowledge and awareness of energy efficiency and/or preparedness to implement energy efficiency retrofits.
	Enable On-bill Repayment	Requires that utilities allow energy efficiency retrofits to be repaid as a line-term on the energy bill, thereby making the savings and payment sources one and the same.
	Utility Decoupling	Utility pricing that separates a utility's profits from the amount of electricity that it sells through a rate adjustment mechanism, removing the disincentive for investment in energy efficiency.
	Direct Technical Assistance	Government publication of technical documents and capacity building.

Figure 4 Favourable Energy Efficiency Policy Descriptions

Not all policy has a positive effect on retrofit uptake and Figure 5 outlines five policies which we identify which impede and create barriers for energy efficiency retrofits:

	Policy Category	Description
Standards	Electric Rates that Decline as Use Rises	When the biggest electricity users get the cheapest electricity rates the incentive to use energy more efficiently declines.
Direct Financial	Subsidized Energy Consumptiuon	Any consumer energy price subsidies will have a negative effect on energy efficiency.
Direct Financial	Limited Direct Government Subsidy	A limited subsidy can limit the amount of energy efficiency retrofits because even projects that are profitable without subsidies are not completed if they have to complete with subsidize projects for funding. Subsidies are necessary, but must be carefully designed to enable the market, not limit its size.
Market Based	Tax Write-offs of Energy Costs	Any energy tax exemp`tions or income tax writteoffs of energy costs send the wrong signal to the market.
Removing Hurdles	Utility Profit Driven Mainly by Amount of Energy Sold	Utility regulation often allows increased profits through increased energy sales, leading to a disincentive to help customers become more energy efficient.

Figure 5. Detrimental Energy Efficiency Policy Descriptions

5. POLICY SNAP-SHOT AND CASE-STUDIES: US, UK AND SPAIN

This section characterizes the use, relative weighting and success of specific policy approaches in our three selected geographies. While this is not an exhaustive policy analysis, we hope to characterise each market and draw from the research some common themes and the more recent developments in each market. While it is ambitious to try and capture the complex policy landscape of three diverse countries in such limited space (risking both insufficient depth and coverage gaps), yet we hope to have found a balance which illustrates several key themes which we will build upon later in our analysis.

5.1 United States: Status of Policy and Practice

Building energy efficiency has received a relatively low level of policy attention in the US since the 1970s, until the last five years when attempts to increase building efficiency have increased significantly. US building energy efficiency policy has been advanced through a mix of federal and state level policies, with the majority of the major policy innovations happening at the state level[28]. However, the federal government has jurisdiction over national appliance and equipment standards, certain direct financial assistance programs and federal government buildings energy usage. The federal government has set a standard for federal government buildings, requiring them to reduce energy use to 30% below 2003 levels by 2015.

In addition to these Standards based regulatory incentives, the US federal government provides a variety of Direct Financial Assistance (DFA) and Markets Based incentives for energy efficiency improvements, such as energy efficient commercial buildings tax deductions and residential energy efficiency tax credits. The federal government provides some support for energy efficient mortgages (EEMs) which provide finance for energy efficiency improvements by increasing existing mortgages. EEM's typically provide additional loans of up to 5% of home value. When

[28] US Department of Energy website, 2010

lenders can prove they know how to write EEMs, they can become Energy Star partners. The Energy Star program had 23 lender partners as of July 2010[29]. Unfortunately, the use of EEMs remains low.

The federal government also provides significant DFA to retrofit low-income homes through the Weatherization Assistance Program (WAP), and to public low-income housing through the Housing and Urban Development Program. WAP was created in 1973 after the fuel crisis and slowly grew in size and scope, weatherizing a total of 6 million homes by 2008, approximately 4.5% of all US residences. In 2009, the Weatherization Assistance Program received US$ 5 billion in funding to weatherize 600,000 homes as part of the American Recovery and Reinvestment Act[30]. The federal government also provides financial support and incentives for state and municipal run programs. $16.8 billion of funding for existing federal programs, as well as trial of some new programs, was provided by the American Recovery and Reinvestment Act

Twenty four US states have passed an Energy Efficiency Resource Standard (EERS), requiring electric utilities (and in eight states gas utilities as well) operating in the state to meet a specified energy savings target by a specified date[31]. Most of the programs require energy savings of around 15% by 2020. As a means of meeting the EERS requirements, many states provide DFA paid for by public benefit charges on all energy bills, which are then deposited in a public benefit fund. Twenty two states, plus the District of Colombia, have some type of public benefit fund in place. State programs deploying the public benefit fund to meet EERS goals vary widely. Some states require electric and gas utilities to use the funds and run programs to improve the energy efficiency of their customer base and meet EERS goals, while others establish not-utility administrators manage the energy efficiency programs to meet the EERS obligations. In addition, some states with regulated electricity markets have simply allowed utilities to recover costs associated with energy efficiency rebate programs by treating those expenditures as if they were investments in new generating capacity. In some states, utilities have realized the potential for economic gains from energy efficiency retrofits and have become the key proponents for the permission to charge customers for retrofit energy savings, for example Duke Energy's Save-A-Watt program.[32]

Various states have passed energy efficiency priority resource requirement and utility rate decoupling programs. All states have some form of energy efficiency rebate programs and provide DFA grants or loans for energy efficiency retrofits. The administrator of these programs varies, sometimes it is the state itself, and in other cases the program is run by the utility or a municipality. In addition, some municipalities have passed Residential Energy Conservation Ordinances, requiring homes to meet certain energy efficiency requirements when they are sold or undergo any major renovation.[33]

Some states also have tax incentives for energy efficiency: State tax incentives vary greatly, and include incentives linked to personal tax, corporate tax, property tax, or sales tax incentives. For each type of tax, between 6 and 16 states have some form of energy efficiency incentive.

[29] For a lender to maintain their partnership they must issue a minimum number of EEMs each year.

[31] Pew Center on Global Climate Change website, *Energy Efficiency Standards and Targets.* 2010

[32] Duke Energy website, 2010

[33] NEEP, *Valuing Building Energy Efficiency Through Disclosure and Upgrade Policies: a Roadmap for the Northeast US,* 2009

Of all the state grant and loan programs, a particularly innovative new program is the Property Assessed Clean Energy (PACE) program. Under the PACE program a municipality issues bonds whose proceeds are lent to commercial and residential property owners to finance energy efficiency retrofits and small renewable energy installations. Property owners repay their loans over 15-20 years via an added annual assessment on their property tax bill.[34] Twenty three states have authorized PACE financing. 14 municipalities have implemented a PACE program so far, and many more are in the process of doing so.

At the time of writing, questions were raised over the PACE program by the Federal Housing Finance Agency as well as mortgage lenders Fannie Mae and Freddie Mac, which announced they would not underwrite new mortgages on properties with outstanding PACE obligations as they view PACE property improvement (retrofit) repayments through property taxes as senior to the mortgage[35]. We believe that, given that PACE retrofit activity is restricted to those retrofits which can be repaid from energy savings over 15-20 years (i.e. many), then mortgage lenders need not worry, in fact they might chose to encourage PACE as the net effect would be to improve the creditworthiness of their borrowers (as we assume PACE repayments are less than annual energy savings and hence the homeowner has more cash to repay mortgages). PACE could theoretically be paired with a tiering of property tax payments based on energy efficiency per square meter so that more cash is made available to owners of energy efficient properties and mortgage lenders' interests more aligned with PACE.

For a case study on how California, is implementing a suite of energy efficiency policies, see endnotes.[iii]

5.2 United Kingdom: Status of Policy and Practice

Until recently, energy efficiency policy in the UK has evolved around a combination of targeted Direct Financial Assistance ("DFA") coupled with on-going initiatives focused on Removing Hurdles strongly supported by the Energy Savings Trust (a combined Government-private sector body established in 1993).

The UK's the Warm Front programme (originally called Home Energy Efficiency Scheme) targets fuel poverty and has provided DFA grants of up to £3,500 per household to over 2 million low income homes since it began in 2000[36]. In 2008, the Carbon Emissions Reduction Target (CERT) programme was introduced requiring all large domestic energy suppliers to make savings in the amount of CO_2 emitted by households they serve. Suppliers meet this target by promoting the uptake of low carbon energy solutions to household energy consumers, thereby assisting them to reduce the carbon footprint of their homes[37]. The CERT programme has increased the pace of retrofit activity in the broader UK housing stock significantly. In 2008, the UK also began to require Energy Performance Certificates (EPCs) any time a home is sold or rented. Accredited energy assessors produce EPCs alongside an associated report which suggests improvements to make a building more energy efficient.[38] The UK government recently made the significant commitment to upgrade the energy efficiency of 7 million British homes by 2020[39].

[34] PaceNow website , 2010

[35] *FHFA Statement on Certain Energy Retrofit Loan Programs,* July 6th, 2010. http://www.fhfa.gov/webfiles/15884/PACESTMT7610.pdf

[36] Warm Front website, 2010

[37] UK Department of Energy and Climate Change website, 2010

[38] DirectGov website, 2010

The majority of UK Government provided DFA has been delivered with a high degree of specificity, meaning it is either directed at specific parts of the community (low income) and/or at specific components within a home retrofit (such as the Boiler Scrappage Scheme or scaling the DFA based upon individual component inclusion, e.g. Loft lagging or cavity wall insulation)[40]. While improving specific retrofit project economics (IRRs) and lowering payback periods, this can cap the speed of uptake and, together with CERT, may lead to energy suppliers engaging in "Cherry Picking" (see below) leaving whole home optimal energy efficiency retrofit measures for a later date when this rump-project will require more capital and deliver less attractive and longer paybacks.

In 2009, the Community Energy Saving Programme (CESP) was introduced to focus the DFA provided to low income housing. CESP specifically targets improved insulation and adopts a whole of home approach[41]. CESP includes incentives designed to combine various retrofit components into a single project and uses the Local Housing Authorities ("LHAs") and landlords as aggregators to build scale. CESP is certainly designed to address a key market segment and proactively engage the LHAs, but it is too early at present to assess its performance.

In 2010, the UK launched its most ambitious programme so far: the CRC Energy Efficiency Scheme which is a Market Based cap and trade programme targeting all sizeable[42] energy consumers not covered by EU Emissions Trading Scheme (i.e. commercial and residential buildings rather than industrial sites). The CRC objective is to save 1.2 million tons of CO2 emissions annually by 2020 and it provides a clear signal and incentives for large consumers to analyse energy efficiency options and invest in whole of building retrofit projects.

Case Study: UK's CRC Energy Efficiency Scheme[43]

The CRC Energy Efficiency Scheme (Carbon Reduction Commitment) is the UK's new carbon emission reduction scheme administered by its Environment Agency covering an estimated 4,000 companies with annual energy bills around £500,000 which started operating in April 2010. The scheme's goal is to drive economy-wide emission reductions at a scale so far not achieved through the European Emissions Trading System (EU ETS), which impacts mainly industrial and power facilities (only 5% of the covered firms' emissions are captured by EU ETS and hence they are exempt from CRC). By 2020, the UK Government expects the CRC to drive 4.4 million tons of annual CO2 emissions reductions and for the scheme to have delivered a total net present value[44] of £ 1 billion of energy cost savings to those same companies.

All organizations that used more than 6,000 MWh of half-hourly metered electricity in 2008 are required to participate. Firms must register for the program this year[45] and calculate the carbon footprint[46] of their activities from 2010 financial year onwards. Participants must buy one

[39] UK Department of Energy and Climate Change *Warmer homes, greener homes: a strategy for household energy management.* 2010

[40] In a similar component-specific way, the Enhanced Capital Allowances (ECAs) program enables businesses to write-off the whole of the capital cost of their investment in qualifying plant and machinery against their taxable profits.

[41] UK Department of Energy and Climate Change website, 2010

[42] Over 6,000 MWh metered consumption per year.

[43] UK Department of Energy and Climate Change, *Consultation on the Draft Order to Implement the Carbon Reduction Commitment, Government Response and Policy Decisions,* 2009.

[44] Using a commercial 10% discount rate.

[45] Or suffer a £5,000 fine.

[46] Based upon a form of self certification.

allowance for every ton of emissions covered by the scheme. The first sale of emission allowances by the UK Government will take place online in April 2011, at an initial price of £12 ($18) per ton of CO2, and all revenues raised from these sales will be recycled back to the best performers under the scheme. Following this initial sale these allowances can be bought or sold in a secondary market. From 2013, the number of allowances will subject to a reducing cap and will be auctioned at the then market price. Finally, every year the Government will publish a full league table of all participating firms and their relative performance under the scheme. Relative performance will be initially calculated based upon the weighting of three factors: Percentage absolute annual CO2e reduction, reduction in CO2e intensity and for "early action" measures.

The price for allowances is likely to go up overtime, increasing participant's incentive to invest in energy efficiency improvements. Scheme models suggest that top performers which implement strong energy efficiency measures could see their overall energy and compliance costs reduce by 8% by 2015, however, the impact on the worst performing firms (making few changes to efficiency) could be to increase their 2015 energy with compliance costs by up to 20%[47]. The CRC league tables themselves are also expected to be a very powerful "show and tell" motivation as customers and other stakeholders use this as an objective way to judge company performance against climate goals. For a detailed CRC timeline, see endnotes[iv].

5.3 Spain: Status of Policy and Practice

Energy Efficiency policy in Spain is coordinated and guided by the resources and technical leadership of the *Instituto para la Diversificación y Ahorro de la Energía* (IDAE, literally the Energy Diversification and Savings Institute) in conjunction with the autonomous regions. IDAE is a government agency reporting to the Ministry of Industry, Tourism and Commerce (MITyC) which manages overall energy policy.

