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Does tenure of business premises influence UK SMEs' ability to benefit from energy efficient technologies?

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ABSTRACT

The UK's historically low cost of energy has encouraged a culture that considers energy to be in limitless supply and excessive levels of consumption acceptable. Now that supplies are becoming restricted and costs rising, it is slowly becoming recognised that this energy culture has created a legacy stock of buildings with poor building fabric, limited energy efficiency equipment and even lower levels of energy awareness.

Cost effective technologies are readily available but are not being adopted by UK SMEs in non-domestic buildings, as rational economic theory would expect. A gap exists between availability of technically feasible, cost effective energy improvements and what is implemented. Policy-makers attribute this to inaccessibility of information and investment and design policies accordingly. However, as escalation of demand continues an alternative driver of this paradox must exist. This research hypothesises that this driver is the ownership structures of non-domestic buildings.

To explore this hypothesis a new framework for energy research is adopted; the segmentation of non-domestic buildings based on ownership and the purchase of energy. A survey of members of these segments is undertaken to test this hypothesis.

This research identifies an energy-efficiency gap caused by building ownership and finds that tenure of business premises prevents the adoption of energy conservation opportunities; 64% of research participants encounter barriers to energy efficiency from building ownership; 50% have relationships with owners/tenants that prevent energy improvements being implemented. When this is increased pro rata to reflect the UK population of 4.99 million SMEs it emerges that almost 2.5 million businesses are unable to benefit from financial savings available from energy improvements and around 0.7 million occupy premises in which the owner chooses to have no involvement in energy management. Non-domestic building owners participating in this research consider that energy costs are not a significant issue for their tenants.

This thesis proposes that an alternative approach to UK energy policy based on regulation and provision of grant funding for energy efficiency improvements could improve the likelihood of SMEs adopting energy efficiency and conservation activities. 75% of research participants highlight legislation as their key driver for change with 70% responding positively to the provision of grant funding for energy improvements. This knowledge of energy behaviours is used to propose the Carbon Allowance Scheme, a simple form of energy rationing based on non-tradable energy quotas, as an alternative framework for energy policy.

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Completing this work would have been all the more difficult were it not for the support provided my family and friends during the highs and lows of my research.

Finally, I would like to thank all of the coffee shops that have provided havens for working over the last 3 years.

DECLARATION

I hereby declare that this thesis with the title ‘Does tenure of business premises influence UK SME’s ability to benefit from energy efficient technology?’ is my own work. All sections of the text and results that have been obtained from other sources are fully referenced. The research project was conducted between May 2011 and August 2014 in the Department of Geography, Environment and Disaster Management in the Faculty of Business, Environment and Society at Coventry University. The thesis has not been submitted in whole or in part as consideration of any other degree or qualification at this university or any other institute of learning.

Ethics approval P1138 applies.

______________________	26th April 2015
Kay Emblen-Perry	Date

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GLOSSARY

Attitude-behaviour gap	The difference between what is considered important and what energy actions are undertaken
Building Regulations	Legislation that relates to the standards of premises or construction and, depending on the type of premises and whether any building work is being carried out. Some energy efficiency requirements are specified
Carbon emissions targets	A set of goals to reduce carbon emissions
Carbon Reduction Commitment (CRC)	A mandatory scheme that aims to improve the energy efficiency of large public and private sector organisations. It incorporates a range of reputational, financial and behavioural drivers which are expected to promote reductions in energy consumption and deliver consequential reductions in carbon emissions.
Climate Change Mitigation Pathways	Strategies that are planned to reduce carbon emission to deliver UK carbon reduction targets
Climate Change Levy	A tax on the unit cost of energy supplied to non-domestic consumers including industry, commerce, agriculture and local administration to fund development of lower carbon energy sources
Display Energy Certificate (DEC)	A declaration of the energy performance of large buildings. They are mandatory for public and commercial buildings over 5000m^2 that are frequently visited by the public. The purpose is to raise public awareness of energy use and to inform visitors to public buildings about its' energy consumption
EU Emissions Trading Scheme (EU ETS)	A cap and trade scheme that caps the total emissions allowed from industrial installations covered by the scheme. Allowances are allocated to installations at their capped level. A trading system is in place to support the sale of unused allowances. Installations may buy additional allowances to increase their emsiitions.
Energy conservation	Reducing the amount of energy used through economy and the elimination of energy that is wasted
Energy efficiency	A way to obtain the same service from less energy by adopting, improving, adapting equipment or behaviour; a way of managing or minimising energy consumption

Energy-efficiency paradox	A gap exists between availability of technically feasible, cost effective energy improvements and what is implemented
Energy inefficiency	Achieving the same service from more energy than is actually required
Energy Performance Certificate (EPC)	A declaration of the expected energy performance of a property based on a set of standardised measures and performance criteria. It gives a theoretical efficiency rating from A (most efficient) to G (least efficient). Their purpose is to help owners and tenants make their building more energy efficient and allow potential buyers and tenants to compare the energy performance of different buildings.
Energy Policy	The processes and procedures the UK Government has established to manage the consumption and conservation of energy
Energy Rating	A categorisation of the energy performance of a building based on a set of standardised consumption criteria
Feed In Tariff (FiT)	A compensation payment made for the small scale generation and supply of renewable energy
Franchisee	An organisation that provides a service on behalf of another organisation
Green Deal	A Government energy-saving initiative that provides up-front funding for domestic energy improvements; the funding is paid back through the consumers' energy bill
Investor/user dilemma	Incentives to invest in energy efficiency are diluted for owners and tenants; neither perceive themselves as benefitting from the financial savings available; it is perceived that the tenant will benefit from the owners' investment and vice versa
Landlord-Tenant Divide	The adversarial relationship between landlords and tenants; the split incentives deriving from commercial leases whereby neither the owner nor tenant will invest in energy improvements as the other party will benefit from the investment
Multi-occupancy building	A single building sub-divided to provide business premises for two or more tenants
Non-domestic building	A building utilised as business premises

Owner	The individual or group that owns the non-domestic building
Polluter Pays Principle	The practice that requires those who produce pollution to bear the costs of rectifying it to prevent damage to the environment or human health
Rational economic theory	Individuals and organisations make decisions and take actions based on optimum financial return or best self interest
Renewable Heat Incentive (RHI)	The Renewable Heat Incentive financial support scheme is designed to encourage the uptake of renewable heating in return for compensation payments
Small and Medium Enterprise (SME)	This thesis uses the classification of SMEs set by the European Commission's Directorate-General for Enterprise and Industry (2005); small and medium commercial organisations with less than 250 employees and a turnover of no more than €50 million
Smart meters	Smart metres provide real-time information on energy consumption to help energy users understand and control use, optimise energy spend and improve energy management
Split incentives	A situation or outcome in which the benefits from energy improvement actions are divided between the owner and tenant so that the benefit for each party is reduced thus providing an inadequate business case to invest
Tenant	An individual or group renting or leasing a property from the owner
Value-action gap	The gap that exists between the availability of cost effective energy improvements and what is implemented
Zero carbon buildings	Buildings that avoid or mitigate all regulated emissions using a combination of on-site low carbon technologies (e.g. solar panels) on-site energy efficiency measures (e.g. insulation), and off-site measures to mitigate any remaining emissions.

CHAPTER 1: INTRODUCTION

1.1 Introduction

Today the central role energy plays in the emission of carbon is widely accepted by the UK Government, politicians and the public with, according to the Committee on Climate Change (2012), energy concerns high on political but few business agendas. Most businesses continue to work within historically developed economic infrastructures that have built up around the availability of low cost energy and do not consider energy concerns a business threat.

Challenging government energy policies and targets have been established to counter this: Zero Carbon Buildings by 2019; 80% carbon emission reduction over 1990 levels by 2050 with at least 34% by 2020 and 14 million homes to be insulated by 2020. The Carbon Trust (2013a) and Kennedy and Gault (2013) indicate that carbon emissions reductions of 3% per annum are required to achieve this. The current underlying rate of emissions reduction is less than 1.5%. Gault and Thompson (2014) attribute only 0.4% of this to energy conservation measures. Bateman (2011) equates this 3% per annum reduction rate to retrofitting a city the size of Cambridge each week until 2020 just to meet 2020 targets.

However, these targets and the ability of energy policies to deliver them are markedly disconnected. Energy policies are primarily focused on both the exploitation of new sources of energy, including the generation of lower carbon electricity and the adoption of voluntary conservation actions by large intensive energy users and owners of domestic properties.

