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FutureFit Finance Programme

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Contents

1 Executive Summary

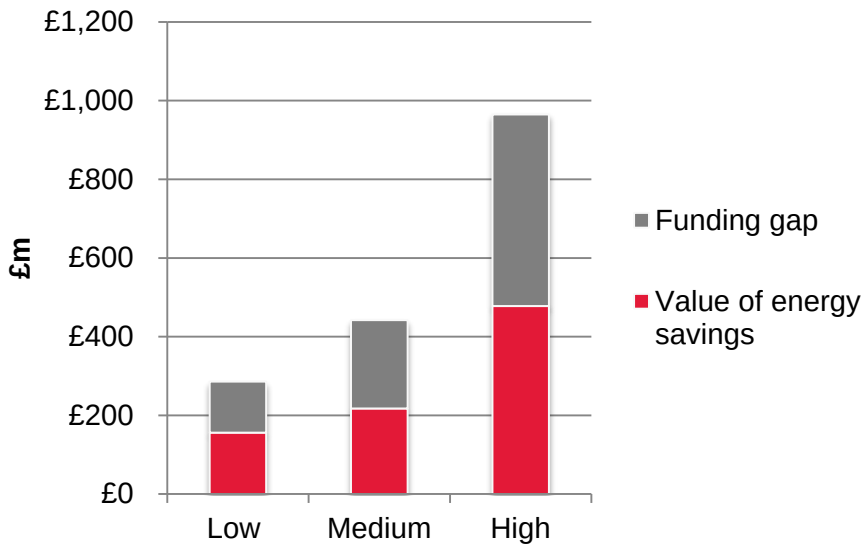
FutureFit is Affinity Sutton's flagship project that aims to provide unique insights into how the Green Deal could work in the context of the 56,000 homes they own and manage, and more widely in the social housing sector. As part of the project, Affinity Sutton installed energy efficiency work packages in 102 of their properties with a view to understanding the practical issues and costs of energy efficient building retrofit.

This report presents the findings of the technical and financial analysis that was undertaken to understand the potential to finance a stock-wide retrofit programme by capturing the revenue from energy savings, and how Affinity Sutton as a organisation can begin to mainstream low carbon activities to deliver significant CO_2 reductions in its existing housing portfolio.

The study is based on 22 property archetypes that represent a significant proportion of Affinity Sutton's housing stock and around 75% of the existing housing stock in the UK[1]. Three different retrofit packages were defined for each of the archetypes – low, medium and high. A notional cap of £6.5k, £10k and £25k was set for these different levels of intervention.

Technical modelling was carried out using SAP methodology to determine the level of energy savings associated with each intervention scenario. Discounted cash flow analysis was carried out taking into account the capital cost for work packages, maintenance costs for measures, and the value of the energy savings over a 20 year period to generate the Net Present value (NPV) of the investment. The financial model has been built around the 'Golden Rule' – one of the core principles within the Green Deal. This requires that the Green Deal payments should not exceed the projected associated cost savings from energy efficiency measures for the duration of the Green Deal Finance arrangement.

The analysis has demonstrated that the value of energy savings across Affinity Sutton housing stock that the Green Deal can help realise is quite significant, to the tune of ~£480m for the high package, £218m for the medium package and £156m for the low package. These work packages can deliver CO_2 savings of between 34% - 18% across ASG stock.



[1] *Refer Appendix B*

NPV of energy savings and funding gap for each intervention scenario					
	NPC of retrofit incl O&M (£m)	Value of energy savings (£m)	Funding gap (£m)	Total CO_2 reduction	Avg. NPC per dwelling (£k)
Low	£283	£156	£130	18%	2.9
Medium	£439	£218	£224	23%	5.0
High	£959	£478	£487	34%	10.8

To realise these savings, there is however a significant funding gap across all three intervention scenarios. On an average it varies from £2,900 per property for the low scenario up to ~£10,800 per property for the high scenario. This excludes the additional upfront costs of delivery a Green Deal programme.

The sensitivity analysis has indicated that Green Deal is very much a dynamic system. A range of variables will impact on the viability of the Green Deal mechanism. These include the cost of capital, costs associated with Green Deal delivery, variance in capital costs of the measures, contract length, level of energy price inflation factored into the Green Deal 'Golden Rule', and the value of energy savings shared with the resident, among others.

To narrow the funding gap and improve the viability of Green Deal as a financing mechanism for delivering energy efficiency improvements in their housing stock, **Affinity Sutton need 'Green Deal Plus'** that will require them to

- **Optimise work packages** further building on the learning from the FutureFit preparatory phase.
- **Align energy efficiency measures with trigger points** to bring down both the marginal costs as well as the disruption for residents. For each package key trigger points should be considered to allow them to be rolled out to the wider stock – e.g. cyclical maintenance visit, annual gas inspection, reactive maintenance, new kitchens and bathrooms, void upgrades, etc.
- **Manage supply chains** - Work with supply chain to appraise potential for bringing down capital costs when scaling up and also review alternative products that can achieve comparable performance at relatively lower capital costs.
- **Review alternative sources of finance** with a view to reduce cost of capital
- **Manage risks**, such as those related to uptake of Green Deal and technical performance of measures installed.
- **Secure ECO funding** to plug the gap.

2 Introduction

Affinity Sutton launched the FutureFit programme, a £1.2m internally funded retrofit project involving low carbon retrofit of 102 Affinity Sutton owned properties, in autumn 2010 with a view to understanding the practical issues and costs of energy efficient building retrofit. The 'FutureFit finance programme' is a parallel initiative that aims to understand the potential to finance a stock-wide retrofit programme by capturing the revenue from energy savings, and how Affinity Sutton as a organisation can begin to mainstream low carbon activities to deliver significant CO_2 reductions in its existing housing portfolio.

This report sets out the main conclusions and recommendations from the technical analysis and financial modelling of Affinity Sutton stock. The analysis is based on 22 property archetypes that represent a significant proportion of their housing stock and around 75% of the existing housing stock in the UK[2].

3 Technical solutions

3.1 Archetype selection

An archetype handbook was produced by Bailey Garner for the FutureFit properties. Camco / Fontenergy worked closely with Baily Garner and ASG's in-house asset management team to develop the archetype handbook and to ensure that it is statistically meaningful in the context of Affinity Sutton's wider portfolio.

The approach to archetype selection and a summary of the housing stock analysis that was carried out to inform the archetype selection is included in Appendix 1.

3.2 Approach

Three different retrofit packages were defined for each of the archetypes by Baily Garner– low, medium and high. For each of these the energy and CO_2 savings were calculated using SAP 2005 software. A notional cap of £6.5k, £10k and £25k was set for these different levels of intervention.

Camco / Fontenergy worked closely with Baily Garner to outline the approach and the key considerations when defining work packages, such as the cost effectiveness of individual measures, levels of disruption to residents and the sequencing of measures. The key considerations are summarised below.

- measures with lower capital cost per tonne of carbon reduced over their lifetime to be considered first
- for the low and medium packages, measures should be capable of being implemented without the need for decanting
- energy efficiency measures should be considered before retrofitting new heating systems and renewables, in line with the energy hierarchy

These work packages were also specified for the FutureFit pilot phase that involved refurbishment of 102 properties across ASG portfolio. The monitoring of the installation phase

[2] *For the purpose, the national housing stock was classified into archetypes based on the property age (very old, old and recent), type (semi/ detached, terrace, flat), wall construction (solid, cavity) and heating type (gas. electricity). .*

has highlighted the key installation and resident issues for the measures installed, plus the cost data collated from this pilot phase has provided insights on the hidden costs in case of some of the retrofit measures. Therefore there is scope for further refinement of work packages drawing on from the lessons learnt from the pilot phase.

It was also observed that there is a wide distribution of SAP ratings in each age band, in particular for the older age band. Therefore modelling a poor and a good variant in terms of SAP performance for properties built before 1983, would help to further refine the modelling outputs and provide a more detailed view of the potential for CO_2 and energy savings across the portfolio.

3.3 Outputs

The figure below shows the baseline CO_2 emissions for each archetype and the reduction in emissions achieved from low, medium and high intervention scenarios. For larger properties built before the 1950s, the total baseline emissions[3] can be as much as twice that of smaller properties. These archetypes therefore offer the most potential for CO_2 savings. The absolute savings vary from around 0.2 tCO_2 to 2.5tCO_2 per annum depending upon the property type and intervention scenario as shown in Figure 2.

Figure 3 shows the aggregated emissions by archetype taking into account the number of each property type in ASG's housing stock. The top three archetypes account for around half of the total CO_2 emissions and between 42 -45% of the CO_2 reduction potential.

