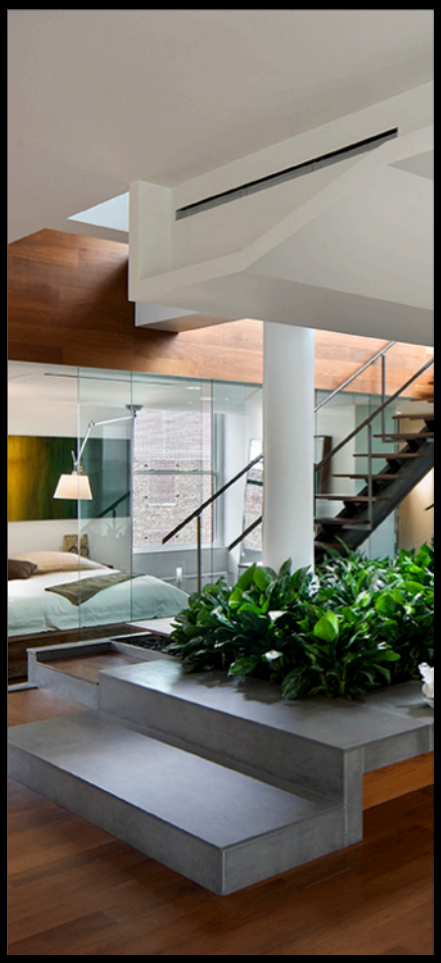
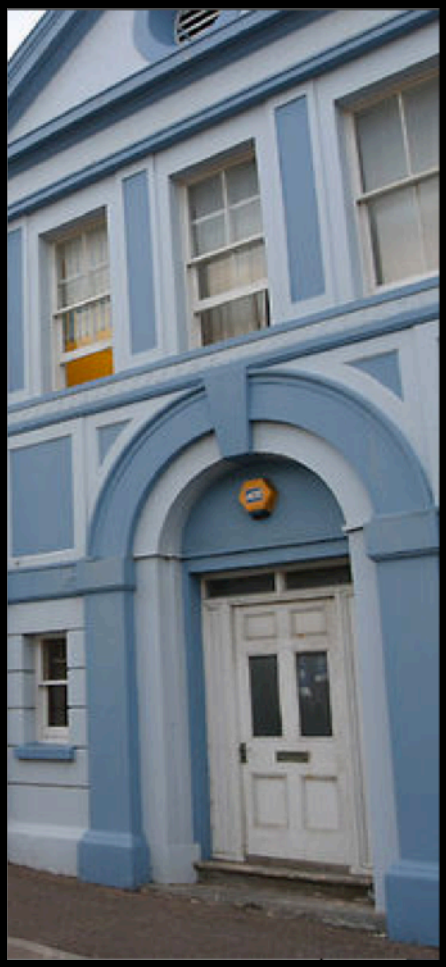
GLOBAL VALUE CASE for SUSTAINABLE HOUSING

Benefits to be gained by transforming the UK housing stock, both new and existing, to improve sustainability





RESIDENTIAL

NEW BUILT

RENOVATION

POUNE ASSET MANAGEMENT

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POUNE
Asset Management

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About
Poune Asset Management

Poune Asset Management is a boutique consultancy firm, a Socially Responsible Company (SRI) focusing on how to make property investment and management a better deal for investors and stakeholders whilst addressing people- and environment-friendly issues.
As such, we are a strong supporter of the United Nations Principles for Responsible Investments (UNPRI) and should become a sponsor soon.

Poune AM caters to two different categories of clients:

- Local governments and housing associations,
- Investment Management companies.

We have a proactive agenda to bring the environmental movement into mainstream property development and management, and as such we aim to reach the new frontier for green and healthy buildings as a profitable investment.

We could summarise our philosophy with a few select words:

Investing in People and Property

Poune Asset Management wants to put itself into the position of blazing a trail that others may follow, as sometimes the road to success is not a road yet, and in the process become a reference in its trading industry.

> *"Blazing a new trail: we need to create growth, not just follow it. Bold visions are essential to fuel hope, energise capacity and extend reach to what might be. Before something becomes conventional, one has to think unconventionally as it takes foresight and global perspective to stay ahead of the game.*
>
> *Adversity is commonplace, but things worthwhile don't come easy; one needs the vision to see what is possible and the resolve to drive it through. It is when you are successful in what you are doing that people start paying attention, and that's the way things begin to change."*

Finally, our Company develops a holistic and integrated approach that contains a clear mission with a strategy and governance structure to achieve that mission. In that respect, we put excellent governance and a willingness to invest in talented individuals at the core of our investment strategy.

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EXECUTIVE SUMMARY

A strong value case exists at a national level to transform a significant proportion of the UK housing stock to a high standard of sustainability with beneficial social, health, environmental and economic outcomes. The majority of the UK housing stock performs poorly in terms of sustainability. Our homes are cold, damp and inefficient in energy and water use. Poune AM is working to develop benchmarks for high standard of sustainability defining the extent of change required, and assess the implications for such a change, while keeping affordability as a key consideration.

- Nearly half of all UK homes are mouldy;
- The UK has a very high rate of asthma related to comparable countries;
- The air inside UK's homes can be more polluted than outdoor air; cold damp homes pose serious health risks, particularly for the most vulnerable groups in the community who spend the most time at home (the young, elderly, infirm, and unemployed).