Although there has been a downward trend in carbon emissions since 1990 due to utilisation of lower carbon fuels for electricity generation, this has not comprised year-on-year reductions. For example, Kennedy and Gault (2013) calculate a 7% fall in emissions between 2010 and 2011 was followed by a 4.4% rise between 2011 and 2012. The Department of Energy and Climate Change (2014a) attributes this rise to increased use of high carbon fuel to generate electricity in response to falling coal prices.

Despite this trend of falling carbon emissions there has been a concurrent upward trend in the per capita consumption of energy. The Department of Energy and Climate Change (2013a) indicates demand is now 1.3% higher than in 1990 and 6% greater than 1970 with 2.1% rise in power consumption between 2011 and 2012 alone. The number of buildings, appliances and gadgets requiring this lower carbon fuel has outweighed improvements in efficiency that may otherwise have reduced overall energy consumption.

Attempts to reduce carbon emissions through conventional approaches of encouraging voluntary energy conservation, generation of low carbon energy, implementation of taxes and financial and non-financial incentives have failed to deliver climate change requirements. This is explored further in the Literature Review in Chapter 2. de Groot, Verhoef and Nijkamp (1999), Janda (2009a), Lorenzoni, Nicholson-Cole and Whitmarsh (2007) and Warde (2010) agree that energy efficiency improvements have not been adopted as expected in spite of extensive information campaigns and financial and motivational incentives.

To date, the expansion of low carbon energy supplies has received far greater attention within UK energy policy than regulatory policies and incentives that would encourage the adoption of energy efficiency and conservation actions. Where implemented, energy regulations and incentives have focused on large commercial energy users, domestic properties and new non-domestic buildings. This has left a sector of 4.99 million small businesses operating within 1.8 million existing non-domestic buildings largely without incentives to become energy efficient or adopt energy conservation. The Carbon Trust (2013b) has determined that this sector is responsible for 20% of all UK carbon emissions. Janda (2008), Kelly (2010) and the Carbon Trust (2013a) consider if the energy efficiency of this building stock is not improved neither the 2020 nor the 2050 targets will be met

Small and medium enterprises are significant contributors to the UK economy. The Federation of Small Businesses (2014) estimate they comprise 99.9% of all UK private businesses by number and employ 60% of the total private sector labour force. Energy savings reduce overheads and could improve their competitiveness with long-term capital investment. Hereafter small and medium enterprises will be referred to by the acronym SMEs.

Given the financial benefits offered, rational economic theory would expect these energy opportunities to be swiftly adopted. However, this has not occurred. DeCanio (1993), de Groot, Verhoef and Nijkamp (1999), Janda (2008) and Warde (2010) recognise that there is now a gap between what energy efficiency improvements are technically feasible and cost effective and what has actually been achieved. DeCanio (1993) describes this as the "energy-efficiency paradox". Energy opportunities have been proven technically viable, financially rational and retrofit feasible therefore another factor must be involved to influence what, at face value, appears to be a simple carbon and cost saving opportunity. This research hypothesises that this factor is building ownership.

Following an exploration of the research aims and objectives established to test this hypothesis; the background to the research is described. This chapter also provides the rationale for focusing on UK non-domestic energy efficiency and conservation in Section 1.4, including reasons for selecting non-domestic buildings, SMEs and building ownership as the evidence base for this research. This is then set against the backdrop of current UK Energy Policies in Section 1.5, which describes the energy challenge currently faced and provides the regulatory and incentive framework within which commercial energy management currently operates. Finally the structure of this thesis is described in Section 1.6.

1.2 Research aims and objectives

The key aim of the thesis is to identify how SMEs can be encouraged to maximise the financial benefits offered by energy efficiency and conservation, which in turn increases their contribution to national carbon reduction targets. A series of objectives are established to deliver this and seek to establish:

i. The extent to which building ownership influences the ability and willingness of both non-domestic building owners and tenants to adopt energy efficiency and conservation opportunities
ii. The factors that motivate UK SMEs to adopt energy efficiency and conservation behaviour
iii. The influence of building ownership on energy conservation behaviour and consequent challenges faced by Government energy policies from this
iv. The opportunities for an alternative approach to energy policy in order to improve rates of energy efficiency and conservation within SMEs

1.3 Scope of research

The scope of this research has been designed to support delivery of the aims and objectives described above. Primary research targets comprise existing non-domestic buildings within the UK, their owners and tenants. Specific definitions of building owners and tenants are adopted for this research; building owners are either owner-occupiers, owners of an individual leased/rented building or commercial landlords with multiple properties. Tenants are small and medium sized organisations from all commercial sectors. The rationale for adopting these research targets is explored further in Section 1.4.

To create a framework for this research, a new segmentation of the SME sector has been adopted. This has been designed to reflect the hypothesis adopted and utilises a segmentation based on the ownership of non-domestic buildings and the purchase of energy. The model is described in detail in Chapter 4.

The extent to which building ownership, particularly within the non-domestic building sector, has been included within energy research is explored in Chapter 2. This assesses the role of ownership within energy research and considers how the characteristics of ownership, including the traditionally adversarial relationship between owner and tenant, are viewed.

Research participants owning and occupying existing non-domestic properties are specifically sought. New buildings are excluded as they have been built under the energy efficiency controls of Building Regulations and therefore considered to have acquired a minimum standard of energy efficiency and conservation.

1.4 Rationale for this research

As described above the key elements of this thesis are non-domestic buildings, building ownership and SMEs. The rationale for focusing on these is explored in turn in more detail below.

1.4.1 Rationale for focusing on existing non-domestic buildings

Greenwise (2012) considers the non-domestic building sector is one of the least successful in terms of energy efficiency and conservation in the UK. To date Government Energy Policy has focused on the encouragement of voluntary good practice to reduce carbon emissions rather than reduce energy consumption. Taxes and carbon-trading schemes attempt to deliver this from large carbon emitters, whilst emissions from domestic buildings are tackled through recently introduced financial incentives programmes. This has left an area of opportunity between the two consisting of 4.99 million UK SMEs occupying 1.8 million non-domestic buildings[1] of which 72% of the buildings are leased or rented. Kennedy and Gault (2013) calculate that 18% of these currently have an Energy Performance Certificate (EPC) rating of “F” or “G” and only 8% are rated “A” or “B”. From 2018 only buildings rated ‘E’ or above can be legally rented or

[1] Multi-occupancy buildings account for the difference between the number organisations and number of buildings.

sold and therefore only 12% of non-domestic buildings are deemed acceptable for continued use. An "E" rating therefore appears to represent the threshold at which a building is considered to have acceptable energy efficiency.

However, there is a concern over the logic of the energy rating thresholds applied. The Committee on Climate Change (2012) indicates that all but 12% of the 118,000 buildings obtaining a Display Energy Certificate (DEC) in 2011 were given an "E" rating or above. This implies that 88% of buildings are considered to be energy efficient. However, 33% of carbon emissions were from buildings with a "C" rating or higher. Energy policy does not address emissions from the "A" to "D" rated buildings, which casts doubt on the ability of current energy policies to meet carbon emissions reductions targets.

The desire for "zero carbon" non-domestic buildings has driven changes to Building Regulations, consequently some energy efficiency improvements to new buildings and larger properties (over 1000m^2) undergoing alterations are achieved. However, Building Regulations affect only 2% of the present commercial building stock. If carbon reduction targets are to be achieved energy savings must also come from the remaining smaller existing commercial organisations, which remain largely energy inefficient. Aldridge (2012) identifies that cost savings generated from energy consumption reduction in non-domestic building far outweigh those from any domestic building. Despite this, retrofit of smaller non-domestic buildings remains a voluntary activity.

For non-domestic building occupants, particularly where they are tenants, carbon emission reduction remains remote from day to day business activity. By focusing on the tangible aspects of energy that resonate most closely with them, rather than simply extending domestic energy incentives to them, opportunities can be targeted more effectively and the greatest returns on investment achieved. The attitudes and motivations of building owners and users are the key to this and is the discussed in more detail below.

1.4.2 Rationale for focusing on building ownership

The evolution in non-domestic property ownership over the last 150 years has created a complex pattern of building ownership and tenancies. This complexity, identified by Dixon (2009) has left a legacy of unsupportive, non-collaborative relationships between landlords and tenants that significantly influence the ability and willingness of building owners and users to invest time and money in energy efficient improvements. It dilutes incentives to make improvements to energy efficiency as they, and the benefits produced, are split between the building owner and tenant. Kennett (2012) considers that incentive schemes have proved difficult to implement because of the differing impacts on each side of the relationship.

Any intervention to improve energy efficiency or conservation in an occupied building carries a level of investment risk. Building owners rarely take risks consequently this attitude results in energy inertia. This thesis aims to propose tools to rectify this.