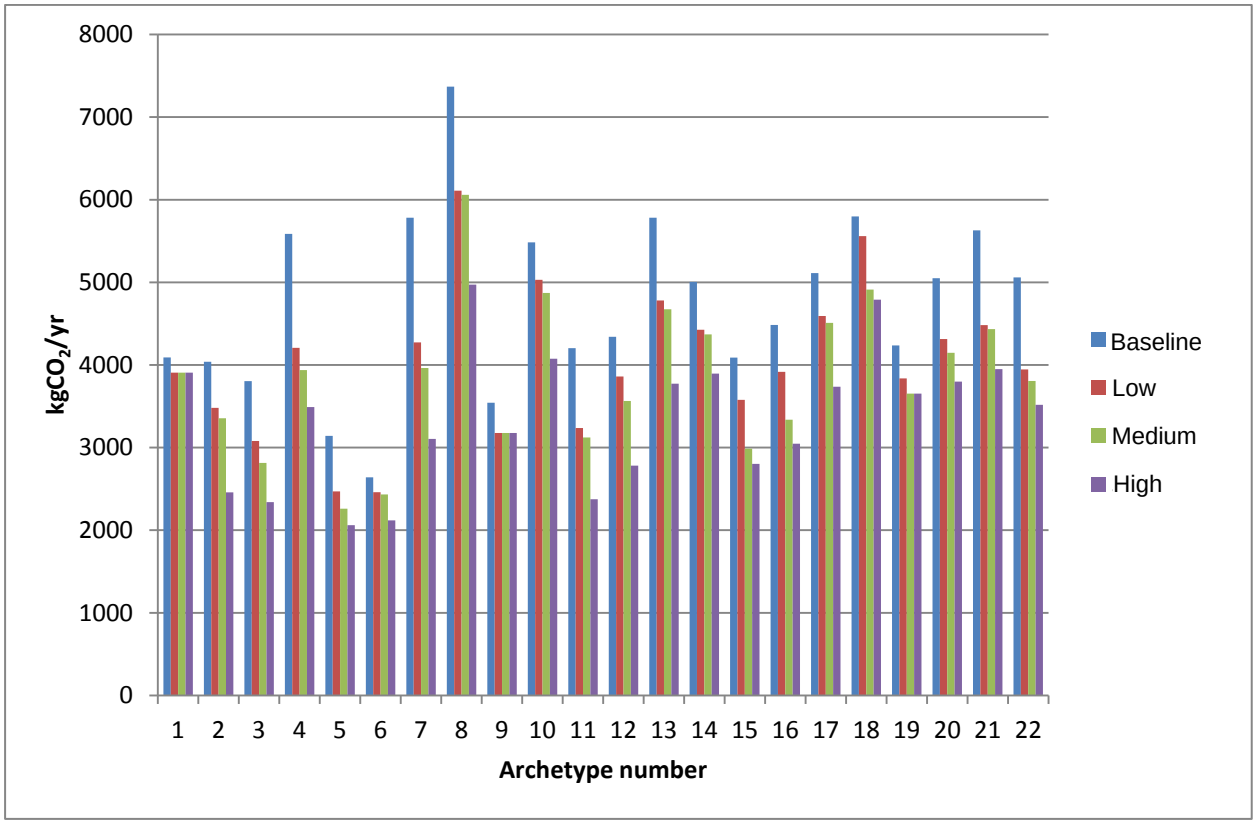


Figure 1: Baseline CO_2 emissions by archetype and reduction in emissions from low, medium and high intervention scenarios