IDAE is the principal architect and agent of Spain's energy efficiency policy framework as articulated in Spain's Strategy for Energy Savings and Efficiency 2004-2012 and as activated through two further legislative developments: The energy efficiency Action Plan 2008-2012 and the Plan to Activate Energy Savings 2008-2011. In addition, there are parallel references and measures included in both Spain's Sustainability Strategy and its 2009 Sustainability law, and in its National Allocation Plan legislation providing for the European carbon trading allowance allocations and emissions reduction strategy.

Spain's energy efficiency Action Plan 2008-2012 sets a national target of 11% energy savings by 2012, thus exceeding the target set by EU Directive 2006/32/EC of energy savings of 9% by 2016[48]. The Plan to Activate Energy Savings 2008-2011 is a consumer awareness campaign that aims to achieve a reduction in energy use equivalent to 10% of the country's annual oil imports mainly through Removing Hurdles by the end of 2011[49]. Both of these programs are run by IDAE in collaboration with the autonomous regions which coordinate much of the DFA provided to invest in energy efficiency and related projects.

[47] Price Waterhouse Cooper LLP, *CRC Modeling*, 2010
[48] IDAE, E4
[49] IDAE website, 2010

The Spanish Climate Change and Clean Energy Strategy include a long list of proposed actions for residential, commercial and institutional buildings. Many of these proposed actions are also included in the 2008-2012 Action Plan. In 2009, Spain drafted their Sustainable Economy Law, which also includes energy efficiency provisions[50].

The principal axis of Spanish Energy Efficiency policy to date has been based around an investment of resources on a sectoral and regional basis, in conjunction with the autonomous regions, based around the E4 plan. By the end of 2007, the Government estimated it would have invested over Euro 700 million ($940 million) along these lines mainly transferred for investment at a regional level. In parallel, IDAE has focused on Removing Hurdles, through information and awareness activities and direct support for ESCOs, coupled with a fairly extensive programme of DFA provided through a series of specifically structured credit lines, grants and soft-loans provided in combination with the state bank ICO ("*Fondo de Economia Sostenible*"). The bulk of this support (by volume) seems to have been targeted at industrial and large scale commercial energy efficiency projects rather than the residential built environment to date.

The Spanish Government plans to improve the energy efficiency of 330 government buildings, having tendered for this work in 2010, and is expanding this programme to a further 2,000 more with the Plan 2000ESE. The Plan 2000ESE, the 'Boost for Energy Service Contracts' commits 1,000 national government and 1,000 autonomous community and local government building to make a 20% reduction in energy consumption. The plan is expected to provide a significant boost to ESCO activity in Spain.

Spain's direct regulatory involvement of the utility sector in mandatory programs, like EERS or CERT, has been limited and its potential use of Market Based policies for the promotion of energy efficiency is yet to be developed. Recent retail energy market liberalization (the ability to change supplier) and the vertical integration of a limited number of large energy players presents some unique challenges to and opportunities for energy efficiency market development in Spain which we shall review in greater detail.

6. OVERVIEW OF EXISTING RETROFIT BUSINESS MODELS

The opportunity to profit from cutting energy costs by making buildings more efficient has existed for decades, but capturing the full potential of this opportunity continues to elude us. Energy efficiency retrofits require a material up-front capital outlay (often for a home-owner of similar magnitude as the purchase of a car) and face not only financing challenges, but also structural and behavioural challenges, all of which we address here.

We chose to highlight the key prevailing themes from our research by reference to three business models which have grown out of the market's need to serve the demand for buildings retrofits, as promoted or hampered by the various policies. Interestingly, although individual policies vary greatly across the globe as we have seen, the private sector response has varied less so. While there are clearly hybrids and blends of the three basic models which we describe, we believe that the analysis of our selected business models and their relative performance against hurdles, and under various policies, is a useful way to judge relative policy successes and future scalability.

[50] Gobierno de España website, 2010

6.1 Owner Financed Model

The Owner Financed Model has grown out of the underlying rational-economic building owner's trend to value the cost savings apparent in an energy efficiency retrofits and independently contract and finance that retrofit using savings or a loan often secured on the building.

This business model is the oldest and most exposed to the barriers to optimal retrofit execution, which we discuss below, and as a result has grown to include a number of variations often focused around making it easier and cheaper for the owner to access finance for the retrofit. Energy Star backed Energy Efficiency Mortgages, in the US, have raised Owner Financed Model's visibility and begun to increase retrofit penetration. The enabling of "on-bill" repayments (energy or property tax), through programmes like PACE, will also help broaden the audience for the Owner Financed Model.

Under Owner Financed Model, the building owner controls contracting, retrofit component selection (and hence the retrofit project price), project management of the work and is fully liable for the retrofit's subsequent economic performance (i.e. volume of energy required to deliver post-retrofit living conditions) as the financing has only recourse to the owner (possibly secured) but not directly to the retrofit components nor its overall energy performance. By assuming all the components of the retrofit's risk, the building owner is well placed to benefit from any economic outperformance (i.e. when energy prices go up faster than planned) and clearly can benefit directly from a higher grade Energy Performance Certificate and improved acoustics and liveability. Owner Financed Model works well for highly motivated, market-oriented communities of single property owner-occupiers who are economically rational. Owner Financed Model penetration rates will also benefit when the market of retrofit providers is competitive, transparent and easy to negotiate and the availability of private finance is high, easy to contract and provided competitively.

6.2 Utility Fixed Repayment Model

Under the Utility Fixed Repayment Model there two central assumptions: the up-front capital cost of an energy efficiency retrofit is organized, subsidized and at times fully provided by a utility, and this investment is repaid through monthly, fixed, non-retrofit performance related surcharges, which in some programs are spread across the whole rate-base and in others appear only on the retrofit customer's monthly energy bill.[51] Utility Fixed Repayment Model requires a supportive policy framework in order to function and the types of legislative changes which regulators have made include: Requiring that electric and gas utilities improve the energy efficiency of their customers by a certain amount each year, white certificate programmes, decoupling utility profits from the quantity of electricity sold and requirements that utilities invest first in the lowest cost sources of energy – which is very often energy efficiency as many efficiency improvements have a negative cost.

The Utility Fixed Repayment Model has several immediate advantages over the Owner Financed Model:

1. Utility cost of finance, access to funds and available leverage should be considerably better than that achieved by owners under Owner Financed Model;
2. Friction costs are reduced from the economies of scale created by a utility executing many hundreds or thousands of its individual client retrofits;

[51] Fuller, *Enabling Investments in Energy Efficiency* 2008, US Department of Energy website, 2010

3. Customer "ease of execution" is enhanced as execution is streamlined and there is less work for the building's owner than in Owner Financed Model [52].
4. Government can use its relationship with the Utility sector to align interests and push national energy efficiency targets down to the corporate level through the imposition of Standards and Markets Based programmes like CERT in the UK or the white certificate scheme in Italy (see case study in section 12).

There are of course pros and cons of using energy companies as the main channel for the achievement of Government energy efficiency targets. As aggregators they are the natural partners: Energy is their business, they have lots of customers, with access to the energy data required to profile them, and utilities are structured to make major, long-term structural investments in electricity or gas markets[53]. However, without fully decoupling energy suppliers' profitability from the gross amount of energy sold and moving to a smart-grid world where "quality aspects" might dominate, it is hard to see to what extent and for how long energy efficiency can be their top priority.

Energy efficiency retrofits require a different business model and resource base than centralized electricity or gas generation, transmission, distribution and sale. While many electric and gas utilities have a strong path dependency and skill set which presently lies in this traditional group of activities, we see several of the leaders investing in "improved service delivery" and customer centric activities which pave the way for a possible paradigm shift to a world focused more on customer energy intensity and efficiency.

The fixed or formulaic approach to pricing under the Utility Fixed Repayment Model leaves the building owner exposed to the actual retrofit performance risk (through genuine over-optimism on savings, energy price volatility or due to the "Rebound effect" – see below). To minimize the risk of customer dissatisfaction related to retrofit performance, the utility may engage in "cherry picking" (doing only the retrofit components which have the highest IRRs) or formula-gaming (sub-optimal retrofit component selection driven by arbitraging the formula). At a national level, this may cause substantial deviation from the optimal pathway to a national portfolio retrofit over the medium to longer term, even with the lower utility cost of funds and other inherent advantages. For example, in the top 14 US utility-run energy efficiency programs lighting improvements account for 2/3 of energy savings and, many of these programs are falling short of achieving state energy efficiency improvement targets. [54]

6.3 Energy Performance Model

The Energy Performance Model can be characterized in three ways: a specialized energy efficiency retrofit contractor, such as an ESCO, finances the retrofit investment, it guarantees future energy performance and it recovers its capital invested directly from the energy savings generated by the retrofit, some of which are often also shared with the building's owner as an incentive to act.

The Energy Performance Model has seen most of its application and success in very large retrofits (and in industrial energy efficiency). In the US, in 2008, ESCOs received 88% of their revenue from government buildings and public housing projects, 6% from utility programs and

[52] Though many utility programs in the US and UK operate on the basis of voluntary participation and require homeowners to make a large portion of the decisions regarding an energy efficiency retrofit.

[53] Duke, *Transforming Utility and Ratepayer support for Energy Efficiency*

[54] ACEEE, *Meeting Aggressive New State Goals*

only 7% from private sector commercial and industrial projects.[55] The growth of the Energy Performance Model into smaller segments of the market has been limited because estimating precise energy savings and measuring them in real time to generate bills that are 'guaranteed' to save money carries many transaction costs that often cannot be justified for small projects.

Business Model	Definition	Initial Investment Paid By	Limiting Factor	Investment Performance Responsibility	Regulatory Support		
					U.S	U.K.	Spain
Owner Financed Model	Energy efficiency building retrofits financed with the building's equity and managed by the building owner.	Building Owner	Owner's Funds	Owner	◔	◔	○
Utility Fixed Repayment Model	Energy efficiency building retrofit financed by a utility and paid for through fixed monthly payments.	Utility or Government	Regulations	No One	◑	◑	○
Energy Performance Model	Energy Service Company (ESCO) finances the energy efficiency retrofit and is paid back from energy bill savings.	Energy Service Provider	Energy Service Provider Balance Sheet	Energy Service Provider	◑	◔	◔

Figure 6 Business Model Definitions

7. STAKEHOLDER ANALYSIS

The energy efficiency building retrofit market is made more complex in part because there are a large number of stakeholders, each with their own set of interests that must be met in order for an optimal portfolio retrofit to take place.[56] Our analysis defines a key driving economic interest for each stakeholder and then highlights the manifestation of their various non-economic interests through a review of how they manifest under the "Market Challenges" section. The following ten retrofit stakeholders fall into four broad groups:

7.1 Client

1. **Building owner** – The owner's primary economic interest is to maximize value of the building (for sale or rental purposes). The building owner is the key customer or client to whom the retrofit product is sold. Many owners may have any number of secondary drivers, such as environmental certification, aesthetic changes, liveability and comfort or just avoiding the project management and possible disturbance of retrofit execution.
2. **Building occupant** – The primary economic interest of the building occupant is to minimize energy costs and non-economic focus is to minimize the "hassle factor" as occupant. The occupant is a crucial stakeholder because they determine the level of energy use through heating, cooling and lighting decisions. The level of energy use is clearly the key factor in determining the performance and hence level of profitability of a building retrofit.[57]

[55] Lawrence Berkeley National Laboratory, *A Survey of the US ESCO Industry,* 2010

[56] As suggested by most theoretical work, for example the MAC curves analysis done by McKinsey, *Pathways to a Low Carbon Economy,* 2009.

7.2 Finance

3. **Equity Funder** – The third party equity funder is interested in maximizing returns to equity at known risk with a pathway to exit or repayment within a determined horizon, say 5-15 years. External equity has been hard to attract to buildings retrofits because there is limited experience in the asset class, there is little performance track record in retrofit investments and deal-size can be very small (requiring aggregation to create an interesting investment).
4. **Debt providing bank** – The debt providing bank wants to see stable and predictable cash-flows at known and manageable risk. Like the equity funder, banks are not yet technical experts in the field of energy efficiency and need to see a track record of performance of energy efficiency retrofits in order to become comfortable with and lend against the retrofit asset's energy savings value-stream.