The majority of energy research conducted to date focuses on domestic buildings and energy intensive commercial sectors and, according to de Groot, Verhoef and Nijkamp (1999), Janda (2008) and Schleich and Gruber (2008), sees the building type as the driver of carbon emissions. These approaches mirror the structure of, and rationale for, energy policies that have excluded organisations below the intensive energy user threshold within the Carbon Reduction Commitment (CRC) energy efficiency scheme. This is described in more detail in Chapter 3.

However, in spite of 30 years of detailed energy policy and well-documented financial benefits achievable, energy efficiency remains remote from business strategy. 2020 and 2050 carbon reduction targets are unlikely to be achieved without a change in policy approach. This thesis proposes this alternative approach.

1.4.3 Rationale for focusing on SMEs

To date Energy Policy for non-domestic consumers has been differentiated on energy consumption and carbon emissions. This has targeted energy consumers with information to encourage voluntary good practice and large carbon emitters with a series of regulatory tools such as the CRC Scheme, EU Emissions Trading Scheme (EU ETS), and Climate Change Levy. de Groot, Verhoef and Nijkamp (1999) believe that commercial energy policies are based on the assumption that energy efficiency and conservation improvements will filter down to SMEs driven by market forces, supply chains or green consumerism. However, this has not occurred. SMEs continue to be significant energy consumers and carbon emitters. Individually they consume relatively small amounts of energy but when combined it becomes a significant proportion of overall business energy consumption. The Carbon Trust (2013b) has estimated that together they emit approximately 110 $MtCO_2$ per annum, which represented 20% of the UK total emissions in 2012.

Waters Wye Associates (2010) believe that within large organisations the cost of energy, which represents a significant proportion of their overheads, offers a significant internal pressure to invest in reducing energy consumption. In addition the financial disincentives of EU ETS and CRC Schemes have increased financial business risks and therefore pressure to reduce energy consumption.

However, de Jong (2013) considers the incentives to reduce energy consumption for owners and occupiers of non-domestic buildings below the threshold applied by the CRC Scheme have traditionally been weak. Energy costs for SMEs remain a low business overhead, which has discouraged them from considering opportunities to reduce energy consumption as a business priority, despite the cost benefits from doing so. Financial and non-financial incentives for energy conservation within this sector remain an extension of domestic energy policies so do not address the specific needs of non-domestic building owners and tenants. The framework proposed attempts to change this.

1.5 The current energy challenge

Warde (2010) considers that the historically low cost of energy has encouraged an energy culture that considers energy to be in limitless supply and excessive levels of consumption acceptable. Now that energy is becoming restricted and costs rising, it is slowly becoming recognised that this energy culture has created a legacy stock of buildings with poor building fabric, limited energy efficient equipment and even lower levels of energy awareness.

McAllister, Quartermain and McWilliams (2009) identify that only 1-2% of existing energy inefficient buildings is replaced each year. Kelly (2010) estimates that in 2050, the deadline to deliver 80% reductions in CO_2 emissions over 1990 levels, 70% of the buildings stock will have been built before 2005 to energy inefficient standards. Kennedy and Gault (2013) have estimated that 80% of the carbon identified as eligible to contribute to emissions targets is already locked-in by the existing infrastructure. To prevent 100% of emissions becoming locked-in all existing high carbon buildings will need to be updated to energy efficient standards or scrapped before the end of their useful life and all new buildings will need to be designed, built and operated to zero carbon standards. Unless these existing buildings' energy efficiency is improved there is little chance that emissions targets can be met.

Warde (2010) considers that UK Energy Policy has introduced numerous initiatives to encourage a change in energy behaviour in addition to legislation and taxes imposed to manage intensive energy users' emissions. However, UK Energy Policy has developed separately from other public policies and has been introduced in a piecemeal fashion. Janda (2009a) and Kelly (2010) consider this has resulted in a regulatory framework that is complex, confusing and remote from day to day business activities. In fact the last survey undertaken by NetRegs (2009) found only 23% of SMEs could name a piece of applicable energy legislation unprompted. The Environmental Audit Committee (2011) considers that this complexity is widely recognised by businesses and has reduced the effectiveness of Energy Policies in raising awareness and securing behavioural change.

UK Energy Policy has been constructed on the basis that organisations will treat energy efficiency and conservation as a rational economic business decision. This premise has, however, proved flawed. Firms will only become engaged in energy efficiency actions and behaviours if there is sufficient incentive to do so. With existing policies and initiatives this is proving difficult as energy is rarely considered a significant business cost and has resulted in energy inertia. Bright (2010) and Delay (2013) have estimated that energy represents only 1-2% of overheads for most organisations which is insufficient to drive behavioural change on its own. To achieve the required business re-prioritisation of energy conservation, the benefits of change must outweigh the costs of intervention. These costs are not simply financial but may include disturbance, time and knowledge.

Within organisations there are numerous points of friction that prevent the adoption of economically viable and retrofit feasible energy efficient behaviours and actions. Behavioural barriers, such as the need to comply with internal hierarchical decision-making structures, or financial barriers, such as energy efficiency having to compete for resources with other economically rational alternative investment opportunities, are significant disincentives that effectively block contributions to energy reduction targets. These barriers to the adoption of energy efficiency and conservation technology and behaviours are discussed in more detail in Chapter 5.

For SMEs the investment decisions may appear less bureaucratic. However, the financial aspects of energy investment may be more significant for them as energy efficiency investment decisions must be balanced against investment for business growth. Although the decision to make energy savings can contribute directly to an organisation's profits it is not always clear how to conserve energy or access efficiency opportunities. As with larger organisations the attitudes of some SME owners and managers to energy efficiency and conservation will also be of major significance in whether energy reduction actions are taken. This is explored further in Chapter 5.

Energy efficiency and conservation still appears irrelevant to many SMEs. The provision of energy efficiency information has been increasing for the last 30 years but has not resulted in significant improvement nor has it reduced absolute levels of energy consumption. Janda (2011) considers that further education is unlikely to be more successful. Kennedy and Gault (2013) consider the Government's drive to secure energy supply improvements is unlikely to change this lack of engagement. The incentivisation and promotion of new sources of fuel, such as shale gas and lower carbon electricity are overshadowing the fact the not using energy is the most cost effective way of cutting carbon emissions and a significant financial opportunity for commercial organisations. This thesis pursues this conservation approach.

1.6 Structure of the thesis

This thesis is comprised of nine chapters as detailed in the table of contents. Each relates to an aspect of the research process followed, which is explained fully in the research methodology in Chapter 4.

The review of literature contained in Chapter 2 and the critique of UK energy policy in Chapter 3 provide the context for this research. The Literature Review explores current academic and business attitudes towards non-domestic buildings' energy consumption. Gaps in knowledge of, and research into, the impact of building ownership on the current landscape of energy inertia are highlighted where appropriate. Impacts on the ability and willingness of owners and tenants to adopt energy efficiency opportunities to conserve energy are also considered. The scale and impact of this energy inertia are then explored further in the analysis of primary research data in Chapter 5 and the proposed alternative approach to energy policy in Chapter 6.

The analysis of data has two components. Firstly, an analysis of qualitative and quantitative information provided by research participants is undertaken in Chapter 5 utilising a framework based on segmentation of non-domestic business premises according to their tenure and purchase of energy. Secondly a discussion of contributions to the research made by the low overall rates of participation, a specifically low rate of response to the surveys issued is included in Chapter 6.

The analysis of participants' evidence establishes the extent to which building ownership influences the ability and willingness of non-domestic building owners and tenants to adopt energy efficiency and conservation opportunities. It also identifies and explores the factors that will motivate tenants and owners of their business premises to implement energy improvements and conservation behaviour. The scale and impact of energy inertia is also considered in relation to these motivating factors. Findings from this data analysis are then used to propose an alternative approach to energy policy in Chapter 7 and to test its implementation through the sensitivity analysis undertaken in Chapter 8. A Scenario-

Planning Model has been designed to integrate the ownership segmentation framework and features of the proposed alternative energy policy to explore opportunities to optimise energy efficiency across the SME sector. It establishes prioritisation for investment in energy efficiency measures by optimising the rates of return on grant funding within the non-domestic property sector.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Agencies aiming to improve rates of energy conservation have, until recently largely followed the traditional technological approach to energy efficiency i.e. the ways to obtain the same service from less energy by adopting, improving or adapting equipment. This has seen energy choices as rational economic decision making, the same approach taken by energy policy makers. However, widespread research consensus has now developed recognising that slow adoption rates of cost effective energy efficiency and conservation opportunities has fallen short of climate change requirements and will not deliver carbon reduction targets. This has led researchers to broaden the scope of energy research in an attempt to explain this slow progress.

