NATIONAL HOUSING FEDERATION

Sustainable investment strategies: Existing stock

A report by CEN

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Report commissioned by the National Housing Federation

www.housing.org.uk/environment

business for neighbourhoods

Contents

1. Executive Summary

The National Housing Federation has appointed CEN to investigate investment strategies for existing housing stock, to provide sustainable and effective ways of reducing fuel bills and CO_2 emissions.

1.1 Background

CEN has previously carried out research on the potential for energy performance contracting to be applied to housing stock. This idea is investigated further in this report, highlighting the potential for a modified version of energy performance contracting to provide a business model with flexibility to cope with fluctuating fuel prices and variations in tenant behaviour.

Performance contracting can be carried out as part of a supply partnership with a utility company. There are however significant barriers to this, and several other organisations have found decreasing value in partnering with supply companies. In addition, while it is still possible that forming a partnership with an energy supply company could generate an income for reinvestment in energy saving measures (ESMs), the need to maintain tenants' right to choose suppliers means that sustainable investment in ESMs should be carried out separately.

Two models for investment in ESMs have been taken forward for financial modelling in this report. One can be applied to blocks with communal heating systems, and one takes the form of a 'green loan' to individual properties.

1.2 Proposed business models

Two business models are proposed, both of which involve recovering the investment made in ESMs via a charge levied on the property. This charge will be less than the fuel bill savings the tenant makes as a result of the ESMs. This is an essential criteria for any future model as any improvements to the property should also contribute to reducing fuel poverty and not be at any additional cost to the tenant. Current service charge and rent rules stipulate that any investment made cannot be recovered via these routes. The new charge must therefore be itemised to ensure this is paid for either by full capital investment perhaps from grant, or by the tenant, provided that there is a corresponding reduction in their fuel bill and therefore no increase in their overall outgoings.

One model can be applied to communal blocks where residents pay a charge for heat and communal electricity use. The energy service company (ESCo) would provide all heat and communal electricity (negotiating supply contracts as part of its service), and charge a fee to the housing association to cover the fuel costs and investment in energy saving measures. The fuel costs and capital repayments must be clearly itemised in order that the housing association can charge transparently for the fuel costs and separate charges for services (i.e. plant, dwelling improvements). The ESCo would secure long-term finance on the energy saving measures in order to ensure that the fee charged to the housing association is lower than the original fuel bills and sinking fund charges. A standard performance contract can be adapted here to allow alterations in the fixed charge for energy services to be made in order to reflect fluctuations in fuel costs and energy consumption beyond the ESCo's control. This reduces the risk to the ESCo of

unreasonable increases in consumption due to tenant behaviour, and also adds an incentive to tenants to use less energy, as they will be rewarded with lower charges, as in a traditional arrangement.

The second model would take the form of a 'green loan' for individual properties. Accurate modelling of property types is used here to accurately predict energy savings from different measures, using a large enough sample to be confident that the impacts of behavioural differences within the same property types could be accounted for when agreeing repayments. Repayments would be set at a level lower than the cost savings achieved by the measures.

To comply with current rent and service charge calculation criteria, all charges for heat and electricity must be passed on to tenants transparently. This will make actual savings clear to the tenant. The running costs for the ESCo, including loan repayments, project costs, monitoring and reinvestment costs should be recovered via a separate financial route. This poses significant challenges, as the new charge cannot be recovered through existing service charge methods, except in the case of leaseholders. Possible routes to recover these charges include capital investment or grants, increasing the net rent of the properties concerned, creating a new service charge or, as has been recently explored by the UK Green Building Council, imposing a local land charge on the property.[1] All of these routes pose significant challenges and most would require significant regulatory change and adaptation to ensure the beneficiaries of the ESMs installed also pay for the measures.

1.3 Key findings and recommendations

The key findings from this report are as follows:

- **Supply partnerships** between an ESCo and an existing supply partnership have the potential to deliver an income from affinity deals, and to reduce fuel prices for EPCo customers paying for fuel as part of a contract. It is however essential to protect consumer rights, so long term investments in ESMs should not tie tenants into supply contracts.
- **Changes in occupancy** can be dealt with by linking loans to properties and not tenants. The investment made can be recovered through a charge to whoever lives in that property.
- **Recovery of investment:** Service charges provide a possible vehicle for recovering investments in ESMs only from leaseholders. For tenants a new charge is necessary, which is likely to require regulatory change. Possible routes for recovering this charge include increasing net rent, Local Land Charges via local authorities, or the introduction of a new service charge mechanism. The ESCo must gain the support of the tenants involved by guaranteeing that their overall expenditure will not increase as a result of the new charge, due to the corresponding reduction in their fuel bills.
- **Returns from investments should be maximised** through intelligent specification of ESMs and regulatory certainty. The report has

[1] 'Pay As You Save: Financing low energy refurbishment in housing' www.ukgbc.org/site/resources/show-resource-details?id=559

highlighted issues relating to the sale of CHP generated electricity, and the impacts of Feed-in-Tariffs and Renewable Heat Incentives.

- **The communal block EPCo model** has the potential to reduce fuel bills and fund ongoing carbon and energy reductions.
- **The individual property 'green loan' model** provides a mechanism to recover the investment made in ESMs through either service charges (for leaseholders) or another charge such as an increase in net rent for tenants or grant funding.
- **Affordable finance** is crucial to both models. When typical commercial loan rates are used, delivering savings from Year 1 is only possible on fast payback measures. Low interest loans, with long repayment terms of often over 20 years are needed to spread the initial costs of ESMs and allow payments to be made from fuel bill savings.
- **Grant funding and subsidies** are still crucial to the funding of high cost measures. These may include government and utility grants, and subsidies such as reduced VAT on all ESMs.
- **Fuel inflation** rates are set to rise faster than standard inflation and because of this, the return on investment of ESMs is likely to increase over time and create a stronger case for investment in the future.
- **Project costs** on each EPCo or green loan must be kept to an absolute minimum due to the relatively low annual fuel bills and therefore income from energy savings.
- **Fuel saving predictions** must be accurate in order to guarantee tenant savings. Detailed monitoring can be used to achieve some certainty, but green loans and EPCos should only be undertaken when relatively large savings are possible, and the impact of behavioural change is unlikely to reduce overall tenant savings to zero or a loss.

Fast payback measures, and measures supplemented with grant funding and affordable finance could be delivered by the business models now, and deliver significant tenant savings and a return on investment to the ESCo.

Although the economic case for investment in higher cost measures through EPCos and green loans currently still heavily relies on grant funding and even subsidised finance, as the sensitivity analysis of fuel price inflation has shown, savings from ESMs are likely to grow over the coming years and deliver more and more return on investment for ESCos delivering these measures. It is therefore essential that the government invests now to ensure long-term savings.

2. Introduction

2.1 Context

Approximately four fifths of the homes that will be lived in by 2050 have already been built. Housing accounts for over 25% of the UK's CO_2 emissions. It is essential therefore for housing providers to focus on reducing the CO_2 emissions from existing stock. With increasingly unstable fuel prices and the added threat of increasing fuel poverty, this challenge must be met. Social housing providers are currently leading the way in the new-build market, already achieving as standard 25% lower regulated CO_2 emissions than Building Regulations currently require.

The Decent Homes initiative has gone some way to reducing fuel bills and CO_2 emissions within existing affordable housing stock. This, coupled with utility grants through the Energy Efficiency Commitment (EEC) and the Carbon Emissions Reduction Target (CERT), has resulted in affordable housing stock achieving higher levels of energy efficiency than private stock.

The challenge for affordable housing providers is now to continue these improvements. Measures with fast paybacks and low capital costs, such as loft insulation and tank lagging, have now begun to reach a saturation point due to the targeted funding of the Home Insulation Scheme, EEC and CERT[2]. It is now essential to identify sustainable methods of financing higher cost, longer payback measures to further reduce CO_2 emissions and energy consumption.

The National Housing Federation has commissioned CEN to carry out a study identifying methods of achieving this goal. This report summarises a two-stage project aimed at outlining the opportunities for, and barriers preventing, long-term investment in energy efficiency and renewable energy technologies. It also covers modelling exercises aimed at identifying potential business models to make investment in energy efficiency and renewable energy technologies a sustainable and effective way of reducing CO_2 emissions and fuel bills in existing stock.

2.2 Outline

This report will begin by summarising the findings of the Energy Performance Contract study conducted by CEN on behalf of the Housing Corporation. It will then summarise the findings of research on existing supply partnerships, outlining the drivers for, and barriers against partnering with utility companies in order to supply energy as part of a performance contract. Other models for investing in energy saving measures (ESMs) will then be explored before modelling the two chosen business models.

Throughout the report, the term 'Energy Performance Contract' (EPCo) is used to refer to the financial model of fixing energy charges. It is also used to refer to the 'Energy Performance Contractor'. The term 'Energy Service Company' (ESCo) is used to refer to the company that may carry out or coordinate investment in ESMs.

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[2] *BRE: Domestic Energy Fact File 2008*, (DECC), p. 22

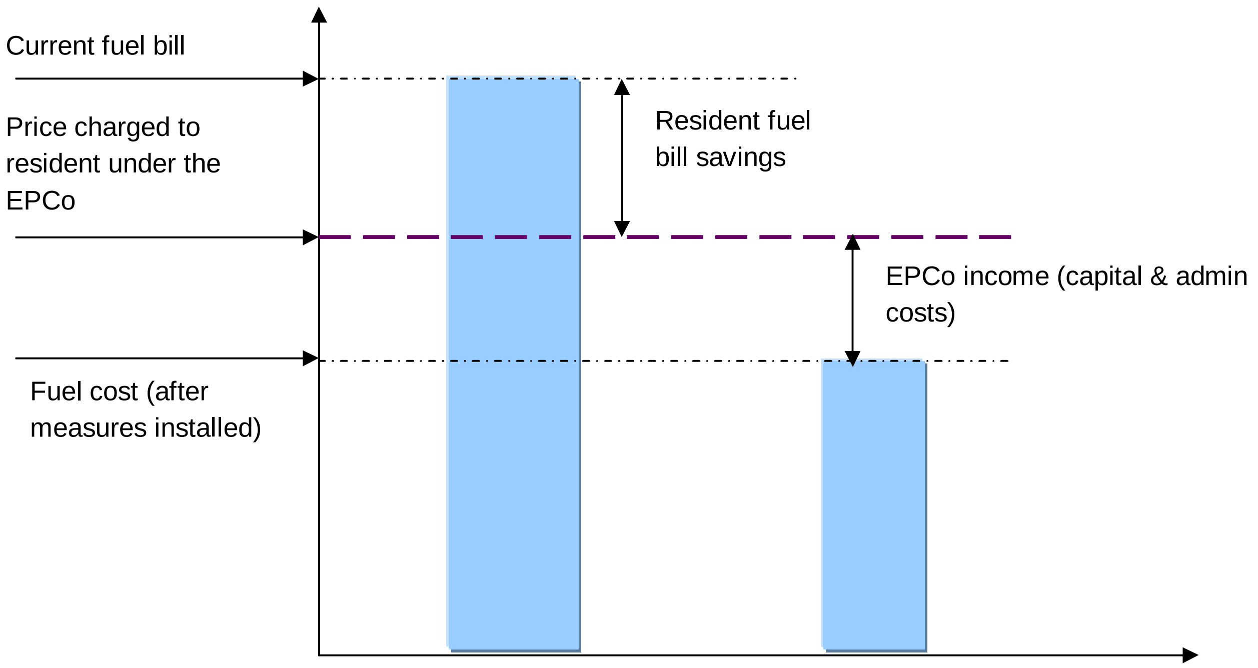
3. Energy Performance Contracts

In a study commissioned by the Housing Corporation in 2008, CEN identified that one method of reducing fuel bills in existing stock would for affordable housing providers to undertake energy performance contracts (EPCos) with their tenants.

An EPCo provides energy services to its clients, and guarantees them cost savings by fixing their annual energy bill, and installing energy efficiency measures to reduce their fuel consumption. The savings are shared between the EPCo and its clients, with the EPCo using the revenue from the savings to pay back the capital of any measures it installs, cover administration fees and, if it is profit making, add value to the company. In this way it differs from traditional ESCos in that the less energy the client uses, the more successful the EPCo.

The basic principle of the EPCO is illustrated in Table 3-1.

Table 3-1: EPCo illustration



The EPCo installs measures, controls and delivers behavioural change package resulting in fuel savings

The EPCo charges the resident for heat and power, providing immediate savings

The reduced consumption provides an income to the EPCo to cover capital and administrative costs

It was identified in the study for the Housing Corporation that one route for delivering EPCo services would be for individual housing associations (or groups of housing associations) to establish supply partnerships with existing utility companies. This would provide the EPCo with established business systems, including billing, metering and navigation of the legislation surrounding supply of

electricity and gas. This model will be discussed in Section 4. In addition, there are ways of delivering EPCo services without supplying energy either directly, or through a partnership. These models will be investigated in Section 4.

Although the ESCo could charge a housing association an all inclusive ‘energy service charge’, it would be necessary to make this transparent so that the housing association could continue charging tenants for the actual heat and power supplied to their properties. Energy services, such as the installation of a CHP engine or insulation improvements, cannot be paid for by service charges. Due to this, the housing association would need to implement at least two separate charges to the tenant; the first for energy delivered, and the second for the services of the ESCo. The second charge would be balanced to ensure the net expenditure of the tenant decreased.

4. *Supply partnerships*

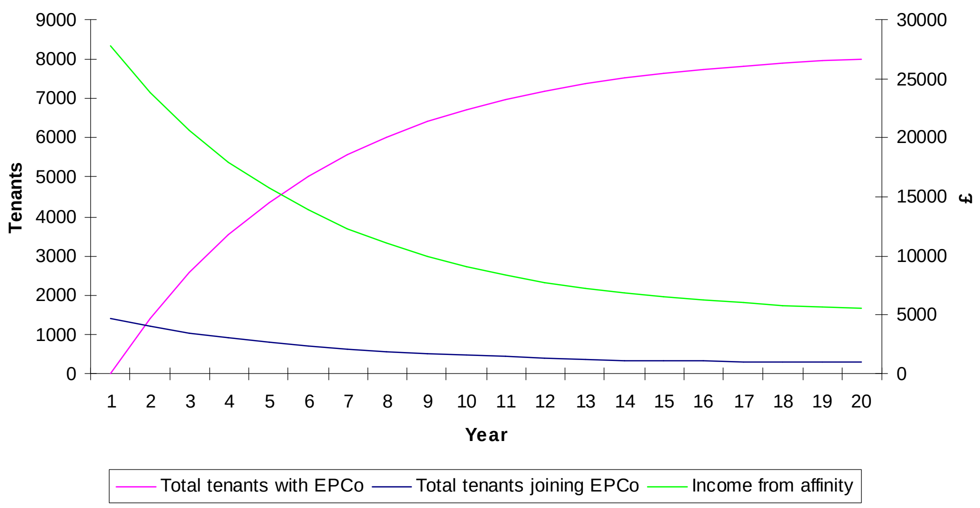
This section will summarise the potential for establishing supply partnerships between social housing providers and utility companies.

CEN has carried out market analysis of existing supply partnerships between social housing providers and utility companies. Two local authorities and *Energyextra*, a group of social housing providers, provided information on their supply partnerships. The feedback from this analysis has been summarised in Table 4-2.

As Table 4-2 highlights, the drivers for supply partnerships are not comprehensive, particularly as interest from suppliers in partnering has decreased since the initial diversification in suppliers following the deregulation of the energy markets in 1990s. Initially this led to an increase in the number of suppliers and greater variation in tariffs available, but more recently differences between tariffs offered by suppliers have narrowed and social tariffs have been introduced to ensure vulnerable customers receive better deals.

In addition, income from affinity deals (transfer fees paid by energy suppliers to housing associations when void properties are signed over to their supply) naturally decreases over time as more and more of the properties within the stock are already customers of the supply partner. For example, if a property becomes void more than once after an affinity deal has been established, a payment will be received only once unless the new tenants decide to change supplier after occupying the dwelling. Therefore, although it would provide a useful income stream in the initial stages of developing an EPCo/ESCo, it is not a sustainable source of income in the long term. Table 4-1 demonstrates this. Using a sample of 10,000 properties, it was assumed that properties will become void every 9 years, that 97% of tenants would stay with the partnership if they moved into a switched property, and that each year, 3% of non-partnership tenants would voluntarily switch supplier (for which the housing association partner would not receive an affinity payment). With a payment of £25 per property, income from such an agreement clearly declines rapidly over time, and would eventually provide only a small sustained annual income.

Table 4-1: EPCo partnership customer forecast example



Although the National Housing Federation and its members could continue to investigate the potential of establishing a supply partnership, this report will focus on other methods of achieving reductions of CO_2 emissions and fuel bills in existing stock.

Table 4-2: Arguments for and against supply contracts

Arguments for supply contracts	
1. The housing provider (or local authority) has the capacity to identify the most competitive tariff for its customers.	All interviewees confirmed that the supply partnerships were under regular review to ensure tenants were provided with good value fuel tariffs. Due to lack of knowledge or time, individual customers are unlikely to review their fuel bills on a regular basis to ensure best value.
2. Affinity deals	Energyextra continue to receive a 'transfer fee' for all void properties signed over to their tariff. Scottish and Southern Electricity (SSE) pay this fee. At one stage, Aberdeen City Council received an annual income of approximately £60,000 for signing over void properties to its supply partner. This income was used to invest in energy efficiency measures in fuel poor private households.
3. Advice for tenants	By being directly involved in the supply of electricity to tenants, supply partnerships can provide targeted advice to influence behaviour and reduce energy consumption. Energyextra provide free home visits, an energy efficiency advice website and discounted energy efficiency measures via. its supply partner.
4. Administration fees reduced	Both Aberdeen City Council and Dundee City Council identified that having only one supplier to deal with when addressing supply to void properties saved on administration time and costs within the council. Aberdeen have now ended their partnership, citing that the reduction in the number of suppliers in the area since the mid-1990s means that the number of suppliers to deal with void properties has reduced administration time.
Arguments against supply contracts	
1. End to affinity deals	Both local authorities reported that suppliers are no longer willing to pay for the transfer of void properties. This, they claimed, is due to a fall in interest by suppliers due to a decrease in the overall number of suppliers competing for customers. In addition, it is likely that social tenants are not an attractive client base for suppliers who are now obliged to supply social tariffs and face the increased risk of defaults on payment. Aberdeen no longer operates a supply partnership, and Dundee received only one reply to its last tender for suppliers. Energyextra reported that they continue to receive payments for new properties signed over to the supply partnership.

2. Social tariffs	All energy companies are now obliged to provide social tariffs to vulnerable customers, and these tariffs must equal their lowest price deal. This reduces the need for social housing providers to partner in order to identify the most competitive deals for their tenants. It also means that any supplier forming a partnership with a social housing provider will be increasing the number of high-risk, low return tenants in its client portfolio.
3. Ongoing barriers to EPCos	Having a supply partner would not enable long-term returns on investment to come from fuel bills as this would involve removing the right of tenants to choose their suppliers. Whilst this is not an intrinsic element of a standard supply partnership, any successful investment in energy efficiency or renewable energy technologies must involve ensuring a guaranteed return on investment.

5. *Barriers and solutions to investment in energy saving measures*

5.1 Introduction

The key barriers preventing wider investment in energy saving measures (ESMs) can be broadly categorised as follows:

- **Economic**: High capital costs and low returns discourage investment in ESMs. Housing associations have no way of recovering cost savings resulting from investment in ESMs, as savings are recovered by the tenant in their fuel bills. Capital investment cannot currently be recovered through rent or service charges so this would also prevent the tenant paying for the energy services from the savings made on their fuel bills.
- **Regulatory**: The right to choose energy suppliers means that investment in ESMs cannot be recovered through fuel bills. Insufficient income from feed-in-tariffs or utility supply obligations (Renewable Obligation Certificates [ROCs]) mean paybacks from investment in renewable technologies are too low.
- **Administrative**: Identifying and securing grant funding, developing business models justifying installations, and organising and monitoring installations requires significant amounts of time, especially when carried out on an ad hoc basis.

This section will address these issues, identifying options for making investment in ESMs more viable, and highlighting areas where changes are needed to stimulate the market.