7.3 Electricity and Gas Utilities [58]

5. **Power generator** – Highly subject to regulation, but mainly power generators look to sell more power (or operate more contracted generation assets) and generate this power at lower costs. The power generator's economic interests may seem far removed from the customer dynamics involved in energy efficiency, however the strength of their voice and, in many states and countries, their vertical integration through to supplier/ retail level makes them very relevant.
6. **Power distributor** – The primary economic interest of the power distributor entity is to maximize its profits from power distribution activity. Without decoupling, these profits are invariably linked to the volume of power flowing down its wires or depend on the number of connecting entities, connections, or its regulated asset base. In regions where the distributor receives a fixed connection charge for the local connection infrastructure to the building, it could act as a collector and redistributor of on-bill fixed charges against the property associated with an energy efficiency retrofit. This is a means to link the retrofit repayments to the building (and hence its current energy user) rather than the individual who contracted the retrofit who may move. The capital cost of the retrofit could also be considered as an increase to the regulated asset base. Finally, load balancing, peak shifting and any greater stability which might accrue to large regional retrofits, or from smart homes, may hold significant economics in the future and is attractive to the system operator.
7. **Electricity retailer or supplier** - The electricity retailer's primary economic interest is to maximize its profits from energy sales (number of customers multiplied by customer volume purchased times customer price less energy and overhead costs), as constrained by the public service objective of any electricity retailer or supplier. In liberalized markets, the electricity retailer can see the benefit of offering energy efficiency retrofits as a "value-added service" and therefore a way to win more customers or lock-in existing customers into long-term contracts (preventing them from switching). In few, ultra-competitive regions (and for new entrants trying to break into retail markets with strong incumbents) this can provide sufficient economic incentive for retailers to enter the retrofit market in force, but additional regulation has been required in most regions

[57] Energy only represents a small portion of household expenditures compared to other services, explaining why retrofits need to be easy to begin to truly interest either building owners or occupants

[58] For the purpose of analysis we have assumed a fully liberalized electric market where the functions of generation, distribution and supply are separate, we recognize that this does not necessarily well reflect the reality of many utilities and will deal with this in our recommendations and conclusions.

to drive the speed and scale of their intervention toward the optimal national portfolio outcome. A decoupling of supply revenues from the volume of power delivered is key to the alignment of the retailer's interests with those of the retrofit customer when it comes to long-term retrofit performance

8. **Gas provider** – like the Electricity retailer, the economic goal of the gas provider is to maximize its profits from its energy sales, yet similarly in the future, the gas provider can also see the benefit of offering energy efficiency retrofits as a "value-added service". The gas provider maybe at the front-line of reduced sales volumes if retrofits improve insulation and hence heat performance, however they stand to benefit through increased gas penetration (as a replacement for diesel or coal), in efficient gas powered appliances and through growth in onsite power (cogeneration and fuel cells).

7.4 Other

9. **Energy retrofit provider** – While the energy retrofit provider's primary economic interest is to maximize profit from retrofit activity, at this stage in the market's development the driving economic factor for many maybe purely business volume growth. Some energy retrofit providers may also have an interest in developing a longer-term relationship with the building owner or occupier to provide energy management or related buildings services, perhaps further reducing the carbon emissions of their customers.
10. **Government** – The primary economic interest of government is to find low cost ways of reducing its national greenhouse gas emissions, improving energy security, increasing employment and the overall economic health and welfare of the region. Buildings energy efficiency retrofits are a good way for Government to achieve many of these goals, not do retrofits deliver no or low cost emissions reductions, but the local jobs created through the growth of the energy retrofit industry and the knowledge it creates are of value to the economy.

	Stakeholder	Primary Economic Interest
Client	Building owner	Maximize value of the building.
	Building occupant	Minimize energy costs, live comfortably, minimal hassle
Finance	Equity funder	Maximize returns to equity at known risk with a pathway to exit or repayment within a determinez horizon, say 5-15 years.
	Debt providing bank	Wants stable and predictable cash-flows at known risk.
Utility	Power Generator	Increase regulated sales reduce generating costs.
	Power Distributor	Increase profit from power distribution revenues.
	Electricity Retailer	Maximize profit from in electricity retail business (generally volume x price, "quiality aspects" only in highly liberalized markets).
	Gas Provider	Maximize profit from regulated gas provision (generally prize x volume).
	Energy retrofit provider	Maximize profit from retrofits.
	Government	CO2 emission reductions at lowest cost, enhace energy security, employment, and economic wellfare.

Figure 7 Stakeholder's Key Economic Interests

8. Market Challenges

Perhaps the most significant body of academic work has been done to analyse and explain why many economically sensible energy efficiency retrofits to buildings remain unexecuted. The following section provides an overview of the key hurdles we identify to the greater penetration of retrofits in existing buildings:

8.1 Structural

1. **Fragmented Market/ Aggregation Challenge** - There are millions of small energy efficiency retrofits required across the globe to deliver against the profitable and optimal greenhouse emission reductions from existing building stock. The challenge is efficiently aggregating these fragmented opportunities to create economies of scale, sizeable investments and reduce the friction costs of execution. There are some natural buildings groups, such as single landlords (i.e. Government owned buildings, housing associations, large property managers or hotel chains), but the ownership of the majority of buildings is highly fragmented. Added to this, optimal whole-building energy efficiency retrofit packages require the aggregation of different retrofit components (lighting, insulation, appliances) which are often provided by separate contractors or firms, and require local tailoring and project management. This barrier is often also referred to as the transaction cost barrier or as "the lack of an adequate offer", meaning

that there are few companies that can put together the full package for a whole of building retrofit provide a simple 'one-stop shop' purchase. Profitability comes with volume, as does operational efficiency, wholesale finance and track-records (for access to diverse and more efficient financing sources).

2. **Change in Ownership or Tenancy** – Energy efficiency retrofits should ideally have a contract with the physical building (as opposed to the owner or occupant), as ownership can change, and, more frequently, tenant and/or energy usage patterns change during the active lifetime of the retrofit. As a building changes ownership the retrofit repayment contract should follow the building. Payments for the retrofit maybe linked to the building's energy accounts, property taxes, or perhaps a new type of 'building account' and therefore be paid by whomever is the building's occupant (independently of energy supplier, ownership and duration of tenancy) as they are the direct beneficiary of the value of the retrofit over time. Bankruptcy risk and gap periods between tenants where the building lies unoccupied can complicate tied-retrofit repayments, especially under Owner Financed Model and Energy Performance Model, but these are often well understood and documented risks which funders familiar with real estate finance can estimate and manage once the principal contracting problem is overcome.
3. **Agent Problems** – Split incentives between the owner (beneficiary of building's market value) and occupant (user of building's energy and appliances) are problematic. The tenant is the primary beneficiary of the retrofit (the energy savings and improved living conditions), but the owner is usually required to make the investment. The tenant also directly suffers any inconvenience of the works and controls retrofit performance through post-retrofit behaviour. Anecdotally, there are owners who perceive enhanced marketability of retrofit properties, yet there is no evidence of a general and direct link between retrofit and rental rates we can find.
4. **Regulatory Distortions** – Many countries maintain policies that actively discourage energy efficiency. In the US, under traditional utility regulation, the price per kWh is set for a period of time by the regulator by dividing expected utility costs by expected kWh sales. This system puts a strong incentive on the utility to then increase their kWh sales and decrease costs in order to increase profitability[59]. In some states, regulations actually legally prohibit electric and gas utilities from charging customers for building energy efficiency improvements. Only 15 US states have restructured their electric power industry to eliminate monopoly control of generation, transmission and distribution and to move beyond traditional utility regulation.[60]

8.2 Financial

5. **Cherry Picking** – Sub-optimal renovations are those that only capture the "low hanging fruit" and lock-in underinvestment and unnecessarily higher energy use (and emissions) until a second, relatively harder, retrofit later implements components with higher capital requirements and lower returns. Less attractive components of a building retrofit become harder to finance if they are not done at the same time as the components with the most attractive returns through a "whole of building approach". Whole of building approach retrofits enable a blended pay-back period, which provides for deeper energy savings through the cross-subsidization of less attractive retrofit components with the

[59] Duke, *Transforming Utility and Ratepayer support for Energy Efficiency*
[60] US Department of Energy, EIA website, 2010

returns on more attractive components in a single decision and transaction with only one set of friction costs and disruption.[61]

6. **Changes in Energy Needs** – retrofits that are profitable for a heavy user of the building may not be as profitable if energy needs decline, this is problematic if re-payment is based on forecast energy savings based on "business as usual" use. Occasionally this may lead to the perverse incentive for the ESCO to require the building user to keep appliances on during "downtime" (e.g. unexpected holidays, tenant gap periods or hotel low occupancies).
7. **High Hurdle Rate Return requirements** – Presently, both individual and institutional investors have high expectations for the returns on energy efficiency investments:

   Consumers often have implicit discount rates for retrofits of 25% to 75%[62]. However, the same consumer may ignore the cliff-like depreciation on new cars (we guess retrofits just aren't that sexy and the retrofit finance market is not nearly as well developed as car finance).

   Many home owners are reluctant to take on additional debt backed by their home, even if the returns on energy efficiency retrofit investments are attractive. Improved information on the quality of an energy efficiency retrofit investment may help overcome this and certainly improvements to the consumer financing products available and their marketing will be necessary to maximize their reach.

   Consumers have been shown to be less sensitive to incremental costs as they become a smaller percentage of the total cost ("diminishing sensitivity")[63]. The incremental cost of an efficient air conditioner appears more palatable to consumers when compared to the price of a new home than when compared to the price of an alternative air conditioner.

   The perceived risk of a retrofit is higher than it could be because energy prices are volatile. Returns based on forecast savings that assume a given energy price are discounted for the possibility of falling energy prices that could lower those returns (a possible ironic consequence of a very successful regional retrofit programme).

   The absence of standardized underwriting protocols[64] (or wholesale financing models or retrofit securitization track record).

Several of the energy efficiency retrofit components with substantial impacts on energy usage have longer payback periods than many other consumer financings (interestingly not cars, but the repossession of a retrofit presents a unique physical challenge).

8.3 Behavioural [65]

8. **Information and Awareness** – Today's building users and building service professionals still have a relatively limited understanding of energy use and the measures available to reduce it while maintaining, or improving, the quality of occupancy. This lack of information and awareness results in both a lack of interest and a lower ability to make good decisions over energy management improvements. The customs and energy consumption habits of building occupants are hard to change. Good information on the

[61] Perspectives on cherry picking vary depending on a reader's perspective: cherry picking poses a significant threat to achieving a low-carbon pathway and to maximizing long-term retrofit value or it can maximizing short-term value.

[62] Fuller, M. (2008) "Enabling Investments in Energy Efficiency – a study of energy efficiency programs that reduce first-cost barriers in the residential sector."

[63] Daniel Kahneman and Amos Tversky, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica,* 1979.

[64] NRDC, *Unlocking the Power of Energy Efficiency in Buildings,* 2008

[65] Behavioural challenges are core to this subject, and while the main thrust of our work is focused on resolving financial and structural challenges, we believe that all three areas need resolution in parallel for optimal outcomes to be met.

value and savings from an energy efficiency retrofit, marketed correctly, with appropriate peer role-models are essential to increase their market penetration and ensure that retrofit repayment contracts hold their value when passed from one owner or renter to the next.

9. **Non-economic Decisions**[66] – Consumers make energy management decisions based on many non-economic factors and their ultimate decisions are not made purely on the basis of economic rational alone. Association, conformity or altruism, among other reasons can provide significant motivation for consumers to select energy efficient alternatives. Sometimes energy management decisions are taken by a group of individuals, making the retrofit decision a social one of the household, business employees, cooperative board, neighbours community (*communidad de vecinos*) or business park manager. Decision making styles of groups can be affected by many non-economic forces that drive varying levels of receptivity to energy efficiency investments, such as extreme risk aversion, hierarchy of decision makers and hierarchies of needs and goals.
10. **The Rebound Effect** – savings from energy efficiency often lead to increased energy use. Examples include keeping the house warmer because you can now afford to, or replacing the kitchen fridge with a more energy efficient model, but keeping the old one in the garage to store cold drinks.[67] The rebound effect, like the other behavioural challenges described here, is complex and has been the subject of much academic research: We draw specifically upon that research in the context of "returns" and the rebound effect:

    The subject of the relative cost of energy efficiency policies, the realized returns on retrofit activity coupled with the behavioural barriers to achieving anticipated emissions reductions has been debated[68]. With limited empirical research, we highlight the recent macroeconomic assessment of one of Europe's largest retrofit programmes: German state-bank KfW has committed Euro 31 billion from 2001 to 2009 in subsidized loans to 1.5 million energy efficiency housing retrofits or highly energy efficient housing constructions. Recent macro-economic analysis of this programme concludes that from 2006 to 2009 it has saved in the order of 3.6 million tCO2 emissions and safeguarded or created on average 200,000 jobs per year. The studies conclude that the German state subsidy was well invested from a macro-economic perspective and the programme continues with a potential total target building stock of 20 million (just over half of Germany's 39 million housing units).[69]

[66] CIEE, *Behavioral assumptions energy efficiency programs for business*

[67] WBCSD, *Energy Efficiency in Buildings: Transforming the Market*

[68] Linares and Labandeira - *Journal of Economic Surveys* (2010) Vol. 24, No. 3, pp. 573–592

[69] Institut für Energieforschun, *Gesamtwirtschaftliche CO2-Vermeidungskosten der energetischen Gebäudesanierung und Kosten der Förderung für den Bundeshaushalt im Rahmen des CO2-Gebäudesanierungsprogramms,* 2009; KfW Bankengruppe, *Effekte der Förderfälle des Jahres 2009 des CO2-Gebäudesanierungsprogramms und des Programms „Energieeffizient Sanieren"* 2010

	Challenge	Description	Can a Good Bussiness Model Fix This?	Can Good Policy Fix This?
Structural	Fragmented Market/Aggregation Challenge	The enormous number of energy efficiency projects need to be aggregated to create economies of scale and wholesale investable opportunities.	Yes	No
	Change in Ownership or Tenancy	Energy efficiency retrofit payment must follow the building, regardless of changes ownership or tenancy.	Yes	Yes
	Agent Problems	Owner and occupant's have different interests: Building owners pay investments in energy efficiency, but occupants pay the energy bills.	Partially	Partially
	Regulatory Distortions	Some policies are still in place that actively discourage energy efficiency.	No	Yes
Financial	Cherry Picking	Sub-prime energy efficinecy retrofits only capture the low-hanging fruit.	Partially	Yes
	Changes in Energy Needs	Energy savings are affect by any changes in energy usage.	Partially	Partially
	High Hurdle Rate Returnrequirements	Both consumers and instituttional investors have high perceived risk and unrealistic expected returns from energy efficiency investments.	Yes	Yes
Behavioral	Information and Awareness	Building users and service proffesionals have low information and awareness regarding energy efficiency.	Yes	Yes
	Non-economic Decisions	Non-economic forces affect many energy consumption decisions.	Yes	Yes
	The Rebound Effect	Cash savings from energy efficiency can lead to increased energy use.	No	Partially

Figure 8 Description of Challenges

9. EVALUATION OF EXISTING BUSINESS MODELS

In order to compare the business models, and subsequently to recommend improvements, we map how they each deliver against the interests of each stakeholder and how they address each of the barriers to greater retrofit market penetration in the underserved residential and small commercial segments[70]. While our method is imprecise and subjective[71], we believe it highlights well several features and conclusions which explain the status quo of the retrofit market and the relative performance of the models.