This review of energy literature goes beyond conventional technological research and explores whether a greater diversity of research approaches has contributed behavioural aspects of energy use and considered the impact of barriers to change in an attempt to understand the drivers of energy consumption. Since rational decision-making is clearly not delivering energy efficiency as would be expected by economic theories alternative explanations may be sought.

Overall the papers cited here highlight the diversity of approaches to energy research undertaken by both academic and business researchers. These include technical, socio-technical, behavioural, economic and legal approaches to energy consumption and efficiency and are considered within both domestic and non-domestic buildings. Although this thesis focuses on non-domestic buildings energy literature on domestic buildings has been included, as non-domestic building research has proven scarce.

Technical perspectives on energy consumption including papers by Schleich and Gruber (2008) and Smid and Neiboer (2008) and Peacock *et al.* (2008) consider that users' energy consumption is determined by the energy efficiency of the equipment installed. Behavioural approaches taken by Brohmann *et al.* (2009), Fawcett (2010), Stephenson *et al.* (2010), Weber (1997), Janda (2008, 2009a, 2009b, 2011) and Janda and Killip (2010) consider energy consumption is determined by the users beliefs and relationships. Janda (2014) and Axon *et al.* (2012) combine these two approaches to consider energy improvement from a socio-technical perspective. The economic approaches to energy research taken by Grubb, Haney and Wilde (2009), Gillingham, Newall and Palmer (2009) and McAllister, Quartermaine and McWilliams (2009) hypothesise that users respond to economic stimuli whereas legal approaches shown by Bright (2010) and Hinnells *et al.* (2008) focus on taking a legal strategy for becoming energy efficient.

Behaviour is recognised as a key driver of energy consumption although opinions as to its importance vary. Biggart and Lutzenhiser (2007) consider energy inefficiency the result of overconsumption whereas Ockwell, Whitmarsh and O'Neill (2009) consider that behaviour will determine the energy-attitude behaviour gap. Weber (1997) and Brohmann *et al.* (2009) take a more general view that people do not consume energy, they consume the service it provides.

Split incentives of energy improvement are widely recognised within energy research reviewed here. The UK Green Building Council (2011) consider that this split of responsibility between tenants and landlords impacts the adoption rates of energy efficiency improvements in both investment and behaviour, effectively providing a barrier to change. Researchers consider that ownership dilutes incentives for both domestic and non-domestic building owners to adopt energy efficiency improvements. This is termed by Schleich and Gruber as the 'investor/user dilemma' (2008: 454). Building ownership has not proved to be a key topic for energy research. It is however, considered an important determinant of energy conservation. This thesis takes and builds on this finding.

Research papers reviewed here illustrate the cross section of energy research topics and approaches taken by both academic and professional researchers. A number of key themes have emerged, some of which are points of consensus between researchers, and some show differences of opinion and some highlight gaps in research. These gaps indicate a paucity of information within the extensively investigated energy landscape and therefore represent an opportunity for further research into energy efficiency. Key themes are explored in turn. Firstly, the approaches taken to research are considered; secondly the role of behaviour within energy research is examined; thirdly the authors' perceptions of building ownership is explored; fourthly explanations for poor adoption rates of energy efficiency are considered; fifthly proposed opportunities for the improvement of energy efficiency are critiqued and finally research gaps are identified that support or challenge the hypothesis tested by this thesis.

2.2 Approaches to energy research

To provide a structure for this review of approaches taken to research, findings are grouped into topics that illustrate the main research strategies that have emerged. Technological, behavioural, financial and legal approaches are defined and where appropriate the research focus on building use (non-domestic or residential) and building status (new or existing) is included.

The traditional approach to energy efficiency research has been to focus on technologies involved. Grubb, Haney and Wilde (2009) look to UK business sectors to identify potential energy improvements and attempt to understand how technology can be embedded into policy making to drive demand for energy efficient goods and services. Existing properties are chosen as their potential for improving non-domestic energy efficiency is considerable and largely unexploited.

Schleich and Gruber (2008) also present a technological approach by examining the extent to which energy efficient products, materials and behaviours are implemented in non-domestic buildings in Germany occupied by small commercial and service organisations. In a similar technological approach, Clarke *et al.* (2008) focus on the potential for technology to deliver energy conservation in the UK. However, this research adopts a wider scope than Schleich and Gruber (2008) and evaluates the technological potential for energy efficiency in domestic and non-domestic buildings.

Although focusing on technological aspects of energy efficiency and conservation Smid and Neiboer (2008) limit their research to evaluate energy conservation opportunities within residential properties owned by three Dutch housing associations. The researchers hypothesise that property asset values will increase in response to landlords' energy efficiency successes and so focus on the development of energy efficiency and conservation within asset management strategies.

Both Kelly (2010) and Warde (2010) incorporate an historical view of energy efficiency in the UK into their technology led research. Kelly (2010) hypothesises that future energy use will be determined by technological improvements achieved in today's building stock. Warde (2010) considers how technology impacts energy consumption and how its' influences can be used to structure incentives for change. The research tests the hypothesis that historically significant patterns of technology development have not led to consumption reduction. For example, Somerville (1987) cites the case of Fair Isle. A wind turbine was installed to provide renewable electricity in place of the long established diesel generator. The new source provided a constant supply of energy in place of the twice-daily supply at one tenth of the cost. Consequently the demand rose markedly and additional turbines were required to cope with the increase in demand within the first 12 months.

Peacock *et al.* (2008) follow the traditional technology based approach in their energy research into UK commercial buildings, although unlike Kelly (2010) and Smid and Neiboer (2008) they focus on non-domestic buildings. The authors use previous energy research literature to segment non-domestic premises by building type such as schools and hotels, each of which is given an idealised energy profile. By segmenting the existing building stock, Peacock *et al.* (2008) propose the opportunity for bespoke technology solutions.

In an alternative methodology a number of authors including Brohmann *et al.* (2009), Fawcett (2010), Janda (2008) and Weber (1997) take a behavioural approach to energy research. In a review of diffusion of energy efficient activities within domestic properties in Germany, Brohmann *et al.* (2009) focus on attitudes and preferences of consumers towards energy. The research defines two factors that affect the German residential energy market: supply side measures, for example the availability of energy efficiency technology; and socio-political factors such as eco-labelling. Brohmann *et al.* (2009) hypothesise that these factors determine the individual choices of consumers when making energy decisions.

Fawcett (2010) researches energy attitudes and behaviours in small commercial and public sector organisations falling outside the existing UK Government interventions. This survey of 400 UK SMEs on behalf of the Department of Energy and Climate Change generates a statistical picture of the SME sector and identifes cost saving opportunities accessible to them. In a similar approach Johnson Controls (2013) surveyed 850 building managers for the Institute for Building Efficiency to capture energy priorities, behaviours, challenges and engagement with energy improvements. Both Fawcett (2010) and Johnson Controls (2013) compile similar pictures of the energy behaviours of UK SMEs that could be used identify cost-effective energy savings.

In an alternative ‘performance based approach’ Janda (2008, 2009b, 2011) and Janda and Killip (2010) hypothesise that energy use in UK commercial buildings is a social problem not a technical one; people, either individually or in groups, are responsible for all energy use. In *Buildings Don’t Use Energy: People Do* Janda (2011) recognises that building users and not just designers have the ability to reduce energy consumption. Organisational characteristics define a culture that favours or discourages the adoption of energy efficiency. Technology or the building itself may influence energy consumption but ultimately the key driver is the choice to use energy or not, a fundamental belief that this thesis supports.

However, Janda (2011) researches firms engaged in voluntary accreditation schemes, all of which have robust energy management, which suggests research findings may be prejudiced. They represent a group of 'early adopters' who will be keenest implement energy efficiency opportunities. As Janda (2011) gathers data through participants' web sites the information will have been filtered for public declaration and does not consider drivers for energy efficiency or barriers affecting its adoption.

de Groot, Verhoef and Nijkamp (1999) adopt a behavioural approach surveying Dutch firms' attitudes to energy use and internal decision making to establish levels of adoption of energy efficiency opportunities. The research hypothesises that attitudes towards the Government preferred voluntary agreements and market mechanisms determines acceptance of energy conservation activities.

Like de Groot, Verhoef and Nijkamp (1999), Revell, Stokes and Chen (2010) also focused on commercial organisations' energy behaviours. This research surveyed UK SMEs leasing workspaces in London, a segment that other agencies have excluded. The survey is combined with a review of previous research to understand responses of SME owner-managers to energy policy and media attention. Despite encountering geographical and ownership restrictions it does offer a new approach to energy research, one that connects organisational ownership to the drivers of energy consumption. This thesis extends this approach to hypothesise that building ownership is the key driver of energy behaviours and consumption.