5.2 Analysis of barriers and solutions

Table 5-1 outlines some of the key barriers to, and suggested solutions for, the encouragement of investment in ESMs. These barriers and solutions are dealt with in greater depth in the rest of this section. Some of the barriers relate directly to issues faced by housing associations, whilst others are issues that should be directed at a national government level.

Table 5-1: Barriers and solutions to investment in ESMs

Barrier	Solution
1. Customers should have the right to switch supplier	• Separate the supply of energy from investment in ESMs
2. Fuel bill savings from ESMs are not guaranteed	• Undertake monitoring (pre and post installation) to better predict savings • Provide behavioural and technical advice to tenants
3. Changes in behaviour after installation of ESMs may result in increased fuel bills	• Provide advice to tenants on how to avoid this • Monitor consumption to prove that the ESMs are performing satisfactorily • Where appropriate, fix payments to ensure returns on investments

4. Tenants might leave the dwelling where the energy saving measure has been installed	• Ensure the repayments are linked to the property, not the tenant • New methods of recovering investment are needed. These may include alterations to the net rent calculation method, new service charges, or recovery via local authority Local Land Charges.
5. Fast payback measures have already been carried out	• Identify new measures with fast payback times • Secure longer-term finance for higher cost, lower return measures • Grant funding should continue • VAT should be cut to 5% on more energy efficiency measures
6. Lack of return on investment in renewable technologies	• Feed-in-tariffs, ROCs, the Renewable Heat Incentive and other utility supply obligations should be set at a rate that makes long-term investment viable. DECC is currently consulting on this via the Renewable Electricity Financial Incentives 2009
7. Regulatory uncertainty means the sale of electricity from combined heat and power over private wires is discouraged, but export arrangements cannot be guaranteed either	• The government must give a clear outline of what is considered acceptable with regards to private wires • Utility supply obligations to purchase electricity generated from low and zero carbon generation could be extended to cover electricity generated by good quality CHP

5.2.1 Customers should have the right to switch supplier

This consumer right was originally encompassed by the '28 Day Rule'. This enabled customers to switch suppliers with only 28 day's notice. Although this no longer applies to supply contracts, the European Court of Justice ruling against the airport operator Flughafen Leipzig/Halle's private wire network demonstrates that the complete removal of the right of customers to choose their supplier remains something which should be avoided.

One method of avoiding this problem, enabling investment in ESMs and maintaining consumer rights to choose suppliers, is to decouple investment in ESMs from the supply of fuel to a property. This can be achieved by establishing an ESCo that focuses entirely on reducing energy consumption within properties and gains an income via a non-fuel supply charge. The bill payer is free to choose their supplier, and monitoring of energy consumption can be used to demonstrate that the ESCo is achieving energy savings in order to justify a charge to the property.

5.2.2 Guaranteeing fuel bill savings

To guarantee a return from an investment in ESMs, savings on fuel bills must be guaranteed, or at least expected with a high level of certainty. This ensures that the proposition is attractive to the client as well as the ESCo, as both can share in the savings.

These savings can be calculated through thorough pre and post installation monitoring. This will enable actual fuel bill savings to be calculated, ensuring any agreement is fair and equitable. In communal blocks, where large installations are

being undertaken (e.g. a CHP installation), monitoring can take place on a site by site basis, and be included in the initial project costs. Post-installation monitoring is essential for predicting energy savings on other sites, and also serves to give the ESCo proof that the measure is achieving energy savings. Where savings are lower than expected, monitoring data can be used to identify why this is the case and enable remedial measures to be carried out.

Monitoring will also enable an ESCo to identify anomalies leading to higher fuel bills beyond both parties' control. For example, a particularly cold heating season may result in a sudden increase in fuel bills for the client. Monitoring of the outside temperatures could demonstrate that, despite the higher fuel bills resulting from this, the savings from insulation that has been installed also increased proportionately during the cold period.

Monitoring in individual dwellings may be cost prohibitive due to relatively high administrative costs and capital costs of the equipment needed. However, by selecting a range of properties to monitor at the outset of the development of an ESCo, more accurate predictions of cost savings than are currently available could be achieved. The repayments for the ESMs can be calculated in order to be less than the overall predicted fuel bill savings, so both loan gets repaid and the tenant achieves a saving.

Key to guaranteeing fuel bill savings will be to ensure thorough dissemination of behavioural and technical advice, ensuring new ESMs are used correctly and changes in behaviour post-installation do not increase fuel bills.

5.2.3 Behavioural changes

It is beyond the remit of an ESCo to ensure tenants do not alter their behaviour and increase their fuel bills. The economy of scale in dealing with a large communally heated block, or a sheltered housing scheme where tenants are not individually metered for electricity or heat means that EPCos could work in these property types, providing pre-installation monitoring has demonstrated that significant savings could be achieved. In some cases it will therefore be feasible for an ESCo to apply fixed energy service charges to schemes such as these, supplying fuel and delivery of energy services, incentivised by reducing energy use as far as possible through 'hard' ESMs and soft measures such as tenant advice and training. The ESCo will still pass on transparent fuel costs to the housing association, as this is necessary to calculate service charges. Therefore any reduction (or increase) in fuel consumption beyond predicted levels will be passed on to tenants. Key to this is that monitoring be used to justify any unexpected fluctuations in fuel consumption, meaning that the ESCo is credited with reductions that it has caused, and tenants can be advised if their behaviour is causing any increase. This model will be discussed in more depth in Section 6. Essentially, the ESCo cannot stand to benefit directly through large reductions in energy use, as these savings will be passed on to tenants. Likewise, increases in fuel consumption beyond the ESCo's control (as demonstrated through accurate monitoring) can be passed on to tenants. Savings can be made for the ESCo on its efficient delivery of energy services however, and in addition, achieving high levels of performance will improve the ESCo's reputation, and encourage other contracts to be established.

In individual homes, the impact of behavioural change could be so large that the risk involved in fixing fuel bills at a certain level is too high to undertake performance contracting at a domestic (individual home) level. Whereas monitoring could be used to justify increases to the fuel charges in a communal block where it was clear that the increase in energy use was beyond the ESCo's control, monitoring on a domestic scale is not cost effective, with a basic remote monitoring kit costing approximately £1,500.

Investments could still be made in these properties however. Aberdeen City Council has used income from their affinity deal with SSE to give loans to private homes for investment in ESMs. Predicting energy savings before installation, and fixing repayments at 50% of the energy costs they were predicted to be saving, the council made approximately 200 loans, and only noted 5 defaults on payments. In this model, responsibility to reduce energy consumption still lies with the customer, as fuel bills are not fixed. Fair and accurate calculations of predicted savings could identify where the ESCo should invest in ESMs without incurring significant risk for either party. The ESCo could use funding generated by affinity deals, or any other sources of funding, such as loans, grants, and income from renewable energy generation, to finance ESMs.

5.2.4 Changes in occupancy

The Department of Energy and Climate Change (DECC) has identified that customers moving house is a key barrier to the longer-term financing of ESMs. On average customers move house every 9 years, so lenders are unwilling to offer longer term loans on home improvements without securing the amount on collateral.

DECC have identified several options for overcoming this barrier in the *Heat and Energy Saving Strategy Consultation*. Asset leasing would reduce the risk, as the ESCo would retain ownership of any ESMs installed and could recover them if the customer did not fulfil their side of the contract by either moving house, misusing the equipment or defaulting on charges. However, many ESMs, such as insulation, are not easily recovered from a property and would not offer reasonable levels of recompense if a contract failed.

An alternative suggestion is to connect the contract with the property, rather than the occupant. The method suggested in the consultation is to enable distribution network operators (DNOs) to invest in ESMs, and recover the repayments via their standing charges, which do not change when occupants change, or alternative suppliers are chosen.[3]

Options for housing associations to directly recover capital investments in ESMs from the tenant all require significant legislative change. For example, increases to net rent, essentially reflecting an increase in the value to the property due to its improved energy performance, new service charges or Local Land Charges.

[3] *Heat and Energy Saving Strategy: A consultation*, 2009 (DECC)

5.2.5 Longer payback measures

In order to fund measures with longer term paybacks, a range of activities must be carried out, including securing long term finance, grant funding and ways of increasing returns wherever possible.

Grant funding will continue under CERT until 2012, and following that a greater focus will be put on 'whole-house' solutions, as will be demonstrated under the Community Energy Savings Programme (CESP). An ESCo will be able to package all grant funding available together in order to give tenants the best available deal, and keep initial expenditure to a minimum.

Long term finance for measures would be easier to achieve if the loan is secured against the property via a reputable, robust ESCo, rather than directly with the tenant. In addition, the *Heat and Energy Saving Strategy Consultation* has suggested using DNOs' access to capital at lower interest rates (due to the fact that they are large, regulated monopolies, pose lower risk to investors). If this is taken forward, and the DNOs choose to make these investments via a third party ESCo, this could be used as a source of finance for installation of ESMs.

In addition, there is scope for government policy to make investment in ESMs in existing stock more attractive. Lowering the rate of VAT to 5% on any works that make a home more energy efficient, would be an added stimulus to invest in ESMs.

5.2.6 Returns from renewables

Currently the main incentive for installation of renewable technologies in existing stock is the Low Carbon Buildings Programme (LCBP). This provides 50% funding on the installation of micro-generation technologies up to 50kW. This funding is due to be replaced by the introduction of compulsory feed-in-tariffs (FiT) and renewable heat incentives (RHI) which is currently under government consultation. In addition, ROCs purchased from micro-generation schemes also offer income to generators, with the added incentive of 2 ROCs per MWh generated for micro-generation since April 2009.

Several suppliers currently offer voluntary FiTs for micro-generation. Good Energy offer £0.15/kWh for domestic generators. This includes both ROCs and FiTs, regardless of whether the electricity is used on-site or exported. However, as a case study of one of their customers demonstrates, this is far from offering a genuine financial incentive for investment in micro-generation technologies. With a 3kWp PV array, one of their customers reports a £345/yr income from the FiT. Assuming an £18,000 capital expenditure, a simple payback on this measure would be 52 years.

Compulsory FiTs and the RHI will have to offer significant increases on the amounts paid to micro-generators in order to provide genuine financial incentives for investment in renewable technologies. The potential impacts of these measures on the market will be modelled in Stage Two of this study.

5.2.7 CHP and private wires

The supply of electricity generated by combined heat and power systems to residents is an area involving high levels of uncertainty with regards to policy. The ruling against Flughafen Leipzig/Halle in the European Court has led to some

developers of larger scale CHP systems avoiding private wires altogether, instead opting to distribute electricity to their customers over the DNO -owned wires in return for distribution charges paid to the DNO. On larger scales this can be cost effective, and is the method used by Thameswey Energy in its Woking CHP network.

On a smaller scale distributing electricity from CHP can be more challenging. Thameswey Energy use private wires in smaller schemes, explaining in tenant contracts that they will supply electricity at a cost of at least 5% below a group of tariffs from the 'Big Six' suppliers. Tenants are free to choose to switch suppliers, although this would involve a supplier installing a grid connected meter in the dwelling. Likewise, the household could theoretically choose to disconnect from the heat network and install electric heating (particularly in owner occupied dwellings). Both these events are unlikely, but in order to maintain the customer's right to choose suppliers, the ESCo incurs the risk of changing heat and electricity profiles lowering the efficiency of the plant installed.

5.3 Summary of barriers and solutions

Following the analysis summarised in Section 5.2, any sustainable investment in ESMs by an ESCo under the proposed models must include the following factors:

- Maintain the right of tenants to choose their fuel suppliers
- Thorough pre-installation monitoring to accurately forecast potential cost savings from ESMs
- Thorough post-installation monitoring to confirm cost-savings from ESMs and highlight reasons for any increase in fuel consumption beyond the ESCo's control
- Where monitoring is not cost-effective due to the small scale of the investment and potential returns, accurately predict cost savings from ESMs through studies on a selection of property types
- Ensure that the cost of the ESMs is paid for by the tenant occupying the property out of the fuel bill savings they benefit from
- Secure repayments for the investment from a charge tied to the property and not the tenant
- Ensure all installations are covered by all eligible grant funding in order to keep repayments to a minimum
- Ensure any heat or electricity generated is eligible for, and secures income from, utility obligation payments (e.g. ROCs, RHIs) and FiTs

6. Business models for ESM investments

6.1 Introduction

This section will outline two business models for ongoing investment in ESMs. The first model will cover larger communally heated blocks, and the second will cover individual properties. The method of recovering the investment and covering the costs of the ESCo should be decided upon in order to make both of these models feasible. It is unlikely however that the exact method of recovering the investment in ESMs will have an impact on the overall economic feasibility of either model.

6.2 Communal blocks

6.2.1 Outline of communal block model

This model assumes that a block is heated by a communal boiler and that tenants pay for heat and communal electricity (i.e. corridors, lifts) via a service charge. This is a typical arrangement within older, communally heated blocks of flats.

The following stages will have to be carried out to ensure financially sound investments in ESMs can be made, with guaranteed returns to cover the capital investment, as well as reductions in tenant fuel bills. It is assumed in this model that the ESCo will provide fuel and services, establishing a ‘tracking’ system to ensure that, should fuel prices increase (or decrease), the fuel charges can be adjusted accordingly.

1. **Pre-installation monitoring:** Modelling of the building’s existing energy use will identify suitable areas for investment. It will also provide a baseline against which energy savings can be predicted and also calculated after installation of ESMs.
2. **Identification of suitable ESMs:** After a monitoring period, suitable ESMs can be chosen for investment. These must guarantee energy savings high enough to payback within the time determined by the ESCo’s finance arrangement, as well as provide savings to tenants.
3. **Identification of grant funding and other income:** Once ESMs have been selected, all grant funding opportunities should be identified to reduce the capital cost of the installation. In addition, any other sources of income, such as FiTs, ROCs and RHIs should be identified and used to calculate the required charge to tenants. This can include funding set aside for planned maintenance works from the housing association.
4. **Arrange agreement between the ESCo and the housing association:** This should confirm the following:
    - **i.** energy savings to be achieved by the ESMs
    - **ii.** where/how those energy savings will be made
    - **iii.** repayments for the investment
    - **iv.** the ‘tracking method’ to ensure the ESCo secures the best possible fuel costs and can adjust charges to reflect fuel price fluctuations

v. post-installation monitoring and verification of energy savings

vi. arrangements for ongoing maintenance of ESMs

vii. agreement on how to deal with unexpected increases in fuel consumption

5. **Secure tenant support:** Whatever the method of recovering the investment in ESMs (e.g. grant, new service charge, increase in net rent, payments via local authorities etc.) full tenant support and understanding is needed to minimise defaults and secure buy-in to the scheme.
6. **Installation of ESMs:** This can be combined with provision of advice to encourage behavioural changes to further reduce energy use.
7. **Collection of charge by housing association:** The housing association will collect the charge from tenants if applicable, to pay back the ESCo for the capital investment and any ongoing running costs. Fuel costs should be passed on transparently.
8. **Ongoing monitoring and verification:** To demonstrate that fuel bill savings are being achieved as predicted and identify areas where additional attention is needed, either through hard measures, or behavioural advice. Where energy use has increased due to forces beyond the ESCo's control, monitoring can be used to demonstrate this and justify an increase in fuel charges. Likewise, decreases in energy use due to factors other than the ESCo's ESMs should be reflected in the fuel charges.
9. **Adjustment of ESCo charges:** Where the income of the ESCo changes, for example due to an increase in the FiT from the installation, charges should be adjusted to reflect this. Alternatively, the loan could be paid off ahead of schedule. Thorough and transparent reporting systems between the ESCo and the housing association should ensure that such issues are known by both parties. The ESCo should also regularly report on fuel prices.

6.2.2 Risks of communal block model

The risks of any performance contract will involve both the ESCo and its client. One of the primary risks to the client is that the ESCo's ESMs indirectly result in a negative impact on any part of its property or services. This should be addressed through concise contracts outlining the responsibility of the ESCo, in the same way that any external maintenance activities are agreed.

Table 6-1 outlines several other risks anticipated in establishing a contract between an ESCo and a communally heated housing block.

Fuel charges must be flexible and transparent to comply with current service charge calculation methods. Charges for repayment of investment in ESMs, day to day management of the ESCo and reinvestment in ESMs could be fixed providing a suitable charging route can be established.

6.3 Individual properties

6.3.1 Outline of individual property model

This model assumes that tenants pay their own fuel bills and charges for the ESMs are dealt with separately. Each property is assumed to have its own heating system.

Key to this model is minimising the administration costs for the ESCo. It is therefore proposed that a simple ‘green loan’ model is applied to individual properties and recovered via a new charge on the property. Accurate forecasting of energy savings can be used to predict reasonable repayments from the tenant via a new charge. The tenant continues to pay their own fuel bills, and therefore the financial incentive to use less energy remains on the tenant.

As an outline, the following steps are recommended for individual properties:

1. **Pre-installation monitoring:** A broad range of data will be needed to accurately predict energy savings across a wide range of property and occupancy types. For ESMs relating to thermal performance (heating systems, insulation, air tightness, glazing improvements), the following factors should be monitored as a minimum:
    - i. External temperature
    - ii. Internal temperature
    - iii. Heating fuel consumption
    - iv. Water consumption
    - v. Humidity
    - vi. Where insulation is being improved, co-heating tests can provide useful information from a short-term test
    - vii. Air tightness tests

    The Energy Saving Trust has suggested that energy consumption in dwellings of the same type has a standard deviation of ±50% and that therefore a sample of 100 dwellings is needed to provide data to accurately predict mean savings within ±5% for each dwelling type.
2. **Identification of suitable ESMs:** In the initial stages these will have to be low risk, high return measures to safeguard both the ESCo’s returns and prevent unexpected increases in tenant expenditure. As higher confidence levels can be placed on returns from other measures, these can be introduced.
3. **Identification of grant funding and other income:** See Section 0
4. **Arrange agreement between the ESCo, tenant and the housing association:** This should confirm the following:
    - i. energy savings to be achieved by the ESMs
    - ii. where/how those energy savings will be made
    - iii. repayments for the investment (to be made via a tenant charge)

iv. arrangements for ongoing maintenance of ESMs
v. provision of advice should fuel consumption increase unexpectedly
vi. provision of advice on how to secure the most competitive fuel prices

5. **Repayment method established:** To include a charge paid for by the tenant to cover ESM or other significant capital investment such as grant.
6. **Installation of ESMs:** This can be combined with provision of advice to encourage behavioural changes to further reduce energy use, and help for the tenant to identify the most competitive fuel prices.
7. **Collection of a new charge by the housing association:** The housing association will collect the charge from tenants to pay back the ESCo for the capital investment and any ongoing maintenance costs.
8. **Ongoing monitoring and verification:** This should take place in a selection of dwellings. Initially all installations should be monitored to create an accurate profile of mean energy savings from ESMs in different property types. Once accurate profiles have been established, selected monitoring can confirm ongoing savings.

6.3.2 Risks of individual property model

Table 6-1 summarises the key risks of the individual property model. As with the communal block model, the key risks involve the technical performance of the equipment, behavioural changes after the installation, and fluctuating fuel prices. Due to the fact that this model involves fixing repayments and leaving the right to choose fuel suppliers with the tenant, the risks primarily fall on the tenant, although the risk of default on payment due to financial difficulties would fall on the ESCo.

Monitoring and creating profiles of property types, allowing for the ±50% standard deviation in energy consumption within dwelling types is essential to ensure that repayments will be set at a rate that accurately reflects the cost savings that the tenant will receive due to the installation of the ESM. Ongoing provision of advice will also serve to help minimise unexpected increases in expenditure on fuel.