We believe that a high standard of sustainability is achievable in both new and existing homes. The Government needs to apply effort where it will best effect long-term national-scale changes in the demand, uptake and supply of sustainable solutions that improve the quality and performance of new and existing housing.

Our paper focuses on how an improved housing stock can be valued across a range of Government priorities, demonstrating the national and economy-wide benefits of having housing stock at a higher standard of sustainability than it currently is.

Increasing the sustainability of UK's housing stock will:

- Improve UK's quality of life through healthier homes;
- Reduce the demand from homes on reticulated energy;
- Reduce total energy requirements;
- Reduce carbon dioxide emissions and assist the UK in meeting our Kyoto commitments;
- Reduce demand for reticulated water (and the associated energy required), with longer life for infrastructure and environmental benefits;
- Improve management of stormwater and greywater to decrease negative impacts on the residential and natural environment, thereby making a more resilient water system;
- Increase productivity and make more efficient use of the UK's resources; and
- Improve the UK's housing stock in terms of resilience to global challenges such as climate change, resource availability, and population change.

A significant role exists for Government to drive the necessary upgrade of the existing housing stock to a higher standard of sustainability. A range of simple interventions are examined here which demonstrate the significant difference that can be made to the sustainability of the housing stock, particularly when implemented in combination.

These proposed interventions provide examples of the compelling case for the kinds of interventions needed to achieve the Government's vision of being a sustainable nation, carbon neutral, and meeting our Kyoto commitments. Given the national priority on sustainable development and the national-scale benefits that would accrue from an improved housing stock, there is a strong argument to be made for incentivising uptake. Our assessment concludes that indeed there is a strong case for both implementation of water efficiency technologies at a national level and for universal metering of domestic water supply.

Programmes aiming to generate sustainability outcomes need to be both targeted differently and promote a much higher standard than is currently the case. The different triggers to incentivise such schemes need to be recognised (health, warmth, comfort, reduced noise) other than just financial savings.

The assessment also identifies that there are particular opportunities and value which are able to be unlocked by combining sustainability interventions, rather than retrofitting on a technology-by-technology basis, and from looking at energy, health, environment, and water efficiency as a combined package, rather than on an issue-by-issue basis.

Most of the energy savings reached thanks to better thermal insulation, even allowing for take-back effects in the form of warmer and healthier and spending of household savings from energy on travel and other commodities, should allow for great economy-wide CO2 savings, thus contributing to a reduction in carbon emissions in line with the UK's Kyoto commitments.

Conservative direct water savings estimates amount to 80 litres per person per day, which is huge.

Realisation of the benefits associated with the interventions identified in this paper requires homeowners, landlords and occupiers to make and implement decisions that will change how they build, insulate, heat and manage the consumption of water in houses they own. In some cases these decisions will involve relatively little cost apart from perhaps time and inconvenience. In other cases, decisions will involve what may be relatively large up-front costs for an individual benefit that will be realised over the long term, yet which may have large collective benefits on a national scale.

The Government can create an environment conducive to more environmentally sustainable housing. It can:

- Lead and communicate the case for change with stakeholders involved in all areas of the research, design, supply, construction, regulation and use of the residential built environment;
- Develop and implement appropriate policy frameworks and associated regulations to ensure that consumers face the full environmental and other costs and benefits of their decisions;
- Provide assistance to households to retrofit their existing houses to a high standard of sustainability;
- Effect change through its direct ownership of household units and related property maintenance and purchase decisions;
- Regulate to mandate the installation or use of particular technologies;
- Communicate and provide information to inform consumer choices and explain the case for change; and
- Set performance levels to improve both owner-occupied and rental housing stock, e.g. through regulation of performance standards for houses at point of sale and at point of rental.

Options for Government to promote the achievement of a high standard of sustainability in the UK's housing stock include regulation and incentives to retrofit homes for high thermal performance (insulation), efficient space and water heating, lighting, water efficiency and healthy indoor environments (heating, insulation and ventilation measures), ensuring that these are delivered as a package rather than the current siloed approach by individual agencies; and setting minimum standards in the building code which will substantially improve sustainability of new housing stock.

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INTRODUCTION

Poune AM is setting out in this research paper to explain the global national benefit of upgrading the UK housing stock according to high sustainability standards. We are trying to provide the Government with the opportunity to participate in interventions by providing the case for investment in sustainable housing and the removal of regulatory barriers.

By providing supportive policies and regulations for sustainable housing, Government removes uncertainty for consumers and industry in demanding and supplying sustainable solutions for homes and neighbourhoods, and can provide stimulus for the implementation of effective solutions where long term individual and national benefits impose short term costs on households. Economic transformation is required to bring the housing stock to a high standard of sustainability, through incentivising and promoting effective sustainable housing innovations. Improving the sustainability performance of the UK housing stock is likely to require Government intervention through a mix of instruments including policy interventions, economic incentives, monitoring and evaluation.

Although we are convinced that best results will be achieved through the combination of different elements rather than on their own, we are focusing on four types of benefits:

1. Private economic benefits for households;
2. Environmental benefits;
3. Social and other private benefits;
4. National resource use efficiency.