Schmidt and Fonseca (2007) also adopt a behavioural approach to energy, hypothesising that solutions to poor uptake of energy efficient technology and behaviour in the EU can only be identified by understanding changing patterns of domestic energy consumption and social aspects of energy use. The researchers review social aspects of energy within previous literature to identify solutions to the poor uptake of energy efficiency technology and behaviour. Whilst this research focuses on residential properties the findings will be considered in framing opportunities for SMEs to develop energy efficient behaviour in this thesis.

Lorenzoni, Nicholson-Cole and Whitmarsh (2007) challenge the traditional technological approach to energy research by gathering data on individuals' responses to climate change through a survey of energy use within the UK residential sector. This identifies barriers to energy efficiency such as distrust of information sources, lack of action by businesses and lack of political action prevent residential consumers developing a greater engagement in energy conservation. Lorenzoni, Nicholson-Cole and Whitmarsh (2007) consider that a radical change in individuals' and groups' behaviour is required to overcome them. Although the research focuses on the residential sector their findings support those of other research into non-domestic building sectors.

In a similar challenge to the technological perspective on energy research Biggart and Lutzenhiser (2007) use elements of sociology to examine energy inefficiency within US non-domestic properties. The research hypothesises that users' behaviour causes energy inefficiency. However, findings indicate that energy users do not change their behaviour, as rational economic theory would expect. Consequently this approach to energy efficiency and conservation is unlikely to reduce energy overconsumption.

Axon *et al.* (2012) combine these sociological and technological approaches to consider the effectiveness of technological solutions to energy inefficiency within the context of UK commercial building use. The research focuses on multi-tenanted properties to understand the impact of buildings and 'organisational communities' (2012:461).

Janda (2014) extends this socio-technical approach to consider the relationship between the stakeholders of UK commercial premises and the physical space they occupy. The research views poor energy performance within buildings as a 'people problem' whereby demands of stakeholders, investors, developers, facilities mangers as well as landlords and occupiers combine to create social and institutional barriers to energy transformation (2014:49).

Weber (1997) sees energy as power consumed for the services it provides; and consequently focuses on decisions and actions that influence energy consumption rather than its technical aspects. Despite this research hypothesis Weber (1997) finds it is not possible to identify true reasons behind the well-recognised lack of energy conservation actions in the EU because they are invisible. This thesis does not support this view and aims to establish motivations for not taking up economically rational energy behaviours and activities.

Stephenson *et al.* (2010) review previously identified drivers of energy use for their behavioural research into the adoption of energy management in New Zealand. They term this the 'energy cultures' approach (2010:121). The research categorises individuals' and groups' responses to external influences such as access to low cost funding for new technologies, creating a model that recognises the complexity of energy attitudes on energy users' behaviour.

A number of researchers including Grubb, Haney and Wilde (2009) and Gillingham, Newell and Palmer (2009) take an alternative approach and consider energy efficiency in the US from an economic perspective. Grubb, Haney and Wilde (2009) see improving energy efficiency of existing materials and behaviours as the quickest and cheapest route to lowering environmentally damaging energy consumption. This is considered from a financial viewpoint in an attempt to understand why energy users do not adopt optimum levels of energy efficiency if energy and product markets are working correctly as policy makers and energy analysts claim.

McAlllister, Quartermaine and McWilliams (2009) recognise it has been more usual for energy research to be conducted into new buildings as energy efficient technologies are easier and cheaper to integrate during construction. The authors highlight that only 2% of the UK commercial building stock comprises new buildings and so, if Government targets are to be met, the remaining 98% of existing buildings must deliver significant retrofit CO_2 reductions. This will only happen if there are cost benefits from doing so.

McAlllister, Quartermaine and McWilliams (2009) focused on buildings owned by commercial investors such as offices, supermarkets, warehouses and light industrial buildings as the Investment Property Forum commissioned their research. In a similar approach to Janda (2011), they segment the investment building stock according to building type to review opportunities to increase energy efficiency above market standards. Seven office types and one segment each for retail and industrial premises are used allowing the researchers to take a more detailed view of a property's potential than the three ownership categories put forward by Janda. This thesis uses a similar framework although segmentation by ownership criteria rather than building type will be used to generate bespoke solutions for energy efficiency.

In an annual survey of energy trends RWE Npower (2013) take an economic perspective of energy issues that represent a major business risk for UK commercial energy users. Although there is an obvious bias in this research as an energy supplier conducted it, the survey identifies attitudes towards energy and trends in commercial energy management. The findings show that only 20% of SMEs consider energy consumption reduction as an important issue for their business.

Both Bright (2010) and Hinnells *et al.* (2008) offer an alternative legal perspective to explore energy opportunities available for UK tenanted commercial properties. Bright (2010) tests the hypothesis that tenancy arrangements determine the ability of building owners and users to conserve energy and adopt energy reduction incentives and evaluates the likelihood of these opportunities meeting the CRC scheme's aims of carbon emissions reduction and improving collaboration between landlords and tenants.

Hinnells *et al.* (2008) consider the legal aspects of the relationship between owners and occupiers as the core barrier to improving the adoption rates of energy efficiency behaviour in non-domestic buildings and hypothesise that the impact of commercial leases prevents energy saving within buildings. The research finds the short-term nature of a tenant's interest in their premises gives little incentive to invest in energy efficient equipment and in multi-let buildings landlords have no incentive to reduce energy usage in common areas, which are generally covered by the service charge. Specific aspects of leases also frequently block energy improvements. For example, they find dilapidations clauses that require tenants to reinstate their premises at the lease end discourage them from upgrading. Hinnells *et al.* (2008) also consider standard 'right to entry' lease clauses are unlikely to give the building owners access to tenants' premises to make changes.

In response to members' widely held view that energy policies for commercial buildings are confused and overly complex, the UK Green Building Council (2011) reviews factors that encourage building owners and leaseholders to improve their energy efficiency. The research uses existing buildings to evaluate the impact of agreed lease terms on the retrofit of energy conservation measures and recommends mandatory application of a landlord DEC to establish energy performance requirements within leases.

Like Kelly (2010) and Warde (2010), Roodhouse (2007) takes an historical approach to consider the possible solutions to energy inefficiency and challenges the ability of current UK policy to drive future change. Roodhouse (2007) hypothesises that energy rationing is the only way forward to deliver Government carbon reduction targets.

This review of energy literature has identified a number of similarities and differences between the research approaches implemented. These support the role of behaviour and perceptions of building ownership that are considered in more detail below.

2.3 The role of energy behaviour within energy literature

For a small number of researchers the key driver of energy conservation is the attitude and behaviour of energy users, i.e. the choice of individuals, groups and firms to use energy or not. Although this has been a component of energy literature in the last 20 years, this thesis has identified that behavioural research into energy consumption still appears to be in its infancy. To date most of this research has simply described attitudes and behaviours of energy users. Few authors extend the understanding gained from this into considering ways to improve the adoption rates of energy efficiency. This thesis aims to widen this research into a greater understanding of energy behaviours related to building ownership and to use these to develop bespoke solutions to reduce energy consumption.

The research conducted by Johnson Controls (2013) for the Institute for Building Efficiency collected data on the importance placed on energy by European commercial organisations. This survey found that 58% of SMEs considered energy efficiency important to their business, a significantly higher figure than established by RWE Npower (2013) in a survey of 500 SMEs. Despite increases in the media's focus on energy and Government generated publicity, this represents only 3% increase over 2010 but a drop on the 2011 and 2012 survey figures published in the 2013 report. Respondents cite cost savings, energy security and the expectation of future Government policies as factors that may encourage them to consume less energy.

Ockwell, Whitmarsh and O'Neill (2009) take a more negative view of the role of behaviour within energy use. The research recognises the importance of the energy 'attitude-behaviour gap' in the adoption of energy efficiency, i.e. difference between what is considered important and what energy actions are undertaken (2009:312). Ockwell, Whitmarsh and O'Neill (2009) find UK individuals' and firms' attitudes create negative responses to 'participatory' approaches to energy conservation. These include avoidance of regulations, superficial action or rebound effects of energy efficiency. The rebound effect comes from the increased efficiency of goods causing operating costs to fall, which in turn stimulates consumption. Herring and Roy (2007) cite the example of electric light. Since 1960 the efficiency of electric light has doubled but per capita consumption has increased over 400%.