Table 6-1: Risks of communal block and individual property models

Risk	Description	Mitigation/discussion
Technical	Equipment underperforms	• ESCo to identify most reliable technologies and manufacturers • ESCo to reflect unavoidable risk (i.e. in more innovative technologies with high potential savings such as CHP) in discount rates on expected returns
Fuel price inflation	Changing fuel prices affecting returns	*Individual properties* • Rising fuel costs will increase the amount saved by the tenant, and as the repayments are fixed in this model, this will benefit only the tenant • Lower than anticipated fuel prices will result in savings being less than expected. Sensitivity analysis should be carried out to ensure this risk is kept to a minimum by setting repayment levels appropriately *Communal blocks* • For most measures this will only make ESMs more valuable to the housing association/tenant if an agreement is established to let the contract 'track' a selection of fuel price indicators. For example, if ESMs achieve a 10% saving on fuel bills, higher than expected fuel price inflation will mean more money is saved by the housing association • Sensitivity analysis should be carried out on all models to ensure that repayments are not excessive if fuel price inflation is lower than anticipated • Comparative fuel prices can result in the 'spark gap'[4] becoming unfavourable for CHP. Likewise, the feasibility of any change in fuel will be affected by the comparative price of the two fuels in question. Again, sensitivity analysis will be needed here to assess the risks and calculate an appropriate discount rate to reflect these risks
Rising energy use beyond control of the ESCo	For example, if the ESCo has installed heat pumps to reduce the overall electricity consumption of a site, but increased electricity load occurs due to appliance use	*Individual properties* • The key risk to the ESCo here is a default on payment by the tenant. This should be avoided by accurate profiling in the initial monitoring stages, and ongoing provision of advice to keep fuel bills to a minimum • As repayments are fixed, but fuel bills remain the responsibility of the tenant, the financial incentive for the tenant to continue conserving energy remains

[4] This term is used to refer to the difference in price between gas and electricity when assessing the feasibility of CHP. Where gas prices are relatively low and electricity prices are relatively high, CHP is more favourable.

		Communal blocks • On-going monitoring and verification will enable the ESCo to demonstrate to the tenants/housing association that any increase in fuel consumption is due to factors outside it's control • By monitoring the appliance, lighting and heating circuits pre and post installation, any variances from the 'baseline' can be accounted for • By retaining transparency of fuel charges, the chances of excessive energy use are reduced, as tenants are still responsible for minimising energy use • Ongoing advice can be provided to encourage energy conservation
Behavioural change results in ESMs underperforming	For example, where heating fuel costs increase despite improved efficiency due to windows being left open	*Individual properties* • The initial monitoring stages should identify mean energy savings from ESMs, allowing for behavioural differences within the same property type. This can allow repayments to be set to allow for behavioural impacts • As repayments are fixed and the tenant is still responsible for their own fuel bills, the financial incentive remains for tenants to conserve energy *Communal blocks* • Ongoing monitoring can be used to demonstrate why ESMs are underperforming • Analysis of external and internal temperatures, heating system output and fuel consumption will confirm that heating systems are performing as required, or identify any shortcomings compared to estimates • A degree of risk can be reflected in the financial modelling. This is necessary as no amount of pre-installation monitoring will be able to accurately predict future patterns of behaviour • A profile of the influence of behaviour on fuel savings should be developed to create 'standard deviations' from technical calculations of savings, for example +/-3% on heating system improvements

7. *Modelling of communal block model*

7.1 Introduction

7.1.1 Summary

Modelling of the business model for a communally heated block, as identified in Section 6, has been carried out to assess the feasibility of implementing the sustainable finance model in affordable housing stock. It has been decided to model three different 'scenarios' in order to reflect the possible savings and challenges facing an ESCo in implementing different measures.

Each scenario has been modelled using a set of basic assumptions, and sensitivity analysis has then been applied to assess the impact the following factors:

- Subsidies and grant funding
- Finance arrangements
- Project costs
- Fuel inflation
- Reinvestment in ESMs

The measures installed, repayment calculation and savings achieved for each scenario are described, and sensitivity analysis is applied to each case (found within this section for Scenario 1, and in the Annexes for Scenarios 2 and 3). A comparison of the different scenarios is then presented, followed by conclusions.

7.2 Methodology

The business model was applied to a notional sheltered block of 81 flats, where heat is supplied to all flats and communal areas from central boilers, and residents are charged a flat rate for space heating, weighted according to the floor area of their dwelling. In addition, a fixed charge is made for electricity for communal areas. Residents are free to choose their own supplier for electricity within their flat, and are billed directly by the chosen supplier.

The following steps were taken in order to assess the feasibility of the business model:

1. Energy modelling of the block to estimate current heat and electricity loads, fuel consumption, energy costs and CO_2 emissions
2. Costing of monitoring equipment required for pre and post-installation monitoring
3. Estimates of costs for establishing the repayment method
4. Identification of 3 different packages of ESMs that could be applied to the block
5. Energy modelling of the 3 different ESM packages to identify energy savings achieved, fuel bill savings and CO_2 reductions

6. Identification of ongoing costs involved with the implementation of the EPCo, including billing, monitoring, introduction of the new charge and energy procurement
7. Financial modelling and sensitivity analysis of each of the 3 scenarios considering:
    - Grant funding
    - Loan term
    - Interest rate on loan
    - Project costs
    - Fuel price inflation
    - Reinvestment of savings in further ESMs
    - Number of blocks the model is applied to
    - Income from feed-in-tariffs

Baseline heat and electricity loads were estimated using fuel bill data from a sample building selected by CEN. Table 7-1 outlines the baseline heat and communal electricity loads for the notional building, based on the following assumptions:

1. 75% efficient gas boiler
2. Unfilled cavity wall (100mm void)
3. 60mm loft insulation
4. 30% low energy lighting in communal areas
5. Double glazing

Table 7-1: Baseline energy use and carbon emissions for communal block model

Current space heating load [kWh/yr]	Current DHW load [kWh/yr]	Current gas use [kWh/yr]	Current communal Electricity use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]
605,580	403,720	1,345,730	120,560	261,070	50,880	311,980

7.3 ESMs modelled

For the communal block studied, the following three packages of ESMs were applied to assess the feasibility of the business model in different scenarios:

Scenario 1: *100mm Cavity wall insulation, top up of loft insulation from 60mm to 270mm, draught proofing, energy efficient lighting in communal areas, upgrade of communal boiler efficiency from 75% to 93%* – this package was modelled to assess the model when applied to relatively low-cost, fast payback measures

Scenario 2: *100mm Cavity wall insulation and external cladding, top up of loft insulation from 60mm to 270mm, draught proofing, energy efficient lighting in communal areas, combined heat and power system* – this package was modelled

to assess the model when applied to medium-high cost measures with a wider range of payback times

Scenario 3: *External wall insulation and external cladding, top up of loft insulation from 60mm to 270mm, draught proofing, energy efficient lighting in communal areas, upgrade of communal boiler efficiency from 75% to 93%* - this package was modelled to assess the model when applied to high-cost measures such as solid wall insulation

In addition, a proportion of the fuel bill savings were taken for reinvestment in ESMs, at 7 year intervals investment in solar photovoltaic systems was modelled, using the revenue generated from fuel bill savings.

7.4 Modelling uncertainties

The uncertainties in predicting fuel bill savings are well documented. The Energy Saving Trust argue that energy consumption in dwellings of the same type has a standard deviation of ±50% and that therefore a sample of 100 dwellings is needed to provide data to accurately predict mean savings within ±5% for each dwelling type.

As detailed monitoring of 100 identical blocks before an EPCo is implemented is unlikely, it is recommended that the EPCo aims for overall tenant savings of at least 10% in Year 1 in order to safeguard itself and the client against unexpected deviations from fuel bill predictions.

In a situation where fuel costs are reduced by 27% in Year 1 of the EPCo, the modelling has shown that the tenant will receive an overall saving of 10% on the over cost of their heat and communal electricity. The remaining 17% of the fuel cost savings will be used to cover project costs and repayment of the loan used to finance the ESMs. It is therefore essential to accurately predict not only the fuel bill savings, but also the project costs and costs incurred through financing the ESMs in order to have a high level of confidence when setting the new charges.

7.5 Communal block ‘Scenario 1’ modelling results

This section will explain the modelling exercise undertaken, and analyse the results, for the communal block model adopting ‘Scenario 1’ ESMs.

7.5.1 Pre-installation phase

In this modelling exercise, it is assumed that the pre-installation phase will begin when a block has been identified as a potential EPCo customer. Costs before this stage, including marketing, development of business systems, agreeing finance sources and arrangements, and creation of contracts and template tenancy agreements have not been included. Table 7-2 outlines the initial costs.

Table 7-2: Pre-installation costs

Activity	Cost	Notes
Site visit and pre-installation monitoring	£2,000	This covers a site visit to determine the possible ESMs for the block, fuel bill analysis and monitoring of data from monitoring equipment.[5]
Preparation of contract between EPCo and landlord	£1,000	To ensure energy services are provided transparently, including methods of adjusting monthly charges if fuel savings are higher than anticipated (or lower than anticipated, but beyond the control of the EPCo), maintenance responsibilities and reporting procedures.
Development of repayment method (rent, service charges, local authority route)	£4,000	Adjustment of tenancy agreements to secure repayments for ESMs. Care must be taken to ensure charges are clearly defined, and that no overall increase to charges eligible for income support are made. Tenant support is crucial at this stage.
Total	£7,000	

7.5.2 Installation of measures and carbon savings

When tenancy agreements have been updated and the recovery of the investment made is possible through new charges, the measures selected for the block can be installed. In this example, the measures in Table 7-3 have been applied to achieve a reduction in heating load of 27.5%, and a 10% reduction in communal electricity consumption.

Table 7-3: Capital cost of measures in 'Scenario 1'

Measure	Cost	Notes
Insulation	£23,220	100mm cavity wall insulation, top up of loft insulation from 60mm – 270mm
Draught proofing	£14,160	Draft proofing on all windows, sills and doors
Low energy lighting	£490	Replacement of incandescent bulbs with compact fluorescent lighting and standard fluorescent tubes with high efficiency tubes
Boiler and controls	£21,000	Replacement of 75% efficient gas boiler to 93.5% efficiency condensing gas boiler with weather compensation, new controls, cylinder thermostat, new thermostatic radiator valves (TRVs) and insulated pipework
Monitoring equipment	£2,000	Equipment for pre and post installation monitoring, including temperature sensors for external and internal temperature, heating system flow and return and hot water cylinder. This includes the cost of a transmitter for remote monitoring.
Contingency	£3,045	5% of capital cost
Total	£63,915	

[5] Equipment for monitoring is covered under capital costs, as this will be used throughout the project.

At this stage, no grant funding has been assumed for the measures outlined in Table 7-3. The predicted energy and carbon savings resulting from these measures are outlined in Table 7-4.

Table 7-4: Predicted energy loads and carbon savings for Scenario 1

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted communal electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%][6]
439,045	403,720	108,530	901,350	174,860	45,800	220,660	29%

7.5.3 Calculation of new charge

The new charge for heating and communal electricity is determined by a number of factors:

- Capital and administration costs
- Interest rate on loan to finance measures
- Term of loan
- Monitoring costs
- Project costs
- Cost of fuel procured by the EPCo and fuel price inflation
- Proportion of fuel bill savings used to reinvest in ESMs

Table 7-5 outlines the factors that influence the new charge and the rates that have been used for the initial calculation of the new charge. Sensitivity analysis has been carried out in Section 7.5.4 to show the impacts of varying each of these factors.

Table 7-5: Factors influencing the new charge

Item	Rate	Notes
Grant funding for capital costs	0%	• No grant funding has been assumed to cover the capital cost of the installation
Interest rate	6%APR	• This reflects a typical commercial loan rate
Loan term	15 years	• This is the term deemed necessary to achieve savings from Year 1
Project costs **Monitoring costs**	0.5%	• This is an annual charge calculated as a percentage of the total capital cost of the installation • This does not include the billing costs outlined in Table 7-6
Fuel cost reduction	0%	• Although the EPCo may be able to secure

[6] Refers to carbon emissions from space heating, domestic hot water and communal electricity only.

		lower fuel costs, no reduction has been assumed at this stage
Proportion of savings reinvested	25%	• This is calculated as a proportion of the savings made by the EPCo over the original energy charges • This level has been selected in order to generate revenue for ongoing carbon and fuel savings, while still giving tenants the bulk of the savings direct

Taking the assumptions made in Table 7-5 and Table 7- 6 the new charge for heat and communal electricity has been calculated based on the income requirement for the EPCo to meet all loan repayments, administration costs, gas and electricity costs and maintenance requirements.

Table 7-6: Annual income requirements for the EPCo

Item	New Cost [£]	Original Cost [£]
Annual repayment*	6,845	-
Project, monitoring and billing costs	3,480	2,835
Sinking fund for new boiler	1,400	1,400
Maintenance	1,000	800
Gas	30,000	44,800
Electricity	12,435	13,810
Fuel savings reinvested**	2,120	
Total	57,280	63,645

*Calculated as a 70,090 loan at 6% interest over 15 years. **25% of total savings reinvested in ESMs

This scenario, would see a 10% reduction in the overall costs for the provision of heat and communal electricity in year one.

Reinvestment in ESMs

Taking 25% of the savings for reinvestment in ESMs in the same block, further savings can be achieved throughout the lifetime of the contract. In this scenario, at 7 year intervals (year 7, year 14, year 21), the total amount saved for reinvestment is reinvested in solar photovoltaic panels for the block.

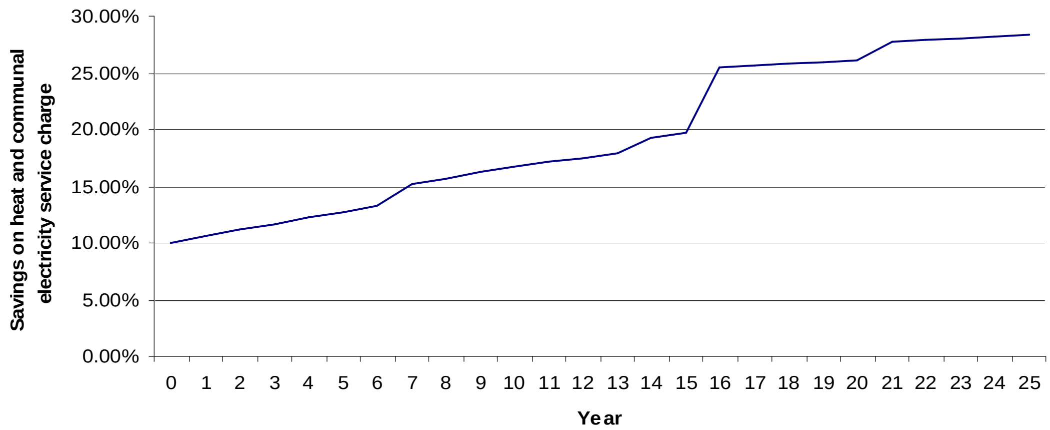
Taking recently published proposed figures for feed-in-tariffs (FiT) from the government's *Renewable Electricity Financial Incentives Consultation*, an income of £0.365/kWh generated, with an additional £0.05/kWh exported to the grid, has been applied. This is reduced to £0.28/kWh for any generation from systems over 4kWp.

In this scenario, enough capital will have been generated for a 2.9kWp system to be installed in Year 7, increasing this to 5.9kWp in Year 14. The income generated from this leads to a further decrease in charges for tenants.

Tenant savings

Taking the assumptions made throughout this section, Table 7-7 outlines the savings made by residents over 25 years. An average saving of £76 is made in Year 1, with an average cumulative total saving of £1,410 by Year 15, discounted at 7%. Savings gradually increase over time due to the difference between the fuel price inflation (4%) and the standard inflation applied to project costs, maintenance and sinking funds (2.5%). Increases in the savings made are evident in the years when solar PV systems are installed or enlarged (Years 7, 14 and 21), and also in Year 15, when the loan repayments stop.

Table 7-7: Savings to tenants from 'Scenario 1' energy saving measures



7.5.4 Sensitivity analysis of the communal block 'Scenario 1' model

Section 7.5.3 outlines the savings residents will make according to the assumptions highlighted throughout the section and in Annex A. This section will analyse the effects that the following factors will have on the model:

- Grant funding
- Reduction in fuel costs through bulk purchase
- Interest rates
- Term of loan
- Fuel inflation
- Project costs
- Reinvestment in ESMs

Grant funding

It was assumed in Section 7.5.3 that no grant funding was available for any of the measures installed. This was to demonstrate that in this case, investments could be made without additional assistance, while still making a saving for tenants from Year 1. It is likely however that grant funding will be available for some of the measures modelled, as outlined in Section 5.2.5. In addition, any decrease in VAT would effectively subsidise an installation. Table 7- 8 outlines the impact different grant funding levels have on the model. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Table 7-8: Savings made from different grant funding levels

Grant funding	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
Insulation – 0% Draught proofing – 0% Boiler – 0%	10%	£76	19.72%	£1,410
Insulation – 50% Draught proofing – 0% Boiler – 0%	11.4%	£89	20.9%	£1,540
Insulation – 50% Draught proofing – 50% Boiler – 0%	12.23%	£96	21.7%	£1,614
Insulation – 50% Draught proofing 50% Boiler – 25%	13%	£102	22.4%	£1,680

Reduction in fuel costs through bulk purchase

It is feasible that as well as reducing the overall energy loads, and supplying heat and light more efficiently, the EPCo could make savings through the bulk purchase of gas and electricity. Table 7-9 outlines the possible savings to tenants through different fuel cost reductions achieved by the EPCo. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Table 7-9: Savings made through bulk purchase discounts on electricity and gas

Fuel cost savings [%]	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
0%	10%	£76	19.7%	£1,410
2.5%	11.2%	£89	21.5%	£1,551
5%	12.4%	£97	23.2%	£1,692

Interest rates

The interest rate on the loan used to fund the initial ESMs will have a large impact on tenant savings and the overall feasibility of the business model. In the following sections, the effects of interest rates will therefore be analysed alongside the other major variables (project costs, fuel inflation, term of the loan and reinvestments in energy efficiency measures).

Term of loan

The impact of the term of the loan used to finance the ESMs is outlined in Table 7-10. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Table 7-10: % savings made by tenants (at Year 1) as determined by loan term – Scenario 1

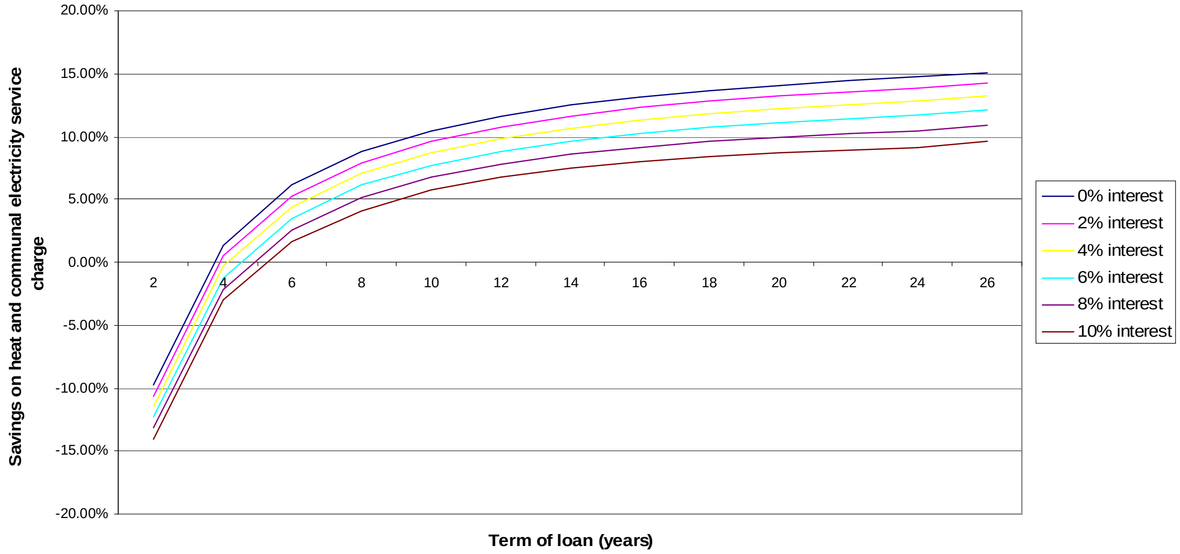


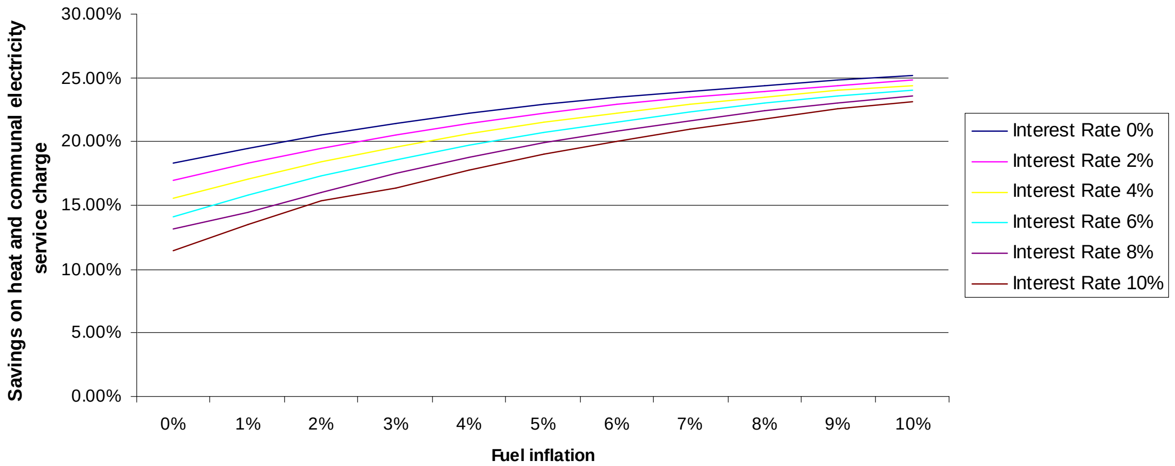
Table 7-10 demonstrates that a 10% saving for tenants could still be achieved in Year 1 if a low interest loan of 2% were available over an 11 year term. Lower interest rates would result in lower payback periods and therefore a shorter period before the full benefit of the ESMs installed could be felt by the residents.