Putting the Same Meaning Behind Words

- **Best Sustainability Standards**: this is a combination of factors that show a home is performing sustainably. Benchmarks are used especially in the areas of energy and water consumption.
- **Housing stock**: term to describe all dwellings and homes across the country. Collectively dwellings can be considered as a national resource providing shelter, security and warmth to the inhabitants. The 'state' or performance of all homes has national implications, e.g. cold damp dwellings mean unwell occupants; inefficient energy use increases the carbon footprint of our homes.
- **Indoor Environment Quality**: this encompasses the aspects of the indoor environment which impact on the health and wellbeing of house occupants, and on the sustainability of a home. It includes aspects such as temperature, relative humidity, ventilation, noise and presence of pathogens and harmful chemicals in the air.

Best Sustainability Standards

The potential exists to transform a significant proportion of the UK housing stock to Best Sustainability Standards in terms of social, health, environmental and economic outcomes. Local Government needs to apply effort where it will best effect long-term changes in the demand, uptake and supply of sustainable technologies and solutions that improve the quality and performance of new and existing housing.

We can have a strong impact on energy and water consumption, waste, indoor environmental quality and materials used in house construction. The percentage reductions in energy and water use will be attributable to the design and features of the home, and it is expected that occupier behaviour modification will see further significant improvements in the efficiency and healthiness of homes.

Through the implementation of benchmarks, we are aiming at:

- 50% reduction in energy use in new homes and 25% reduction in energy use in the existing housing stock;
- 35% reduction in water use in new homes and 20% in existing ones, with a benchmark of 125 litres per person and per day;
- Indoor temperatures which meets the World Health Organisation minimum standards of 16°C in bedrooms and 18°C in living space;
- Adequate ventilation without excessive draughts, mechanical ventilation of kitchen – bathroom – laundry;
- Certified low VOC paints, furniture and finishes;
- Provision for kitchen waste minimisation, recyclables storage;
- Consideration of sustainability issues in the choice of materials used for construction or renovation of homes, use of off-site technologies whenever possible.

UK Unsustainable Housing Stock

National researches and statistics show that the UK's housing stock is generally poor quality with poor environmental performance. Our homes are unhealthy for many and are large consumers of energy, water and materials, creating an increasing burden on the economy. Upgrading the existing stock to higher levels of sustainability is critical:

- There are tens of millions of existing homes with only a few hundred thousands new builds every year at most.
- Hence, the condition and performance of the existing stock are critical as it is where most UK residents will live in the short and medium term future;

- Existing housing stock represents considerable resource investments which should be optimised where possible;
- Significant reductions can be made in greenhouse gas emissions from reduced energy use in homes and embodied energy in water use: both costs of energy and the production of greenhouse gases are inherent in water supply and disposal.

Direct burdens on the economy of poor performance of our housing stock include higher than necessary needs for health, police, and emergency services; energy demand and carbon emissions relating to climate change.
Indirect burdens include lost productivity and reduced educational achievement.

The performance of the economy is affected by growth and employment, which in turn are reliant on education, health and partly immigration. Poor performance of the housing stock can adversely affect health leading to lost time from education, employment and leisure. Sustainable housing can favourably affect health thus reducing these losses.

For households, spending decisions involve a trade-off between leisure and consumption. Household investment in improving the sustainability of homes will be dependent on their ability to switch spending between leisure and consumption. The cost of housing represents a long-term investment for most households. Additional investment to achieve Best Sustainability Standards for the home is a complex decision influenced by motivation and perceived return on investment. In addition, low-income households are often not in a position to make such decisions despite the benefits.

Indoor Environmental Quality

Largely due our weather conditions, our houses are generally cold, damp and hard to heat in winter. There is a growing awareness that cold damp homes pose health risks, especially for particular groups in the community, mainly the very young, the elderly, and those with chronic health problems. In addition, the types of heating used poses health concerns, in particular air pollution caused by inefficient methods of solid fuel heating and the release of combustion products.

Our damp cold homes are a significant contributor to asthma and bronchial diseases, therefore measures to decrease respiratory irritants and damp, cold homes are critical. Furthermore, it would seem that health is a more persuasive driver for homeowners to upgrade their home than climate change or energy efficiency.

Household Energy Use

If the UK is to fulfil its Kyoto commitments and move in the direction of carbon neutrality, household energy use will need to be reduced, become more efficient, and/or rely on alternative renewable energy sources.

There are substantial challenges, especially when factoring in estimates that electricity demand will increase dramatically in the coming years and energy-related greenhouse gases will increase as well under a business-as-usual scenario.

Transforming UK's homes to meet our Best Sustainability Standards can help deliver the Government's vision through a reduction in energy demand and increased use of renewable energy sources.

Energy use has a significant impact on the spending of families in the UK; reducing household spending on energy will impact on:

- The amount that families have to spend on other commodities;
- The amount and price of energy available for business use, and hence the competitiveness of UK's industry in the global market place;
- And creation of greenhouse gases contributing to climate change.

Considerations Around Water Use

Water and energy efficiency are usually considered independently of each other. Yet, collection, storage, transport, treatment, use and disposal of water have significant associated energy costs, not necessarily currently considered in water planning. Governments might be more interested in developing new costly infrastructures incurring significant extra energy costs in construction, operation (pumping stations, pipe network) and disposal of wastewater instead of introducing measures to promote efficient use of water or introduce water-collection incentives (rainwater harvesting and grey water filtration).