DeCanio (1993) adopts an alternative approach to determining energy use with an investigation into impacts of energy consumers' behaviour on energy consumption at the level of US commercial organisations. The research hypothesises that these behaviours are a barrier to energy efficiency, particularly the behaviour of a firm in response to its rules and procedures. DeCanio (1993) concludes that commercial organisations' rules and procedures will be conditioned by the need for profitability. This, along with rational business decisions, can explain why profitable energy investments are often avoided. The research identifies that management compensation, status, reputation, tenure and the 'principal-agent problem' all influence energy decision-making. DeCanio defines the principal-agent problem as a conflict of interest between stakeholders within the organisation, which frequently leads to a state of organisational energy inertia (1993: 908). In a multisite organisation these will be compounded by relationships between sites and central management. Subsequent research by Brohmann *et al.* (2009), Fleiter, Worrell and Eichammer (2011), Weber (1997) and Janda (2008) has incorporated these determinants of energy inefficiency. However, no solutions to reduce energy consumption have yet been proposed.

Articles by Janda (2009a, 2009b, 2011, 2014) and Janda and Killip (2010) reviewed here argue that complexities of people's energy behaviours are not rational or predictable so the simple presence or absence of information that will not determine consumption. In addition, building users tend to treat their building as a fixed object rather than an adaptable system so there is little or no recognition of their ability to make changes. Brohmann *et al.* (2009) take a similar approach and recognise the importance of users' choice in energy decision-making.

Fleiter, Worrell and Eichammer (2011) also challenge the view of energy users as rational decision makers. Rather they find energy behaviour of firms is controlled by the success of the energy market, which in turn is determined by internal barriers and failures and the behaviour of external decision makers. Consequently firms operate 'satisficing' rather than rational 'optimising' behaviour, which achieves an adequate result rather than the best available performance, with decisions made on rules of thumb rather than rational economic assessments. The traditional economic view of firms as rational decision makers is considered flawed as it expects investment to be made if cost effective. This excludes the complex corporate context and so overestimates the level of investment made by organisations in energy efficiency. Lack of knowledge, risk management strategies and the availability of financial resources all contribute to this.

In a similar challenge to rational energy decision-making Biggart and Lutzenhiser (2007) see behaviour as a key conflict in energy use. Non-domestic buildings represent major social investments but users do not approach them as such. Energy cost savings from reduced energy consumption and efficiency investment is not exploited as would be expected. Fleiter, Worrell and Eichammer (2011) and Biggart and Lutzenhiser (2007) consider traditional research that treats economic assumptions such as demand and supply as rational decision-making has failed to deliver energy improvements. Focusing on an economic approach that excludes human dimensions of energy use excludes choice and ability that can change if price does not wholly or partly change behaviour.

In order to take a more detailed investigation into constraints on energy behaviours than Biggart and Lutzenhiser (2007), Lorenzoni, Nicholson-Cole and Whitmarsh (2007) distinguish between 'personal' and 'social' barriers to UK energy efficiency. This allows the authors to consider their impacts on individuals' and groups' behaviours from either an internal or external perspective.

Stephenson *et al.* (2010) take an alternative approach to understanding energy users' behaviours. They consider a combination of three features of energy use determine the energy attitudes of individuals; technologies, users' activities and users' aspirations. The integration of these behavioural factors overcomes the researchers' concern that the heterogeneity of users, the scale of their energy use and the external context are excluded from previous research.

Brohmann *et al*. (2009) support the generally held research view of the role of people within energy management; people do not actively consume energy, rather they use the services it provides. As Stephenson *et al*. (2010), the researchers consider the external environment within which consumers operate influences energy consumption and behaviour. Together these influences create tenant users who act as barriers to their own energy efficiency. Brohmann *et al*. (2009) consider the key external influence is that of a landlord on a tenant. This is recognised by a number of researchers including Bright (2010), DeCanio (1993), Fawcett (2010) and Schleich and Gruber (2008) and termed the 'Landlord-Tenant Divide' by the Carbon Trust (2013a). This has resulted in tenants frequently having little responsibility for or involvement in energy decisions. This relationship is considered further in the following section.

The research described above views energy behaviour from the energy users' perspective. Fawcett (2010), however, considers non-domestic building owners' and tenants' behaviour from an external perspective by investigating the role of firms' customers as a driver of change. From a survey of UK SMEs Fawcett (2010) identifies that very few organisations consider their customers' requirements to be drivers for energy efficiency. This suggests that supply chain policies are not sufficiently widespread to force behavioural change.

This review of energy literature finds a limited acceptance of behaviour as the key driver of energy consumption. Researchers' views on the importance of behaviour range from the perception of Biggart and Lutzenhiser (2007) that energy inefficiency results from users' overconsumption to the complexities of users' energy attitudes and behaviours that determine participatory approaches identified by Ockwell, Whitmarsh and O'Neill (2009).

2.4 The authors' perceptions of building ownership within energy research

Within the energy literature reviewed here only a small number of the articles have considered the implications of building ownership on energy consumption. For these researchers the characteristics of building ownership are considered to dilute the incentives of both tenants and building owners to introduce energy efficient behaviours and actions. The ways in which characteristics of ownership, including the traditionally adversarial relationship between owner and tenant, are used within energy research are explored further here.

Bright (2010) and Hinnells *et al.* (2008) highlight the influential role relationships between building owners and tenants play in the adoption of energy efficiency. Neither research clarifies their definition of building ownership. As Schmidt and Fonseca (2007), both Bright (2010) and Hinnells *et al.* (2008) conclude that building ownership is an important variable in energy behaviour as it has an effect on landlords' and tenants' freedom to invest in energy efficiency. This is considered further in the primary research undertaken for this thesis.

Bright (2010) considers that this is due to a number of tenancy and energy arrangements that determine whether tenants are in charge of their energy supply or consumption levels. This thesis follows this principle although from a behavioural perspective rather than a legal one.

2.4.1 The Landlord-Tenant Divide

The Landlord-Tenant Divide is recognised as a long-standing feature of the commercial property sector. Bright (2010) identifies two elements to this: firstly the adversarial relationship between landlords and tenants and secondly the split incentives of commercial leases. The structure of the lease will influence ability and/or willingness to invest in energy efficiency and receipt of benefits from doing so. This research found that a change to lease terms may be the only way to overcome barriers to energy efficiency created by leasehold contracts.

Hinnells *et al.* (2008) also consider that lack of building energy saving is a function of the impact of commercial leases, particularly the relationship between the landlord and tenant driven by them. The research finds these lease structures do not encourage voluntary environmental efficiency in buildings as lease terms such as 'damage and destruction clauses' which impose the obligation to repair damage on tenants or 'dilapidations' clauses in which the building must be returned to its original condition at the end of the tenancy are a core barrier to change. This is explored further in the next section.

RWE Npower (2013) highlights the role played by building owners and tenants within energy management; 46% of SMEs surveyed rent their premises. The survey finds more than one third of their landlords had not improved building energy efficiency in the

2012/2013-survey period. No causes are identified. The report uses the terms ‘rent’ and ‘own’ to define non-domestic property ownership styles. It is assumed that those who own their premises are responsible for energy improvements and those that rent are not.

Research by Schleich and Gruber (2008) differentiates between ownership structures using ‘private’, ‘public’, ‘quasi-public’ (not for profit) categories of ownership. These are considered in relation to barriers to the adoption of energy efficiency. Schleich and Gruber (2008) find that tenants’ opportunities to reduce energy consumption are affected by the investor/user dilemma. The research hypothesises that the investor/user dilemma is less severe in smaller commercial organisations occupying rented premises than in domestic properties as the rental periods are longer. This gives owners and tenants less incentive to withhold energy efficiency. It is at odds with the general research view that sees the investor/user dilemma as significant for all rental properties. The researchers’ view may be influenced by legal conditions of German non-domestic rental contracts. The experiences of UK SMEs are followed up in this thesis.

Within the commercial research undertaken, McAlllister, Quartermaine and McWilliams (2009) find that the widely recognised, traditionally adversarial relationship between landlord and tenant exists within all buildings operated as commercial investments. This not only reduces their attraction to investors but also prevents a landlord from directly benefitting from energy efficiency improvements. The researchers consider that few voluntary investments are likely to be made. This view may be biased to meet the interests of the Investment Property Forum that commissioned the research.

Brohmann *et al*. (2009) take the opposite view and consider that tenants lose out within the investor/user dilemma. They find the key impact of building ownership is believed to be the influence of a landlord who has no interest in energy saving investments. The research concludes tenants have little responsibility for, or involvement in, energy decisions that ultimately limit energy conservation measures both chosen and able to be adopted where this relationship exists. No definition of ownership is provided, rather it is considered as one of a number of characteristics that describe the household: age, size, ownership and education. This thesis takes an alternative view and considers that the energy characteristics of an SME stem from the ownership of its business premises.