9.1 Performance against stakeholder interests

The following chart provides an evaluation on how well each type of business model being used today meets the interests of each stakeholder in the energy efficiency market.

[70] It is difficult to score these models without being specific about the regulatory framework.

[71] We have asked each of our reviewers to specifically review these judgments, although the final results represent exclusively the opinions of the authors.

	Stakeholder	Owner Financed Model	Utility Fixed Repayment Model	Energy Perfomance Model
Client	Building owner	◔	◑	◕
	Building occupant	◔	◔	◑
Finance	Equity funder	○	○	◔
	Debt providing bank	◔	◔	◔
Utility	Power Generator	○	○	○
	Power Distributor	○	◔	○
	Electricity Retailer	○	◑	◑
	Gas provider	○	◔	○
	Energy retorfit provider	◔	◕	◕
	Goverment	○	◑	◔
	Average Successs	**10%**	**33%**	**33%**

○ No Interests Met

◔ Most Interests not met

◑ Interests partially met, or depends on circumstance

◕ Interests mostly met

● Interests all mett

Figure 9 Business Models' Ability to Meet Stakeholder's Interests

Owner Financed Model: The Owner Financed Model scores the lowest at addressing stakeholder interests and even in the client category (including the owner) it has the lowest score. Notably, Owner Financed Model does nothing for any of the varied utility interests and even the retrofit provider can grow more rapidly under different business models (resulting from helpful aggregation and limitation of component selection). Owner Financed Model works well for leading, environmentally conscious, owner-occupier households with access to finance who have time to understand and manage the retrofit process.

Utility Fixed Repayment Model: Utility Fixed Repayment Model ranks well against stakeholder interests, but still overall only scores a meagre 33% or delivers "very partial" fulfilment of the matrix of stakeholder interests. With the provision of finance, formulaic approach, big-co branding, fixed repayments and potential cherry picking (a negative at a national optimal level, but potentially a short-term positive to the occupier), the customer's needs are fairly well met. Notably, however, third-party finance providers' needs are poorly met and unless electric and gas utilities wish to fund the bulk of a nation's retrofits on their balance sheets (which does not seem to be the case), this looks like an important short-coming for the model. Intra-group issues within vertically integrated utilities and the required changes to the traditional business model are also significant hurdles to Utility Fixed Repayment Model's higher delivery rates over the longer term. In addition, when the Utility Fixed Repayment Model is funded by a flat 'public benefit charge' across all bills, some customers who do not receive a retrofit are going to be unhappy especially when the charges begin to become material.

Energy Performance Model: The Energy Performance Model seems to best address the customer's immediate interests, although as the ESCO's returns are linked to retrofit performance, eventually the building's occupier's energy usage maybe more curtailed and/ or they may be economically penalized for energy usage deviations than in other models. The Energy Performance Model faces issues to scale due to balance sheet constraints and its low scores against the needs of the finance segment of stakeholders. We believe that the Energy Performance Model would score better if it could tap directly into the balance sheets of the utilities or wholesale finance markets, however today this is not the case.

In general, the main weakness for all three models is access to wholesale finance and while Utility Fixed Repayment Model is likely to deliver greater activity in the short term, it is unclear if alone this model can deliver an optimal portfolio execution in the medium to longer term. The ESCO's operating under the Energy Performance Model have, in particular, often had trouble initially as small start-up's with gaining access to wholesale finance. According to Spain's Energy Efficiency Business Association, today "access to wholesale finance is one of the key issues facing ESCOs in Spain" and the Pew Centre on Global Climate Change survey of businesses implementing energy efficiency programs[72] notes "the largest obstacle to efficiency improvements....was access to capital."

9.2 Performance against the challenges

The following chart provides an evaluation on how well each type of business model being used today addresses each challenge in the energy efficiency market.

[72] Pew Center for Global Climate Change, "*From Shop Floor to Top Floor: Best Business Practices in Energy Efficiency*", 2010

	Challenge	Owner Financed Model	Utility Fixed Repayment Model	Energy Perfomance Model
Structural	Fragmented Market/Aggregation Chanllenge	○	◑	◔
	Change in Ownership or Tenancy	◔	◕	◔
	Agent Problems	○	◔	◑
	Regulatory Distortions	○	○	○
Financial	Cherry Picking	◑	○	◔
	Changes in Energy Needs	○	○	◕
	High Hurdle Rate Return requirements	◔	◕	◑
Behavioral	Information and Awareness	◔	◑	◑
	Non-economic Decisions	○	◑	◔
	The Rebound Effect	○	○	◑
	Average Successs	**13%**	**33%**	**37.5%**

○ Not addressed

◔ Mostly not addressed

◑ Partially addressed

◕ Mostly addressed

● Completely addressed

Figure 10 Business Models' Ability to Address Challenges

Owner Financed Model: The Owner Financed Model addresses the challenges to greater retrofit penetration in as limited a way as it delivers against stakeholder interests. While it is the best defence against cherry picking, due to the close attention and management of the owner, it fails to address almost every other challenge. Perhaps if leading green consumers virally market their retrofit experience and push their neighbours into action and Green Mortgages are re-positioned and better marketed this could change, but presently more than this model is required to reach scale.

Utility Fixed Repayment Model: Utility Fixed Repayment Model deals with around a third of the challenges in the energy efficiency retrofit market. Utilities are good aggregators and have sufficient energy data, profile and understanding of billing to package the retrofit in ways to counter some structural and behavioural barriers. By offering standard information and programs to customers, Utility Fixed Repayment Model helps get the owner and occupant on the same page and can help avoid some agent problems. Utility access to low cost finance coupled with fixed potentially on-bill repayments can reduce customer return requirements and gives confidence to the economics of the retrofit package. Utility Fixed Repayment Model does not presently combat changes in energy needs or rebound effects and cherry picking looks to be a mid to long-term issue when the low-hanging fruit are picked.

Energy Performance Model: The Energy Performance Model best addresses the challenges facing greater retrofit uptake, albeit still only addressing under 40% of the aggregate challenge.

In practice, ESCOs (often smaller firms) have trouble aggregating and seem to focus on large one-off projects. Not having direct access to utility bills nor a large national customer bases makes it harder for Energy Performance Model to address changes in ownership or occupant. However, being closer to the execution of the retrofit, ESCOs are better able to deal with agent problems and with changes in energy needs through guarantees and detailed contracting. Retrofit provider experience and proximity allows them to better judge and understand the financial risks and although their cost of funds is usually higher than utilities, returns for the majority of the aggregate whole building retrofits are currently sufficient to allow a close to optimal approach to economic hurdle rates. Interestingly, the Energy Performance Model's focus on retrofit overall performance makes it the only model capable of partially managing the rebound effect through detailed contracting, however contract execution is complex and time consuming. Energy Performance Model operators do not have the reach of utilities to blanket market to energy customers the benefits of energy efficiency, but ESCOs are working hard, with Government support, to market their experience and knowledge to help address some of the behavioural issues.

Interestingly, none of the models scores more than 40% delivery against stakeholder interests, nor in addressing the barriers to greater up-take. We think this is why the market is not yet delivering its full growth potential (in the absence of additional policy measures or improvements to the business models). Furthermore all the models have low scores across the finance category which explains why, to date, there have been such limited amounts of wholesale funding deployed into this segment.

While no business model can directly address regulatory distortions (i.e. policies that drive us to be more energy inefficient) and no model scores more than 40%, there are complimentary elements of Utility Fixed Repayment Model and the Energy Performance Model which if combined could produce an overall score around 60%. This conclusion has led us to develop a hybrid business model which is described in the following section.

10. PROPOSED SOLUTION: THE AGGREGATED INVESTMENT MODEL

For a new business model to work, and be additive to the existing models, we believe it must deliver wholesale and efficient retrofit financing at scale and to a broad base of competing distribution channels (utilities, banks, retrofit providers, ESCOs, Government channels, Construction firms etc). To achieve this, our proposed model - the Aggregated Investment Model ("AIM") - is designed around this premise, to create 'bankable' energy efficiency assets that have broad access to the capital markets for well structured retrofit portfolios through the use of standards and an open-origination architecture to spur multi-channel competition.

The Aggregated Investment Model focuses on delivering repayment security, with appropriate government and regulatory support, a cost effective and simple customer proposition, designed to generate positive cash flow for the customer, through the use of standard "point of sale" documentation. While we believe that many of its features are applicable in many of the segments of the retrofit market, in its design and evaluation we have focused on the residential,

multi-unit and small and medium enterprises (SME) segments with investment value per dwelling of US$ 50,000 or less[73].

10.1 New Model Design Features

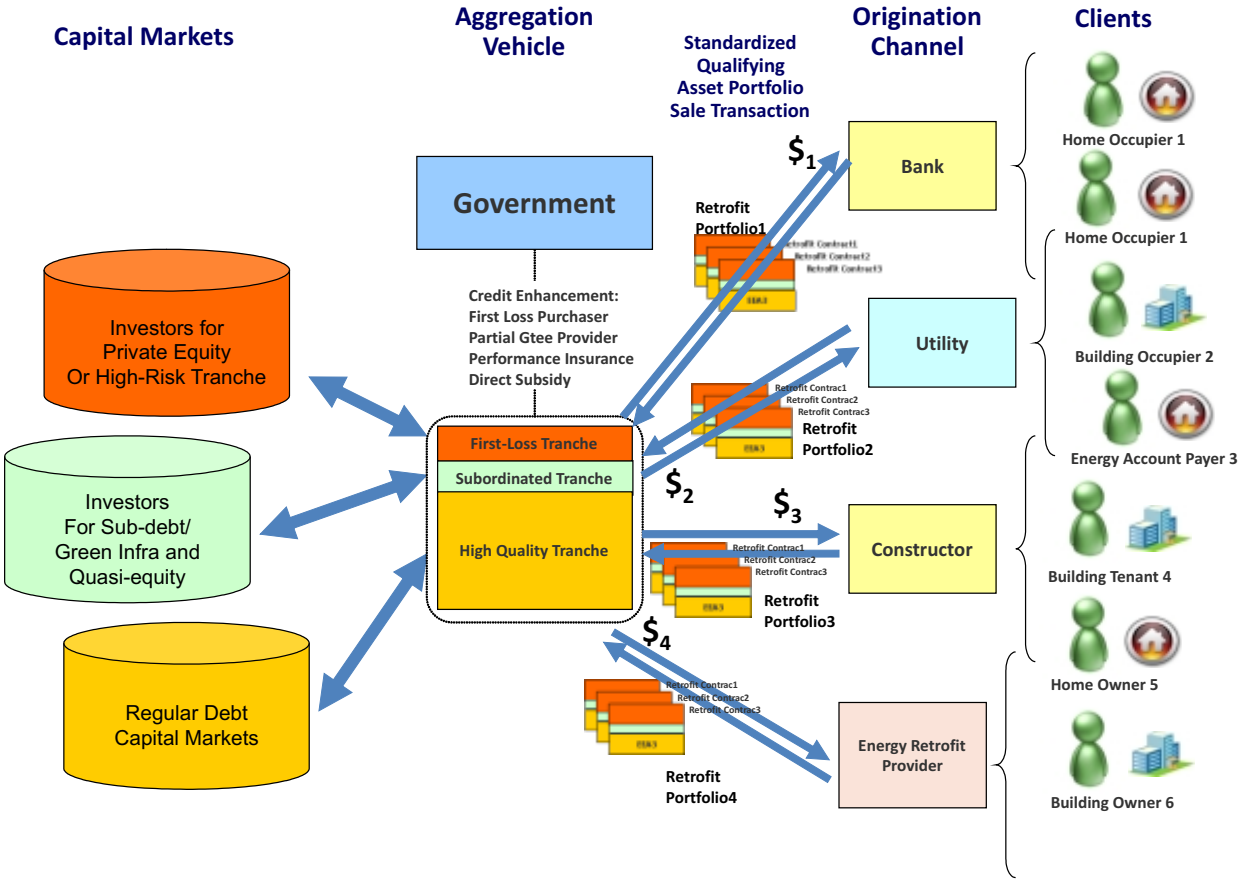

Figure 11 Aggregated Investments Model

The Aggregated Investment Model has five core elements: A standardized Energy Efficiency Asset, Standard Documentation, Multi-channel Origination, On-bill repayment and Government Credit Enhancement and Support. Each element forms part of an open-architecture which then can be marketed by each originator to best fit their clients' needs. The goal for AIM is to enable retrofit assets, once created, documented and completed by an approved origination partner, to be aggregated in a financing vehicle with access to the broadest and cheapest possible financing sources available at any time. The five core features of our model are:

1. **The creation of a standardized Energy Efficiency Asset ("EEA")**: A standard Energy Efficiency Asset is created through the signature of a transferable contract documenting "the right to receive a pre-agreed stream of payments from the building's occupant related to the verified execution of a qualifying energy efficiency retrofit". The Aggregated Investments Model creates an energy efficiency asset which balances the occupant's "energy debt" which by contracting the occupant agrees to certain behaviour

[73] Other models are beginning to deliver retrofit activity in large public buildings and large industry, therefore we focus our analysis on the smaller units with a greater aggregation challenge..

and repayments in the future in return for up-front finance for the retrofit. The retrofit investment might even be characterized as a part or full pre-payment against expected future energy savings. The asset created can be amortized in pre-agreed amounts over a fixed timeframe or based upon realized or indexed energy savings until fully repaid. The standardization of energy efficiency assets will open new liquidity to portfolios of retrofits and provide retrofit originators access to whole sale financing via, for example, government sponsored or credit enhanced securitization vehicles. We note that a significant amount of legal work is necessary to establish standardized assets for all appropriate segments and sub-segments of the market, yet it is achievable, and with more focused resources (legal teams, stakeholder and market research groups, etc) from a broader array of interested originators, progress will be made (as it was in other similar retail financial products).