[3] *including emissions from both regulated and unregulated energy uses*

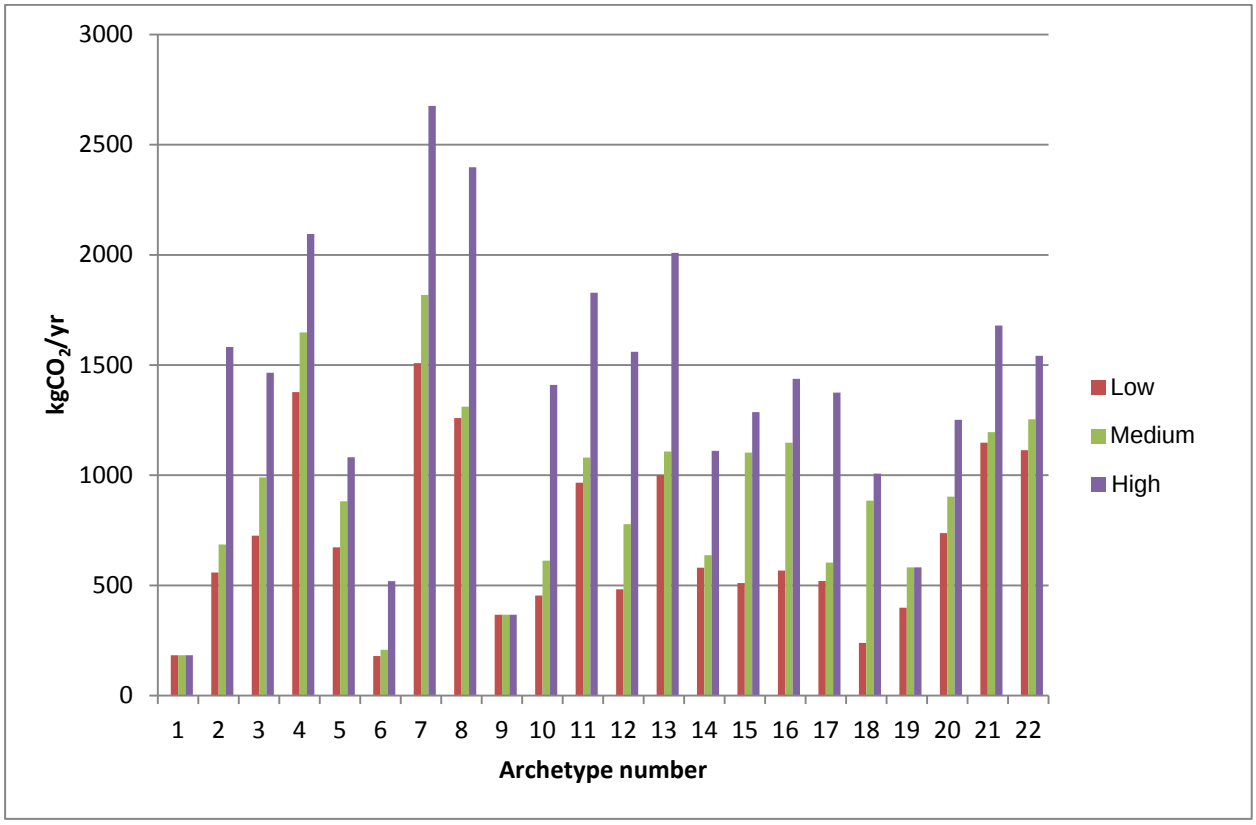


Figure 2: CO_2 savings by archetype and intervention scenario

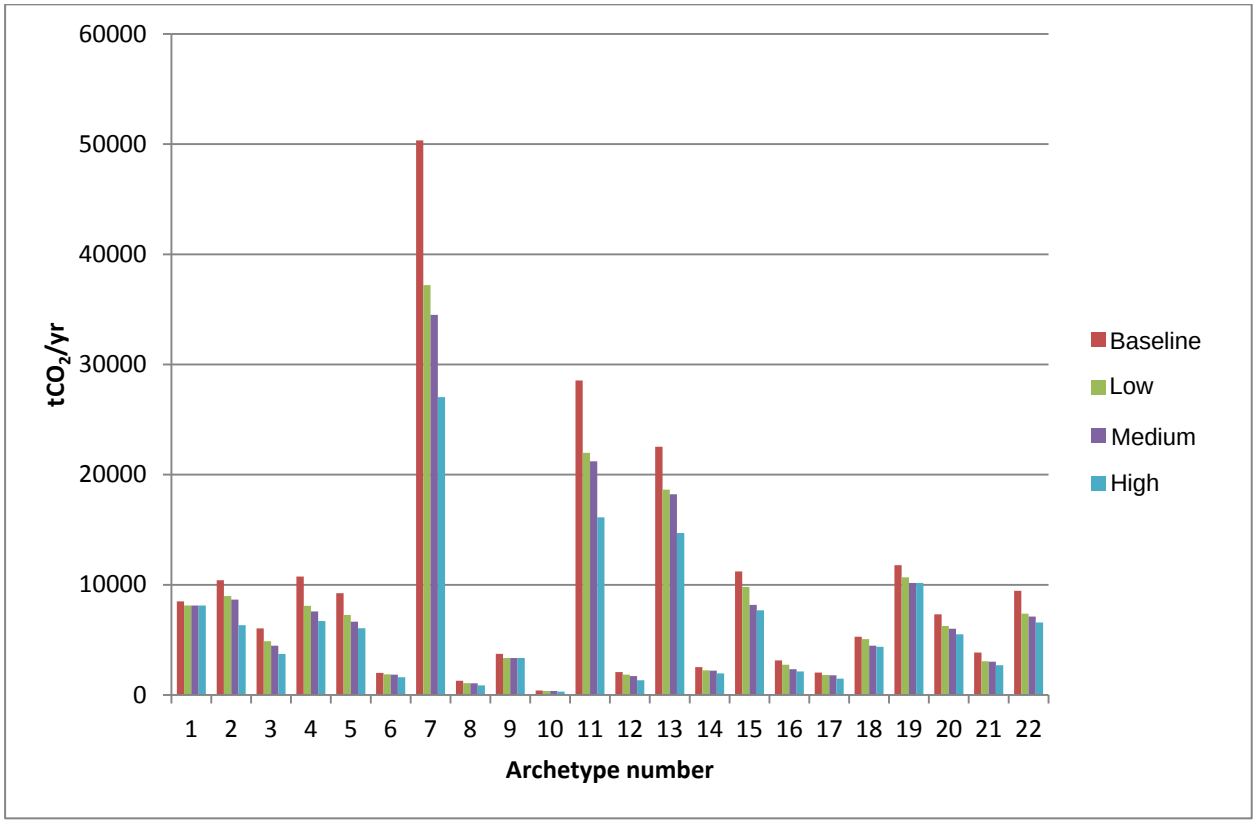


Figure 3: Aggregated CO_2 savings by archetype

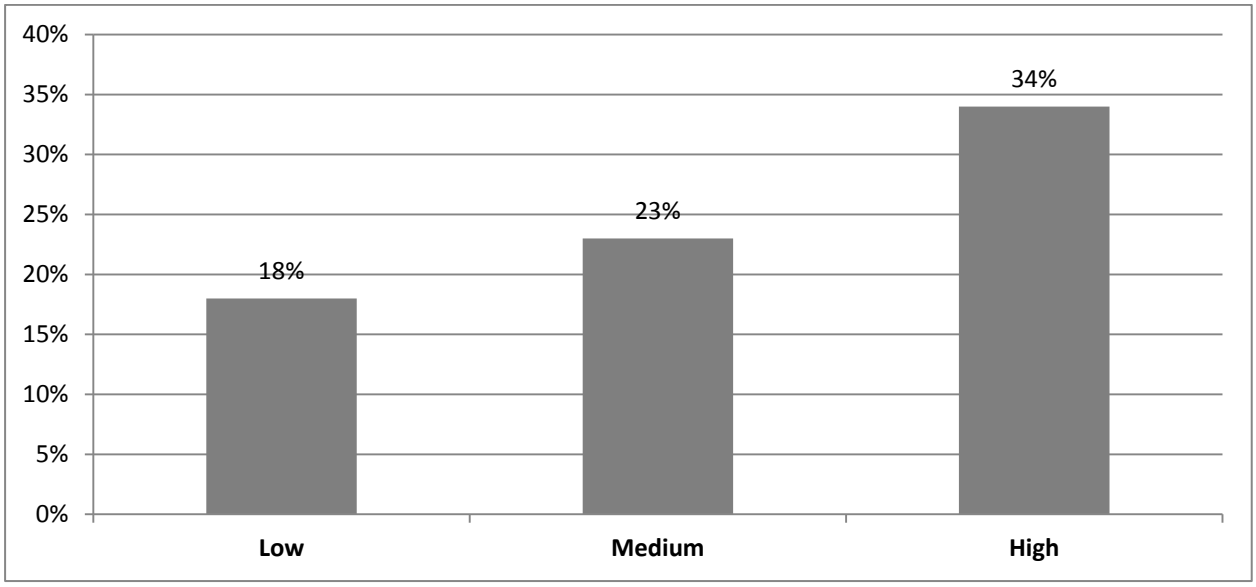


Figure 4: CO_2 savings for ASG housing stock by intervention scenario (excluding grid decarbonisation)

Figure 4 above shows the percentage CO_2 savings that can potentially be achieved within ASG's housing stock from low, medium and high intervention scenarios. This ranges from 18% for the low scenario to 34% for the high scenario. The figures exclude the impact of progressive decarbonisation of the electricity grid.

4 Financial modelling of costs and revenues

4.1 Methodology

The financial model has been built around the 'Golden Rule' – one of the core principles within the Green Deal. This requires that the Green Deal annual payment should not exceed the projected associated cost savings from energy efficiency measures for the duration of the Green Deal Finance arrangement. Working within this 'Golden Rule', the model assesses the financial value of the range of intervention scenarios outlined in the preceding section.

Discounted cash flow analysis was carried out taking into account the capital cost for work packages, maintenance costs for measures, and the value of the energy savings over a 20 year period to generate the Net Present value (NPV) of the investment. As some packages include photovoltaic panels, the Feed in Tariff as at October 2011 was included in value calculations.

Energy consumption was modelled for the different intervention scenarios by Bailey Garner using SAP 2005 methodology.

To provide a more accurate picture, the analysis uses actual capital costs from the refurbishment of Future Fit Homes. These reflect the total costs of installing the work packages, including any associated or hidden costs.

4.2 Input Parameters and assumptions

Capital costs

Capital costs were initially obtained from the four contractors retained to carry out the works to the FutureFit properties. Further negotiations and the realities discovered on the ground then

resulted in a final set of capital costs per measure. These included consequential building works, preliminaries, overheads and contractor profit in order to provide the most realistic picture possible. VAT is included in the capital costs of the measures, were applicable.

The capital costs modelled do not, however, include the costs associated with the surveys and resident engagement. Affinity Sutton has estimated that these upfront costs could be as much as £1,350 per property.

Maintenance costs

Maintenance costs were taken into account only for those measures that were believed to have an ongoing maintenance requirement, over and above the 'business-as-usual' scenario. For example, maintenance cost for PV systems was included while costs for gas boilers were not. Costs were calculated as a percentage of capital cost per year over the asset life of the measure, and are based on Camco/ Fontenergy internal estimates.

Replacement cycles

Replacement cycles for installed measures were based on industry standard information where information was available or a common sense approach where it was not. As noted below because contract length should be tied to asset life, replacement of major items in a refurbishment package should not strongly influence results.

Discount rate

In general, discount rate (and by extension the investor's cost of capital) has a dramatic effect on cost-effective carbon reductions for extensive refurbishment. The discount rate of 6% used for the analysis broadly reflects the cost of capital for Affinity Sutton.

Energy price inflation

The value of savings resulting from energy efficiency improvements increases with the cost of energy. For this reason, a higher energy inflation rate results in more cost-effective carbon savings across all scenarios. An energy price inflation of 3% over and above general inflation has been used for modelling the funding gap for the three intervention scenarios. A range of energy inflation rates has been used in the sensitivity analysis.

Value share between investor and occupier

A key point of discussion for Green Deal has been whether there is sufficient value in the energy savings to both pay for the capital cost of measures and provide a financial incentive to the resident to have the works carried out in the first place.

Our analysis shows that, once all costs are taken into account, most refurbishment packages do not create enough value to cover capital cost of refurbishment. In those cases where a package does stack up, it usually does so marginally. Therefore value share is unlikely to be available as a means of influencing the resident to participate. If value is shared, the funds available to cover refurbishment cost are reduced. This is modelled in the sensitivity analysis.

Contract lengths

By contract length we mean an energy services contract between a Green Deal implementer and a householder where the implementer invests in the low carbon refurbishment package and commits to operating plant (where relevant) over a defined number of years. Revenue accrues each year to the implementer through FIT and Green Deal payment mechanisms but the implementer also incurs costs associated with the operation, maintenance and replacement of plant up to the end of the contract period.

The results show that contract length has a critical impact on the cost-effectiveness of an investment. Typically, any contract length less than 15 years is significantly less attractive. The modelling demonstrates the importance of establishing contract lengths that coincide with the lifetimes of key measures implemented in the refurbishment packages but, in the case of packages including PV, are also no longer than the FIT revenue periods. The figures presented in the subsequent section are based on a contract length of 20 years.

Dependence of grid decarbonisation

The modelling ignores the effect of planned decarbonisation of electricity from the grid. This is to assess the carbon savings resulting purely from measures carried out within the boundary of the home or its curtilage. Including DECC projections for grid decarbonisation radically changes the overall carbon savings. In general, the effect of this rapid decarbonisation is to favour technologies that rely on electricity (e.g. heat pumps) rather than gas (e.g. district heating and gas CHP). **The level of grid decarbonisation has profound impacts on the level of carbon savings that can be assumed over time.** Therefore this effect was not included in the modelling.

Default rate

Default rate by the resident strongly influences economic viability of packages. While the Future Fit packages were installed free of charge, for the purposes of the financial modelling we assumed a default rate of 2%. This is in line with the current rate of default on energy bills as per data provided by DECC.

4.3 Outputs

The figure below shows the Net Present Value (NPV) of the investment for low, medium and high intervention scenarios. This indicates that, given the energy cost savings associated with the package of measures, only the low package for two of the archetypes (archetypes 4 and 7) pay back the investment over the Green Deal contract length. Archetype 4 just breaks even, while archetype 7 had a positive value of £550. Both archetypes are large, older properties built between 1900-1950. All other archetypes end up with a negative NPV (or a net present cost) ranging from under £2k per property for the low package to anywhere up to £15.7k for the high package.

Figure 6 shows the NPV of the investment in energy efficiency improvements per tonne of CO_2 saved. This ranges from marginally positive in case of low packages for archetypes 4 and 7 to a negative NPV of £1400/ tCO2 saved over the lifetime of the measures for archetype 6.

Figure 7 shows the aggregated NPV of each of the archetypes across total ASG housing stock. This demonstrates that rolling out low packages across archetype 7 gives a positive NPV of ~£4.5m.

The aggregated figures across ASG stock are presented in Figure 8. The value of the energy savings over the life of the Green Deal contract offsets around half the installation and maintenance cost of the measures over that time period across all three intervention scenarios. The remainder is a gap in the funding which translates into around £2.9k per property for the low package, £5k for the medium package and £10.8k for the high package.