Hot water is a major energy use in households and the majority of households do not have low flow devices. New hot water systems are often high-pressure mains systems, which exacerbate the problem. Use of such devices as low flow showerheads would have a significant positive benefit in terms of both water and energy efficiency.

There are good arguments for basic water efficiency measures (low-flow devices, dual-flush toilets) and rainwater harvesting to be used throughout the country, regardless of the security of water supply and energy implications:

Considerations around Water Use
Negative aspects
■ Abstraction of water always has an environmental impact which should be minimised. ■ In addition the reticulation, maintenance and renewal of water infrastructure has a high cost to the ratepayer. ■ In some instances the procurement of water services to private companies has been granted a "poor" or "very poor" value for money from Government Audit services. Poorly drafted contracts left end users paying huge bills for under-achieving services and waste (leakage) on a huge scale.
Positive aspects These costs can be reduced if water efficiency measures are in place.
■ Water efficiency and use of rainwater and greywater will also allow for growth without putting pressure on water supplies and systems. ■ In some instances water efficiency would allow for surplus water to be reticulated to other surrounding areas where water sources may be depleted. ■ Water use results in wastewater production, so water efficiency also results in a reduction in wastewater quantity and the requirement for wastewater treatment and disposal, with associated financial – health - environmental benefits. ■ Considering the efficiency of water use by households and management of water at all levels with less reliance on reticulated systems will ensure wise use of our current resources and resilience in the face of climate change.

Sustainable Homes are Achievable

Retrofitting existing homes for sustainability can be achieved relatively easily. Standard 1960s and 70s homes come with the normal suite of energy, water, waste and indoor environment issues: little insulation, high heating costs, use of inefficient electric hot water cylinders, high moisture levels, under-heated homes and wasted water. On top of these, there might be asbestos and/or lead based issues.

A well designed, well-insulated new home can easily use 30% less energy than a standard home, and these improvements in design can be undertaken within an affordable context.

Instead of being put off by the scale of the works to be done, refitting such a property offers a great opportunity as most probably the whole unit will be completely stripped out, thus allowing

for an easy and convenient rewiring, replumbing and other refurbishments. Once it is done, the property will be fit for many more years except for the everyday wear and tear to be expected.

Significant gains can be made from increasing the energy and water efficiency and indoor environmental quality in homes, but this needs to be undertaken with a view to upgrading homes to a high standard, not to "slightly better" standards. To date, much of the focus of retrofit measures has been on improving only the insulation of houses to reduce heat loss, improve indoor temperatures, and reduce the amount of heating required. The primary benefits of home insulation are:

- Improved energy efficiency of home heating systems;
- Reduced pollution from the energy sources; and
- The ability to better maintain comfortable indoor temperatures.

Sustainable housing is about reducing the adverse effects of housing on the environment while at the same time making houses more comfortable and healthy, and doing both in a nationally cost-effective manner.

This means that evaluation is needed of what might happen in housing in an economy-wide context. Essentially, the Global Value Case for sustainable Housing depends on the benefits to the nation exceeding the costs: resources need to be used more efficiently in the consumption or production of hosing services, or be allocated more efficiently between activities, and/or deliver social and environmental benefits in addition to economic benefits.

Part I. Retrofitting Homes

Significant effects can be achieved through simple actions. We will be focusing on:

Energy:

- Retrofit ceiling and floor insulation;
- Space and water heating;
- Energy efficient lighting; and

Water:

- Low-flow devices and appliances;
- Water metering and pricing.

Section 1. Energy

Retrofit Insulation

Retrofit insulation is cost-effective from an energy-saving perspective. It performs well on environmental grounds by promoting more sustainable consumption and less pollution. It has positive health effects, as well as using recycled materials in the manufacture of some types of insulation. It is also very good at producing better health (apart from economic benefits) and a more comfortable home.

Extreme retrofit insulation can achieve passive house standards, even in traditional buildings such as Victorian houses for instance.

The health benefits of warmer homes also contribute to national resource efficiency through an increase in labour productivity (fewer days off work) and savings in public health costs. There may also be other benefits such as the effect on children: less coughing and respiratory inflammation, and fewer days absent from school, as well as gains in health and comfort from less noise.

The benefits from retrofit insulation is a saving in household energy consumption, and health benefits it delivers resulting from an overall positive economic benefit. Hence the case for insulating homes is exactly that:
Healthy and more comfortable homes, not solely energy savings or CO_2 reductions (although it delivers both.)

Most of the economic benefit of healthy homes is captured more widely in the form of less spending on health, and greater worker productivity rather than direct economic savings.

Efficient Lighting

Lighting is estimated to account for nearly 9% of household energy consumption. Most of it is incandescent lighting which, if replaced with compact fluorescent lighting (CFL) or LED would deliver savings of between 80 and 90%.

The cost of CFL or LED bulbs is between 3 to 6 times more than that of an incandescent bulb, but EU regulations make it now mandatory in new builds across Europe. The longer life of these bulbs means that there is effectively no difference in capital cost s relative to incandescent lighting.