2. **Standard Documentation**: The material form of the Energy Efficiency Asset is a standard contract with two parts:
   - **Term sheet**: A term sheet with determined standard categories should contain record of all the key variable terms required to describe the anticipated cash-flows related to the asset, such as: Retrofit Investment Size, Repayment schedule (fixed if pre-determined repayments, e.g. Utility Fixed Repayment Model, or retrofit performance related or indexed[74]), Term (i.e. length of time of contract), Guarantor (who warrants the performance of the retrofit and under what conditions and for how long), Names and details of the counterparties to contract and so on. The goal of having a standard term sheet is to capture all required information on the size, timing and amounts of cash flowing from the EEA which is needed to fully financially characterize each retrofit and enable easy aggregation and portfolio management within a securitized portfolio. The remainder of the contract (the standard terms and conditions or "small print") can then be fixed for all retrofit assets.
   - **Standard Terms and Conditions**: The Standard Terms and Conditions of an EEA would include full detail on the mechanics of the working of the contract and deal with definitions, procedures, form of payments, notifications, counter-party rights, transfer mechanisms, events of default, recovery mechanisms, counterparty obligations, information provision, registration, guarantee terms and so forth. These standard terms would be designed to allow portfolio managers to more easily and efficiently deal with the mechanics and on-going monitoring and management of large portfolios of EEAs.

   We believe that a drive towards greater standardization of contracts, detailed terms and the way term sheets are presented will not only lead to easier creation and securitization of portfolios of energy efficiency assets but will add to consumer confidence as numerous branded channels offer comparable products.

3. **Multi-channel Origination**: The Aggregated Investment Model aims to create a combined retrofit and financial product (like 0% finance, store-card or car-loan) that can be distributed by retail banks, energy suppliers, ESCOs, retrofit providers and other retailers (eg. supermarket chains, telecoms companies etc). The standardized product

[74] Authors envision potential for retrofit providers to index repayment to formulas including the future energy price and other independently determinable market variables to enable providers to hedge their energy price exposure with good customer optics.

will be designed to be paired with authorised and approved retrofit providers who can guarantee expected energy savings, and specific retrofit component bundles meeting independent quality standards and/or complying with certification schemes, thereby reducing risk.

The financing will be initially provided by the originator at point of sale and they will need to hold the energy efficiency asset on their books until it demonstrates the required performance track record to be on-sold into a securitization vehicle. If the holding period for EEAs is say 2-3 years then the amount of balance sheet required by originators is greatly reduced, originator balance sheet cost becomes less of an issue, more originators can compete and the capacity to hit national targets suddenly becomes more attainable. The originator can lock-in an origination fee based upon the difference in value of the asset when contracted and when on-sold to the securitization vehicle. In this way, a badly performing retrofit asset may have to be on-sold at a loss, whereas expected or out-performance would generate an attractive origination fee upon on-sale. Finally, once EEA track-records are better understood, it may become possible for originators to on-sell assets earlier with a low price together with a "catch-up" payment based upon the subsequent asset's performance.

4. **On-bill repayment:** Our research suggests that the size and scale of national optimal portfolio retrofits can only be reached with consumer access to low-cost finance for retrofits. To de-risk the repayment streams from EEAs we believe that their security and collection methods are important. This leads us to recommend "on-bill" repayments for AIM. There are three main bills associated with the building to consider: Mortgage (EEMs), Property Tax (or Community Charge) or Energy. The addition of retrofit repayment streams into an existing collection channel immediately provides: A collection track record, an existing customer repayment relationship, security and it can lever a back-office and collection resources which are already in operation with the large number of buildings required for optimal retrofit portfolio numbers.

   Which bill is "better" is a harder question and we believe this depends upon customer segment and geography. The mortgage asset class has suffered lately, and there has been resistance in the US to increasing mortgage repayments under EEMs among some segments. Property taxes are interesting and being trialled in the US under PACE, yet our preference for AIM is the energy bill, as retrofits are designed to save energy and emissions and we see the contraction of an "energy debt" as more naturally being repaid on energy bills. The connection between retrofit and energy use, in our opinion, is fundamental and easily understood by the consumer. On-bill repayments will require adaptation of existing billing processing (or back-office) systems within energy companies (as bill design will change and new payments will appear and need directing to the bank-accounts of third parties). These are real costs, and it is clear that not all of the benefit will accrue to the repayment collector (opening up a branded channel on "my" bill to a third party has risks – what if that party fails to deliver and the reputational damage is done to me ?) and we see Government as having a role to help draw the lines of responsibility and framework around the mechanics required to

achieve this.[75] To mitigate the processing and on-bill related risks we envisage retail banks teaming up with energy suppliers (and regional groups of approved retrofit providers) to provide branded retrofit product benefitting from the team's collective strengths. As a bridge-to-bill, initial investments could be secured through government loan-guarantees or loan-loss reserve funds, especially in the early years as the market develops. Alternately, the investment could be secured with an appropriate source for each form of repayment. Security would clearly be provided by the termination of energy services for missed energy bill repayment (on energy bills) and through home value for missed payments on mortgages.

5. **Government Credit Enhancement and Support**: It is clear that supportive regulation is required to open-up the on-bill channel for retrofits. Government resources are required and appropriate in supporting energy efficiency retrofits until such point that the marginal macro-economic returns from energy savings, emissions reductions and employment creation from retrofitting are exhausted. To date, governments have played a key role in funding and promoting energy efficiency. We believe that as national ambition for energy efficiency retrofits increases, and the mainstream market grows, Governments will look to complement or replace some of their direct financial assistance, project based programmes with alternative more capital efficient mechanisms. Such new support mechanisms could include the provision of a credit wrap, interest rate softening, partial guarantee, insurance or first-loss provision to an aggregation vehicle purchasing specific portfolios of retrofits from high quality originators to improve the vehicle's overall finance cost and access to the capital markets. It is beyond the scope of this paper, and AIM in its current conceptual form, to precisely recommend among these alternatives (especially as it is likely to depend greatly on exact regulation, portfolio, timing and a series of factors as yet undefined), however we believe that the AIM platform is the right basis through which to pursue this more detailed work.

   We see the Government's role as central in bridging the gap between the requirements of the capital markets and making the deal economics work for the retrofit customer. To bridge this gap we require a critical mass of performance track-record in the asset class, supportive policies to reduce the real repayment risks, improve collection and reduce defaults and the vast amount of education and sensitization required to remove the behavioural barriers to retrofit market penetration. Economic subsidy is also a necessary requirement to achieve a national optimal retrofit portfolio as Government is the only stakeholder who (at present) perceives the wider scale macro-economic benefits and emissions reductions resulting from the programme. Unless the retrofit customer can personally monetize these wider society benefits (through certificate schemes or other support) then Government will also need to bridge this economic gap

   Recent UK proposals describing the activities of the proposed "Green Investment Bank" contain a useful example of how Government Credit Enhancement for retrofits may work, see below:

[75] We note that on-bill recovery through third parties is not a new concept in energy markets, as the fixed grid-connection charge is an on-bill recovery to repay transmission and may have other components depending upon regulation and geography.

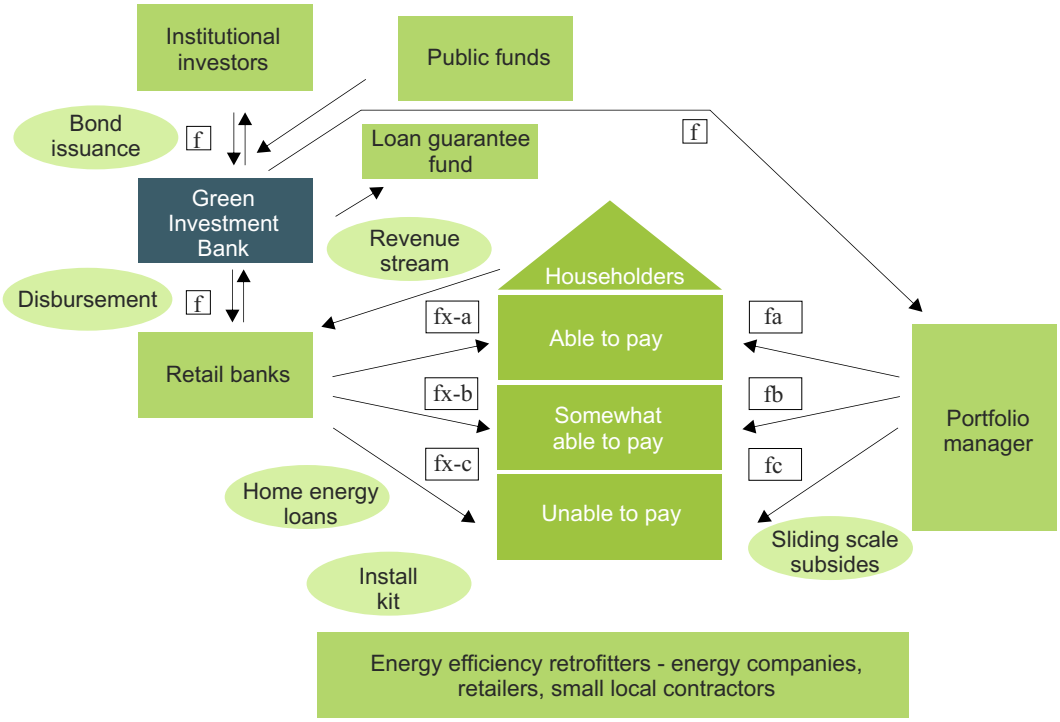

Figure 12 Green Investment Bank Commission Report

In summary, we believe that AIM can deliver more than the existing business models through the delivery of the following improvements:

- **Simplified customer choice and process**: Knowing that the detailed standard terms and conditions of all qualifying energy efficiency product is regulated (like bank deposits), the customer can focus on a more limited and easier to understand set of variable terms contained on the term sheet like: Investment size, fixed or projected repayments, retrofit provider warranties and so on. Comparable templates would also make it easier for the customer to get the best price for a proposed combination of retrofit components. Simplifying the customer decision making process will also help the market overcome some of the behavioural barriers such as lack of information and awareness and potentially lower hurdle rates.
- **Broad distribution**: With greater confidence that the standardized EEA created from the execution of the energy efficiency retrofit has future liquidity banks, utilities and other intermediaries will be more confident and able to extend their balance sheets initially to originate and to temporarily warehouse energy efficiency assets until their performance track record and the portfolio's scale allows them to be on-sold to a securitization vehicle. We believe that giving future liquidity to standardized energy efficiency assets will increase the number of potential distributors (notably allowing banks, utilities, retailers and ESCOs to produce competing product), increase each individual firm's throughput and create a more level playing field among originators with different sized balance sheets initially.
- **Point of Sale Financing**: Enabling contractors to offer financing at the retrofit's point of sale is a key ingredient to drive success in the residential market. In the context of an AIM partnership between bank, utility and retrofit provider, we believe that such "off the shelf" financing made immediately available to the residential home owner for highly standardized component bundle based retrofits will be considerably more attractive than currently available alternatives.

10.2 AIM Performance Overview

Compared to existing business models, we believe that the Aggregated Investment Model shows a considerably improved performance both in satisfying stakeholder interests and against the market challenges as described below. While the our model's scores are not perfect, and we acknowledge our subjectivity, we consider that its expected relative performance would be markedly improved in some key areas, notably financial and structural, that AIM has the strongest chance to gain the critical mass and momentum necessary to both deliver scale and optimal wholesale finance access for the enormous potential energy efficiency retrofit market.