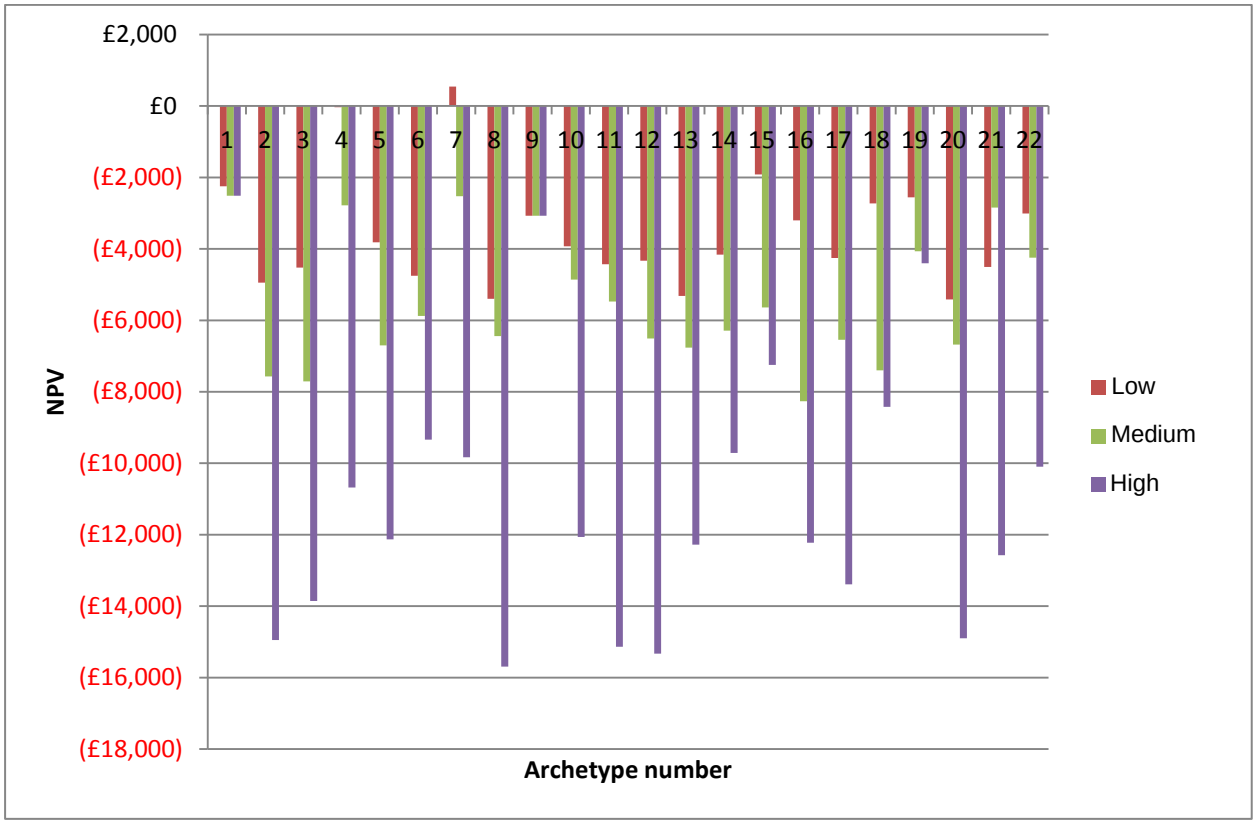


Figure 5: NPV of investment by archetype and intervention scenario

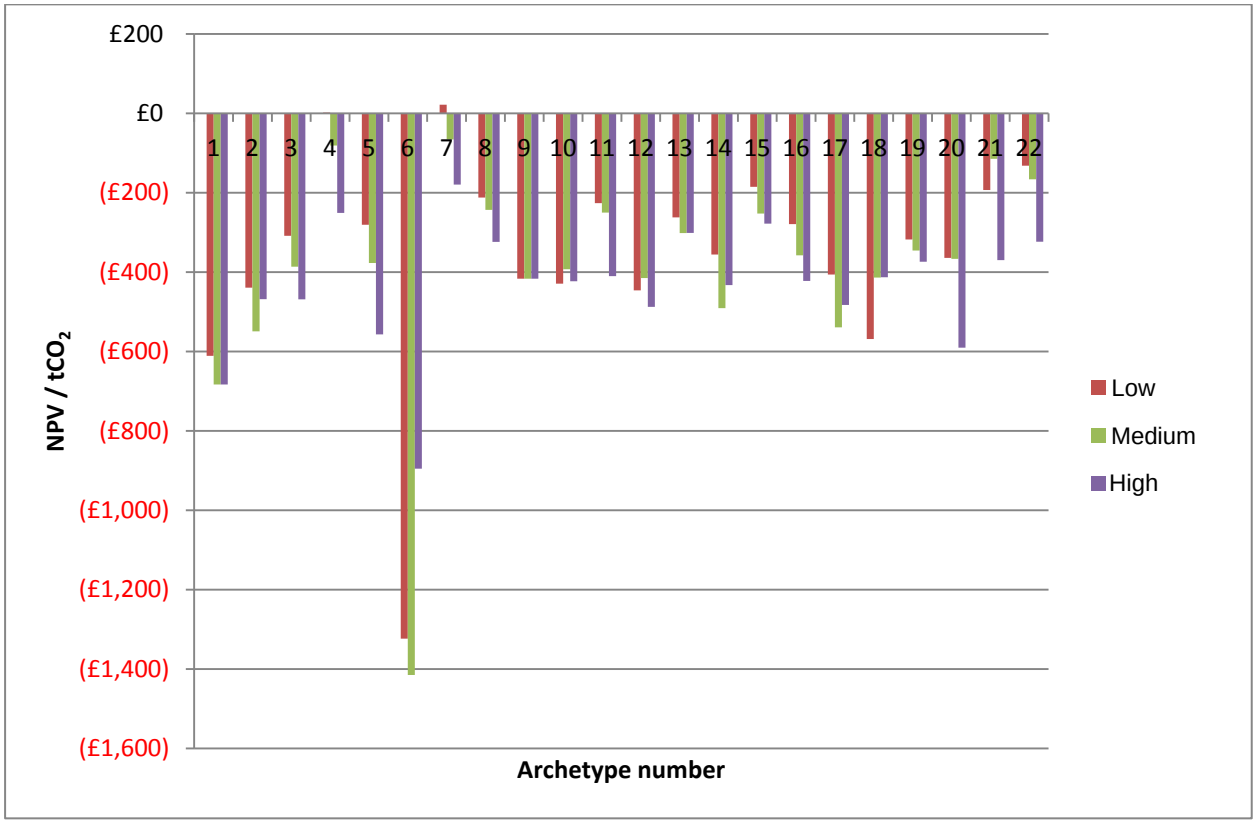


Figure 6: NPV per tonne CO_2 saved (lifetime) by archetype

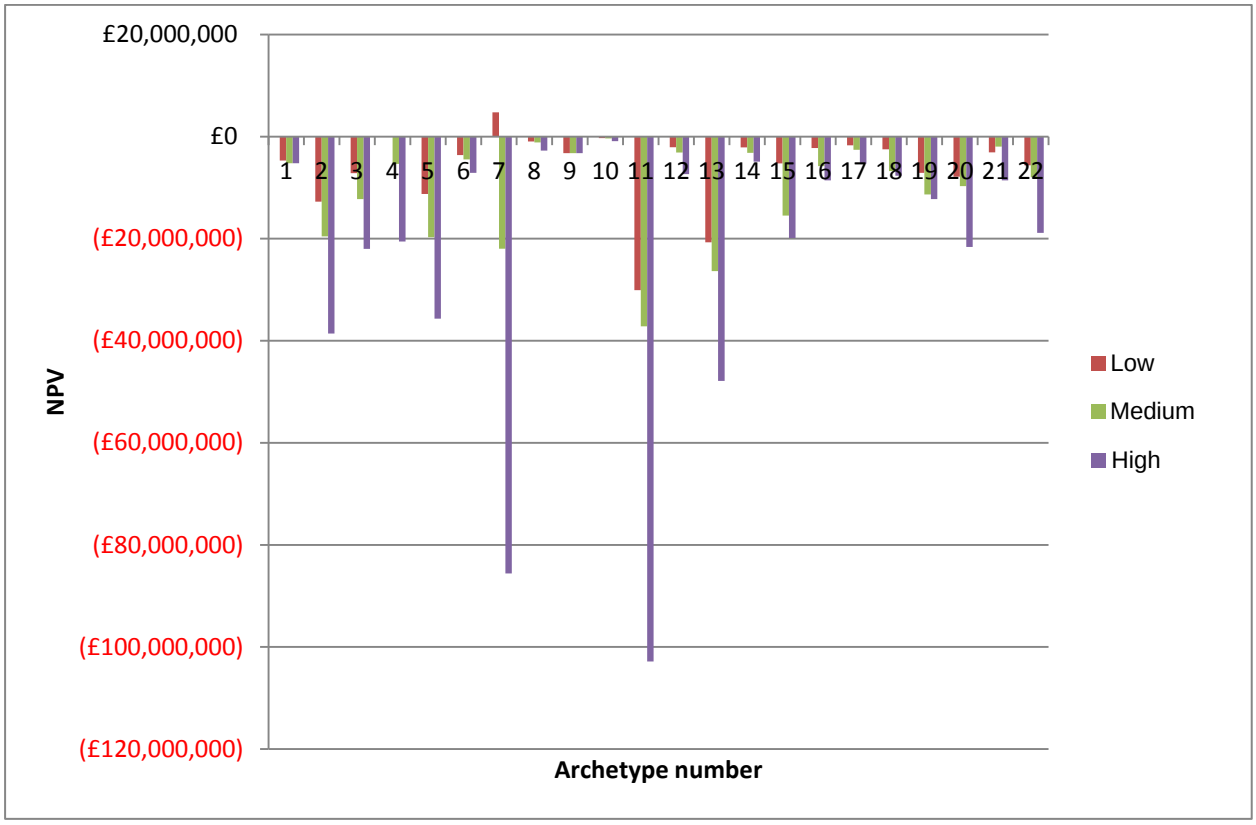


Figure 7: Aggregated NPV of investment by archetype

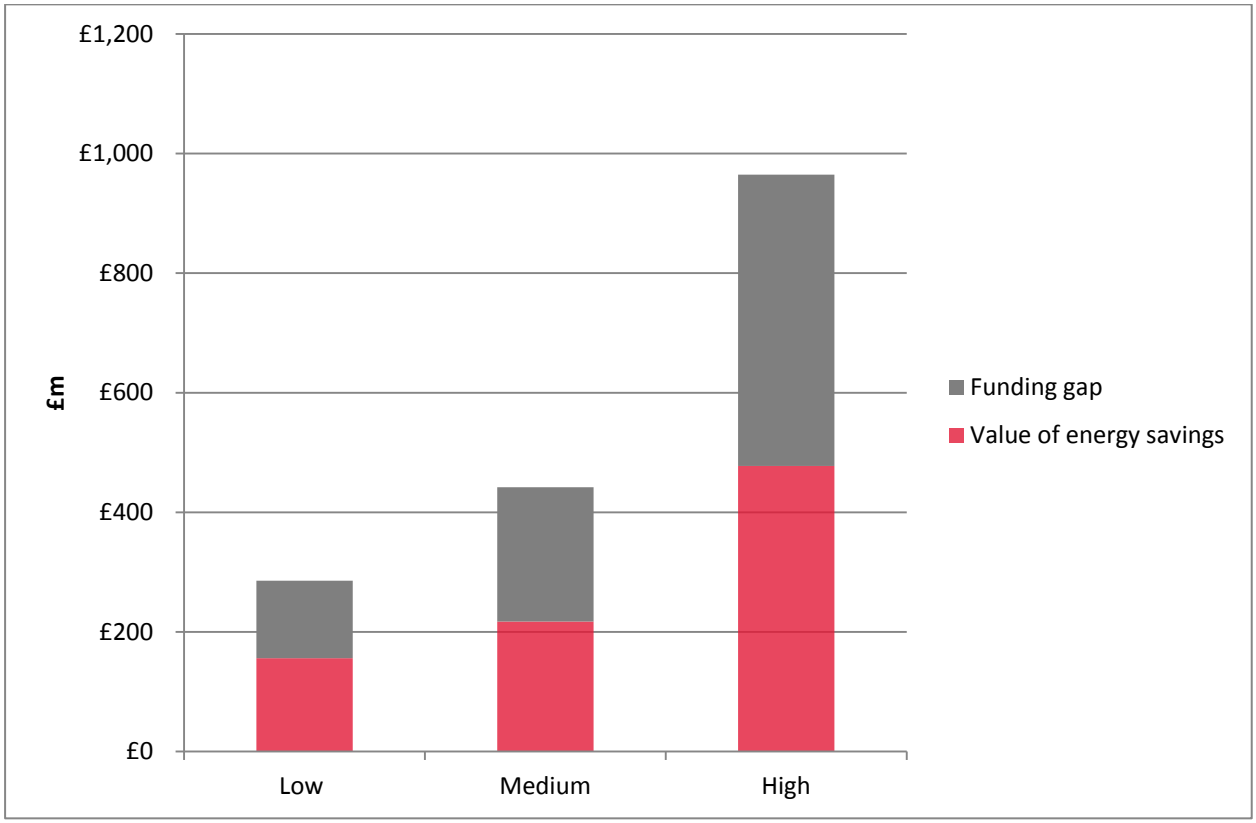


Figure 8: Total NPV of energy savings and funding gap for each intervention scenario across ASG stock