Aiming for a predicted Year 1 tenant saving of greater than 10% is recommended in order to minimise risk.

Fuel inflation

The impact of fuel price inflation on tenant savings after 15 years is outlined in Table 7-11. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Table 7-11: % savings made by tenants (Year 15) as determined by fuel inflation - Scenario 1



This graph demonstrates that as fuel inflation increases, the savings made by tenants will also increase. This demonstrates how investment in ESMs will reduce the overall vulnerability of the tenants to future fuel price variations. Interest rates have an impact on the savings made, although as the fuel inflation increases, the impact of interest rates becomes less significant.

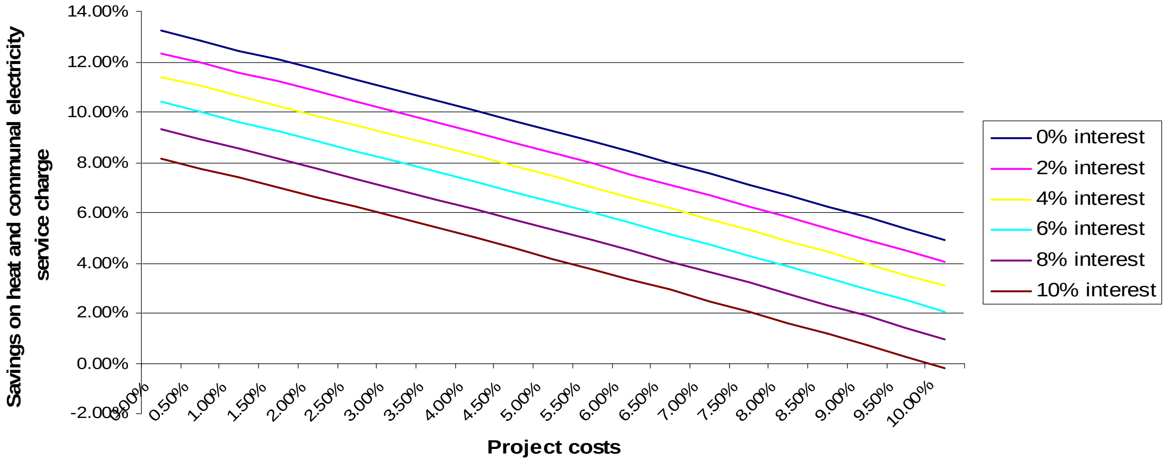
Project costs

The impact of project costs on tenant savings in Year 1 are outlined in Table 7-12. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Project costs should be kept to a minimum, and this can be achieved by having a dedicated member of staff, or team, working on the project, and setting up replicable templates and business systems for tenant agreements, monitoring and reporting, maintenance contracts, billing and reinvestment programmes.

It is estimated that where 12 projects of a size similar to this model were being carried out by an ESCo, this would fund a full time project manager (£40,000-£45,000) through project, monitoring and billing costs.

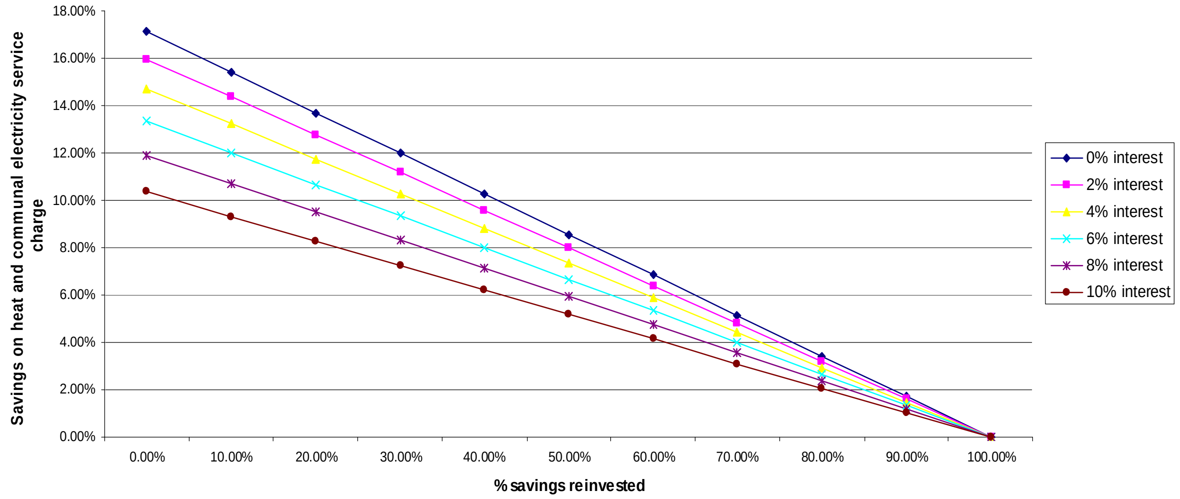
Table 7-12: % savings made by tenants (Year 1) as determined by project costs - Scenario 1



Reinvestment in ESMs

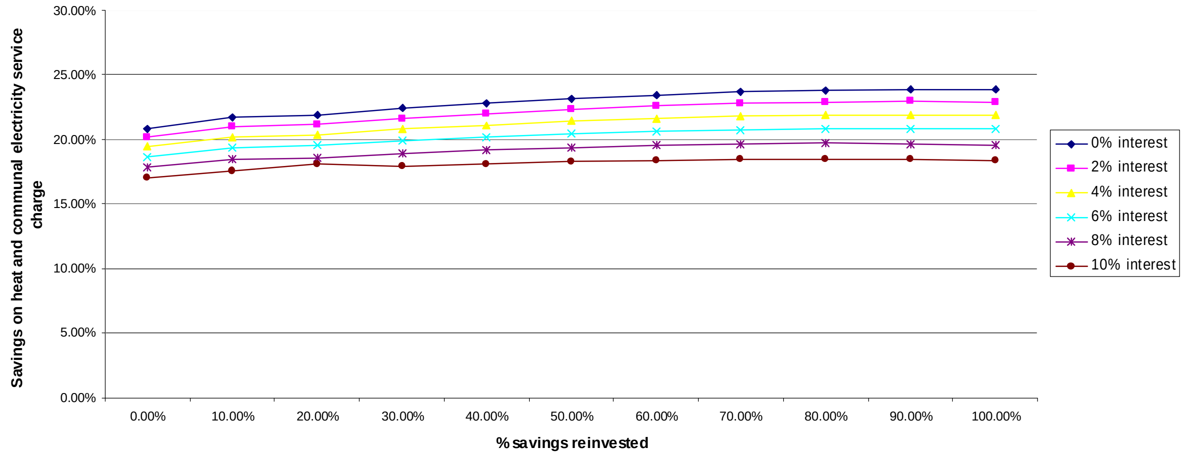
The impact of taking a proportion of the overall savings for reinvestment in further ESMs on tenant savings in Year 1 is outlined in Table 7-13. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Table 7-13: % savings made by tenants (Year 1) as determined by the proportion of savings reinvested in ESMs - Scenario 1



This demonstrates that as more of the savings made by the EPCo are reserved for reinvestment in ESMs, less of the savings can be passed on to the tenant in Year 1. In the long term, reinvestment will provide greater savings to tenants and ongoing reductions in carbon emissions, as Table 7-14 demonstrates. In this case, the investments made in solar PV in Year 7 and Year 14 result in higher savings for tenants by Year 15 if the reinvestment level is higher. However, in order to give acceptable tenant savings in Year 1, reinvestment of approximately 15-40% of the total savings, depending on the interest rate, is recommended.

Table 7-14: % savings made by tenants (Year 15) as determined by the proportion of savings reinvested in ESMs - Scenario 1



7.6 Communal block 'Scenario 2' modelling results

This section will explain the modelling exercise undertaken, and analyse the results, for the communal block model adopting 'Scenario 2' ESMs. This includes the same measures as modelled in Section 7.5, but with a micro-CHP engine to generate heat and electricity for the communal areas and additional external solid wall insulation to further improve the performance of the building envelope. Sensitivity analysis can be found in Annex B.

7.6.1 Pre-installation phase

The pre-installation phase is assumed to be the same as in the 'Scenario 1' modelling exercise.

7.6.2 Installation of measures and carbon savings

In this example, the measures in Table 7-15 have been applied to achieve a reduction in heating load of 32.5%, and a 10% reduction in communal electricity consumption.

Table 7-15: Capital cost of measures in 'Scenario 2'

Measure	Cost	Notes
Insulation	£86,400	100mm cavity wall insulation, external solid wall insulation top up of loft insulation from 60mm – 270mm
Draught proofing	£14,160	Draft proofing on all windows, sills and doors
Low energy lighting	£490	Replacement of incandescent bulbs with compact fluorescent lighting and standard fluorescent tubes with high efficiency tubes
Boiler and controls	£21,000	Replacement of 75% efficient gas boiler to 93.5% efficiency condensing gas boiler with weather compensation, new controls, cylinder thermostat, new thermostatic radiator valves (TRVs) and insulated pipework
Monitoring equipment	£2,000	Equipment for pre and post installation monitoring, including temperature sensors for external and internal temperature, heating system flow and return and hot water cylinder. This includes the cost of a transmitter for remote monitoring.
CHP	£35,000	15kWe CHP engine, buffer vessel and controls
Contingency	£7,950	5% of capital cost
Total	£167,000	

At this stage, no grant funding has been assumed for the measures outlined in Table 7-15. The predicted energy and carbon savings resulting from these measures are outlined in Table 7-16.

Table 7-16: Predicted energy loads and carbon savings for Scenario 2

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted communal electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%][7]
408,770	403,720	108,530	1,005,320	140,380	5,200	145,580	53%

[7] Refers to carbon emissions from space heating, domestic hot water, and communal electricity only.

It is assumed that all electricity generated by the CHP engine will be used on site in the communal areas.

7.6.3 Calculation of new charge

The charge has been calculated using the same methodology outlined in Section 7.5.3 and assumptions listed in Table 7-5 and Annex A.

Taking the assumptions made in Table 7-17 the new total energy charge has been calculated based on the income requirement for the EPCo to meet all loan repayments, administration costs, gas and electricity costs and maintenance requirements.

This scenario would see a 4.5% reduction in the charges for heat and communal electricity in year one, therefore not meeting the target of a 10% reduction.

Table 7-17: Income requirements for EPCo as compared to the baseline scenario - Scenario 2

Item	New Cost [£]	Original Cost [£]
Annual repayment*	16,795	-
Project, monitoring and billing costs	4,500	2,835
Sinking fund for new boiler	1,400	1,400
Maintenance[8]	3,000	800
Gas	32,860	44,800
Electricity	1,410	13,810
Fuel savings reinvested**	920	
Total income required	60,885	63,645

*Calculated as a 174,000 loan at 6% interest over 15 years. **25% of total savings reinvested in ESMs

Reinvestment in ESMs

As with the 'Scenario 1' scenario, by taking 25% of the savings for reinvestment in ESMs in the same block, further savings can be achieved throughout the lifetime of the contract.

In this scenario, enough capital will have been generated for a 1.8kWp solar PV system to be installed in Year 7, increasing this to 4.3kWp in Year 14. The income generated from this leads to a further increase in tenant savings.

Savings over time

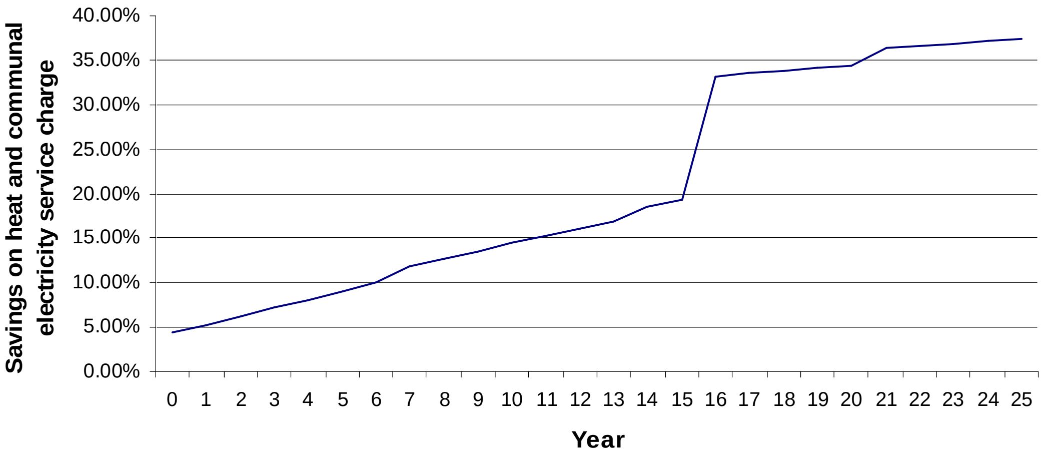
Taking the assumptions made throughout this section, Table 7-18 outlines the savings made by residents over 25 years. An average saving of £34 is made in Year 1, with an average cumulative total saving of £1,090 by Year 15, discounted at 7%. Savings gradually increase over time due to the difference between the fuel price inflation (4%) and the standard inflation applied to project costs, maintenance and sinking funds (2.5%). Increases in the savings made are evident in the years

[8] Including replacement of CHP engine every 15,000 hours of operation

when solar PV systems are installed or enlarged (Years 7, 14 and 21), and also in Year 15, when the loan repayments stop.

Although the initial savings are far lower than those achieved by the lower cost, faster payback measures in 'Scenario 1', the savings achieved once the loan has been repaid are far higher. The sensitivity analysis summarised in Annex B outlines some of the methods of increasing Year 1 savings in this scenario.

Table 7-18: Savings to tenants from 'Scenario 2' energy saving measures



7.7 Communal block 'Scenario 3' modelling results

This section will explain the modelling exercise undertaken, and analyse the results, for the communal block model adopting 'Scenario 2' ESMs. As in Scenario 2, the block has cavity wall insulation and external cladding, an improved boiler, draught proofing, and loft insulation. However, in this scenario, no CHP engine has been modelled. Sensitivity analysis can be found in Annex B.

7.7.1 Pre-installation phase

The pre-installation phase is assumed to be the same as in the 'Scenario 1' modelling exercise.

7.7.2 Installation of measures and carbon savings

In this example, the measures in Table 7-19 have been applied to achieve a reduction in heating load of 32.5%, and a 10% reduction in communal electricity consumption.

Table 7-19: Capital cost of measures in 'Scenario 3'

Measure	Cost	Notes
Insulation	£86,400	100mm cavity wall insulation, external solid wall insulation top up of loft insulation from 60mm to 270mm
Draught proofing	£14,160	Draft proofing on all windows, sills and doors
Low energy lighting	£490	Replacement of incandescent bulbs with compact fluorescent lighting and standard

		fluorescent tubes with high efficiency tubes
Boiler and controls	£21,000	Replacement of 75% efficient gas boiler to 93.5% efficiency condensing gas boiler with weather compensation, new controls, cylinder thermostat, new thermostatic radiator valves (TRVs) and insulated pipework
Monitoring equipment	£2,000	Equipment for pre and post installation monitoring, including temperature sensors for external and internal temperature, heating system flow and return and hot water cylinder. This includes the cost of a transmitter for remote monitoring.
Contingency	£6,200	5% of capital cost
Total	£130,250	

At this stage, no grant funding has been assumed for the measures outlined in Table 7-19. The predicted energy and carbon savings resulting from these measures are outlined in Table 7-20.

Table 7-20: Predicted energy loads and carbon savings for Scenario 3

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted communal electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%][9]
408,770	403,720	108,530	869,000	168,580	45,800	214,380	31%

7.7.3 Calculation of new charges

The new charges have been calculated using the same methodology outlined in Section 7.5.3 and assumptions listed in Annex A.

Taking the assumptions made in Table 7-21 the new total charge has been calculated based on the income requirement for the EPCo to meet all loan repayments, administration costs, gas and electricity costs and maintenance requirements.

This scenario would see a 2.9% reduction in the overall costs for the provision of heat and communal electricity in year one, which would not provide the necessary margin of error for an EPCo to be implemented with a reasonable degree of confidence.

[9] Refers to carbon emissions from space heating, domestic hot water, and communal electricity only.

Table 7-21: Income requirements for EPCo - Scenario 3

Item	New Cost [£]	Original Cost [£]
Annual repayment*	13,250	-
Project, monitoring and billing costs	4,150	2,835
Sinking fund for new boiler	1,400	1,400
Maintenance	1,000	800
Gas	28,900	44,800
Electricity	12,450	13,810
Fuel savings reinvested**	625	
Total income required	61,775	63,645

*Calculated as a 137,250 loan at 6% interest over 15 years. **25% of total savings reinvested in ESMs

Reinvestment in ESMs

As with the ‘Scenario 1’ scenario, by taking 25% of the savings for reinvestment in ESMs in the same block, further savings can be achieved throughout the lifetime of the contract.

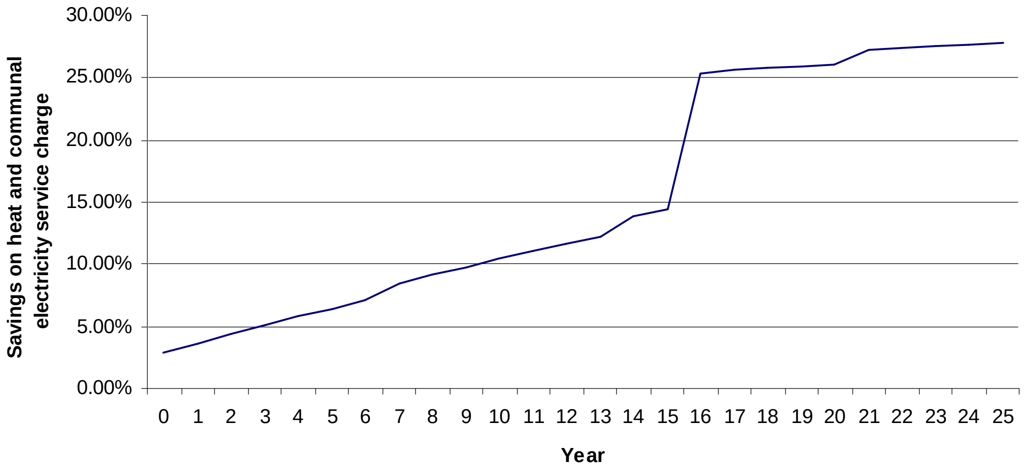
In this scenario, enough capital will have been generated for a 1.25kWp system to be installed in Year 7, increasing this to 3.1kWp in Year 14. The income generated from this leads to a further decrease in the charge for tenants.

Savings over time

Taking the assumptions made throughout this section, Table 7-22 outlines the savings made by residents over 25 years. An average saving of £23 is made in Year 1, with an average cumulative total saving of £785 by Year 15, discounted at 7%.