Part I. Retrofitting homes

Section 2. Water

Before getting into the details of technical solutions related to the consumption of water, one fact is showering is a main cause of use. Thus, reducing the time one spends having a shower or a bath might be a solution... Of course a line should be drawn somewhere about how much time and water someone spends having a shower, but the truth is when there is no more hot water, then, no more shower…

In that respect, unlimited hot water might have a negative impact on water and fuel (to heat the water) consumption; once we know how much hot water is available, we optimise our use of it.

Low-Flow Devices for Water Efficiency

Three technical innovations that reduce water use are being scrutinised:

Innovation	Saving	Explanation	Cost
Low-flow shower head	8.4%	Low saving due to high proportion of low-pressure systems and assumed take-back from occupiers.	No extra cost*
Dual-flush toilets	55%	5 litres versus 11 litres per flush.	No extra cost*
Efficient washing machines	60%	60 litres per wash compared to 150 litres.	Around £100 above standard machine

* When part of a property retrofit as concerned devices would have been replaced anyway.

Theses three measures combined reduce per-person-usage drastically with a very positive impact:

On communities' infrastructures:

- Less discharge of wastewater;
- Less pressure on water infrastructures;
- Less waste flowing into natural waterways.

On households:

- Lower water use in showers also means lower energy use to heat it;
- But many households do not pay for direct water consumption, because of the absence of water meters, only through estimated demand only. In this case, it is hard to mobilise households as they don't see any financial impact on their bills.

Incorporating low-flow devices should really deliver only if used alongside the pragmatic installation of water meters in properties.

Water Metering

Charging for water use through property rates removes people from price signals and leads to excessive water consumption.

The main reason for introducing water meters is to give a price signal to consumers, providing them with an incentive to reduce wastage, and ensure that decisions are made based on the true economic costs of water to the household.

But in some cases households might object to the change, for instance where the homes are over-crowded. There are more people living in a property than should be according to property rates, and thus the water bill might be lower than a real, metered base reading.

Part II. Best Sustainability Standards

Part II. Best Sustainability Standards

Section 1. Energy

Insulation on its own is not sufficient to reduce household energy consumption to Best Sustainability Standards target, but with the addition of a more efficient heat source the target should easily be met.

Gas instant water heating presents an overall good, if not perfect, solution, because in UK climate switching to solar or wind systems is not easily achievable yet. Ground source heat pumps are very good alternative to the use of gas, but it is not a practical solution especially in urban areas with small – if any – plots of lands available.

Gas instant water heating is primarily fuel substitution and overall household energy consumption changes little. Direct use of gas, however, is more thermally efficient than using it to generate electricity. It also means fewer CO_2 emissions per unit of delivered energy.

Other energy saving options such as more energy efficient appliances and lighting generate only small savings in total household energy use, but are significant in their own domains. Taken together they could make a worthwhile contribution to reducing domestic power costs.

Part II. Best Sustainability Standards

Section 2. Water

For new builds, the UK Government decided on a baseline for household water consumption of 125 litres per person and per day (l/p/d). Globally UK households' water consumption is a far cry from that target, well in excess of 200 l/p/d. To help meet the UK target, we are exploring a package of three water consumption innovations: low-flow showerheads, dual-flush toilet cisterns and AAA washing machines. These innovations are easily incorporated into any retrofit and new builds, and the addition of rainwater harvesting tanks would produce a further major increase in water savings.

Installing a rainwater tank produces no direct reduction in water consumption, but does produce a significant reduction in the use of reticulated water.

And the Best Sustainability Standards target relates to use of water from a reticulated supply. Reducing consumption of water is not our main objective; what we are looking to achieve is to

ensure that the nation's resources are used in an efficient manner, along their whole life cycle from extraction and production through to final consumption and eventual disposal.

Reducing water consumption per se is not the goal, but rather not wasting water, ensuring it is allocated efficiently across different users and that it is delivered to users in a resource efficient manner (which may be through water tanks instead of reticulation).

Reticulation of water and maintenance of water infrastructure has high costs to the ratepayer and water efficiency will reduce pressure on this infrastructure. However, there are also good arguments for a reduction in water use as abstraction of water always has environmental impacts, both from the view of reducing the water available for ecosystem services and also the disposal of wastewater after use by households. Water efficiency results in a reduction in wastewater quantity and the requirement for wastewater treatment and disposal, with associated financial-health-environmental benefits.

Improving the sustainability of the housing stock will require looking at wider effects and benefits than only energy and water use. The materials used in construction, the waste produced, and the quality of the indoor environment with the associated benefits for health and comfort of families and social and environmental benefits are significant.

Implementation of a combination of innovations to transform the sustainability of the UK housing stock will have multiple benefits on a nationwide scale.

Part III. The Case for Intervention

The majority of the UK's housing stock performs poorly in terms of sustainability. Our homes are cold, damp, unhealthy and inefficient in energy and water use.

The potential exists to transform a significant proportion of the UK housing stock to Best Sustainability Standards with beneficial social, health, environmental and economic outcomes, in both new and existing homes.

The Government needs to apply effort where it will best affect long term national scale changes in the demand, uptake and supply of sustainable solutions that improve the quality and performance of new and existing housing.

Transformation of the housing stock can be considered at different levels:

- Physical transformation of the housing stock itself;
- Economic transformation creating an economic environment that recognises the value of improving the performance of the housing stock; and
- Market transformation creating demand from consumers and supply by industry for improvements in the housing stock.