Table 1: NPV of energy savings and funding gap for each intervention scenario					
	NPC of retrofit incl O&M (£m)	Value of energy savings (£m)	Funding gap (£m)	Total CO_2 reduction	Avg. NPC per dwelling (£k)
Low	£283	£156	£130	18%	2.9
Medium	£439	£218	£224	23%	5.0
High	£959	£478	£487	34%	10.8

4.4 Sensitivity analysis

This section highlights the impact of key parameters such as contract length, energy price inflation and value share, on the NPV of the investment and therefore the funding gap.

The sensitivity analysis shows that the average net present cost per dwelling (weighted by the quantity for each archetype within ASG stock) is strongly influenced by the percentage of savings value shared with the resident. This is particularly marked for the high scenario where sharing 40% of savings results in an additional value shortfall of around £3k per dwelling (refer Figure 9 below).

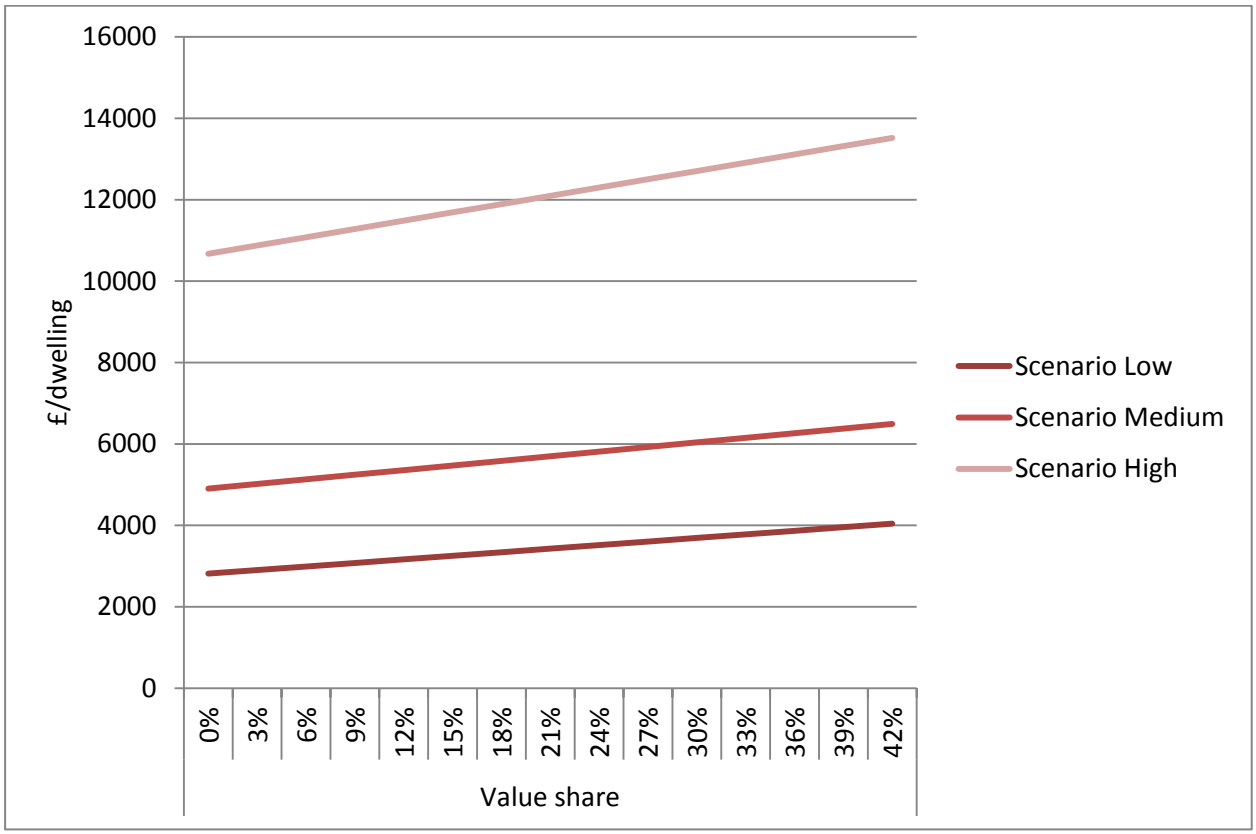


Figure 9: Sensitivity analysis showing average net present cost per dwelling as a function of value share

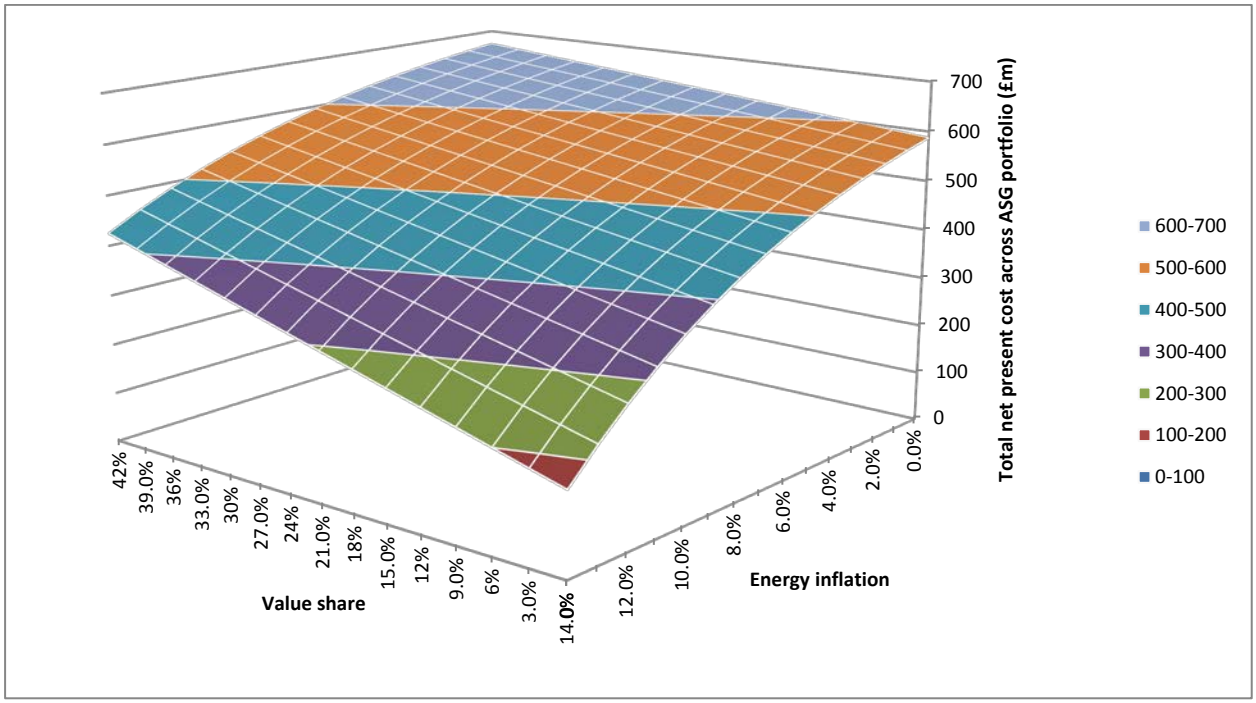


Figure 10: Sensitivity analysis showing impact of energy inflation and value share on total net present cost for the high intervention scenario