As with Scenario 2, the initial savings are far lower than those achieved by the lower cost, faster payback measures in ‘Scenario 1’. The burden of the high capital cost of the solid wall insulation is clear during the loan repayment period. Methods of increasing the tenant savings during this period include using grant funding, extending the term of the loan, securing lower interest rates and keeping project costs to a minimum. Sensitivity analysis of these measures has been carried out and is summarised in Annex B.

Table 7-22: Savings to tenants from 'Scenario 3' energy saving measures

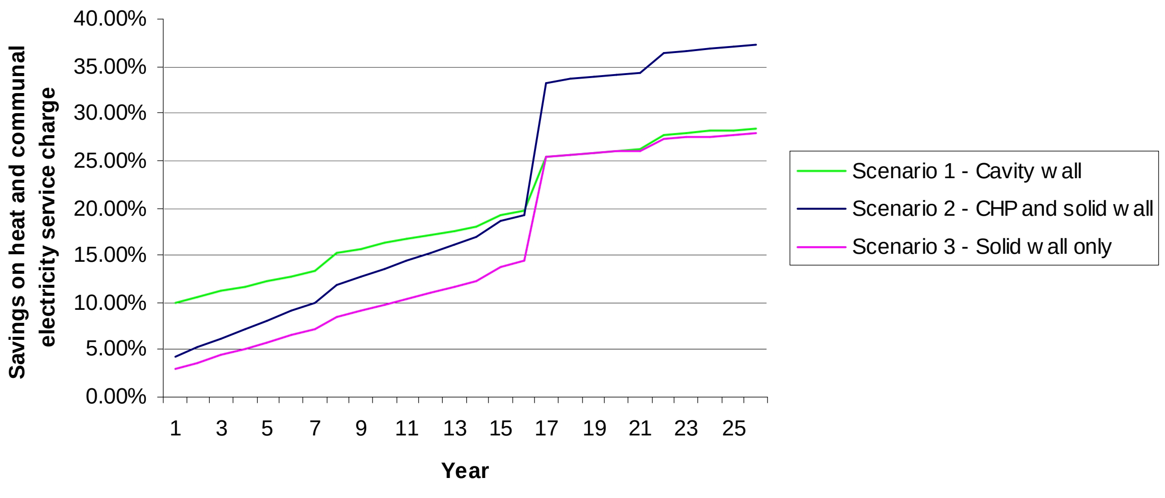


7.8 Comparison of the different scenarios

7.8.1 Standard case

Table 7-23 gives a comparison of the tenant savings achieved by each of the three scenarios in the standard case (i.e. using the assumptions outlined in Annex A).

Table 7-23: Comparison of scenarios' tenant savings over time



The graph demonstrates that despite the higher fuel savings delivered by Scenarios 2 and 3, the Year 1 savings are highest from the fast payback measures installed in Scenario 1. High capital costs in relation to fuel savings mean that the burden placed on the tenants by loan repayments is higher in Year 1 for Scenarios 2 and 3.

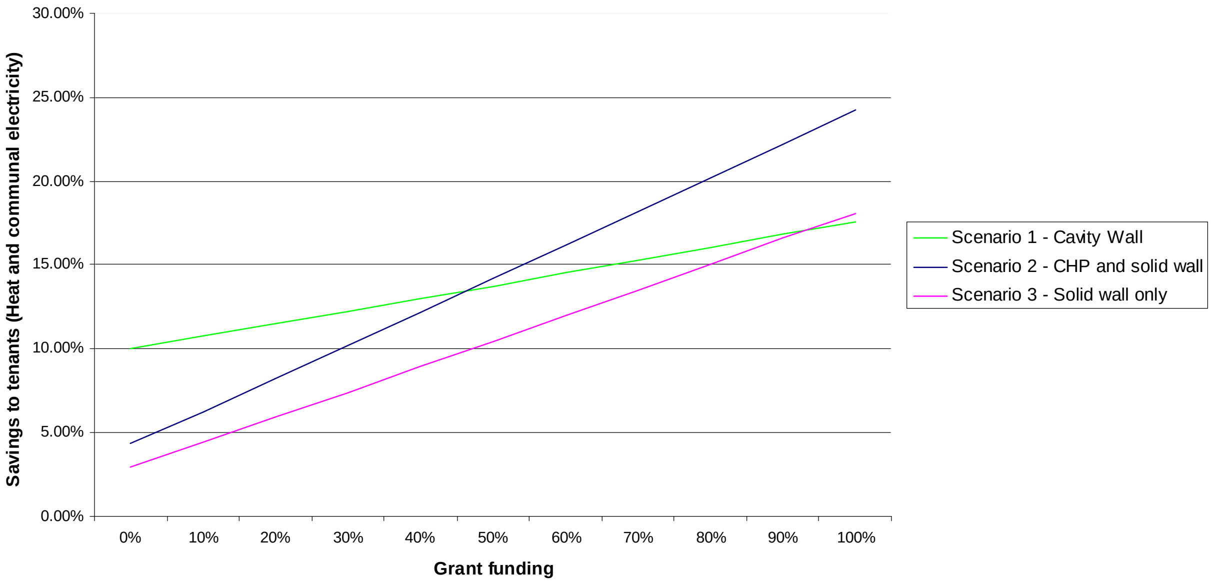
Despite the higher capital cost of Scenario 2 when compared to Scenario 3, the Year 1 savings are higher for Scenario 2. This is due to the large fuel bill savings achieved by the CHP generation in Scenario 2.

In summary, Year 1 savings are largely determined by the capital cost of the measures installed and the fuel bill savings that these measures can deliver.

7.8.2 Grant funding impacts

The sensitivity analysis in each section has identified that grant funding will increase the overall feasibility of all models by reducing the loan repayments required from tenants. Table 7-24 outlines the impact of different grant funding levels on the tenant savings in Year 1 for each scenario (using the assumptions outlined in Annex A).

Table 7-24: Comparison of the effects of grant funding on tenant savings in each scenario (Year 1)



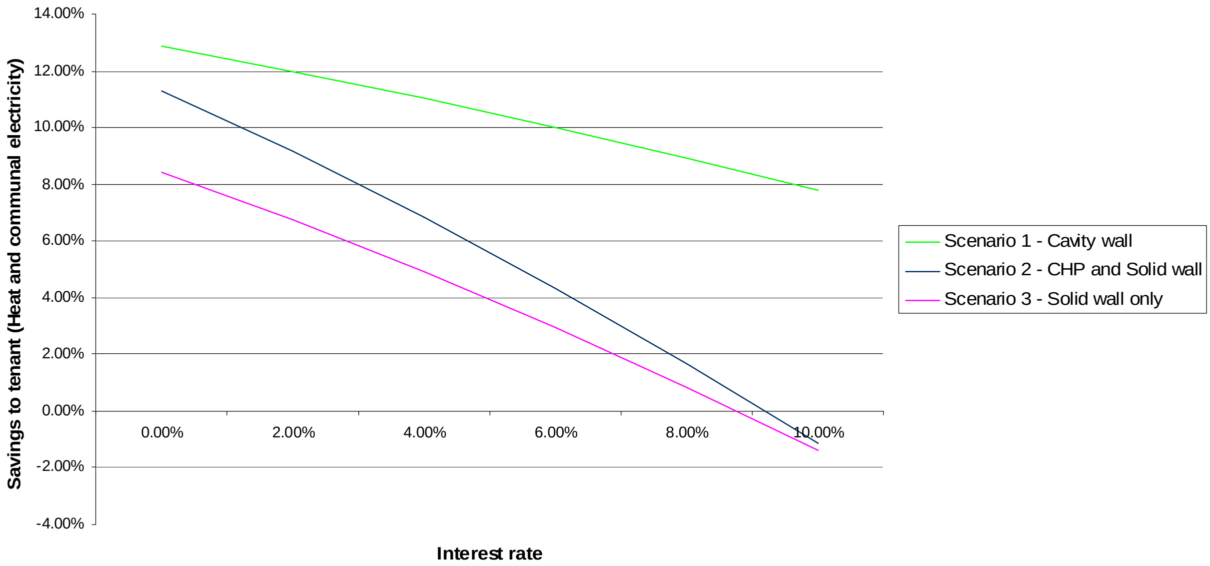
In order to achieve tenant savings of 10% in Year 1, Scenario 1 requires no grant funding. If the total capital cost of the higher cost measures in Scenario 2 could be reduced by approximately 30% through grant funding, a tenant saving of 10% would be achieved in Year 1. The longer payback measures of Scenario 3 would require grant funding to cover 50% of capital costs in order to achieve tenant savings of 10% in Year 1.

Grant funding has the largest impact on the Scenario with the highest capital cost, as here the loan repayments make up a higher proportion of the energy charges.

7.8.3 Interest rates and loan terms

By reducing interest rates on the finance used to install measures, the loan repayments in the service charge can be reduced. Likewise, by spreading the finance over a longer period, the Year 1 charges can be reduced. Table 7-25 shows the impacts that interest rates have on Year 1 tenant savings on a 15 year term loan.

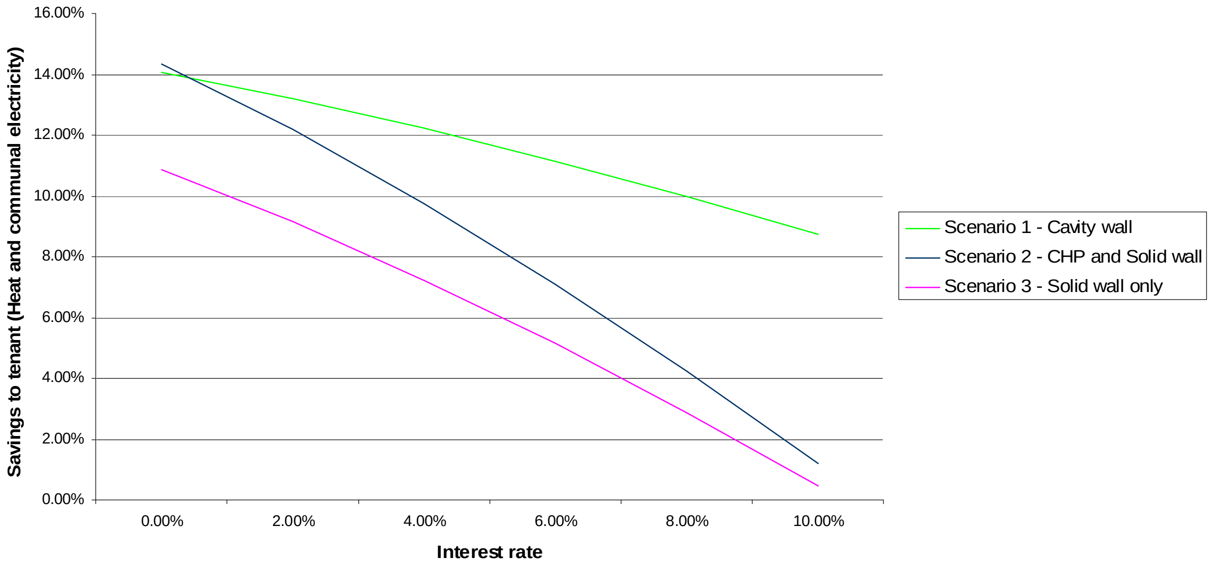
Table 7-25: Comparison of the effects of interest rates (15 year term) on tenant savings in each scenario - (Year 1)



The impact of interest rates is largest on the highest cost measures, but as Table 7-25 demonstrates, even with an interest free loan, tenant savings of 10% or more cannot be achieved for Scenario 3, and a very low interest loan would be required to achieve this for Scenario 2.

In this situation, where no grant funding could be used to reduce the capital cost, and project costs were as low as possible, an option is to spread the loan over a longer term. If the loan for each scenario were paid back over a 20 year period, with an interest rate of 6% APR, Scenarios 2 and 3 still could not achieve Year 1 tenant savings of 10%. As Table 7-26 demonstrates, lower interest rates are still required to achieve tenant savings of 10% or more in Year 1 for the two higher cost scenarios.

Table 7-26: Comparison of the effects of interest rates (20 year term) on tenant savings in each scenario - (Year 1)



7.8.4 Other impacts

The sensitivity analysis for the three scenarios has also demonstrated that the following factors are also important in maximising the benefits of the EPCo to tenants:

- Project costs
- Reinvestment in ESMs
- Fuel cost savings
- Fuel inflation

Project costs

Project costs should be kept to a minimum in all cases in order to maximise tenant savings. Project costs make up a higher proportion of the charges when low cost measures are installed, making situations such as that in Scenario 1 more sensitive to project cost variations.

Reinvestment in ESMs

In order to deliver ongoing reductions to the tenant energy charges, a proportion of the savings made can be taken for reinvestment in further ESMs. This will reduce the savings by the tenant in Year 1, so should be set at a level where Year 1 savings are adequate, and the revenue collected for reinvestment is large enough to make a worthwhile reinvestment in ESMs. Where tenant savings in Year 1 are low, as in Scenarios 2 and 3, reinvestment in ESMs can be seen as a lower priority as this will reduce the benefits being passed on directly to tenants.

Another option would be to make the reinvestment charge flexible, so it is only applied when tenant savings reach a target level each year. If the reinvestment charge prevents Year 1 savings of 10% for example, it could be waived until 10% savings are achieved due to fuel inflation later in the project.

Fuel cost savings
If the EPCo can secure lower fuel costs than the landlord is currently paying, this will further increase tenant savings. Scenarios where fuel bills has been reduced less, such as Scenarios 1 and 3, will benefit more from fuel cost savings, compared to those where the fuel bills have been dramatically reduced, such as in Scenario 2.

Fuel inflation
By reducing fuel consumption, the sensitivity to fuel cost inflation is also reduced. The higher the energy savings made, the less sensitive the model is to fuel inflation.

7.9 Conclusions

7.9.1 Summary

This modelling exercise demonstrates that the business model for communal blocks can achieve savings for tenants and deliver long term, economically sustainable carbon savings. There remain significant financial challenges to installing high cost measures such as solid wall insulation.

The key findings of this modelling exercise are as follows:

- ***The capital cost to energy saving ratio must be kept to a minimum***, either through installing low cost, short payback measures, or through subsidising ESMs
- ***Grant funding is still crucial*** for higher cost measures such as solid wall insulation
- ***Low interest finance is needed***, especially for higher cost measures
- ***Finance over long time periods is required***, ranging from 15 – 20 years, to deliver significant savings to tenants from Year 1
- ***Fuel cost savings made through EPCo fuel procurement*** could deliver further savings to residents
- ***Project costs must be kept to a minimum*** through economies of scale and efficient business systems
- ***Higher cost measures can be balanced with measures with faster paybacks*** to achieve significant Year 1 savings and higher long-term savings
- ***A significant predicted Year 1 saving is needed***. Lower savings increase the risk of unforeseen fuel consumption patterns resulting in an overall loss to the EPCo
- ***Fuel inflation will increase savings over time***. This means that even when savings in Year 1 are minimal, these savings will increase at a rate higher than standard inflation.

For successful implementation, the EPCo should aim to pay for measures with long-term affordable finance, and reduce capital costs as much as possible with grant funding and other subsidies.

7.9.2 Subsidies and grant funding

Government and utility funding for high payback measures significantly reduces the burden placed on the tenants repaying the loan as part of their energy charges, passing a higher proportion of the fuel bill savings to the tenants during the loan repayment period. Subsidies such as CERT funding, CESP, and reductions in VAT could all serve to make this model effective on longer payback measures. An affinity deal between a supplier and the EPCo could also provide a source of funding for the installation of measures.

7.9.3 Affordable finance

Lower rates on commercial loans, or low interest loans subsidised by the government or utility companies and DNOs, would have a significant impact on tenant savings. Extending loan terms to 20 years would also increase the savings passed on to the residents during the repayment period, although would delay the time when the full benefit of the ESMs could be passed on to the tenants.

7.9.4 Accurate analysis

Accurate analysis of fuel bill data, pre-installation monitoring information, and predictions of fuel bill savings are essential in order to accurately set energy charge reductions. This will lower the risk of deviations between the predicted fuel savings and actual fuel consumption.

Where deviations mean that fuel savings are more than anticipated, fuel charges can be amended to pass this benefit on to tenants. Where fuel savings are lower than anticipated, some of the impact could be taken by reducing the amount reinvested in ESMs and using this to subsidise the shortcomings. More significant losses will require the ESCo to analyse the monitoring data and justify why fuel savings are less than anticipated. Where this is clearly beyond the control of the ESCo, for example through fuel inflation higher than the level agreed in the ESCo-Landlord EPCo, charges could be adjusted to reflect this. Where it is due to the ESCo's implementation of the ESMs, the ESCo would have to absorb the losses.

Clearly the latter situation should be avoided at all costs. Accurate analysis and predictions can make a contribution to this, but it is recommended that blocks with high potential Year 1 tenant savings (10% and over) are targeted initially until a high degree of certainty can be achieved when predicting fuel bill savings.

7.9.5 Economies of scale

As demonstrated in each scenario, project costs must be kept to a minimum in order to maximise tenant savings. This can be achieved when the EPCo business is applied to multiple blocks, allowing for a full time member of staff to be dedicated to its delivery. Project costs involved in setting up the EPCo, including creating template contracts, training and developing efficient business systems are likely to make it more challenging to achieve significant savings in the initial applications of the model. Subsidized pilot schemes will reduce this initial burden on the business, as will employing companies with experience of delivering energy services.

Another significant advantage of delivering multiple EPCos is the potential to gain reductions in fuel costs over the rates currently paid by landlords.

7.9.6 Metering and billing

In the modelled scenarios, tenants pay a flat rate charge for heat based on floor area. The EPCo could also be applied where tenants are currently individually metered and billed for heat. Individual metering could also serve to provide the ESCo with information on any anomalous heat consumption, allowing targeted advice to tenants using significantly more heat.

8. *Individual property modelling*

8.1 Introduction

Provisional modelling has been undertaken for the 'green loan' model identified as a way of delivering ESMs to individual properties. This model is similar to the 'Pay-as-you-save' model currently being researched by the UK Green Building Council.

One property type has been modelled using three different scenarios.

8.2 Methodology

The business model was applied to a 3 bedroom, semi-detached property. The tenant pays fuel costs directly to the supplier.

The following steps were taken in order to assess the feasibility of the business model:

1. Energy modelling of the property type to estimate current heat and electricity loads, fuel consumption, energy costs and CO_2 emissions
2. Costing of monitoring equipment required for pre-installation monitoring
3. Identification of 3 different packages of ESMs that could be applied to the property
4. Energy modelling of the 3 different ESM packages to identify energy savings achieved, fuel bill savings and CO_2 reductions
5. Identification of ongoing costs involved with the implementation of the loan
6. Financial modelling and sensitivity analysis of each of the 3 scenarios considering:
    - Grant funding
    - Loan term
    - Interest rate on loan
    - Fuel price inflation
    - Reinvestment of savings in further ESMs
    - Number of dwellings the model is applied to
    - Income from feed-in-tariffs

Baseline heat and electricity loads were estimated using fuel bill data from a sample property selected by CEN. Table 8-1 outlines the baseline heat and communal electricity loads for the notional building, based on the following assumptions:

1. 60% efficient gas boiler
2. Unfilled cavity wall (100mm void)
3. 60mm loft insulation
4. Poorly insulated hot water cylinder
5. No low energy lighting

6. Double glazing

Table 8-1: Baseline energy use and carbon emissions for gas-heated property

Current space heating load [kWh/yr]	Current DHW load [kWh/yr]	Current gas use [kWh/yr]	Current electricity use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]
8,460	4,620	21,810	3,500	4,230	1,477	5,707

One scenario has also been modelled wherein the dwelling has an electric-heating system, and this is replaced by a ground source heat pump (GSHP). In order to model the effects of changing from a standard electric heated property to a property heated by GSHP, the carbon emissions for the same property were calculated assuming electric heating. The results are shown in Table 8-2.