	Challenge	Aggregated Investment Model's Ability to Address Challenges
Structural	Fragmented Market/Aggregation Chanllenge	●
	Change in Ownership or Tenancy	◕
	Agent Problems	◕
	Regulatory Distortions	○
Financial	Cherry Picking	◑
	Changes in Energy Needs	◑
	High Hurdle Rate Return requirements	◕
Behavioral	Information and Awareness	◑
	Non-economic Decisions	◔
	The Rebound Effect	◑
	Average Successs	57,25%

Average Success of 59%

Stakeholder	Aggregated Investment Model's Ability to Meet Stakeholder's Interests
Building owner	●
Building occupant	◕
Energy retrofit provider	◕
Equity funder	◕
Debt providing bank	◕
Power generator	○
Power Distributor	◔
Electric Retailer	◑
Gas provider	◑
Goverment	◕
Average Success	60%

Figure 13 AIM's Ability to Address Challenges and Meet Stakeholder Interests

The above chart will be discussed, analyzed and summarized in the following two sections:

10.3 AIM's Ability to Address Challenges

Our explanations for AIM's scores in addressing the current challenges in the energy efficiency retrofit markets are as follows:

- **Fragmented Market/Aggregation Challenge** – AIM, at its core, targets a "cookie cutter" approach to a component-based and highly standardized retrofit which is easy to aggregate. Policy support for the standards and component based approach inherent in AIM would substantially reduce the aggregation challenge.

- **Changes in Ownership or Tenancy** – On-bill repayments can reasonably eliminate the challenge caused by changes in ownership and tenancy because it links repayment to the building, and as long as the building is occupied, the repayments related to the retrofit will be paid by the beneficiary of it, the current building occupant.
- **Agent Problems** – On-bill repayments ensure the tenant's direct involvement with the retrofit as the result will impact their future energy costs. While AIM does not change the naturally divided interests of owner and tenant, it does provide necessary communication and agreement between the two prior to execution.
- **Regulatory Distortions** – AIM does not directly address these.
- **Cherry Picking** – AIM cannot prevent cherry picking as this relates more to short-termism by various stakeholders than anything else. However, we believe that over time a greater market penetration through AIM of standardized retrofit component bundle solutions offered by experienced professionals (with proven track records) will build consumer confidence and peer marketing making it easier to implement a whole-of-building approach.
- **Changes in Energy Needs** – AIM assessments and repayment schedules are built around estimated energy savings against a "business as usual" background, supported by a track record in certain similar standard component bundles. Investor protection can be derived through the use of fixed repayment schedules transferring economic retrofit performance to the customer, and hence isolating the financing providers from changes in energy use. In addition, under an AIM contract struck on the basis of repayments based upon savings, additional legal language and recourse (through penalty rates) maybe included to help constrain energy use changes during the contract term.
- **High Hurdle Rate Requirements** – While AIM does not directly change implied consumer discount rates, when the on-bill mechanism of AIM is enabled the consumer should focus less on the period of the investment and more on the monthly energy bill savings. Consumer's short-term view on financing will be replaced by institutions whose capabilities lie in evaluating longer-term financing options. In addition, we believe that it will stimulate large bank-utility partnerships which will increase the range of customer finance packages and the credibility with which they are viewed. If AIM delivers lower cost finance, greater confidence in retrofit execution and track record to savings, then we believe that implied consumer discount rates will fall for high quality retrofit product.
- **Information and Awareness** – The enabling by AIM of multi-channel origination will increase levels of competition for customers for energy efficiency retrofits requiring a rash of new education and marketing tools being delivered by many originators. Simplified customer choice and point of sale financing should also lower the level of information and awareness that is necessary for the purchase of an energy efficiency retrofit.
- **Non-Economic Decisions** – AIM will help eliminate these in the same ways it improves high hurdle rate requirements and information and awareness, see the point above.
- **The Rebound Effect** – AIM cannot fully resolve the rebound effect, however the Standard Terms and Conditions could include behavioural penalties and/ or different rate choices to deal with increased energy use post-retrofit. Perhaps the combination of increasing energy prices and awareness of energy expenditures provided through energy efficiency and smart meter schemes might be the only effective limiters to the rebound

effect.[76] As a minimum, AIM seeks to insulate wholesales financiers from the financial consequences of the rebound effect.

In summary, AIM's ability to address challenges in the energy efficiency market is not perfect, but it scores much better than existing models at 57.25% success. AIM achieves a high degree of success in overcoming four crucial challenges that no other model has presented a way to overcome today: The Fragmented Market/Aggregation Challenge, Changes in Ownership or Tenancy, Agent Problems, and High Hurdle Rate Requirements. AIM makes significant progress in overcoming most other challenges, in part because thoroughly overcoming the first four challenges should enable a robust market to develop more of its own mechanisms for overcoming the other challenges to continue growth.

10.4 AIM's Ability to Meet Stakeholder's Interests

We believe that AIM makes significant progress towards meeting the majority of stakeholders' interests in the energy efficiency market. The following explains the logic for AIM's scores against for meeting the interests of each stakeholder:

- **Building Owner** – AIM is designed to reduce funding costs, make building owners' decisions easier and engage a broader array of retrofit origination to improve owner choice. AIM also contemplates on-bill repayment and hence well addressing the owner's needs.
- **Building Occupant** – Occupants need to buy-into the economics of an AIM retrofit, and will be the beneficiary of those together with all of the secondary benefits. Furthermore, easier to understand, standardized and powerfully marketed solutions will give occupiers more choice. AIM can be tailored to occupant's repayment preference (fixed or savings based) and repayment collection is easier through the existing on-bill relationship.
- **Energy Retrofit Provider** – The energy efficiency retrofit marketplace should expand rapidly under the AIM as it allows smaller retrofit providers access to branded billing channels and reduces balance sheet constraints. In addition, working with regulated standard documentation should serve to remove some customer concerns around contracting.
- **Equity Funder** – AIM is designed to produce aggregate portfolios which have access to wholesale funding at a scale and with the characteristics which better suit institutional equity providers.
- **Debt Provider/Bank** – Banks can have a more active distribution and structuring role in the context of AIM with input into standards and the creation of new retail product. We also believe that retrofits will increase the quality of the underlying building stock and allow equity cushions (institutional, owner and Government) enter the equation to provide first loss absorption and risk reduction for the debt tranche of AIM securitizations.
- **Power Generator** – In a one-dimensional market, the success of AIM reduces demand for electrons and gas. However, power generators may benefit tangentially from reputational benefit from regulators and customers for their part in delivering success. We see the development of smart meters as being more beneficial to power generators than pure demand side activity.
- **Power distributor** – Greater energy efficiency should lower stress and increase the resilience of the local grid. In addition, in some geographies, the distributor can act as a

[76] Various reviewers suggested that penalty tariffs for above BAU energy usage is the only solution to this.

conduit for the on-bill payments and as such could be interested to engage in the broad based promotion of retrofits to customers.

- **Electricity Supplier** – Electricity suppliers under AIM have access to additional liquidity for on-balance sheet retrofits and greater customer stimulation (in the form of policy support and partnerships). There will be a natural advantage for electricity suppliers marketing on bill retrofits to their own clients and to enhance the perceived value of their services and garner customer loyalty for longer term relationships (less chance of switching).
- **Gas Provider** – Gas providers can offer retrofit product using AIM which may reduce heat demand (through better insulation in cases) but will also tend to lock-in customers and increase focus and demand for the lower carbon alternative (gas) over less efficient heating alternatives (and in some cases appliances). Gas providers should also benefit from a departure from high-emissions fuels (onsite diesel) and increased penetration of CHP in multi-unit dwellings (as an important part of a retrofit package).
- **Government** – AIM seeks to capture the widest array of private sector entities and engage them in the retrofit market. Government targets should become easier to attain and the growth in retrofit activity will generate the emissions reductions and employment benefits cited by research in this area. We also believe that AIM can increase the efficiency of Government spending in the retrofit market – by swapping credit enhancement for direct project assistance. Finally, increased retrofit enhances building stock quality and energy security.

In summary, AIM's ability to meet stakeholder's interests seems good, scoring much better than existing models at 60% success. AIM achieves a high degree of success in meeting all but three key stakeholder's interests. The alignment of stakeholder's interests is absolutely crucial to develop the market, because each stakeholder is dependent on the others. The high success here bodes well for AIM 's ability to significantly advance the energy efficiency market.

11. HOW NATIONAL POLICY CHOICES IMPACTTHE BUSINESS MODELS

The national policy environment is the most significant driver for all the business models and for a large part of the relative successes between them. Our research suggests that in the absence of supportive policies the natural level (or background flow) of energy efficiency retrofits is low, is unlikely to meet national targets and is sub-optimal from a number of other macro-economic national perspectives.

The following chart lists the fourteen most commonly used supportive global energy efficiency policy types (described previously) and how they impact each of the business models discussed here:

	Policy Option	Owner Financed Model	Utility Firex Repayment Model	ESCO Energy Performance Model	Aggregated Investiment Model
Standards	Strong Building Codes	=	+	++	++
	Labeling or Retrofit requirements at Time os sale/Rental	++	++	++	++
	Retrofit Provider Accreditation	++	+	++	+++
	City-wide Opt-out Policy	=	++	++	++
	Utility Minimum Spending Requirement	=	+	+	+
	Utility Energy Efficiency Priority Resource Requirement	=	++	+	+
	Appliance Standards	++	++	++	++
Direct Financial	Direct Government Subsudy unlimited	++	=	+	++
	Government Risk Insurance	+++	=	+	+++
	Property/Council Tax Financing (PACE)	+++	=	+	+++
Market Based	Certificate Programs [CERT/EERS]	+	+++	++	+++
	Fiscal Incentives, e.g. stamp tax	++	=	+	+
Removing Hurdles	Requiere Building Energy Labels	=	-	=	=
	Education	++	+	++	++
	Enable On-bill Repayment	+++	+	++	+++
	Decoupling	=	++	++	++
	Direct Technical Assistance	+	+	+	+

+++	Highly Favors and Helps this Model
++	Favors and Helps this Model
+	Somewhat Favors and Helps this Model
=	Neutral
-	Neuative for this Model

Figure 14 Degree to Which Favourable Policies Bolster Each Policy Option

The following chart describes the almost universally negative impact across all the business models of five energy policies, described previously, which harm the rates of energy efficiency retrofit uptake:

	Policy Option	Owner Financed Model	Utility Firex Repayment Model	ESCO Energy Performance Model	Aggregated Investiment Model
Standards	Electric Rates that Decline as Use Rises	-	=	-	-
Direct Financial	Direct Govemment Subsidy - limited	-	-	-	-
	Subsidized Energy Consumption	-	-	-	-
Market Based	Tax Write-offs of Energy Costs	-	=	=	=
Removing Hurdles	Utility Profit Driven by Amount of Energy Sold	=	-	=	=

+++	Highly Favors and Helps this Model
++	Favors and Helps this Model
+	Somewhat Favors and Helps this Model
=	Neutral
-	Neuative for this Model

Figure 15 Degree to Which Detrimental Policies Impact Each Business Model

In the case of the Aggregated Investment Model, we believe that the single most important area for Government policy work is on the legal mechanics required to facilitate the creation of third party rights to access the "energy efficiency component" on bills. In addition, we believe that

Government involvement in the creation of broadly accepted national standards for documentation and contract as well as for retrofit quality and component categorization is critical to lowering the barriers to greater market activity. Aside from these specific requirements for AIM, there are general regulatory barriers which can be removed to benefit all models (Figure 15) and many of the proposed fiscal and educational policies are required to work in tandem with all the retrofit models to lower behavioural barriers.

12. EUROPEAN UNION CONTEXT

The EU has set the goal of cutting its annual primary energy consumption by 20% by 2020. Buildings are responsible for 40% of final energy use in the EU, making them a core component required to meet this goal. The EU's approach to energy efficiency in buildings has been implemented through an Action Plan and two key Directives, complemented by several smaller Directives regarding appliance standards and labelling requirements, all of which are being incorporated into national law within each member state.

The Energy Performance of Buildings Directive (EPBD) was adopted in 2002 (2002/91/EC). The directive includes a common methodology for calculating the energy performance of buildings, minimum standards for energy performance of new buildings and major renovations, systems for energy certification of buildings and requirements for the regular inspections of boilers and central air-conditioning systems.[77]

Many member states have failed to implement the EPBD on time, so the European Commission proposed a recast of the directive in 2008. This recast was approved by the European Parliament in May of 2010 (2010/31/EU). The recast is designed to reduce total EU Energy consumption by 5-6% and create 280,000 to 450,000 new jobs through cost-effective measures by 2020. EU member government buildings are now required to consume "nearly zero" energy by the end of 2018 and the same is required of new private sector buildings after 2020. Energy performance certificates will also become mandatory for the rental and sale of all properties. But, no firm standards are proposed to be put in place on the energy performance of existing buildings, though member states do have to develop national plans to encourage owners to make energy efficiency improvements in the existing building stock.

In early 2006, the Commission adopted the Energy End-use Efficiency and Energy Services Directive, 2006/32/EC. This Directive includes an energy savings target for the Member States of 1% per year and a requirement that member states draft a plan for how they are going to reach this target. It also includes obligations on national public authorities for energy savings, energy efficient procurement and measures to promote energy efficiency and energy services.

Later in 2006 the EU also adopted the Action Plan for Energy Efficiency (2007-2012) - COM(2006) 545. A mid-term review of the Action Plan was to be carried out in 2009. The Commission plans to present a new Energy Efficiency Action Plan in 2011[78]. The Action Plan includes improvements to equipment and appliance energy efficiency standards and labelling requirements and extends the scope of the Energy Performance of Buildings Directive, highlighted below. It also calls on the banking sector to offer energy efficiency financing opportunities, calls on public European investment institutions to facilitate public-private

[77] Europa - Summaries of EU Legislation, website, 2010
[78] EurActiv Network website, 2010

partnerships, and sets a goal for the Commission to remove national legal barriers to shared savings, third-party financing, energy performance contracting and recourse to businesses providing energy services. Finally, the action plan includes a number of educational and awareness building measures.