Homes and neighbourhoods are critical for delivering sustainability. Our case demonstrates how an improved housing stock delivers multiple benefits and can be valued across a range of Government departments, demonstrating the national and economy-wide benefits of having housing stock at a higher standard of sustainability than currently.

A significant role exists for Government to drive the necessary upgrade of the housing stock to Best Sustainability Standards, but that won't be achieved without significant investments in new and expanded programmes, and not without regulation to eliminate the most inefficient products and processes whilst encouraging the uptake of more efficient ones. Incentives and information are not enough.

Education programmes to date have focused around behaviour (turn off switches etc) and need to focus also on purchasing decisions, design and retrofitting of houses, and this needs to include working with key industry groups. A different model of provision of incentives also needs to be considered with engagement of the health, insurance and banking sectors and to a stronger degree with the electricity supply sector.

- Banks could offer incentives for energy efficiency retrofits to new mortgage holders;
- Electricity suppliers could provide for the capital cost of energy efficiency measures to be repaid through power bills;
- Health insurers could offer lower premiums for insulated houses and heating methods which enable a healthy internal environment.

In short, the Government needs to engage far more widely with the range of industry players who could assist in promoting sustainability outcomes for both public and business benefit.

Incentives offered by Government must be sufficiently attractive to change behaviour. This means those incentives, which will significantly increase uptake in more efficient technologies and cover the range of different types of sustainability programmes, targeting the areas where biggest gains can be made for the level of investment and assisting those who cannot afford such improvements.

Programmes aiming to generate sustainability outcomes need to be both targeted differently and promote a much higher standard than is currently the case. The different triggers to incentivise such schemes need to be recognised (health, warmth, comfort, reduced noise) other than just financial savings.

The Government can create an environment conducive to more environmentally sustainable housing. It can:

- Lead and communicate the case for change with stakeholders involved in all areas of the research, design, supply, construction, regulation, and use of the residential built environment;
- Develop and implement appropriate policy frameworks and associated regulations to ensure that consumers face the full environmental and other costs and benefits of their decisions;
- Provide assistance to households to retrofit their existing houses to Best Sustainability Standards;
- Effect change through its direct ownership of many properties and purchase decisions;
- Regulate to mandate the installation or use of particular technologies;
- Communicate and provide information to inform consumer choices and explain the case for change; and
- Set performance levels to improve both owner-occupied and rental housing stock, for instance through regulation of performance standards for houses at point of sale and at point of rental.

The UK Government has already implemented many regulations with ambitious deadlines, but current economic conditions are threatening to derail, postpone or empty of their meaning some much needed elements of our global solution.

In practice, successful policy and its implementation usually require a mix of the above rather than reliance on a single intervention. A policy approach that comprises a baseline of regulation, supported by non-regulatory Governmental initiatives and active private sector participation is likely to deliver the best outcome in terms of uptake of sustainable housing innovations.

There are compelling evidence that low standard of sustainability in the UK's housing stock, along with evidence that a higher standard would improve national welfare, demonstrates the role for policy intervention with regards to sustainable housing. A number of issues are evident in our analysis:

- People's housing decisions seem to be at odds with their own best interests: they use expensive and inefficient heating options, do not insulate their houses adequately and have poor health and high energy costs as a result.
- Benefits and costs of the actions of individuals accrue to third parties and to UK society in general: impact of wastewater in the absence of direct water pricing, impact on the environment from housing decision, cost of carbon emissions from inefficient energy use.

A number of key factors may prevent people from acting in their own best interests. These include time, convenience and short-term comfort that may offset the adoption of more

sustainable housing choices. For example, irrespective of cost, the inconvenience and disruption associated with house alterations will discourage the adoption of beneficial improvements.

Another major issue is the sunk cost of previous decisions and existing structures. Although there might be little difference in the price between more or less efficient appliances, the gains in efficiency are unlikely to be sufficient to encourage the early replacement of existing appliances by households.

There are also concerns raised by the analysis regarding the externalities imposed on society in terms of carbon emissions (Kyoto protocol), environmental degradation and high costs in health care and poor health of the population. The analysis of energy saving innovations in particular shows how individual actions are at odds with national interests. The analysis indicates that the benefits to individual households, via lower energy costs, are not sufficient to encourage most households to voluntarily undertake insulation retrofits.
Yet when the national savings associated from improved health consequences are included, there is a compelling case for the promotion of retrofitting improved insulation in the existing housing stock.
However, the benefits of these gains do not go directly to the individual households, but rather are seen in lower national health costs and higher labour productivity. Individuals benefit from feeling healthier, but the main gains go to Government via significantly lower health costs and to businesses that have lower overheads due to fewer days lost due to sickness.

This warrants policy intervention in the interest of the public good.

Part III. The Case for Intervention

Section 1. Retrofit Insulation

Homes built before the 70s' oil crisis do not benefit from the same standards of thermal performance as those built today. Given that the vast majority of the UK housing stock was built before the oil crisis, there are significant gains to be made from retrofitting insulation in existing homes.