Table 8-2: Baseline energy use and carbon emissions for electric-heated property

Current space heating load [kWh/yr]	Current DHW load [kWh/yr]	Current gas use [kWh/yr]	Current electricity use (appliances) [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]
8,460	4,620	0	3,500	0	7,000	7,000

8.3 ESMs modelled

For the semi-detached 3-bedroom property modelled, the following three packages of ESMs were applied to assess the feasibility of the business model in different scenarios:

Scenario 1 – Cavity Wall: *100mm cavity wall insulation, top up of loft insulation from 60mm to 270mm, draught proofing, 6No. compact fluorescent light bulbs, upgrade of boiler efficiency from 60% to 91%, new heating controls, thermostatic radiator valves (TRVs), cylinder thermostat and cylinder insulation, smart meter* – this package was modelled to assess the model when applied to relatively low-cost, fast payback measures

Scenario 2 – Internal Wall: *100mm cavity wall insulation, internal wall insulation, top up of loft insulation from 60mm to 270mm, draught proofing, 6No. compact fluorescent light bulbs, upgrade of boiler efficiency from 60% to 91%, new heating controls, thermostatic radiator valves (TRVs), cylinder thermostat and cylinder insulation, smart meter* **–** this package was modelled to assess the model when applied to a package of measures including predominantly low-cost measures, but including some high cost measures.

Scenario 3 - GSHP: *100mm cavity wall insulation, top up of loft insulation from 60mm to 270mm, draught proofing, 6No. compact fluorescent light bulbs, cylinder insulation, ground source heat pump, new heating controls and low temperature radiators, smart meter* – this package was applied to the electric-heating baseline

(Table 8-2) and modelled to assess the impact of improvements on an electric heated property.

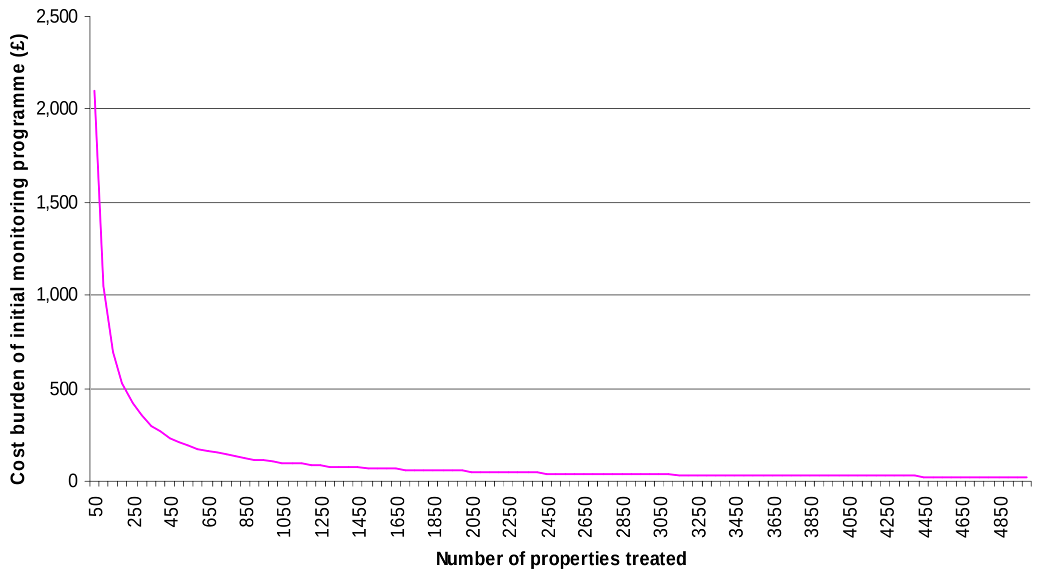
8.4 Pre-installation monitoring

In order to set the energy charges at a rate which will allow the total expenditure of the tenants on fuel and energy services to decrease, while still recovering the loan repayments, energy savings must be accurately predicted. Taking the Energy Saving Trust assumption that energy consumption in dwellings of the same type can be predicted to within ±5% when a sample of 100 dwellings have been monitored, a thorough monitoring programme is needed for each property type that the EPCo is intending to address, and for each set of measures that are installed in those property types.

This provides a high upfront cost for the EPCo, which needs to consider the capital cost of the monitoring equipment and staff time involved in processing the information gathered. For a monitoring programme for this property type, an indicative cost of £105,000 to monitor 100 properties has been assumed, including all equipment and staff time.

Table 8-3 outlines the cost impact of the monitoring programme on each property treated.

Table 8-3: Cost burden of monitoring programme per property



The impact of this is that a large number of properties need to be treated after the monitoring programme in order to spread the cost. These costs will be included in the administration costs of setting up each loan, and can be paid back over the period of the loan. For this modelling exercise, it is assumed that when the number of properties treated reaches 500 (corresponding to a monitoring cost of £210 per dwelling), the cost burden becomes acceptably low.

8.5 Other initial costs

As well as establishing accurate predictions of energy savings, the ESCo will incur significant administration costs when establishing contracts between the ESCo, landlord and tenant. Business systems for delivering the measures identified on a property, and setting up and receiving loan repayments will need to be put in place, along with arranging finance agreements between the ESCo and the finance provider. These costs have not been included in the modelling exercise at this stage.

8.6 Individual Scenario 1 fuel bill and energy charge calculation

8.6.1 Capital costs

The charges for the cavity wall scenario has been calculated using the capital costs in Table 8-4. These measures correspond to a 32.5 reduction in space heating demand, a 12% reduction in domestic hot water demand, and a 15% reduction in electricity consumption.

Table 8-4: Capital cost of measures in Individual Scenario 1

Measure	Cost	Notes
Insulation	£583	100mm cavity wall insulation, loft insulation top-up from 60mm to 270mm
Draught proofing	£190	Draft proofing on all windows, sills and doors
Low energy lighting	£12	Replacement of incandescent bulbs with compact fluorescent lighting (6No.)
Boiler and controls	£3,320	Replacement of 60% efficient gas boiler to 91% efficiency condensing gas boiler with weather compensation, new controls, cylinder thermostat, new TRVs
Cylinder insulation	£150	New cylinder insulation (including pipework)
Smart meter	£60	Visual displays of electricity consumption and costs
Contingency	£216	5% of capital cost
Total	£4,531	

8.6.2 Fuel bills

Table 8-5 outlines the energy loads, fuel consumption and carbon emissions resulting from the installation of the measures in Table 8-4.

Table 8-5: Predicted energy loads and carbon savings for Individual Scenario 1

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%]
5,710	4,070	2,980	10,515	2,040	1,260	3,300	42%

Using the figures from Table 8-1 and Table 8-5, a comparison of annual fuel bills pre and post installation has been carried out using the assumptions in Annex A. This corresponds to a fuel bill saving of 38% in Year 1.

Table 8-6: Comparison of fuel bills pre and post installation – Individual Scenario 1

	Pre-installation	Post-installation
Gas	£726	£350
Electricity	£401	£341
Total	£1,127	£691

These fuel bill savings will be recovered by the tenant through lower charges from their energy supplier.

8.6.3 Energy charge

In order to pay for the measures installed, an energy charge is added for 'energy services' and has been calculated in Table 8-7.

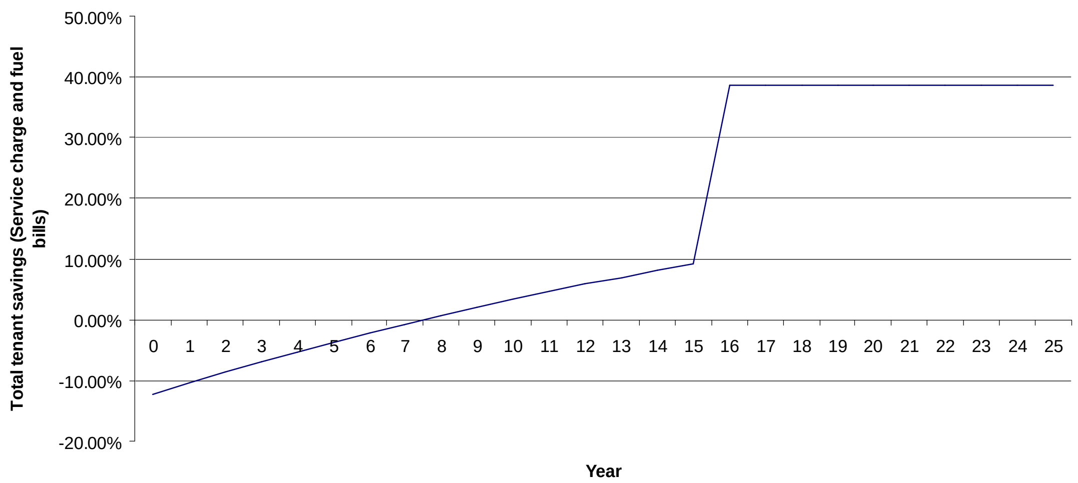
Table 8-7: Energy charge – Individual Scenario 1

Item	New Cost [£]
Annual repayment*	496
Administration and billing charges	50
Bad debt charge (5%)	23
Total service charge	569

*Calculated as a £5,140 loan at 6%APR over 15 years – includes capital cost, administration fee and initial monitoring programme cost

The result of this is that total tenant expenditure increases in Year 1 by £133 when both the energy charge and fuel bills are compared with the original fuel bills. Savings over 25 years are shown in Table 8-8.

Table 8-8: Total tenant savings over 25 years (energy charge and fuel bills) – Individual Scenario 1



In this scenario, grant funding or more affordable finance would be needed to achieve savings of more that 5% in Year 1. The effects of these factors will be explored in Section 8.9.

8.7 Individual Scenario 2 fuel bill and energy charge calculation

8.7.1 Capital costs

The energy charge for the solid wall scenario has been calculated using the capital costs in Table 8-9. These measures correspond to a 37.5% reduction in space heating demand, a 12% reduction in domestic hot water demand, and a 15% reduction in electricity consumption.

Table 8-9: Capital cost of measures in Individual Scenario 2

Measure	Cost	Notes
Insulation	£1,383	100mm cavity wall insulation, internal wall insulation, loft insulation top-up from 60mm to 270mm
Draught proofing	£190	Draft proofing on all windows, sills and doors
Low energy lighting	£12	Replacement of incandescent bulbs with compact fluorescent lighting (6No.)
Boiler and controls	£3,320	Replacement of 60% efficient gas boiler to 91% efficiency condensing gas boiler with weather compensation, new controls, cylinder thermostat, new TRVs
Cylinder insulation	£150	New cylinder insulation (including pipework)
Smart meter	£60	Visual displays of electricity consumption and costs
Contingency	£256	5% of capital cost
Total	£5,371	

8.7.2 Fuel bills

Table 8-10 outlines the energy loads, fuel consumption and carbon emissions resulting from the installation of the measures in Table 8-9.

Table 8-10: Predicted energy loads and carbon savings for Individual Scenario 2

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%]
5,290	4,070	2,980	10,060	1,950	1,260	3,210	44%

Using the figures from Table 8-1 and Table 8-10, a comparison of annual fuel bills pre and post installation has been carried out using the assumptions in Annex A. This corresponds to a fuel bill saving of 40% in Year 1.

Table 8-11: Comparison of fuel bills pre and post installation – Individual Scenario 2

	Pre-installation	Post-installation
Gas	£726	£335
Electricity	£401	£341
Total	£1,127	£676

8.7.3 Energy charge

In order to pay for the measures installed, an energy charge is added for 'energy services' and has been calculated in Table 8-12.

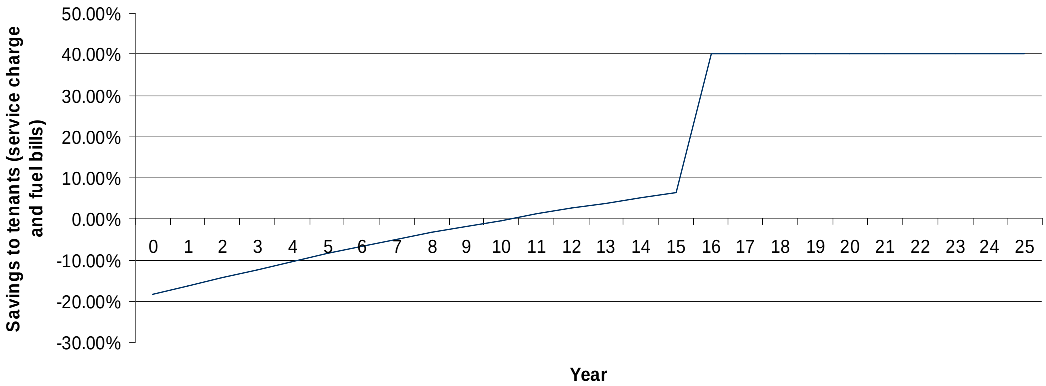
Table 8-12: Energy charge – Individual Scenario 2

Item	New Cost [£]
Annual repayment*	577
Administration and billing charges	50
Bad debt charge (5%)	31
Total energy charge	658

*Calculated as a £5,980 loan at 6%APR over 15 years – includes capital cost, administration fee and initial monitoring programme cost

The result of this is that total tenant expenditure increases in Year 1 by £207 when both the energy charge and fuel bills are compared with the original fuel bills. Savings over 25 years are shown in Table 8-13.

Table 8-13: Total tenant savings over 25 years (Energy charge and fuel bills) – Individual Scenario 2



In this scenario, grant funding or more affordable finance would be needed to achieve savings of more that 5% in Year 1. The effects of these factors will be explored in Section 8.9.

8.8 Individual Scenario 3 fuel bill and energy charge calculation

8.8.1 Capital costs

The energy charge for the scenario where a standard electric heating system is replaced with GSHP has been calculated using the capital costs in Table 8-14. These measures correspond to a 32.5% reduction in space heating demand, a 12%

reduction in domestic hot water demand, and a 15% reduction in electricity consumption (for appliances).

Table 8-14: Capital cost of measures in Individual Scenario 3

Measure	Cost	Notes
Insulation	£583	100mm cavity wall insulation, loft insulation top-up from 60mm to 270mm
Draught proofing	£190	Draft proofing on all windows, sills and doors
Low energy lighting	£12	Replacement of incandescent bulbs with compact fluorescent lighting (6No.)
Ground source heat pump	£12,000	Replacement of standard electric heating system with GSHP, low temperature radiator system, new zone controls, hot water cylinder
Smart meter	£60	Visual displays of electricity consumption and costs
Contingency	£642	5% of capital cost
Total	£13,487	

8.8.2 Fuel bills

Table 8-10 outlines the energy loads, fuel consumption and carbon emissions resulting from the installation of the measures in Table 8- 9.

Table 8-15: Predicted energy loads and carbon savings for Individual Scenario 2

Predicted space heating load [kWh/yr]	Predicted hot water load [kWh/yr]	Predicted electricity use [kWh/yr]	Predicted gas use [kWh/yr]	Carbon emissions from gas [kgC/yr]	Carbon emissions from electricity [kgC/yr]	Total carbon emissions [kgC/yr]	Carbon reduction over baseline [%]
5,710	4,070	6,035	-	-	2,545	2,545	55%

Using the figures from Table 8-2 and Table 8-15, a comparison of annual fuel bills pre and post installation has been carried out using the assumptions in Annex A. This corresponds to a fuel bill saving of 69% in Year 1.

Table 8-16: Comparison of fuel bills pre and post installation – Individual Scenario 2

	Pre-installation	Post-installation
Gas	-	-
Electricity	£2,252	£691
Total	£2,252	£691

8.8.3 Energy charge

In order to pay for the measures installed, an energy charge is added for ‘energy services’ and has been calculated in Table 8-17.

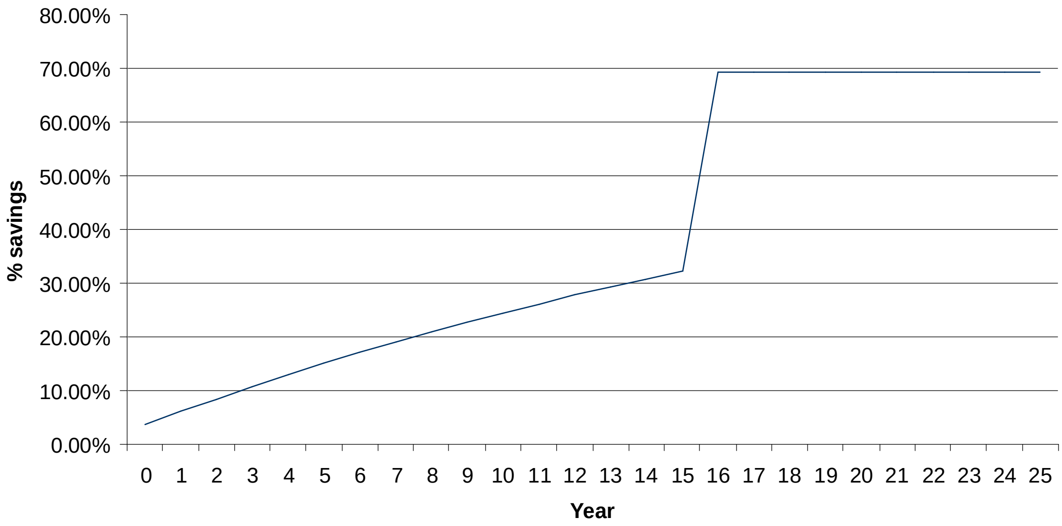
Table 8-17: Energy charge – Individual Scenario 2

Item	New Cost [£]
Annual repayment*	1,360
Administration and billing charges	50
Bad debt charge (5%)	71
Total energy charge	1,481

*Calculated as a £14,097 loan at 6%APR over 15 years – includes capital cost, administration fee and initial monitoring programme cost

The result of this is that total tenant expenditure decreases in Year 1 by £80 when both the energy charge and fuel bills are compared with the original fuel bills. Savings over 25 years are shown in Table 8-18.

Table 8-18: Total tenant savings over 25 years (Energy charge and fuel bills) – Individual Scenario 3



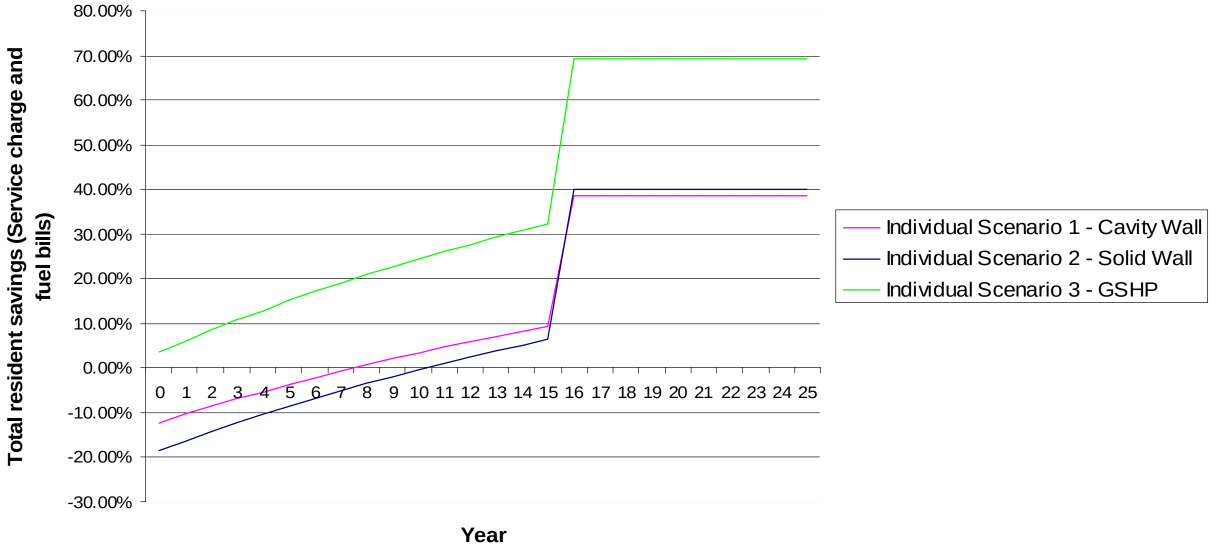
In this scenario, grant funding or more affordable finance would be needed to achieve savings of more that 5% in Year 1. The effects of these factors will be explored in Section 8.9.

8.9 Comparison of individual scenarios

8.9.1 Standard case

With no grant funding and a commercial loan at 6%APR over 15 years, none of the three individual loans achieve savings of more than 5% (the level necessary to guarantee that the tenant does not make a loss after a monitoring programme has predicted fuel savings with a certainty of ±5%). Figure 8-1 compares the savings of each scenario of 25 years.