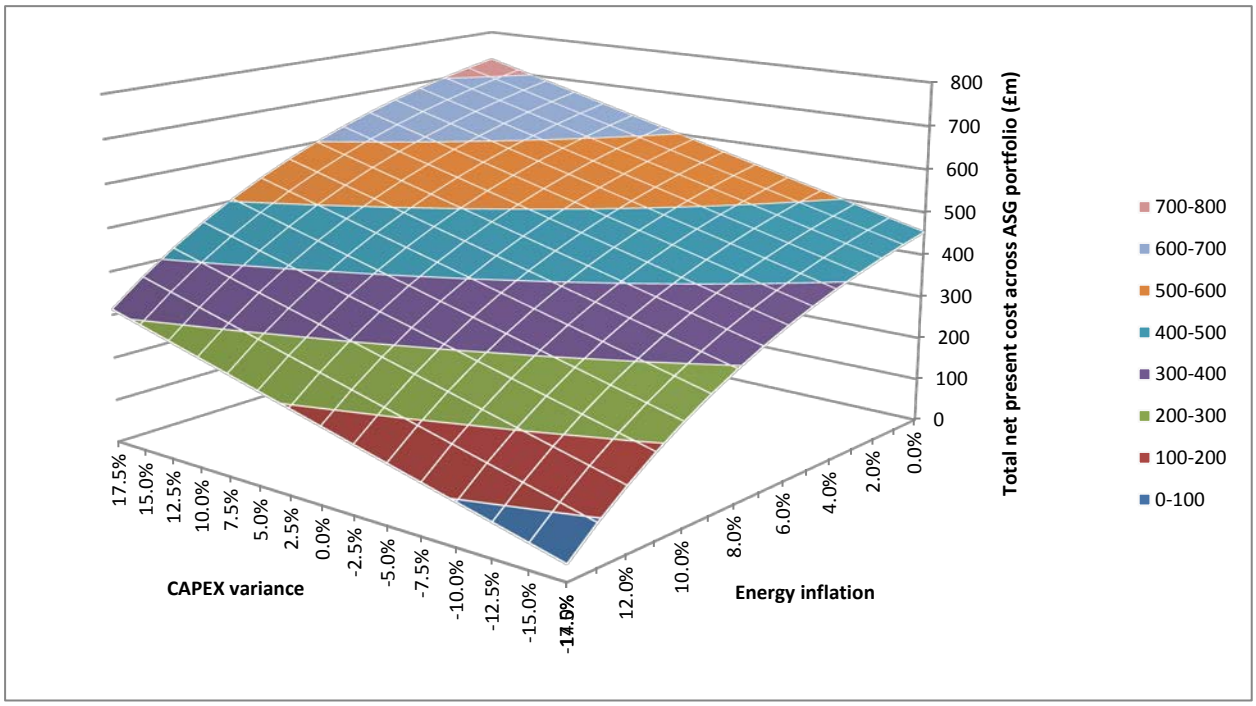


Figure 11: Sensitivity analysis showing the impact of energy inflation and CAPEX variance on total net present cost for the high intervention scenario

The sensitivity analysis in Figure 10 shows the relative effects of energy inflation and value share with residents for the high intervention scenario. This shows that value share affects net present cost of refurbishment (and therefore the funding gap) in a nearly linear fashion (i.e. the slope of the graph moves upward in a straight line as value share increases). Because energy inflation is compounded each year, its effect on net present cost is more marked the higher the energy inflation rate.

Under the most favourable conditions of 0% value share and 14% annual energy inflation, the NPC to Affinity Sutton dips below £200m. Assuming no value is shared (i.e. another means is found for inducing occupants to sign up to refurbishment) and more moderate energy inflation rate of 6% results in an NPC of around £500m.

Figure 11 shows the relative effects of energy inflation and capital cost for the high scenario. This demonstrates the importance of minimising cost of refurbishment measures. For example, a 12.5% reduction in CAPEX reduces the net present cost to ASG by around £100m. A combination of high energy inflation and reduced CAPEX could bring the net present cost for the high scenario near to zero.

5 Legal and regulatory considerations for Green Deal Providers

Under the Green Deal, consumers are able to enter into a financial arrangement with Green Deal Providers that allows them to pay for energy efficiency improvements over a period of time without the need for up-front finance. The level of Green Deal payments are capped by the predicted savings in energy bills, referred to as the 'Golden Rule'.

Legal mechanisms introduced as part of the Energy Bill in December last year allow the costs of energy efficiency measures to be attached to the energy bill at a property, rather than to an individual. Green Deal will therefore mean they only pay while they remain at the property.

'The Green Deal and Energy Company Obligation' consultation document was published in November 2011. The key provisions likely to be included in the Green Deal are

- Ensuring an accurate, impartial and accredited assessment takes place as the first step to a Green Deal, so consumers have confidence that the measures are right for their property;
- Ensuring only accredited measures and products are installed, by appropriately-qualified and accredited installers, giving consumers confidence that the measures are high-quality;
- Ensuring that Green Deal providers are duly authorised, plus adequate consumer protection measures are put in place to ensure that consumers are protected at each stage;
- Limitations over how much finance can be attached, to ensure that only packages of measures which are likely to pay for themselves over time are included;
- Requirement for Green Deal providers to offer warranty for measures over the term of the Green Deal Plan; and where measures with different lifetimes are combined to ensure that consumers do not pay for a specific measure beyond its lifetime.
- Requirement for energy suppliers to collect Green Deal payments via the electricity bill, and pass these onto the Green Deal provider/ nominated finance provider;
- The liability to make Green Deal Payments to rest with the person who pays the energy bill for the property; and

- That people are informed of whether there is a Green Deal Finance arrangement in place (before assuming responsibility for paying energy bills for a particular property).

The key considerations for Affinity Sutton, should they decide to take up the role of a Green Deal Provider, are briefly summarised below:

Green Deal licensing and accreditation – To operate as Green Deal providers, authorisation is required from the 'Green Deal oversight company' – an independent body proposed to be set up for the purpose. For the purpose, providers are required to

- comply with the *Green Deal Code of Practice;*
- enter into a *Green Deal Arrangements Agreement* (GDAA) with the electricity supplier;
- hold a valid Consumer Credit Act (CCA) licence issued by the Office of Fair Trading;
- ensure that consumers are protected in the event of the Green Deal Provider becoming insolvent (with the preferred solution being a surety bond to cover all existing and future obligations); and
- establish an independent conciliation process for customer complaints

Green Deal Code of Practice – The Code has been developed in partnership with industry[4] and is intended to ensure that all providers are operating to an agreed minimum standard. It outlines the specific criteria that Green Deal advisers, providers and installers are required to comply with, for instance, the type of products and specifications standards for materials installed, levels of qualification and training, process for handling customer complaints, rules relating to marketing, etc. The code will also apply where installations are totally funded by ECO (Energy Company Obligation).

Consumer Credit Act - Green Deal is classified as a fixed-term credit arrangement, and therefore will fall under the Consumer Credit Act (CCA). This will govern the whole life of the Green Deal Plan, protecting customers at every stage. In line with the Consumer Directive, the Green Deal Provider will be eligible for compensation in case of early repayments.

Defaults on Green Deal payments - Another key issue is the allocation of customer default risk. The liability of defaults payments will, in all likelihood, lie with the Green deal provider and not the energy supplier. The energy supplier will chase up payments on behalf of the GD provider, and in case of part recovery, will pass on payments in line with the proportion of the total bill recovered. The risk of default and the likely default rates, therefore, would also need to be factored in when developing a stock-wide Green Deal programme. The default on Green Deal payments is expected to be in line with current default rates on electricity bills.

Landlord, Tenant and Leaseholder consent issues – Consents are required from both the bill payer and the owner/ landlord before entering into a Green Deal Plan. The consent is demonstrated via a written confirmation of the bill-payer agreeing to the charge being added to

[4] *A draft version is currently available on the DECC website at http://www.decc.gov.uk/assets/decc/11/consultation/green-deal/3585-draft-green-deal-code-practice.pdf*

their electricity bill. Freeholder consent is not required in case of a long lease where the remainder of the lease runs longer than the Green Deal Plan.

Requirements are also proposed to be put in place to ensure that Green Deal Plans are disclosed to potential new bill-payer before entering into a binding agreement relating to renting/ buying the property. This will be done via the EPC (Energy Performance Certificate) that will be adapted to include relevant financial information relating to the Green Deal. For the landlord letting the property, a written acknowledgement is required from the new bill-payer confirming that the person is aware of the responsibility of paying the Green Deal charge.

6 Conclusions

The analysis above has demonstrated that the **value of energy savings from retrofitting of Affinity Sutton housing stock that the Green Deal can help realise is quite significant, to the tune of ~ £480m**

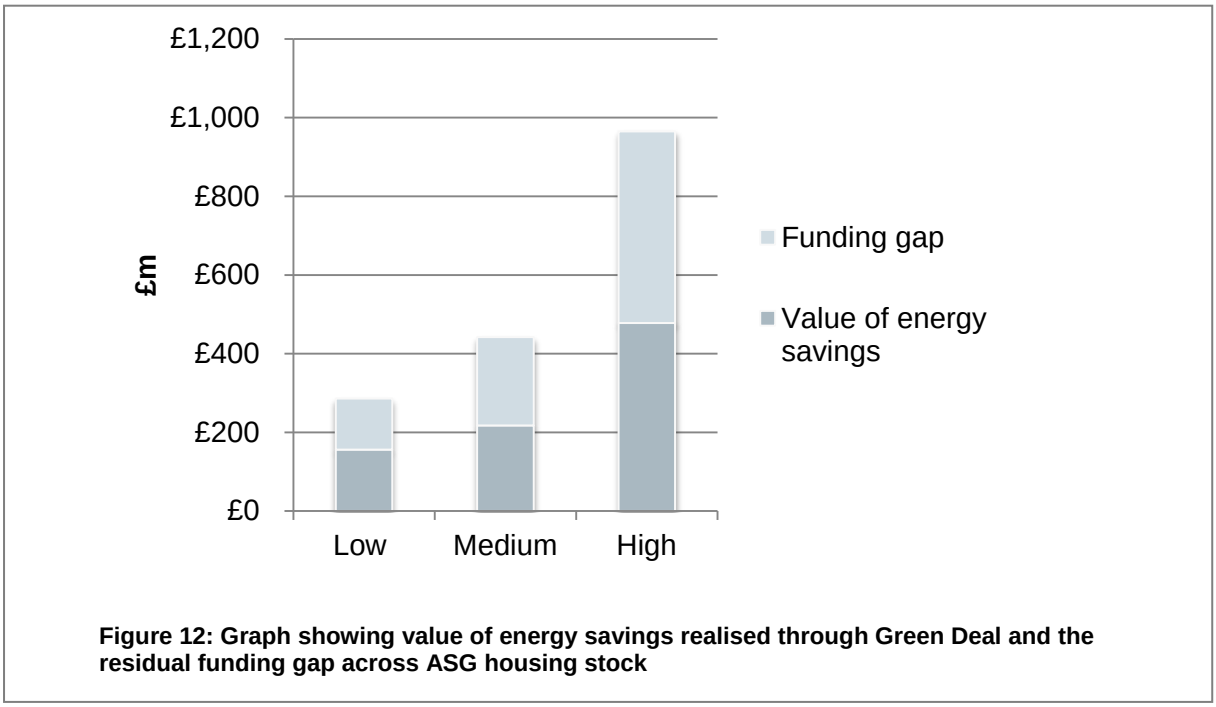


Figure 12: Graph showing value of energy savings realised through Green Deal and the residual funding gap across ASG housing stock

A significant funding gap, however, remains across all three intervention scenarios. On an average it varies from £2,900 per property for the low scenario up to ~£10,800 per property for the high scenario. This excludes the additional upfront costs of delivery a Green Deal programme.