Retrofit insulation is cost-effective from an energy-saving perspective. It performs well on environmental grounds and has positive health effects as well as using recycled materials in the manufacture of some types of insulation. It produces better health and a more comfortable home; the health benefits of warmer homes increase labour productivity (fewer days off work) and create savings in public health costs (less hospital admissions).
Its primary benefit is healthy and more comfortable homes, not energy savings or CO_2 reductions, although it delivers both. Most of the economic benefit of healthy homes is captured more widely in the form of less spending on health and greater worker productivity.

Because of the misalignment between private benefit (over the long term as well as indirect and non-monetary) and private costs (up-front installation), there is a case for Government intervention:

- Economic benefits are longer term and are often outweighed by short term imperatives;
- Many homeowners may be unaware of the potential benefits and the ease of retrofitting insulation; and
- A great part of the population live in rented homes, and landlords may not see any economic or amenity benefits to themselves in retrofitting insulation.

The vast majority of homes that will be in use over the next 50 years have already been built, and most of the work in the coming century is likely to be on modifying existing buildings.

The rental property segment is very challenging because owners will not necessarily reap the ongoing benefits of the improvements directly.

Part III. The Case for Intervention

Section 2. Space Heating

Efficient space heating solutions have high private economic benefit and good social and non-economic benefits. There are significant reductions in CO_2 emissions and a gain in national resource use efficiency through health and energy savings.

Nevertheless, up-front capital costs of installation may present a barrier for many households, outweighing the longer-term benefits. The Government intervention is necessary to overcome this cost barrier.

Part III. The Case for Intervention

Section 3. Efficient Lighting

Replacement of incandescent bulbs with efficient alternatives (Compact Fluorescent Lighting and LED) results in large benefits for homeowners and the nation in terms of resource use efficiency, more sustainable consumption (longer-lasting bulbs) and less waste and pollution (less thermal generation and greenhouse gases). Further, the cost of changing are very low if incandescent bulbs are replaced when they expire.

Part III. The Case for Intervention

Section 4. About Water Efficiency Measures

Water use by households accounts for about 45% of total reticulated supplies. There are good arguments for basic water efficiency measures to be used throughout the country, regardless of the security of water supply:

- Water shortages in some areas;
- Abstraction of water always has environmental impacts which should be minimised;
- Maintenance and renewal of water infrastructure has a high cost to the ratepayer, these costs can be reduced if water efficiency measures are in place;
- Water efficiency allows for growth without putting pressure on water systems;
- Water efficiency results in reduced wastewater and the requirement for wastewater treatment and disposal, with associated financial, health and environmental benefits, and less waste flowing into natural waterways.

The three water efficiency measures (low-flow shower heads, dual-flush toilets and water efficiency washing machines) have very high benefits in that they produce both water savings and energy savings.

From a national resource use efficiency perspective, the water savings are virtually costless, with benefits gained from both water savings and energy savings.

Whilst the financial costs to homeowners of implementing the initiatives are very low, it is likely that a number of other factors including amenity concerns, finding the time to make or arrange for the switch, incomplete information on choices and the potential benefits of installing these features in new and existing homes are all barriers to their widespread take-up.

Exposing homeowners to the full environmental costs of their water consumption through better pricing would result in improved incentives for homeowners to switch to such measures.

As mentioned before, the main reason for introducing water meters is to give a price signal to consumers, providing them with an incentive to reduce water wastage, and ensure that decisions are made based on the true costs of water. Charging for water use through property rates removes people from price signals and leads to excessive water consumption. Direct pricing of the provision of household water through metering is likely to lead to significant savings, and water metering presents a strong case for Government intervention to ensure the most efficient allocation of national resources.

Part III. The Case for Intervention

Section 5. Linkage

Homes consist of a complex combination of systems: walls, roofs, floors, energy systems, plumbing, heating, ventilation etc. Each one provides a specific performance level for a home, and collectively they result in a certain level of comfort, resource use and quality of life.

There is a need to understand homes as a comprehensive system.

The practical reality of designing, building and living in a dwelling involves balancing the performance of one system with the performance of another. The design, construction, operation and maintenance of a sustainable home requires more than the aggregation of a set of energy or water efficient products and systems. It is the combination of these things as well as the materials used and the indoor environmental quality, and the trade-offs between them that arise when considerations of affordability and future flexibility are applied.

Currently, many UK homes are not operating as sustainable systems. They are cold, damp and inefficient. There is a significant role for Government to play in improving the sustainability of the UK housing stock and the homes of our people. This will require recognition of the "joined up thinking" needed for sustainable building and renovation, and work across Government to achieve gains in health, energy efficiency, reduction in carbon emissions, increased labour productivity and quality of housing. One issue of the "Green deal" being set up is the level of formation of the workforce responsible for carrying out retrofittings.