Italian White Certificates Program[79]

Italian White Certificates have been in place in Italy since January 2005. They are an obligation on electricity and gas distributors to save energy in the properties and premises to which they distribute. One-third of Italy's expected carbon dioxide savings by 2012 are anticipated to come from the White Certificate activities.

The obligation now covers 14 electricity distributors and 61 gas distributors. The White Certificates cover all energy end users. Although in principle any fuel can be saved, in practice, electricity accounted for 74.7%, gas for 21.9% and other fuels for only 3.4% of White Certificates issued by the Italian electricity and gas authority, AEEG through 2009. Annual expenditure on White Certificates in 2008 was estimated to be around €200 million (£177 million) per year. Despite being open to saving energy in all sectors, most savings in the period 2005 - 2008 were delivered mainly in the residential electric sector.

In 2009, the Energy Labelling Directive, originally adopted in 1992 (92/75/EEC), was revised to broaden the existing provision beyond household appliances to include energy-using products in the industrial and commercial sectors as well as all energy-related products with an impact on energy consumption, including insulation materials. Other EU measures include Directives with energy-efficiency requirements for boilers and refrigerators, labelling requirements for ovens, refrigerators, air-conditioners, labelling for office equipment.

13. SPANISH CONTEXTAND REGULATORY ALTERNATIVES

As we have described, Spain has implemented a number of parallel energy efficiency policies which have begun to develop institutional appetite and interest in buildings retrofits. The Spanish Government has allocated resources providing finance for energy efficiency to a broad base of sectoral and regional actions as designated by its agent IDAE and via soft-finance lines provided by state bank ICO. Like the US and the UK, Spain still has a considerable way to go to reach the optimal market penetration of energy efficiency retrofits in residential and commercial buildings.

Against this back-drop, combined with ambitious economy wide energy efficiency targets, we consider how the ideas and observations from our research can be best tailored to fit the current regulatory, institutional and macro-economic realities in Spain. From first principles and interviews, we conclude that in Spanish buildings, as in all regions, there are many cost effective retrofits that maybe applied and repaid from the cost of energy savings. We have not uncovered any evidence which supports a view that Spain will diverge greatly from other countries' expectations (based upon high level metrics), and building stock seems to well fit the age-distribution patters for savings, which suggests that cost effective energy savings from buildings retrofits can be in the 20-50% range. We therefore conclude that there are many millions of buildings in Spain for which an economically efficient retrofit maybe applied and from which the nation will benefit macro-economically as well as the buildings' owners and occupants.

[79] Regulatory Assistance Project, *A Comparison of Energy Efficiency Programs for Existing Homes in Eleven Countries,* 2010

In addition, while the Spanish institutional and regulatory frameworks are different from those in the UK and USA, we have not uncovered any fundamental rationale as to why a move towards the Aggregate Investments Model would not be an appropriate long-term objective for Spain to help efficiently deliver on its optimal national retrofit portfolio. We cannot ignore the fact that there are many other areas of energy policy in the short term which will dominate the focus of many energy market participants and stakeholders, however we see their adequate resolution as only likely to improve the business case for retrofits and make energy efficiency measures more attractive on a national and household basis.

We believe that there is a ground-swell of potential energy efficiency activity in Spain and some leading indicators from ESCOs, construction firms, industries and municipalities that energy efficiency is a resource requiring greater attention and with the potential to deliver meaningful gains to the economy. The pathway towards gathering the broad based institutional support for greater retrofit activity, as in other countries, will be a mixture of carrot and stick regulation supported by strong evidence and poignant local case studies some of which are now underway.

13.1 Spanish Stakeholder Analysis

The timely execution of an optimal energy efficiency retrofit investment creates value at a national level (requiring less fossil fuels to be imported, less national emissions and creating employment). In addition, a sizeable retrofit program delivers a better quality and upgraded building stock with secondary benefits (such as liveability and acoustics) to occupants outside energy. However the individual repercussions falling on specific sectors, firms and buildings are mixed: there are likely to be winners and losers. For this reason, we focus our initial thinking on building out the advantages of such a programme for several of the incumbent stakeholders in order to frame our final analysis of AIM in the Spanish context.

1. Electric and Gas Utilities:

The initial successes of the UK's CERT, the US EERS programmes and white certificate programme in Italy provide useful insights into how to engage positively with the utility sector. Given the value and flexibility of energy in its raw form (as electricity or gas delivered direct to the building) we believe that the future for energy suppliers is to develop away from a commodity supply and into higher value added services, of which energy management is one core aspect. We believe that long-term and value added relationships with consumers will be an increasingly important component of shareholder value as the breadth and depth of energy and related products and services increase.

The freely competitive energy supply marketplace in Spain is still developing (having become fully liberalized in July 2007), and many customer relationships remain distributed regionally among incumbents with customers having exhibited relatively low levels of switching thus far. However, Spanish utilities are global leaders in renewable energy, they were among the vanguard to quickly adapt to and work with EU ETS upon its implementation and have begun to show a clear interest in engaging more thoroughly with energy efficiency. For these reasons we do not anticipate energy efficiency to remain an under-invested resource for long. As the prospect of value-added services derived from smarter grid enabling and potential demand drivers like growth in electric cars, we see the parallel growth for energy services and energy efficiency investments.

2. Buildings Owners and Occupants:

With the increased pressure brought to household budgets in recent years, we believe that the opportunity to "invest to save" – with the capital provided by an external third party – should be very attractive to buildings owners and occupiers. Retrofits can be seen by energy account payers as a tool to maintain or improve comfort levels (through secondary benefits) and reduce costs. While there have been several campaigns to promote energy efficient light-bulbs, replacement boilers and insulation, there has been limited "whole building" approach on a national scale. We believe that the development of high quality retrofit product and the technical skills and depth among retrofit providers is required simultaneously to regulatory signalling and broad-based awareness activities to stimulate demand.

3. Financial Institutions:

Spanish banks (and *cajas*) with substantial retail customer reach can be more proactively engaged in a dialogue over the financial characteristics and appeal of energy efficiency assets and the wholesale market for them. Already the bank retail channel is used by ICO to offer its soft-loan facilities and it is a small step to include a broader array of retail energy efficiency products targeted more generally across the customer base. Banks have a clear role in the structuring and design of the retrofit asset class to help give them access to the broader capital markets. Advice regarding legal and fiscal treatment and overall approach to programme liquidity and securitization is pivotal in the design of efficient financing solutions which appeal to customers and which are simple to process and operate. The exact detail of the retrofit Standard Terms and Conditions should be road-tested by banks as they will need to be comfortable in their future intermediation. The size of the potential retrofit asset backed market (both domestically and internationally) should be sufficient to justify initial resource investment into the design of this asset class. Finally, there are also potential reputational benefits associated with the provision of energy efficiency financial products through future 'energy efficiency partner' certification, such as the "Energy Star partners" in the US.

4. Retrofit Providers:

The stimulation of capacity building among potential retrofit providers began in Spain with the development of the *Código Técnico de la Edificación* (CTE) and its application to all new construction. The continued development of Standards, both contractual and for accreditation purposes, in consultation with retrofit providers of all classes (construction firms, retrofit providers broadly, ESCOs, electric and gas utilities, engineering firms, services companies) is essential and will build consumer confidence. The stimulation of demand and increased activity associated with the Plan 2000ESE and the expectation of new policies will certainly have the effect of increasing the amount of resources available to these firms and their experience and professionalism. A simplified and more component driven approach with bundling and associated private sector and government supported financing proposals could reduce the transaction costs facing today's retrofits and help to increase turn-over and activity. Enhanced codified approaches to Standards are also liable to give confidence to the building's owners and simplify contracting and contract resolution. While it is clear that the retrofit provider sector in Spain is still small and under-developed, we are confident that the supply-side would grow to match retrofit demand, as the skills required for retrofitting can be found presently in the Spanish workforce.

5. Municipalities:

Spain's municipalities are familiar and engaged with the benefits of energy efficiency (including savings from street lighting, municipal government buildings, and the delivery of energy

efficiency education and assistance services, etc.) and these activities have been supported by funds from central Government and EU Sources (notably EIB).

Municipalities in Spain have an interesting potential role in promoting the economics of buildings retrofits and could be involved in programs designed like the US PACE program, through which energy efficiency may be funded through increased property taxes (*Impuesto sobre bienes inmuebles* or "IBI"). PACE provides a channel to achieve government credit enhancement and on-bill repayment, two key elements of the Aggregated Investments Model. In addition, if IBI levels could be linked to a building's energy performance (higher for those with lower ratings, and commensurately lower for those with high efficiency ratings) then we believe there would be an important increase in retrofit activity and commensurate improvements in their economics. This is a potential parallel development track for Spain coupled with increasingly required buildings' energy performance certification.

Municipalities should also be interested in supporting "opt-out" structures, in which zones of a city or its suburbs are targeted for retrofit activity in all buildings and buildings owners are offered an "opt-out" rather than an "opt-in". In this way, municipalities can act as local aggregators and provide a way of ensuring that all buildings owners had the chance to complete a retrofit prior to the increase in IBI that maybe associated with poor energy performance. The engagement of municipalities might prove to be a pathway to achieving greater economies of scale, engagement with larger construction firms, support in solving permitting issues, engage *communidades de vecinos* and accelerate implementation regionally. Further pilot programmes following on from the current initiatives across more regions with varied climate and building stocks will also provide important data and insights into the likely energy performance of these retrofits.

13.2 Regulatory Pathways to AIM

While we acknowledge that Spain maybe a few years from a fully supportive regulatory framework which can deliver the full benefits of the Aggregated Investments Model, we believe that taking steps in that direction will build capacity in the retrofit market and deliver the initial robust data sets and track records for the retrofit asset class that will prove invaluable in implementing new energy efficiency policies. In the following section we review the five core components of AIM in the Spanish context:

1. **Characterization of Standard Energy Efficiency Assets:** Detailed work is required to consider the legal and fiscal character of an energy efficiency asset under Spanish law[80]. This can be achieved in similar fashion as for mortgages and credit card debt, and yet as this is a new asset class the up-front work is yet to be undertaken and would shed light on the numerous challenges and regulatory modifications required to enable the market.
2. **Standard Documentation:** In parallel with the legal characterisation of the asset, a set of standard contractual documents can be developed in conjunction with the current and growing experience of Spanish retrofit providers. This process will doubtless feedback into step 1 and will also help align the many operators in the market.
3. **Multi-channel Origination:** Awareness drives bringing all interested parties with retail distribution channels together and engaging with them in the design of the national retrofit programme (and including them in activities 1 and 2) and in the potential

[80] There is a precedent for legal obligations, such as other debts and charges, being recorded as entries in the registry of the property. Such a precedent needs to be established for energy debt.

benefits of retrofit origination is a key step. The likely robustness and marketability of a final product will depend greatly on its consumer appeal and the early engagement of the sales channels in this development is critical.

4. **"On bill" repayments**: As previously outlined, we see on-bill repayment as core to the success of AIM and the attainment of national optimum retrofit penetration. Given the limited experience and experiment in Spain of the various on-bill channels it may be interesting, in the context of the design of the legal structure, to contemplate and contrast the local benefits to using any of the three on-bill alternatives: Mortgage, Property Tax and Energy bill. We continue to favour energy bill repayment because it best aligns payments for the energy efficiency retrofit with the energy savings they create. We have not been able to identify (from limited research) strong impediment to its use, however we remain open to the possibilities of other secured channels and support their parallel review. All other features of AIM could be implemented immediately, prior to the implementation of on-bill repayment. With out on-bill repayment it will be difficult to capture the full scale of the energy efficiency opportunity, but the market can get started scaling up.
5. **Government Credit Enhancement and Support:** Our rational for the potential for increased efficiency for government spending on energy efficiency through the provision of credit enhancements to broad based energy efficiency retrofit portfolios remains as potentially true for Spain as in other countries. There is less data on current retrofit funding costs and a greater degree of uncertainty around some of the friction costs incurred in the transition from retrofit origination to securitization, however we see no reason to believe such local effects will change the overall picture although a more detailed evaluation is required to assert this conclusion. As in all jurisdictions, government and regulatory support is clearly required to enable the key components of AIM and provide the all important back-drop of consumer education and awareness to help lower behavioural barriers. Also, government can establish liability guidelines and draft regulations for retrofit providers and their auditors. In addition, government can provide useful assistance to the market by commissioning a report that maps energy efficiency opportunities and identifies the biggest areas for improvement. We believe this would be likely to highlight an excellent opportunity among Communidads de Vecinos and lead to their entry into the energy efficiency market in a robust way. Many participants highlight the need to make economically efficient retrofit decisions very easy to make and add a framework alongside regular technical inspections to also verify energy standards.

We believe that Spain can draw upon the successes of CERT, EERS and other white certificate programmes to evaluate the benefits of a results-based retrofit program for retail residential and SME buildings owners. We believe that key features of a new programme could include targets linked to national energy efficiency goals which can then be transferred to the energy suppliers serving these buildings with the creation of traded certificates in a market open to accredited third parties such as retrofit providers and banks. Targets could be established with a 2020 horizon and worked into a programme which might be launched with a 2012 horizon following extensive consultation with the sector and third party stakeholders. In addition, domestic CO2e savings could be captured and the value delivered to the retrofit provider or household through CERT-like certificates valued by energy companies or as traded domestic carbon reductions.

Intra-sector working groups could be established to provide feedback and alternatives to implement on-bill repayment channels. A CERT or EERS type program in Spain could be

financed by the utility itself, alternatively it could be financed following the US model of including a "public benefit surcharge" on all utility bills or potentially through transfers from IBI increases linked to building energy efficiency performance.