The sensitivity analysis has indicated that **Green Deal is very much a dynamic system**. A range of variables will impact on the viability of the Green Deal mechanism as indicated in the table below.

Worse	Better
Green Deal delivery costs	Optimised packages
Value Share	Economies of scale
Comfort Take	Trigger points
Cost of Capital	ECO funding

Green Deal as a financing mechanism means for Affinity Sutton stock

To help realise the value of energy savings, **Affinity Sutton need 'Green Deal Plus'** that will require them to

- **Optimise work packages** further building on the learning from the FutureFit preparatory phase.
- **Align energy efficiency measures with trigger points** to bring down both the marginal costs as well as the disruption for residents. For each package key trigger points should be considered to allow them to be rolled out to the wider stock – e.g. cyclical maintenance visit, annual gas inspection, reactive maintenance, new kitchens and bathrooms, void upgrades, etc.
- **Manage supply chains** - Work with supply chain to appraise potential for bringing down capital costs when scaling up and also review alternative products that can achieve comparable performance at relatively lower capital costs.
- **Review alternative sources of finance** with a view to reduce cost of capital
- **Manage risks**, such as those related to uptake of Green Deal and technical performance of measures installed.
- **Secure ECO funding** to plug the gap.

The graphs below show the indicative impact of reduction in capital costs and lower interest rates on the funding gap. Where a combination of measures outlined above can help drive around 30-35% reduction in capital costs plus the cost of capital can be reduced from 7% to 3%, then this brings down the funding gap to zero.

Figure 13 FutureFit pilot costs, 7% interest rate

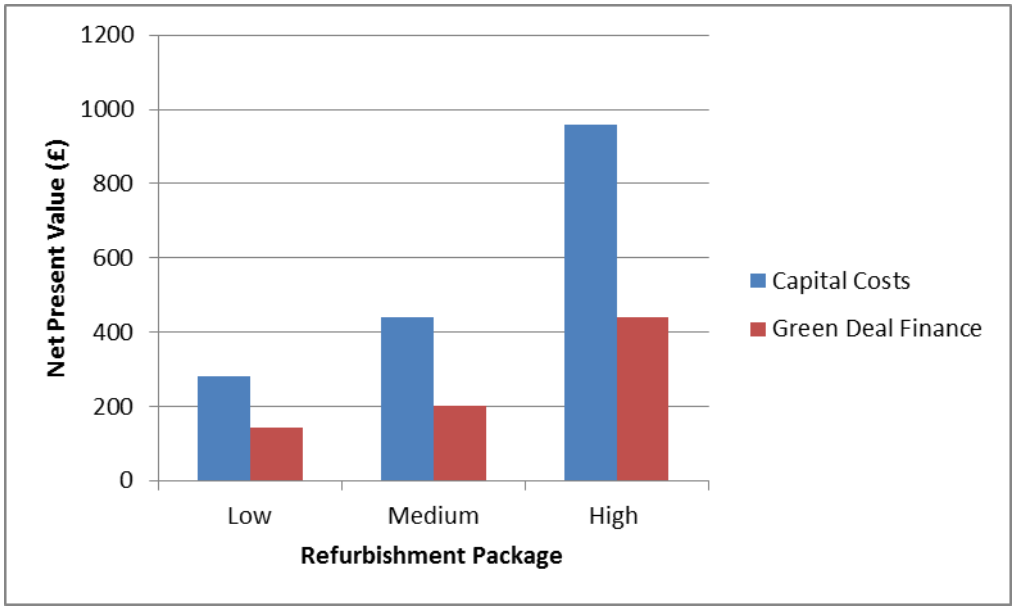


Figure 14 Capital costs 35% lower, 7% interest rate

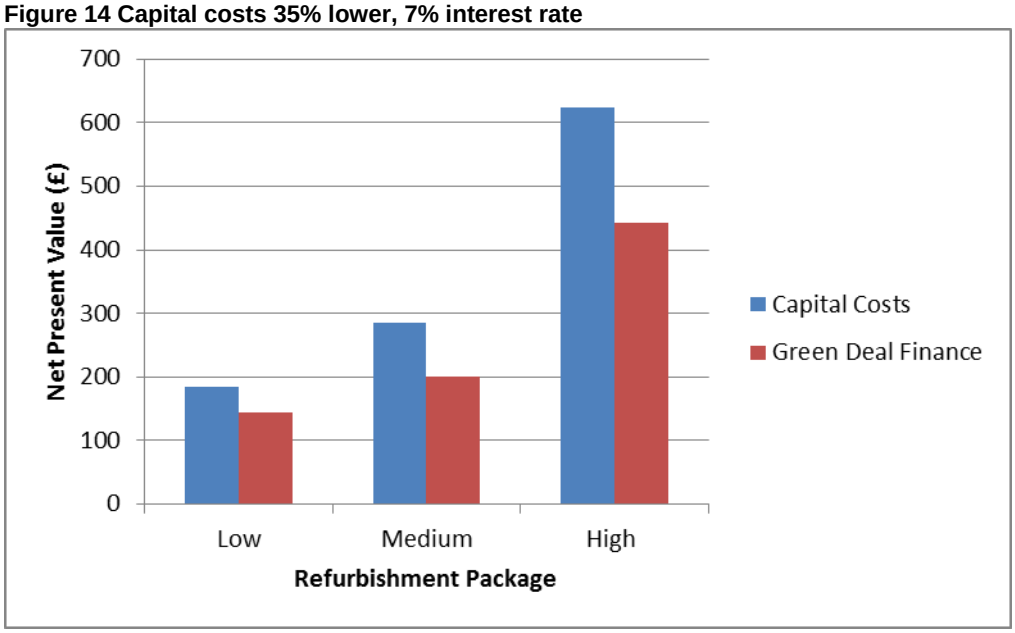
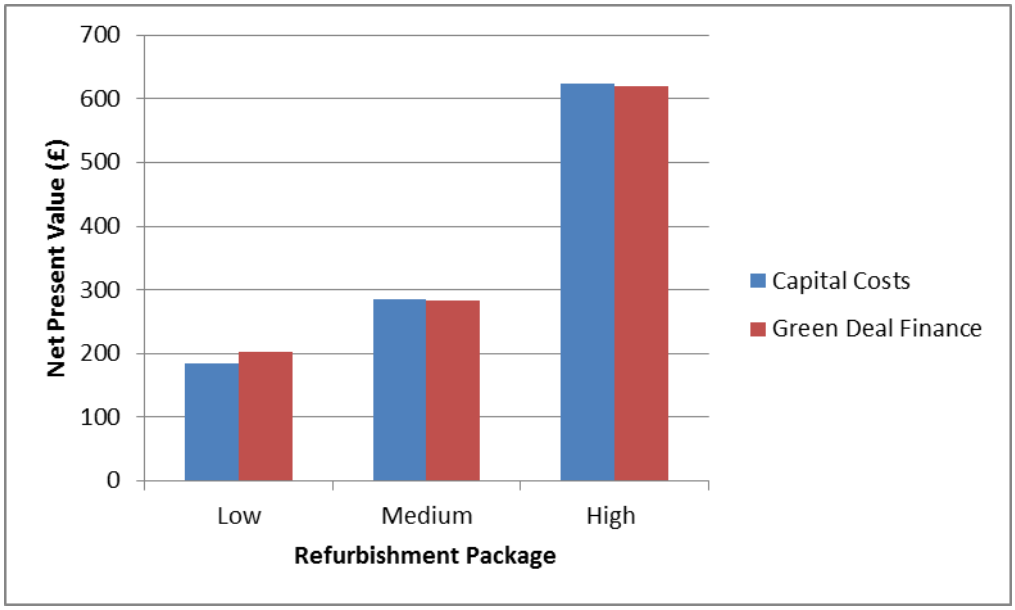


Figure 15 Capital costs 35% lower, 3% interest rate



Appendix A: Portfolio analysis and identification of archetypes

A.1 Portfolio analysis

An analysis of property attributes in ASG's housing stock was carried out to inform the archetype selection. A summary of the findings in presented in the figures below[5]. The analysis indicates that around 70% of ASG's current stock was built prior to 1982 and around 48% of the stock was built before 1966. There is a mix of house and flats across the different age bands.

In terms of construction type, masonry construction is the predominant type with a little under 3% of the properties being timber frame or system built. Most of the timber-frame properties were built between 1967 and 1982, while most of the system built properties were built between 1930-1975. Solid wall properties, regarded as being 'expensive to treat' account for around 6% of the total stock.

In terms of thermal performance, around 92% of the properties are EPC band D or higher, and around 90% of the properties built before 1982 are Band D or higher. As is expected, most of the properties with SAP<55 are older properties built before 1982.