Apendix

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ENERGY

Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
Retrofit ceiling insulation	- More comfortable homes. - Better health. - Energy cost savings.	- Lower health expenditure. - Less absenteeism in the national workforce which is more productive.	- Less investment in large energy generation. - Fewer work days lost through illness.	- Lower greenhouse gas emissions from less thermal generation. - Use of waste materials in insulation.	- Credit constraints. - High discount rate. - Insufficient information. - Inability to capture sufficient benefits.	
Retrofit floors and walls						Is the floor suspended or is it a slab on the ground?
Double glazing	- Less noise and improved amenity. - Less condensation and dampness.					Limited benefit without insulation.
Instant gas water heating	Energy cost savings. Long payback period.		- Direct use of gas. - No cylinder.	- Less thermal generation at margin. - Could lower GHG emissions.		
Energy efficient appliances.	Energy cost savings.			Lower ozone depletion as some appliances made in China still have CFCs as ther refrigerant.		Accelerated replacement probably not economic.
Energy efficient lighting (CFL+LED)	Energy cost savings.			Lower thermal generation.		LED technology is developing rapidly.
Passive solar design	- Energy cost savings. - More comfortable indoor environment. - Better weather tightness.		Less investment in large energy generation.	Lower thermal generation.		Possible airconditioning savings.

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WATER

Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
Rainwater capture	Lower water fees or rates.	Less local government spending on new water supply, stormwater transport, treatment and disposal.	Less use of reticulated water.	- Less damming of waterways and less stress on quifers. - Less damage and contamination from stormwater discharge to streams and coast.	- Many householders do not directly face price of reticulated water. - Health regulations may conflict.	
Low-flow devices	Less energy use.	Less local government spending on new water supply, stormwater transport, treatment and disposal.	Less water use from technical efficiency.	- Less wastewater discharge to receiving environments. - Less damming of waterways and less stess on aquafers.		Could be marked comfort trade-off, but not for toilets.
Water metering (potable and waste)	Financial impact could be positive or negative.	- Less local government spending on new water supply, stormwater transport, treatment and disposal. - Better leak detection.	Less water use from price signal.		Introduce a price signal. Perceived social issue for low-income households with a large number of occupants.	
Collection of grey water	Lower water fees or rates.	Less spending on local government wastewater transport, treatment and disposal.	Less use of reticulated water.	Less waste into waterways.	Householders not directly face price of wastewater removal.	Chemical build-up in garden?
No in-sink waste disposal unit	- Power savings. - Disbenefit of more waste handling with more composting.	Less spending on local government wastewater transport, treatment and disposal.	Less water use.	Less waste into waterways.		

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	Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
WASTE	**Composting of green waste vs landfills**	Lower charges for rubbish collection.	Less local government spending on land-fills and cost of collection and transport of waste.	Less energy use transporting waste.	- Fewer landfills. - Fewer emissions (local air and greenhouse effect) from transporting waste.	Some councils have user charges, but many in general rates.	- Possible loss of electricity generation. - Larger regional landfills have better environmental standards but more waste is moved.
	Space for recyclables storage	Lower charges for rubbish collection.	Less local government spending on land-fills.	Waste returning back into the consumption stream.	Fewer landfills.		Particularly an issue for apartment and medium density housing developments.

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BUILDING MATERIALS

Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
New homes made of sustainable materials. Also apply to renovations to older homes.	Health benefits from use of materials with low Volatile Organic Compounds.		Less resource use to make the materials.	Less hazardous waste input to the environment.	Building Code issues in some cases.	Only apply to verified or certified materials based on cleaner production components and minimisation of hazardous inputs.
Reduce construction waste going to landfills	Prefabrication may lower costs as does use of standard material sizes.	Less local government spending on landflils.	- Less energy use from transporting waste. - Less imbodied energy in materials going to landfill.	Fewer emissions from transporting waste and embodied energy in materials.	Waste disposal may not be priced below the true social cost.	Global reduction of waste as a result of design using standard material sizes.

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	Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
INDOOR ENVIRONMENT	**Ventilation: active mechanical in wet areas**	- More comfortable home. - Lower maintenance. - Better health. - Energy cost savings.	Lower health expenditure.	Fewer work days lost through illness.		As for retrofit insulation.	Synergy with insulation, but double glazing could raise humidity level.
	House orientation	- Warmer home. - Less cost to heat. - Better amneity of living space.		Lower energy use.	Lower energy use.	- Needs to be considered at the individual house. - Meets resistance from developers.	
	Passive vents	- More comfortable home. - Better health. - Lower maintenance.	Lower health expenditure.	Fewer work days lost through illness.			Passive vents reduce mould growth and poor indoor air quality.

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NEIGHBOURHOOD

Initiative	Private Benefits	Fiscal Benefits	Resource-Use Efficiency	Environmental Benefits	Externalities and Barriers	Other
Access to public transport	Cheaper transport.	Possible reduction in expenditure on new road capacity, but more on road maintenance.	- Less fuel use. - Net roading expenditure unclear.	Lower CO2 emissions.	Requires urban density and dominant travel routes.	Very dependent on frequency, reliability and comfort.
Siting of dwellings in relation to one another	- More privacy. - More community spaces. - Lower crime.	Less policing.			Cost of land.	
Multi-purpose dwellings and functional flexibility	Disbenefit from sub-optimal floor plan if try to build whole house for both domestic and commercial use.		Less use of building materials.	Less use of building materials.	Future needs difficult to predict: how much flexibility to build in?	Apartments can be designed so that walls are easy to move to accommodate changing needs.
Higher density land use	- More affordable house prices. - Disbenefit from more crowding.	Councils gain through more efficient use of infrastructure (public transport etc).	More efficient use of land.	Less pressure from expansion of cities on natural resources unless intensive housing pushed into natural areas.		- Only appropriate where services exist. Higher density land use in sparsely populated areas is not efficient. - Good design is essential.