Figure 8-1: Comparison of individual scenarios in the standard case

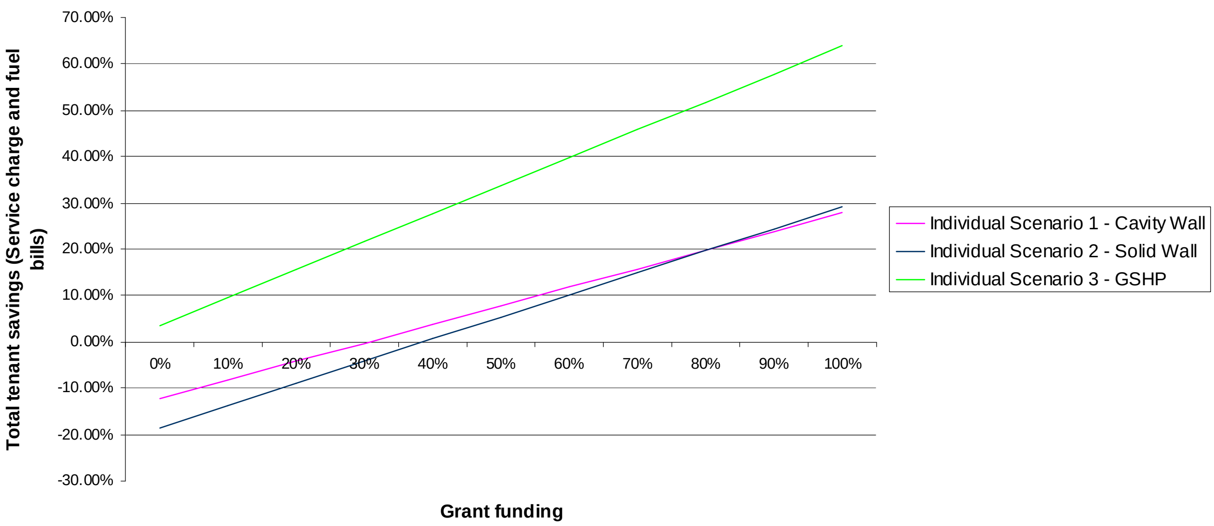


The savings made by the cavity wall insulation model are not high enough to achieve a tenant saving in Year 1, and the additional cost of internal wall insulation in Scenario 2 is not offset by the fuel bill savings it makes in Year 1. Despite the high capital cost of the GSHP, the high level of fuel bill savings made by replacing a standard electric heating system mean that this scenario does achieve a Year 1 saving. However, given the assumption that fuel bill savings cannot be predicted with an accuracy of greater than ±5%, the 4% saving made in this scenario is not high enough to confidently guarantee an overall reduction in tenant expenditure.

8.9.2 Grant funding

Using grant funding to reduce the capital cost to the tenant of the ESMs is an option for increasing tenant savings beyond 5% in Year 1. Figure 8-2 shows the impact of grant funding on Year 1 tenant savings for each scenario.

Figure 8-2: Comparison of the effects of grant funding on tenant savings in each Individual scenario – (Year 1)



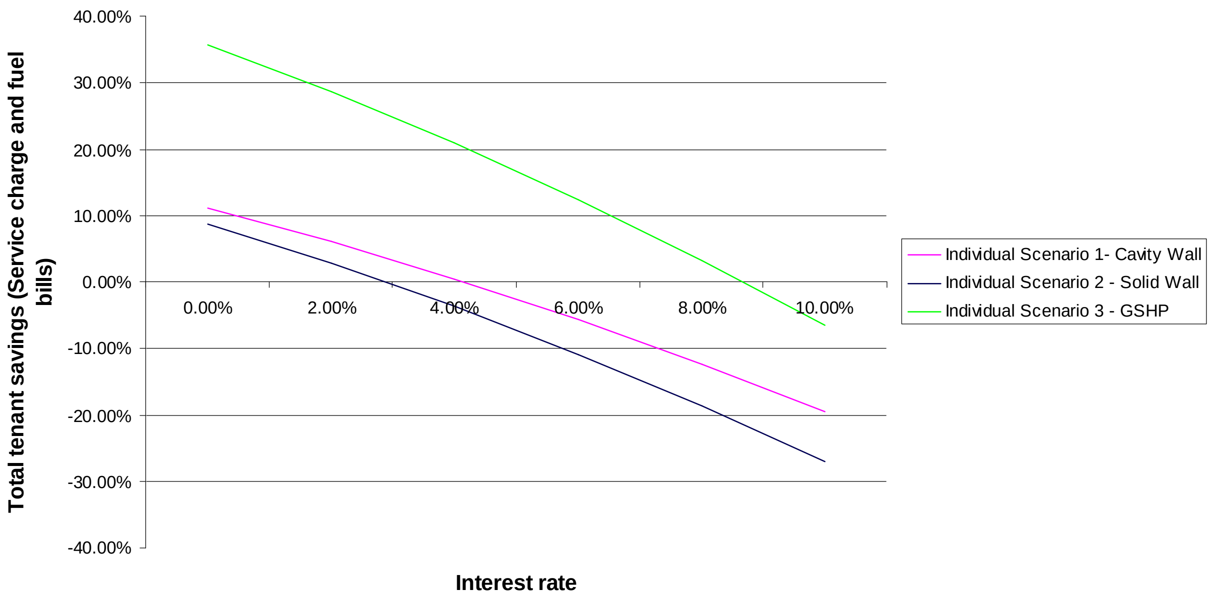
This demonstrates the crucial role that grant funding (or other subsidies, such as VAT reductions) could play in making whole house measures affordable to individual households. When paying for measures over a 15 year period at 6%APR, funding of 10% of the total capital cost would make the high-cost measures in Scenario 3 achieve a tenant saving of more than 5%. This is due to the large fuel bill savings achieved by the measures installed.

More grant funding would be required to achieve the same proportion of tenant savings in the two gas savings. This is due to the fact that many of the measures in these scenarios are offsetting gas rather than electricity which has a smaller impact on fuel bills.

8.9.3 Loan terms and interest rates

Extending the term of the loan and reducing the interest rate applied to that loan is another option for increasing Year 1 tenant savings. Figure 8-3 shows the impact of changing the interest rate applied to the loan over a term of 20 years.

Figure 8-3: Comparison of the effects of interest rates (20 year term) on tenant savings in each individual scenario - (Year 1)



This demonstrates that without grant funding, the interest rate would have to be significantly reduced and the loan term increased for Scenarios 1 and 2 to deliver savings of over 5% in Year 1. The impact on Scenario 3 of reducing the interest rate and increasing the loan term would be to deliver a far larger saving to the tenant from Year 1.

8.9.4 Other factors

This model has fewer options for increasing savings to tenants. Grant funding and more affordable finance are the two main options for delivering a higher proportion of the fuel bill savings to the tenants from Year 1. It should be noted however that fuel cost inflation has the potential to increase the savings tenants would receive due to the overall reduction in consumption.

8.10 Conclusions

The individual property ‘green loan’ model has the potential to deliver significant carbon reductions and fuel bill savings. However, except in situations where there is a very high fuel bill saving compared to capital expenditure, this modelling exercise has demonstrated that the successful implementation of the model requires affordable finance and grant funding to deliver tenant savings from Year 1.

As with the communal block model, even in situations where Year 1 savings are relatively low, fuel inflation has the potential to increase these savings rapidly, as the refurbished property will be far less vulnerable to fuel cost rises. Due to this, a consideration may be a finance arrangement is established wherein the repayments on the loan could be less for the first years of the contract, and increased in proportion to the fuel bill savings.

Accurate energy modelling is recommended in order to achieve a high degree of confidence that when the measures have been installed, the tenant will be able to save money when both the new energy charge and the fuel bills have been paid.

9. Conclusion

9.1 Summary

This report has demonstrated two business models that can deliver long term energy and carbon savings, and reduce the vulnerability of tenants to the risks of rising fuel prices and fuel poverty.

One of the key challenges to overcome remains the method of recovering the investment in ESMs. This will involve changes to current regulations, which would allow a charge to be placed on properties which can be paid for by the tenant from the fuel bill savings they have made as a result of the ESM installation.

Research and modelling has demonstrated that these models are feasible, but also that there are significant barriers remaining which must be addressed before an EPCo can be successfully implemented.

9.2 Key findings and recommendations

The key findings from this report are as follows:

- **Supply partnerships** between an ESCo and an existing supply partnership have the potential to deliver an income from affinity deals, and to reduce fuel prices for EPCo customers paying for fuel as part of a contract. It is however essential to protect consumer rights, so long term investments in ESMs should not tie tenants into supply contracts
- **Changes in occupancy** can be dealt with by linking loans to properties and not tenants. The investment made can be recovered through a new charge levied on the property
- **Service charges** provide a possible vehicle for recovering investments in ESMs from leaseholders. For tenants, a new charge must be introduced that allows them to pay for the ESMs from the savings they have made in their fuel bills.
- **Returns from investments should be maximised** through intelligent specification of ESMs and regulatory certainty. The report has highlighted issues relating to the sale of CHP generated electricity, and the impacts of FiTs and RHIs
- **The communal block model** has the potential to reduce fuel bills and fund ongoing carbon and energy reductions. This model is unlikely to provide high levels of profit to the ESCo provider, but could be implemented as a sustainable not-for-profit enterprise.
- **The individual property 'green loan' model** provides a mechanism to recover the investment made in ESMs if a method of recovering the investments made can be linked to the properties treated
- **Affordable finance** is crucial to both models. When typical commercial loan rates are used, delivering savings from Year 1 is only possible on fast payback measures. Low interest loans, with long repayment terms of up to 20 years are needed to spread the initial costs of ESMs and allow payments to be made from fuel bill savings

- **Grant funding and subsidies** are still crucial to the funding of high cost measures. These may include government and utility grants, and subsidies such as reduced VAT on all ESMs
- **Fuel inflation** rates are set to rise faster than standard inflation and because of this, the return on investment of ESMs is likely to increase over time and create a stronger case for investment in the future
- **Project costs** on each EPCo or green loan must be kept to an absolute minimum due to the relatively low annual fuel bills and therefore income from energy savings
- **Fuel saving predictions** must be accurate in order to guarantee tenant savings. Detailed monitoring can be used to achieve some certainty, but green loans and EPCos should only be undertaken when relatively large savings are possible, and the impact of behavioural change is unlikely to reduce overall tenant savings to zero or a loss

Fast payback measures, and measures supplemented with grant funding and affordable finance could be delivered by the business models now, and deliver significant tenant savings and a return on investment to the ESCo.

Although the economic case for investment in higher cost measures through EPCos and green loans currently still relies on grant funding and even subsidised finance, as the sensitivity analysis of fuel price inflation has shown, savings from ESMs are likely to grow over the coming years and deliver more and more return on investment for ESCos delivering these measures.

Annex A

Annex Table 1: Modelling assumptions

Item	Assumption
Discount rate	7%
Fuel price inflation	4%
General inflation	2.5%
Electricity price	£0.11/kWh
Gas price	£0.0317/kWh
CCL* gas	£0.00159/kWh
CCL electricity	£0.00456/kWh
Feed in tariff <4kWp	£0.365/kWh
Feed in tariff >4kWp	£0.28/kWh
Export tariff	£0.05/kWh

*Climate change levy

Annex B

Sensitivity analysis of Scenario 2

Section 7.6.3 outlines the savings residents will make according to the assumptions highlighted throughout that section and in Annex A. One problem identified with this scenario is the low savings achieved in Year 1. It is therefore necessary to explore methods of increasing the Year 1 savings giving more security to both the EPCo and the tenants.

Grant funding

It was assumed in Section 7.6.3 that no grant funding was available for any of the measures installed. Annex Table 2 outlines the impact different grant funding levels have on the model. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Table 2: Savings made from different grant funding levels

Grant funding	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
Insulation – 0% Draught proofing – 0% Boiler – 0%	4.3%	£34	19.3%	£1,090
Insulation – 50% Draught proofing – 0% Boiler – 0%	9.5%	£75	23.8%	£1,560
Insulation – 50% Draught proofing – 50% Boiler – 0%	10.3%	£81	24.5%	£1,640
Insulation – 50% Draught proofing 50% Boiler – 25%	11%	£87	25.2%	£1,705

Reduction in fuel costs through bulk purchase

It is feasible that as well as reducing the overall energy loads, and supplying heat and light more efficiently, the EPCo could make savings through the bulk purchase of gas and electricity. Annex Table 3 outlines the possible savings to tenants through different fuel cost reductions achieved by the EPCo. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Table 3: Savings made through bulk purchase discounts on electricity and gas

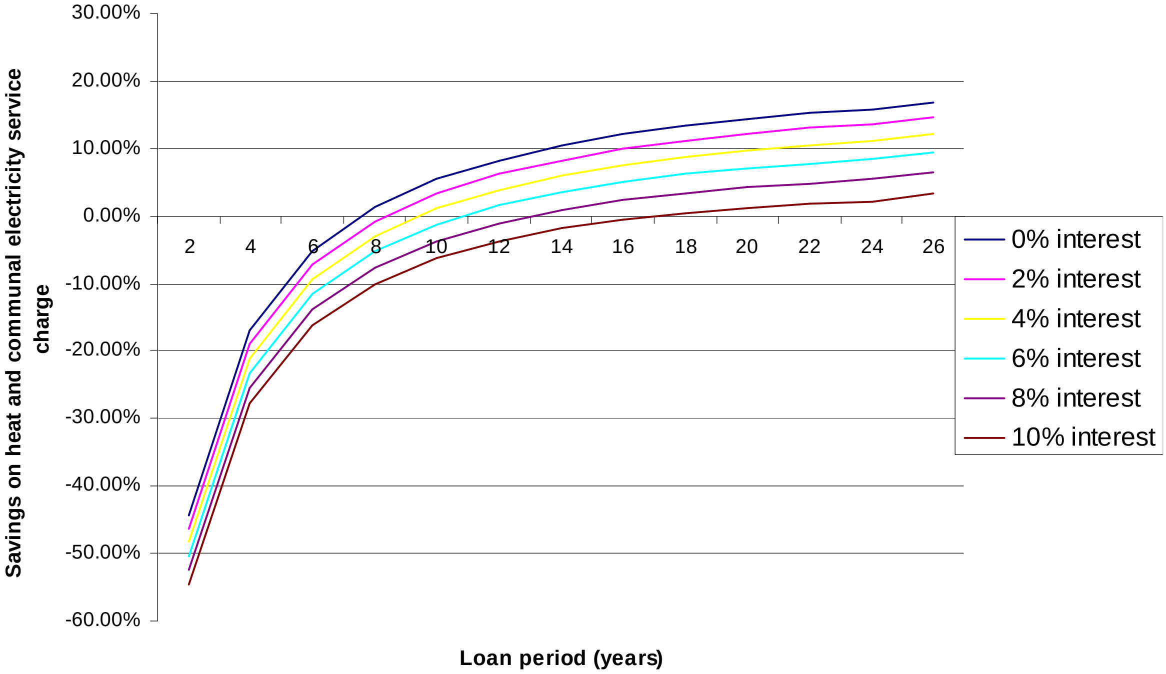
Fuel cost savings [%]	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
0%	4.3%	£34	19.3%	£1,090
2.5%	5.3%	£42	20.7%	£1,200
5%	6.3%	£49	22.2%	£1,320

Although on their own these savings do not make a significant impact on the Year 1 savings, they could be combined with other measures, such as grant funding, to achieve a more desirable Year 1 saving.

Term of loan

The impact of the term of the loan used to finance the ESMs in 'Scenario 2' is outlined in Annex Figure 1. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 1: % savings made by tenants (Year 1) as determined by loan term - Scenario 2



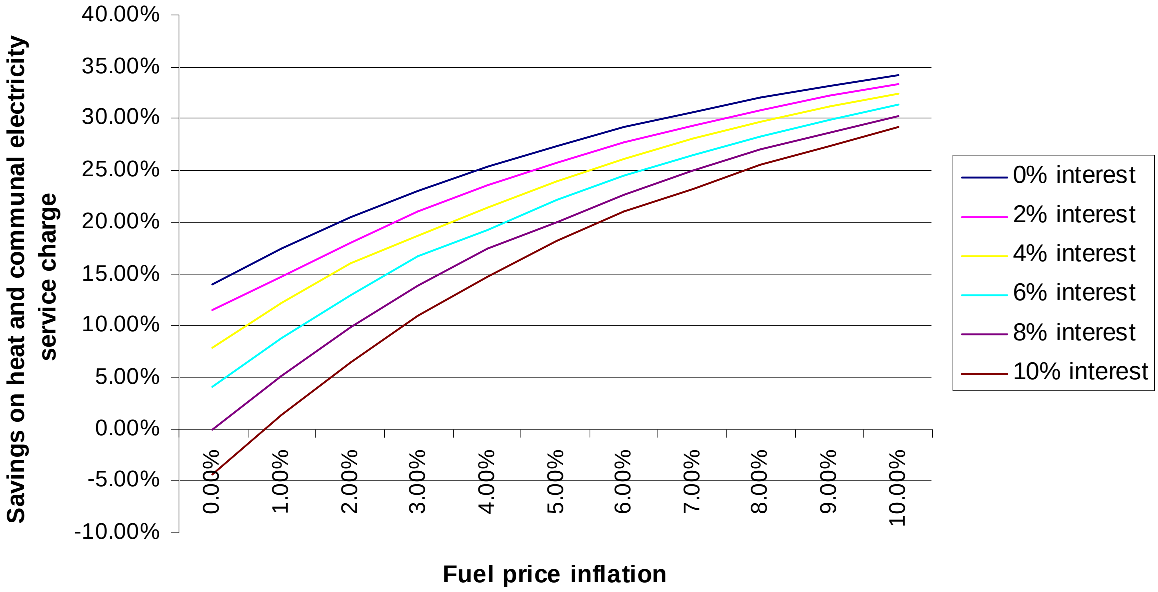
Annex Figure 1 demonstrates that even with an interest free loan over 15 years, a 10% reduction in overall energy charges could not be achieved in Year 1. Extending the loan period to 20 years and obtaining a more competitive interest rate could improve the Year 1 savings. Combining a lower interest rate with grant funding and lower fuel costs could also achieve higher Year 1 savings.

Fuel inflation

Annex Figure 2 outlines the impact of fuel price inflation on tenant savings in by Year 15. This reiterates the fact that ESMs will make tenants less vulnerable to fuel price fluctuations and that tenants will see larger than anticipated savings if fuel price inflation rises above the anticipated 4%.

It is recommended that consideration is given to the 'spark gap' where CHP installations are considered. If electricity prices rise more slowly than gas prices, the overall financial benefits of CHP are diminished.