Fawcett (2010) supports the views of Brohmann *et al.* (2009) finding that tenants are unlikely to have investigated or undertaken actions to save energy in properties where the landlord (defined as those managing commercial premises and distinct from the building’s owner) pays the energy bill. Landlords are frequently unsupportive of energy efficiency investments, which severely impact the ability of tenants to make changes. Fawcett

(2010) finds that most survey respondents consider building owners responsible for making energy improvements.

Fleiter, Worrell and Eichammer (2011) take a wider view of the split of incentives than is taken by Fawcett (2010). They extend it to include the divide between different market players or between business sectors, firms and individuals as well as between landlord and tenant. No definition of these stakeholders is given.

Axon *et al.* (2012) consider that the primary driver of split incentives is the inability to value the savings available from any intervention proposed. This stems from the lack of awareness of energy and pay back times compared to the duration of the lease. The authors are, however, one of the few groups that provide a definition of the ownership structures considered within their research. They define tenanted properties as “divergent communities that share specific buildings” and “organisational communities represented by multi-site landlords and tenant companies” (Axon *et al.:* 2012: 2).

The UK Green Building Council (2011) recognises that a complex relationship between tenants and landlords proves a major barrier to investing in energy efficiency. In rented buildings the split of responsibility between tenants and landlords influences adoption rates of energy improvements in both investment and behaviour. In turn the lack of data to demonstrate this split of responsibility prevents agreement to a fair division of costs and benefits. Together they combine to prevent the adoption of energy efficiency behaviour and technology. The research distinguishes between owners and occupiers and between owners, landlords and tenants. The owner is considered to have little to do with the practical running of the building and no influence over energy; the landlord is considered to have stronger influence over energy but does not control the tenants’ use; the tenants are seen as having no control over building design or shared services provided by the landlord, whilst the single owner-occupier is fully responsible for their premises. Research undertaken by the Green Building Council includes some consideration of ownership influencing energy use within business premises.

From the research reviewed above it can be seen that whilst few authors have made the ownership of buildings the main focus of their energy research, a number of them do consider it an important determinant of energy consumption. Few however, give a definition of the ownership structures considered. The researchers agree that the traditional adversarial relationship between landlords and tenants is, and will continue to be, a major barrier to driving energy efficiency within rented buildings. The Landlord-Tenant Divide and its consequent split of incentives make it insufficiently attractive to both the landlord and tenant to invest in energy efficiency.

2.5 Explanation for the poor adoption rates of energy efficiency

The research papers examined here all recognise that there has been a lower take up of energy efficient behaviours and actions than would be expected since cost effective opportunities to reduce consumption are readily available. This is termed the "energy-efficiency paradox" by DeCanio (1993), the attitude-behaviour gap by Lorenzoni, Nicholson-Cole and Whitmarsh (2007:447) and the "value-action gap" by Revell, Stokes and Chen (2010: 273). In response Lorenzoni, Nicholson-Cole and Whitmarsh (2007) and Revell, Stokes and Chen (2010) propose a number of reasons for this. Whilst all agree the problem is significant many different causal theories emerge. These are examined in more detail below.

A large pool of cost-effective and available technologies is readily available. However, to benefit from them the series of barriers preventing their adoption need to be overcome. These have been categorised by the Carbon Trust (2013c) as cost barriers, organisational inconsistencies and market failures. The Carbon Trust (2013c) finds that current energy efficiency policies fail to adequately exploit customer, employee and investor pressures for lower carbon lifestyles, workplaces and investments that could help overcome these organisational and behavioural barriers. The research concludes energy inefficiency will continue, as enforcement of existing policies is patchy and principally concentrated on large intensive energy users and larger buildings. There is lack of resource to enforce policies, which makes it difficult and costly to monitor SMEs compliance.

Fleiter, Worrell and Eichammer (2011) attribute the failure to widely adopt energy efficient products and behaviours to the ineffectiveness of Government policies. The research finds that most models used to develop energy policies have failed to adequately consider the hurdles that determine the likelihood of adoption of energy efficient technology and behaviour. Heterogeneity of firms and differences in their barriers are too complex to be handled adequately by current energy strategies. Policies aiming to address the excessive energy consumption by commercial and domestic premises fail to recognise this complexity consequently they have failed to deliver their energy saving targets.

From their survey of US domestic energy users Attari *et al.* (2010) support this explanation that poor rates of energy efficiency are due to policy failures. The research finds the main reason policies and incentives promoting energy efficiency fail is the policy makers' lack of understanding of energy decision making. The researchers consider the paucity of data to evaluate the impact of policies; the inaccessibility of information and the fact that sources of information are considered untrustworthy have all contributed to this. Policies consequently remain remote from the households surveyed.

Ockwell, Whitmarsh and O'Neill (2009) and Roodhouse (2007) suggest that the poor adoption rate of energy conservation measures is due to the inappropriate use of policies to drive change. Ockwell, Whitmarsh and O'Neill (2009) conclude that policies implemented to encourage voluntary action have not worked. Similarly Roodhouse (2007) argues that carbon taxes have proved to be ineffective and inequitable, and that emissions trading, information campaigns and policies to increase energy efficiency may be insufficient to halt the increasing demand for energy.

Both Kelly (2010) and Warde (2010) consider high rates of energy inefficiency are due to historical economic growth not driving consumption reduction through the development of energy efficient technologies. Kelly (2010) attributes this to technology improvements having failed to overcome increases in energy demanded from a growing building stock and the huge expansion in electrical appliance ownership.

Warde (2010) considers reliance on energy intensive industries and voluntary activities to deliver Government targets is unlikely to be successful. These industries have largely been exported to benefit from less stringent energy regulations elsewhere and reliance on voluntary actions have, to date, proved to be poorly supported. The CBI (2013) considers that has left a UK SME sector that has largely been excluded from the energy policy framework.

In an alternative explanation to those described above, Grubb, Haney and Wilde (2009) consider finance to be the key determinant of energy management. They consider costs to improve energy efficiency and the lack of skills available, particularly within SMEs, have ensured that energy bills remain as a 'written off incidental cost' (2009: 15). Sub-division of the total non-domestic building sector allows Grubb, Haney and Wilde (2009) to identify opportunities largely ignored by SMEs. The research concludes that this sector has between 15% and 25% cost savings available from adopting energy efficient actions, a figure that is second only to the large energy intensive organisation sector in the scale of efficiency improvements. More than two-thirds of these savings are in activities not related to production.

Schleich and Gruber (2008) also consider access to finance a key determinant of energy efficient behaviours. They find that within smaller organisations energy is considered an unimportant overhead so is largely left unmanaged. Instead firms concentrate investment in core business processes which limits their willingness to invest in energy saving.

Decision-making within smaller organisations also depends on the power of energy decision makers and so can follow patterns of personal preference. Cost effective but lower profile energy savings can therefore be easily shelved.

RWE Npower (2013) considers poor adoption rates of energy efficiency are due to lack of finance available to fund energy improvements. The survey finds most UK SMEs focus on turning off equipment to reduce energy consumption and educating staff to do so. Consequently only small reductions of less than 10% have been achieved. This is attributed to the lack of up-front investment. The number of businesses reporting a reduction in energy use fell in the 2013 survey although causes of this are not identified. Two thirds of survey respondents believe the Government and/or energy companies should fund installation of energy efficient equipment.

Bright (2010) considers current energy performance of non-domestic buildings from the perspective of the CRC scheme. With cost effective technologies readily available the research concludes that economic factors alone cannot explain this widely recognised slow rate of adoption of energy efficient materials and behaviours. Instead Bright (2010) suggests that as energy costs represent only c. 1-2% of an organisation's overheads they are not significant enough to command management attention and not large enough to change energy behaviours. Delay (2013) agrees that at 1-2% of overheads energy savings appear small relative to the overall cost base of a UK business so will frequently be overlooked. This supports the hypothesis of Schleich and Gruber (2008) that energy is considered an unimportant overhead so it is frequently ignored.

The cost to comply with CRC is likely to exacerbate the tension in landlord-tenant relationships and does little to improve the split of improvement incentives. In fact the regulation only gives tenants a duty to co-operate with landlords. Bright (2010) concludes that this is likely to have little impact on relationships as most leases give landlords no legal right to influence a tenant's use of energy.