The mandatory application of a simplified version of the CTE could be required of properties[81] to be rented or sold and fiscal deductions at a local level (from say the property tax IBI) could be considered for those properties reaching certain minimum threshold criteria. The compensating revenue item to balance any income reduction arising from those achieving IBI deductions could be a wholesale future increase for those not meeting alternative minimum building energy efficiency criteria within a time-period of say 5-10 years (i.e. sufficiently far into the future to allow householders to have implemented a retrofit, assuming the providers are actively promoting them and capital is available).

Finally, given the high concentration of multi-unit residences in Spain, we believe that a significant boost to the retrofit activity could be enabled by making it easier to promote and approve economically beneficial energy efficiency retrofits to the decision making bodies of *communidades de vecinos*. If these could be packaged in such a way (together with financing) that it merely represented an expectation of similar or lower energy costs to the community in the future, together with the secondary benefits of improved livability and acoustics, then the legal processes and requirements for approval should be facilitated.

14. CONCLUSION

More efficient energy use in buildings continues to be one of the largest potential untapped sources of value in each of the countries and regions we have assessed. The barriers to accessing this untapped resource are numerous and complex, but they can be overcome. We believe that enough relevant research, ideas and approaches exist to justify the greater investment and regulatory support dedicated to mining this value in the US, the UK and Spain. In a world struggling to recover from financial crisis and endeavouring to confront climate change, an investment in increased energy productivity must be a priority as it returns cash to homeowners, improves liveability, reduces emissions and invests in long-term national value streams.

There is growing international experience in the relative success and shortcomings of policies designed to stimulate a greater resource focus on energy efficiency retrofit investments. These policies are not yet fully mature, although there are sufficient results upon which to judge initial performance and make deductions and enhancements. Presently, there are also sufficient low hanging fruit in energy savings opportunities in every market to sustain and grow retrofit penetration even as policies improve.

Spain can seize the economic and environmental opportunity presented by energy efficiency through a combination of market and policy developments. We recommend that Spain invest in the analysis of the regulatory framework for the Aggregated Investments Model, clearly considering each of its four key elements: A standardized Energy Efficiency Asset, Standard Documentation, Multi-channel Origination, On-bill repayment, and Government Credit Enhancement and Support. The evolution of energy market regulatory frameworks in

[81] modeled on the Energy Performance Certificate in the UK

accordance with this model, away from a focus on energy supply, towards greater demand-side management and value-added energy services will greatly increase energy efficiency retrofit activity and improve energy productivity in buildings. In addition to what can be learned from the Aggregated Investments Model, there is also a parallel investment required to overcome behavioural barriers to action, by educating and informing energy consumers of the opportunities available to invest to reduce their energy bills and improve their residential or commercial space.

A robust, rapid development of the Aggregated Investments Model in Spain fits with the interests of many key stakeholders in the energy market place:. Utilities can seize the opportunity to deepen their relationships by bring value-added services to their customers; Building owners and occupants will save money through lower energy bills and will see an increase in the liveability of their homes; Financial institutions can benefit from participating in the development of a new investment grade asset: energy efficiency; Retrofit providers will see their businesses grow in leaps and bounds; Municipalities can promote cost savings for their residences by trying out innovative energy efficiency policies at the local level to compliment national action to get the market moving; and the nation stimulates employment, reduces emissions and invests in the potentially exportable refit know-how and new technologies.

The energy efficiency market in buildings presents a huge opportunity. This opportunity will, by necessity, be captured in pieces over time yet each year we wait value slips between our fingers. We believe this paper takes an important step forward in its international assessment and in the application of this learning in the Spanish context. Spain, like other countries, has a considerable untapped resource that can drive consumer savings and environmental benefits at precisely the right time. An enhanced focus can now be directed at increased energy productivity in buildings in Spain to accelerate the delivery of long-term national value at a time when precisely these benefits are those which resonate best with national stakeholders.

Appendices

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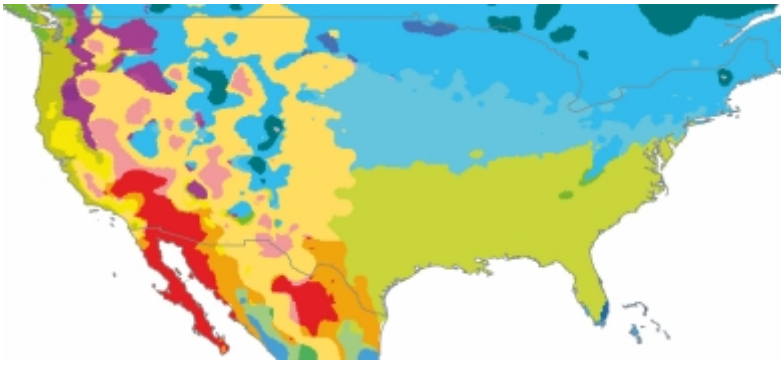
End Notes

[i] US, UK and Spain Climate Comparison

The heating, cooling and lighting requirements of residents in the US, UK, and Spain are similar, making their comparison valid as "mature OECD markets" for energy efficiency building retrofit policies and practice.

Spain has four major climate zones, defined by the Köppen classification system using averages and typical ranges for temperature and precipitation. Northern Spain shares what is called the 'Marine West Coastal' climate with the South of the UK The remainder of Spain shares two varieties of 'Mediterranean' climates as well as a 'Cold Semi-Arid' climate with California and much of the western U.S.

According to Eurostat Spain had 1,829 heating days in 2008 while the UK had 3,043. That said, Spain has significantly more "cooling days" during summer, particularly in the hot southern regions of the country.



[ii] Residential Building Calculations

US:

- The number of multi-unit residences are based on the 2005 US Census of 'Housing Characteristics by Year of Construction'.
- The portion of residences that are owner occupied is based on the % of housing units that were rented units the 2005 US Census of 'Housing Characteristics by Year of Construction'.
- Residence ownership period is the average of the division of the total number of residences by the number of new and existing residences sold in 1999, 2001, 2003, 2005 and 2007 (the years for which US Census data was available regarding housing turnover rates).
- The residences constructed before 1980 is from the 2005 US Census of 'Housing Characteristics by Year of Construction'.
- The total number of residences is the number from the 2005 US Census of 'Housing Characteristics by Year of Construction'.

UK:

- All UK data is calculated in the same way as US and Spain data, but is based only on the latest census data from the England Housing Survey of 2008.
  Residence ownership period is the average of the division of the total number of residences by the number of new and existing residences sold in 2007 and 2008 (the years for which UK Housing Census data was available).

Spain:

- The number of multi-unit residences are based on the total number of single family (unifamiliar) residences and multi-family residences (en bloque) both according to *Instituto*

Nacional de Estadísticas 2001 plus the *Ministerio de Viviendas* 2002-2008 construction numbers for each type of unit.

- The portion of residences that are owner occupied is based on the % of residences that were rental units in the 2001 *Instituto Nacional de Estadísticas* data.
- Residence ownership period is calculated based on the average annual number of residences sold between 2004-2008 using *Ministerio de Viviendas* numbers, divided into the total number of residences.
- The residences constructed before 1980 is from the *Instituto Nacional de Estadísticas* 2001 data on how many residences were constructed each decade, plus the *Ministerio de Viviendas* 2002-2008 construction numbers.
- The total number of residences is the number from the *Ministerio de Viviendas* from 2008.

[iii] Case Study: California

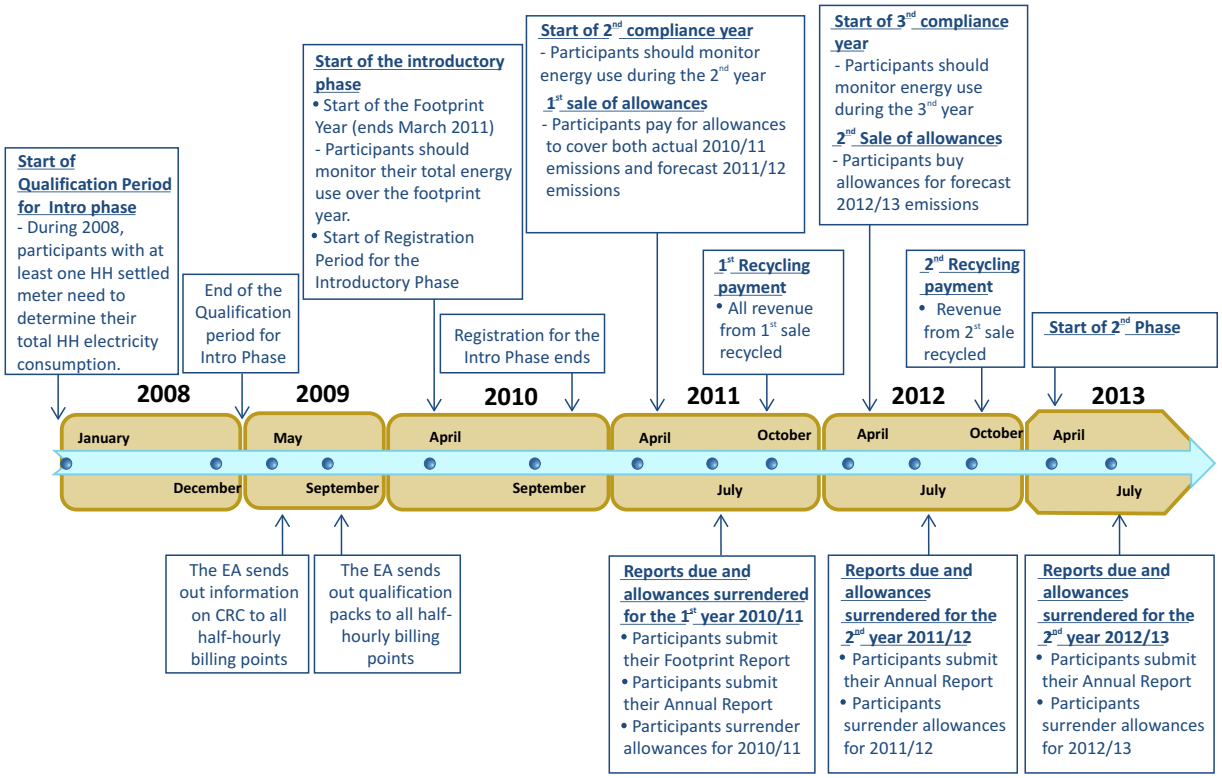
California has long been a leader in energy efficiency in the U.S., frequently acting as the proving ground for new programs (eg. PACE), later implemented in other states and nationally. With 12% of the US population and the world's 8th largest economy, policy innovations in California have a significant influence on the US and the world. The benefit to cost ratio for California's extensive energy efficiency programs in 2006 was 2.7 (i.e. the total benefits were 2.7 times the total costs.) California's per-capita electricity use has remained nearly constant over the past 30 years, illustrating the success of its energy efficiency programs.

The California Public Utilities Commission (CPUC) sets goals for electricity and natural gas usage reduction; they then oversee and approve utility programs that are designed to meet these goals. In 2008, the CPUC set a goal for the 2012-2020 period that would have California using 8.5% less electricity than it would under a "business as usual" scenario, while this goal is not as ambitious as some states' Energy Efficiency Resource Standards, the CPUC will be reviewing the goal in 2010 and may strengthen the target.

Californian utilities collectively spent over $1 billion on energy efficiency programs in 2008. Most utilities invested the money in energy efficiency rebate programs, which reimburse their customers for a portion of any energy efficiency investments they make. Some utilities offered low-interest or on-bill financing options to their customers to help them find the money to make energy efficiency improvements. To pay for these programs California electric utilities collect a Public Good's Charge of 0.48¢ cents/KWh, 0.3¢ cents of which supports energy efficiency programs. In addition, utilities can petition the CPUC for permission to add other energy efficiency charges to recover their costs. Utilities are penalized for missing and rewarded for meeting their energy efficiency targets.

PACE was developed in California, and has been passed into law in 7 cities. In 1996, and 2000, California passed laws making energy efficiency the priority resource, requiring utilities to use all cost-effective efficiency resources before building any new generating capacity. And since 2000, California has implemented revenue decoupling programs for nearly all of their electric and gas utilities.

[iv] UK Government CRC timeline:



Comments from Expert Reviewers:

"It's a fascinating piece of work!"
- *Mike Taylor, Honeywell*

"I think the method of analysis is extremely thorough and transparent and summarizes and frames the challenges very well. Looks like it's going to be a strong piece of work!"
- *Thomas Rowlands, Bloomberg New Energy Finance*

"Evidently great effort has gone into producing this piece of work. I liked the aspect that a new idea is being developed in a systematic manner".
- *Markus Perkmann, Imperial College London*

"Congratulations for the excellent work."
- *Diego Mateos, Gamesa/AE3*

"A stunningly good report. I am impressed."
- *Skip Laitner, American Council for an Energy Efficient Economy*

"It provides an excellent context and discussion of key issues for structuring a new institutional framework for efficiency financing."
- *Meg Gottstein, Regulatory Assistance Project*

"The study does an excellent job assessing both the key barriers and potential solutions for developing the EE retrofit market"
- *Bruce Schlein, Citi*

"It has been a pleasure to take part in such brilliant initiative."
- *Valentin Alfaya Arias, Ferrovial*

"The white paper is extremely well done and highly informative. It is a repository of useful information. An excellent piece of analysis. I learned a lot from reading it."
- *Michael Hanemann, University of California, Berkeley*

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