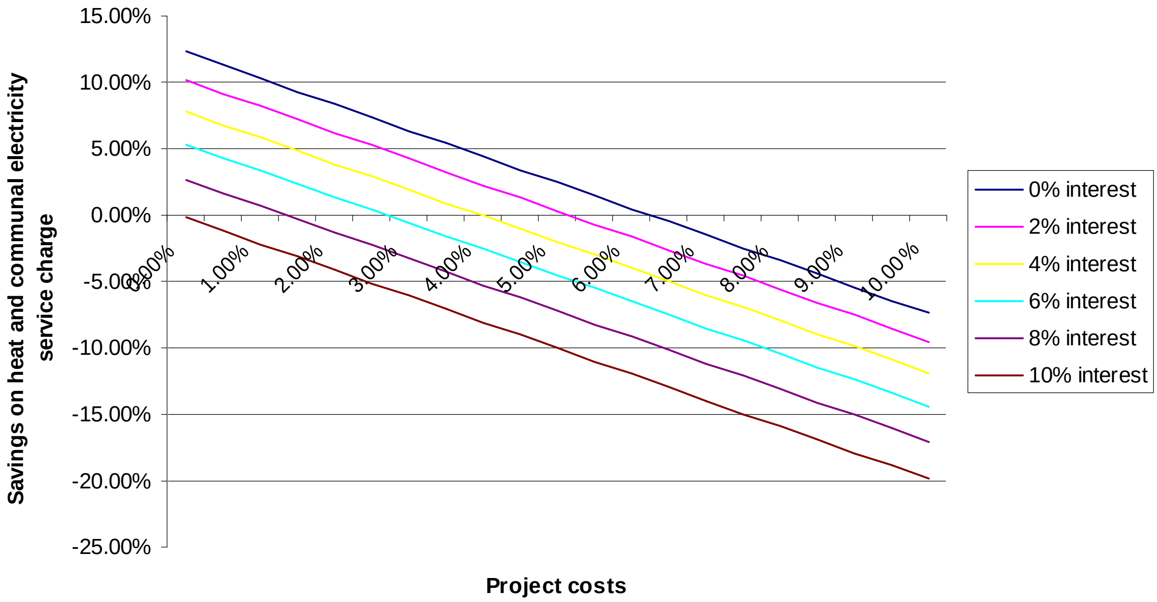
Annex Figure 2: Savings made by tenants (Year 15) as determined by the fuel price inflation – Scenario 2



Project costs

The impact of project costs on tenant savings in Year 1 are outlined in Annex Figure 3. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 3: Savings made by tenants (Year 1) as determined by project costs – Scenario 2

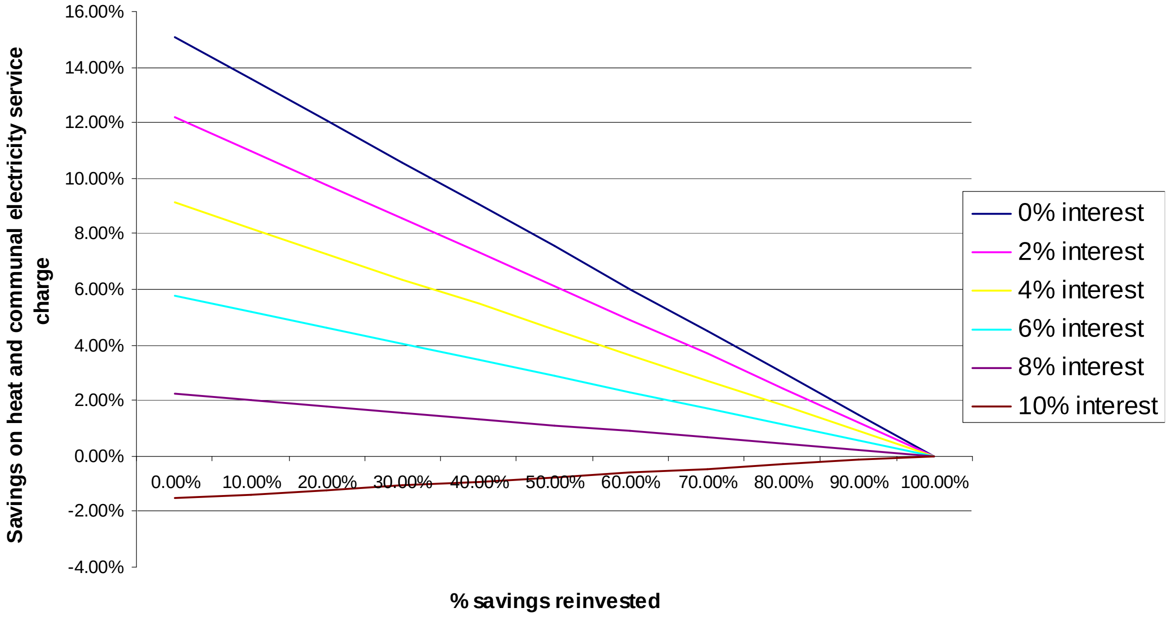


As with Scenario 1, the project costs must be kept to a minimum. In this scenario, if project costs were to exceed 2.5% of the capital cost of the installed ESMs, the project would result in tenant charges increasing.

Reinvestment in ESMs

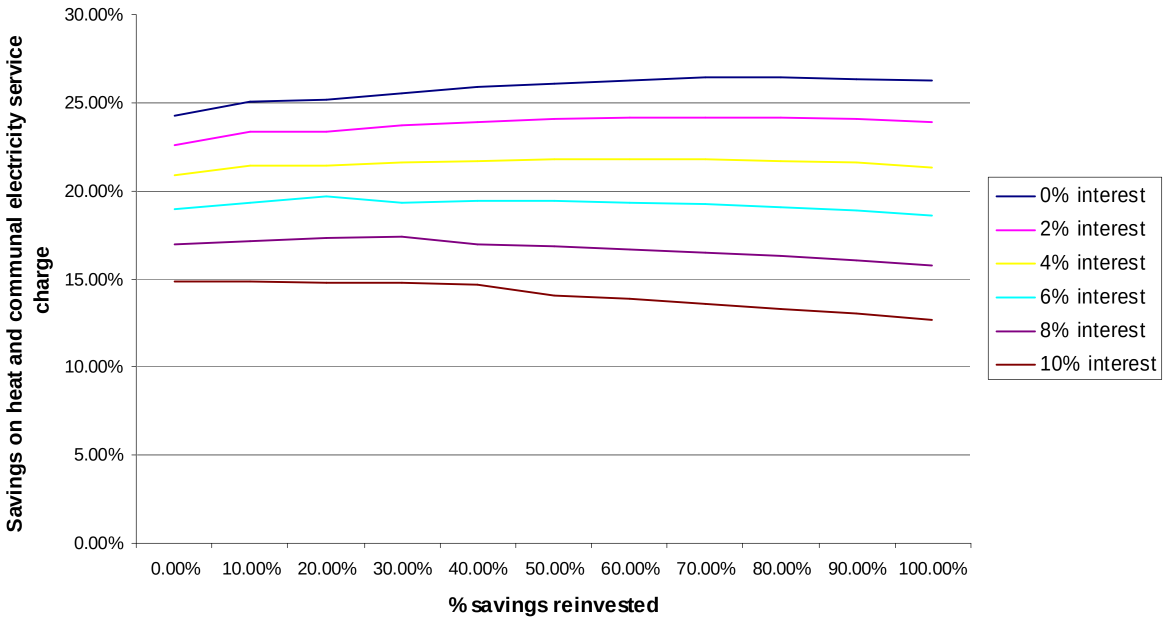
The impact of taking a proportion of the overall savings for reinvestment in further ESMs on tenant savings in Year 1 is outlined in Annex Figure 4. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 4: Savings made by tenants (Year 1) as determined by the proportion of savings reinvested in ESMs - Scenario 2



The lower savings made in this scenario mean that any extra savings given directly to the tenant in Year 1 instead of being set aside for reinvestment has a significant impact on the percentage savings made. As with Scenario 1, in the long term, reinvestment will benefit tenants, although as the savings during the loan repayment period are less than in Scenario 1, reinvestment makes a smaller improvement on savings by Year 15, as Annex Figure 5 demonstrates.

Annex Figure 5: % savings made by tenants (Year 15) as determined by the proportion of savings reinvested in ESMs – Scenario 2



Sensitivity analysis of Scenario 3

The low tenant savings in Year 1 in this model mean that there is a higher degree of risk to both the EPCo and the client with this undertaking. Predicted savings of under 3% mean than only a small deviation from the predicted savings could result in a loss being made. It is therefore necessary to explore methods of increasing the Year 1 savings giving more security to both the EPCo and the tenants.

Grant funding

It was assumed in Section 7.6.3 that no grant funding was available for any of the measures installed. Annex Table 4 outlines the impact different grant funding levels have on the model. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Table 4: Savings made from different grant funding levels - Scenario 3

Grant funding	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
Insulation – 0% Draught proofing – 0% Boiler – 0%	2.9%	£23	14.4%	£785
Insulation – 50% Draught proofing – 0% Boiler – 0%	8.1%	£64	18.6%	£1,260
Insulation – 50% Draught proofing – 50% Boiler – 0%	9%	£70	19.3%	£1,335

Insulation – 50% Draught proofing 50% Boiler – 25%	9.7%	£76	20%	£1,400

Reduction in fuel costs through bulk purchase

Annex Table 5 outlines the possible savings to tenants through different fuel cost reductions achieved by the EPCo. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Table 5: Savings made through bulk purchase discounts on electricity and gas - Scenario 3

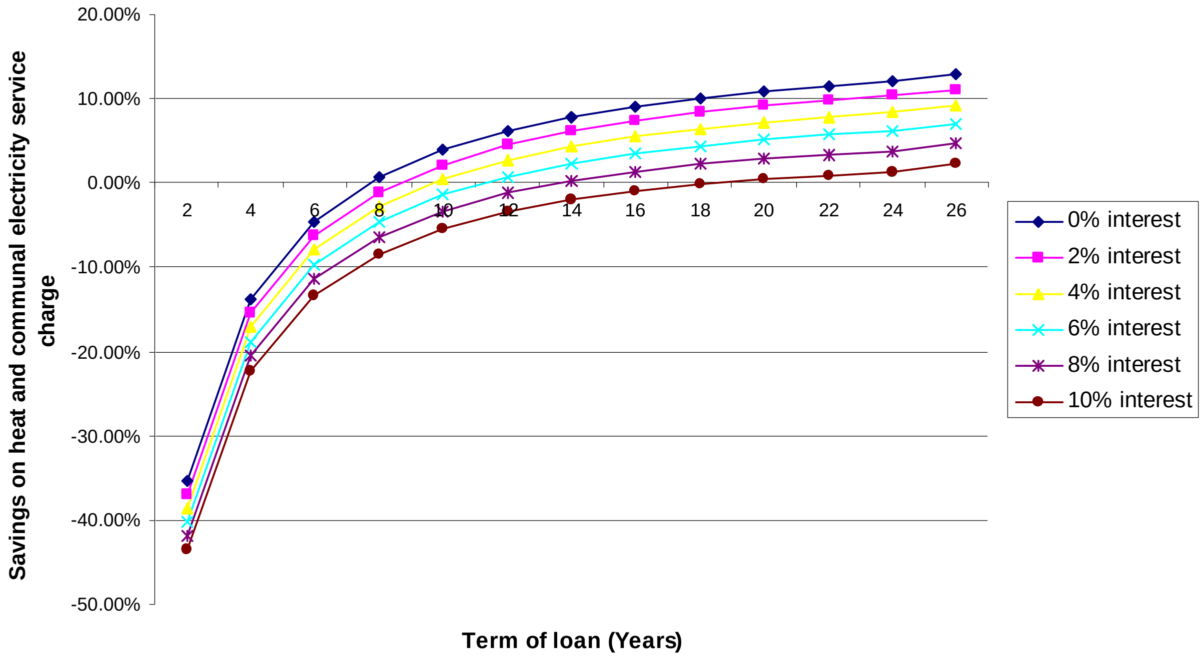
Fuel cost savings [%]	Average tenant savings – Year 1 [%]	Average tenant savings – Year 1 [£]	Average tenant savings – Year 15 [%]	Average cumulative tenant savings – Year 15 [£]
0%	2.9%	£23	14.4%	£785
2.5%	4.1%	£32	16.2%	£925
5%	5.3%	£41	17.5%	£1,060

Due to the overall higher fuel costs compared to the CHP scenario, the impact of securing discounts on fuel are proportionately higher in this scenario. When combined with other measures, such as grant funding, this could take the Year 1 savings to a more secure level.

Term of loan

The impact of the term of the loan used to finance the ESMs in 'Scenario 3' is outlined in Annex Figure 6. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 6: Savings made by tenants (Year 1) as determined by loan term - Scenario 3

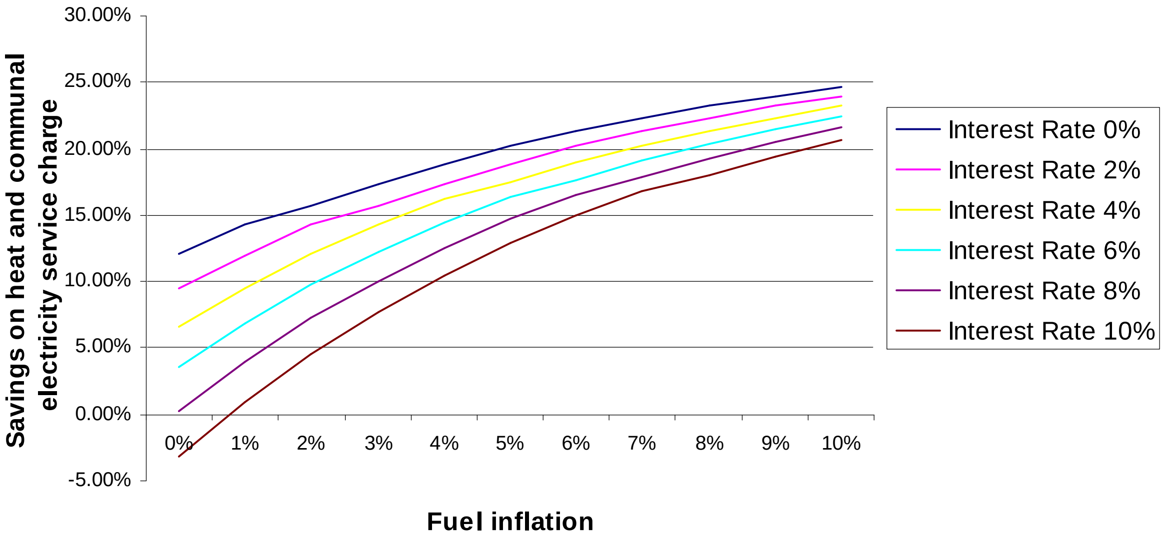


Annex Figure 6 shows that even with an interest free loan, a 10% saving to tenants in Year 1 is not achievable if it is paid back over 15 years. Extending the loan period to 20 years and obtaining a very low interest rate, or combining a lower interest rate with grant funding and lower fuel costs could improve the Year 1 savings.

Fuel inflation

Annex Figure 7 demonstrates the impacts of fuel inflation on tenant savings by Year 15 in Scenario 3. As with Scenarios 1 and 2, this shows that ESMs will make tenants less vulnerable to fuel price fluctuations and that tenants will see larger than anticipated savings if fuel price inflation rises above the anticipated 4%.

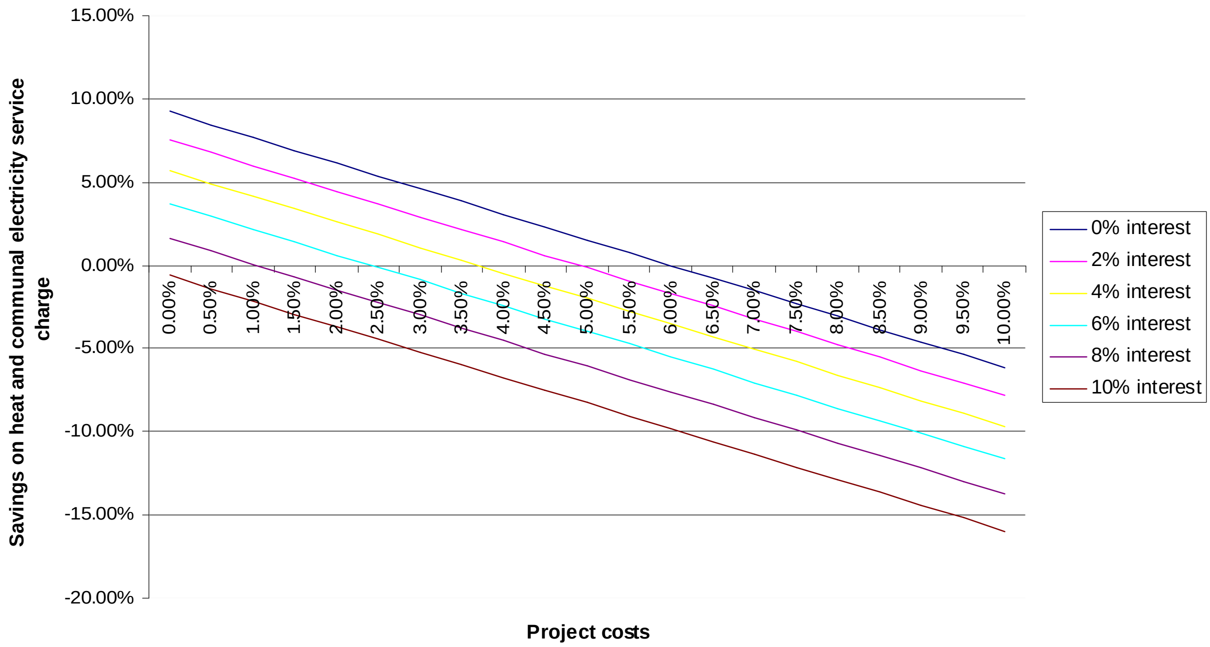
Annex Figure 7: Savings made by tenants (Year 15) as determined by the fuel price inflation – Scenario 3



Project costs

The impact of project costs on tenant savings in Year 1 are outlined in Annex Figure 8. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 8: Savings made by tenants (Year 1) as determined by project costs – Scenario 3

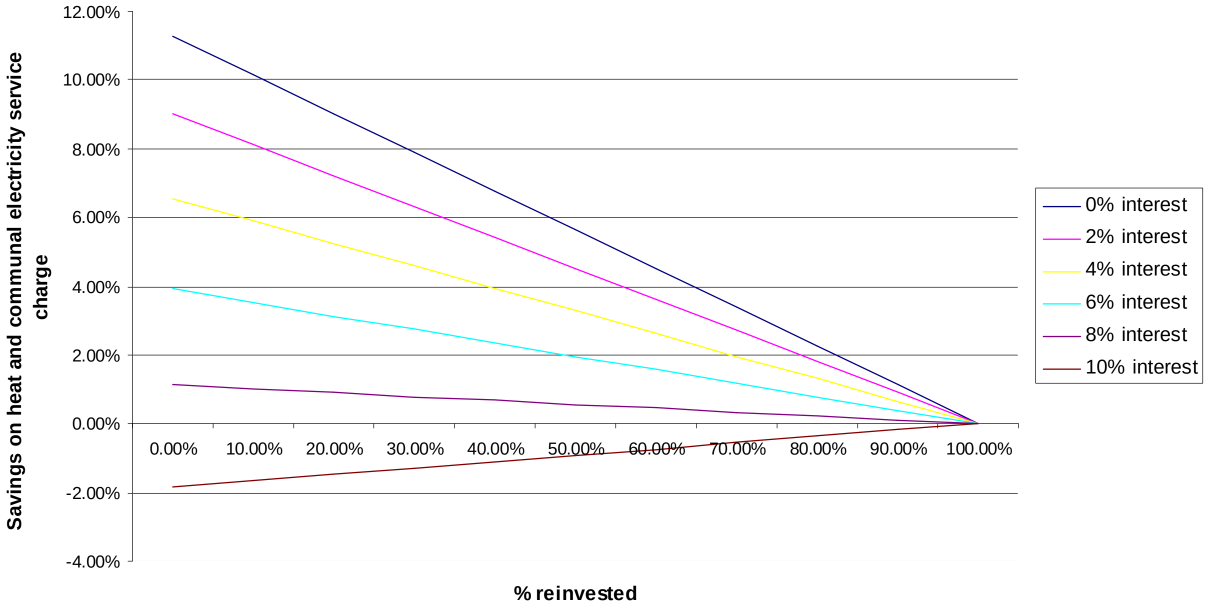


As with Scenarios 1 and 2, the project costs must be kept to a minimum. In this scenario, if project costs were to exceed 2.5% of the capital cost of the installed ESMs, the project would result in charges increasing.

Reinvestment in ESMs

The impact of taking a proportion of the overall savings for reinvestment in further ESMs on tenant savings in Year 1 is outlined in Annex Figure 9. These figures are calculated using the assumptions outlined in Annex A unless otherwise stated.

Annex Figure 9: Savings made by tenants (Year 1) as determined by the proportion of savings reinvested in ESMs – Scenario 3



The lower savings made in this scenario mean that any extra savings given directly to the tenant in Year 1 instead of being set aside for reinvestment have a significant impact on the percentage savings made. As with Scenario 1, in the long term, reinvestment will benefit tenants, although as the savings during the loan repayment period are less than in Scenario 1, reinvestment makes a smaller improvement on savings by Year 15, as the Annex Figure 10 demonstrates.

Annex Figure 10: Savings made by tenants (Year 15) as determined by the proportion of savings reinvested in ESMs – Scenario 3