Figure 16: Distribution of properties by age band and property type

[5] *The analysis was based on housing stock data provided in October 2010. We understand that the stock database has subsequently been updated and therefore some of the figures may change marginally.*

Figure 17: Distribution of properties by age band and construction type

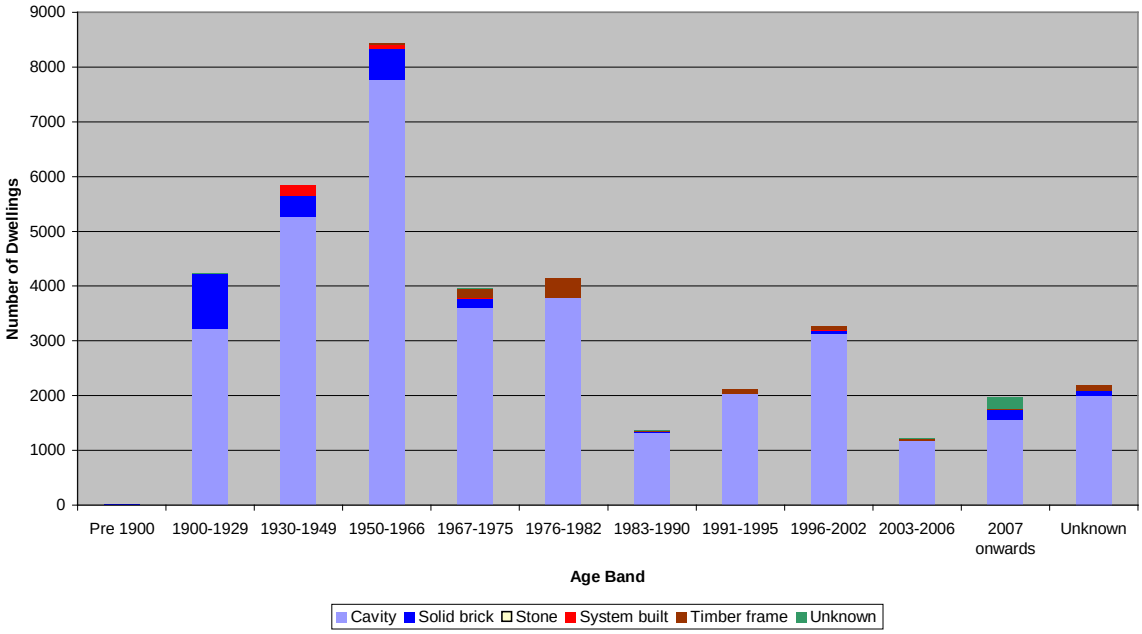


Figure 18: Distribution of properties by SAP rating

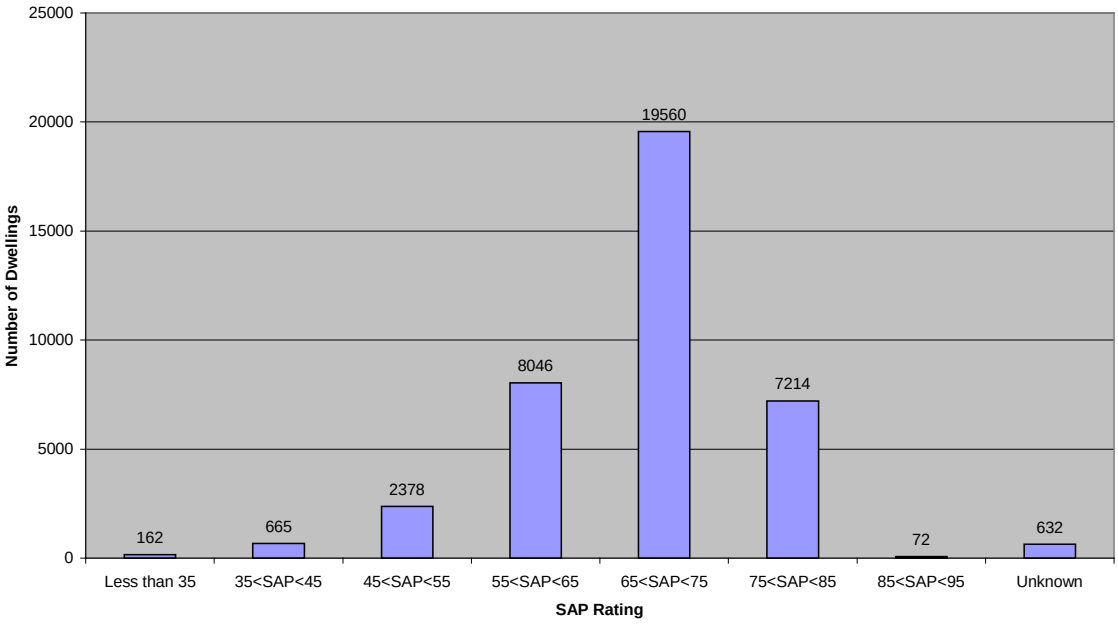
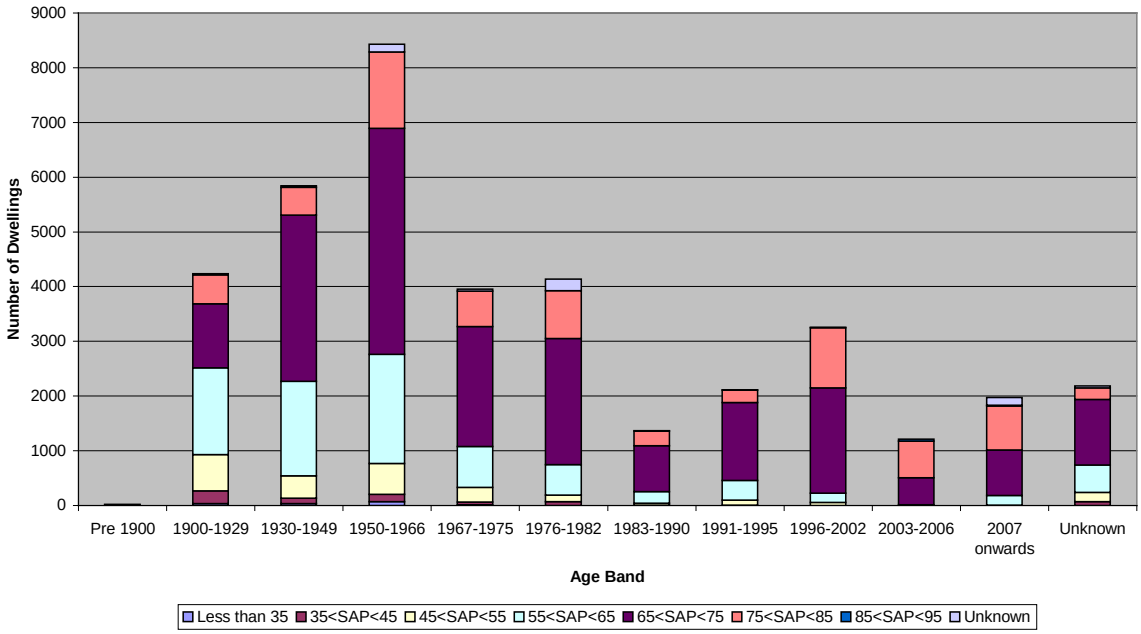


Figure 19: Distribution of properties by age band and SAP rating



A.2 Identification of archetypes

An archetype handbook was produced by Bailey Garner for the FutureFit properties. Camco/ Fontenergy worked closely with Baily Garner and ASG's in-house asset management team to develop the archetype handbook and to ensure that it is statistically meaningful in the context of Affinity Sutton's wider portfolio. These archetypes in turn form the basis of the technical and commercial analysis. The archetypes were chosen such that

- There is good mix of properties, both house and flats, in each age band. The archetypes were expanded to include dwellings built between1985 and 2002. Although it was acknowledged that older properties generally offer the most potential for improvement, properties from this age band form a significant proportion of total ASG stock and also offer significant potential for CO_2 savings. A carbon benchmarking study by Camco[6] that compared the relative performance of dwellings built to 1990 and 2006 regulations indicated that, for example, there may be potential to reduce CO_2 emissions by as much as 32-48% (or 44-56% reduction in energy use) for gas heated dwellings to bring then to 2006 Building Regulations standard.

- The archetypes cover the main construction types within the stock, with cavity wall and solid masonry construction being the predominant type. Most of the timber frame houses in the portfolio are built between 1967 -1982; while system built properties are mostly in the age band 1930-1949. Archetypes 17 and 10 pick up on these typologies.

- There is a mix of heating fuels across the archetypes. About 7% of ASG stock is heated using electricity and only about 0.06% by solid fuel[7]. The most electric heated properties in any property type of a certain age band are block of flats built between 1967-1975. Archetype 18 reflects this typology and is modelled as being electrically

[6] *1990 and 2006 Carbon Benchmarking Report produced for Energy Saving Trust , May 2009*
[7] *Figures based on BHA and WSH stock database only*

heated as well as Archetype 1, that is flats built between 1983- 1990. Properties heated by solid fuel represent a very small minority and therefore this fuel type has not been modelled for any of the archetypes.

In total, 22 archetypes were identified that represent around 56% of the Affinity Sutton stock.

Table 2: Archetype classification and attributes

Archetype	age	Type	built form	wall type
1	1983-1990	Flat		Cavity
2	1900-1929	Flat		Cavity
3	1900-1929	House	Mid-terrace	Cavity
4	1900-1929	House	End-terrace/ semi	Solid Brick
5	1930-1949	Flat		Cavity
6	1991-1995	Flat		Cavity
7	1930-1949	House	End-terrace/ semi	Cavity
8	1930-1949	House	End-terrace/ semi	Solid Brick
9a	1996-2002	Flat		Cavity
10	1930-1949	House	End-terrace/ semi	System Built
11	1950-1966	Flat		Cavity
12	1950-1966	Flat		Solid Brick
13	1950-1966	House	End-terrace/ semi	Cavity
14	1983-1990	House	End-terrace/ semi	Cavity
15	1967-1975	Flat		Cavity
16	1967-1975	House	Mid-terrace	Cavity
17	1976-1982	House	Mid-terrace	Timber Frame
18	1967-1975	Maisonette		Cavity
19	1976-1982	Flat		Cavity
20	1976-1982	House	Mid-terrace	Cavity
21	1991-1995	House	End-terrace/ semi	Cavity
22	1996-2002	House	End-terrace/ semi	Cavity

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