Bright (2010) also considers the structure of commercial leases contributes to poor adoption of energy efficiency activities. Despite the availability of cost effective, energy efficient technologies the terms of leases generate split incentives that effectively discourage any investment being made to improve energy performance. Hinnells *et al.* (2008) also consider the lack of energy saving activities is due to terms of commercial leases, particularly relationships between the landlord and tenant driven by them. The researchers find that commercial lease structures do not support energy efficiency in building use. At best they largely ignore energy performance and at worst they actively hinder the adoption of potential improvements.

DeCanio (1993) recognises that profitable energy efficient products and behaviours are frequently ignored. Although this was proposed in 1993 it remains a feature of energy consumption and management in both domestic and non-domestic settings and is still a focus of research today. DeCanio (1993) considers lack of energy investment is due to a paucity of information on financial benefits and payback periods to support energy investment decisions and concludes that without sufficient information energy projects may not appear to support corporate strategies even if they ultimately prove to be cost effective. Projects with a known rate of return will be selected in competition for limited investment funds even if they offer longer payback period.

Janda (2011) disagrees with the findings of Brohmann *et al.* (2009) that energy attitudes and behaviours contribute little to the use of energy and those of Schleich and Gruber (2008) that lack of finance is the key determinant of poor rates of energy efficiency adoption. Instead Janda (2011) concludes a lack of understanding of how people expect to use buildings has prevented environmental education programmes being put in place to teach users how to save energy. Profitable energy efficient investments can therefore frequently be ignored. Janda (2011) finds this feature of energy consumption and management in both domestic and non-domestic settings and concludes that existing educational and information programmes have not driven reduction in energy consumption to date and additional new communication in a similar style is unlikely to make a difference.

Axon *et al*. (2012) consider that the large number of stakeholders including solicitors, investors, developers, agents as well as owners and tenants add complexity to the process of energy improvement and limit the adoption of efficient technologies. This complexity comes from the different levels of control over change, interest and investment within the building. In addition the authors see that an organisation's structure, size and interests will determine how energy efficiency is addressed.

The UK Green Building Council (2011) hypothesises that lack of good data on energy use prevents organisations developing a clear case for investing in energy efficient refurbishment and energy reduction strategies. The research finds that commercial landlords have significant reservations over the effectiveness of DECs to provide this information and that encouragement from reputational drivers such as publicly displayed poor energy efficiency ratings and price signals such as the promise of lower building running costs is insufficient to reduce energy consumption.

Fawcett (2010) considers the lack of technical advice regarding improvement opportunities is another significant cause of energy inefficiency and a key explanation for sub-optimal energy investment behaviour. This is found particularly within small firms. de Groot, Verhoef and Nijkamp (1999) support this view, suggesting a knowledge gap in small companies proves a significant barrier to investment in energy efficient technologies. This is tested further in this thesis.

Clarke *et al.* (2008) consider the current non-domestic building sector's poor energy performance is due to a lack of energy awareness in building designers, owners and occupants and unwillingness of energy users to accept and implement energy efficient technology. Johnson Controls (2013) supports this view and considers the lack of in house expertise a key cause of energy inefficiency. Their survey finds that only 13% of respondents have energy knowledge to manage energy conservation in house.

In common with other researchers Lorenzoni, Nicholson-Cole and Whitmarsh (2007) find an individual users' lack of knowledge and lack of energy awareness prevents energy efficiency actions being implemented. This is enhanced by the perception of a lack of action by Government and business, prioritisation of financial concerns over environmental ones and energy habits. Together these have created the energy attitude-behaviour gap.

Revell, Stokes and Chen (2010) challenge this explanation of low rates of energy conservation. They find access to information is not a significant cause of poor rates of energy efficiency adoption as Fawcett (2010) and de Groot, Verhoef and Nijkamp (1999) believe. With only one third of respondents to their survey considering the level of information received to be a barrier to change, Revell, Stokes and Chen (2010) conclude that information is not a significant barrier to energy efficiency improvements. Despite this there is still a lack of progress towards energy conservation, which suggests that relying on SME managers, who only manage energy as part of their role, to obtain information and make voluntary energy changes may not be an appropriate policy.

In addition to the explanations described above, Schmidt and Fonseca (2007: 54) believe the gap between actual energy usage and 'responsible consumption' is due to an individual's need to be recognised as a member of a higher income social group. The researchers find that, even where users have knowledge of potential improvements, this is more important than energy saving, and recognise that knowledge, attitudes and values do not automatically deliver energy saving behaviour. The desire of domestic energy consumers to have their social status recognised, for example by their higher energy consumption, usually takes precedence, determining energy behaviour.

Herring and Roy (2007) consider that energy users' behaviour has prevented reductions in energy consumption thus reinforcing the energy efficiency paradox. The researchers find that widely recognised poor uptake rates of energy efficient products in the UK are often due to consumers' social, economic and functional needs not being considered during their development. Low rates of energy saving are also partly due to consumers not using efficient technologies in an energy saving manner, a factor that Warde (2007) considers critical to overcome the UK's lack of energy efficiency. Long-term increased levels of consumption soon dwarf short-term energy conservation savings. This pattern is hard to alter as changing behaviour cannot be forced by financial incentives and regulation, as it demands changing a person's lifestyle.

Unlike researchers citing users' behaviour as the cause of energy inefficiency Brohmann *et al.* (2009) find that energy users' environmental attitudes contribute very little to their actual use of energy. The researchers find that finances, peer pressure and cultural preferences combine to create energy users who act as barriers to their own energy efficiency. These barriers are exacerbated where organisations lack resources to prioritise energy efficiency. Brohmann *et al.* (2009) conclude that financial considerations and economic incentives are more important in determining energy behaviour than personal attitudes and values. This can be used to structure opportunities to change energy behaviour.

In a similar challenge to behavioural causes of energy inefficiency both Weber (1997) and Attari *et al.* (2010) seek alternative explanations. Weber (1997) attributes the poor adoption rates of energy efficiency to barriers from political institutions, market barriers, barriers within organisations and behavioural barriers. Although these are identified, there is no attempt to identify solutions to overcome them. Attari *et al.* (2010) find that most survey respondents underestimate their energy use and therefore the potential savings, which limits the likely adoption of energy efficiency behaviours and actions as it skews cost, benefit calculations. Other researchers do not raise underestimation of energy consumption as a factor influencing energy behaviours.

The most consistent explanations for the poor rates of adoption of energy efficient behaviours and actions found within the literature are the lack of investment available to fund improvements and information available on energy saving opportunities. In reality it is unlikely that one single cause of energy inefficiency should be identified as each user will be influenced by a complex mix of different attitudes, values, resources and property ownership as well as the intricacies of the energy market. The opportunities proposed to overcome these are explored further below.

2.6 Critique of proposed opportunities for the improvement of energy efficiency

There is a general consensus amongst research reviewed that low rates of the adoption of energy efficiency behaviours and technologies need to be overcome to deliver carbon emissions targets to mitigate climate change. Despite recognition by both academics and energy professionals, less than half of the research reviewed here proposes solutions to raise the implementation rates of energy conservation. Increases in the provision of information and additional Government interventions are the opportunities for improvement most frequently proposed. These are considered in more detail here.

Only Kelly (2010) and Schmidt and Fonseca (2007) consider social pressure a potential opportunity to generate a greater acceptance of energy saving. Kelly (2010) suggests that a change of attitude towards energy efficiency would be achieved by making profligate use of energy anti-social, so that individuals favour exploiting technology interventions rather than avoiding them. Kelly (2010) used the change of attitude towards drinking and driving as evidence that such behavioural change is possible. However, the lack of energy conservation advocates identified by their research suggests the influence of social pressure is limited. This may be a missed opportunity. If individuals can be encouraged to take their environmental attitudes to work, pressure on organisations to make energy changes may be developed. The potential for social pressure to motivate energy improvements is considered further in the research undertaken for this thesis.

Hinnells *et al.* (2008) propose harnessing expectations of tenants and landlords to guide change. New environmentally efficient buildings are likely to be sought by tenants wanting energy friendly premises and by owners wanting higher valued assets that can attract higher rental changes. The research predicts poor energy performance is likely to affect a rental property’s capital value. Methods of exploiting these expectations are not proposed.

Bright (2010) considers the CRC Regulation a route for change. Research findings suggest a change to lease terms requiring the tenant to contribute to the cost of CRC may be the only way to encourage both landlords and tenants to invest in energy efficiency or overcome the split incentives that limit the CRC scheme’s potential to succeed in reducing energy consumption.

In proposing the need for future policy intervention, the Carbon Trust (2013c) concludes that UK Government support for innovation can fill gaps created where the market is failing to deliver strengthened policies to incentivise change. The research suggests that strong public sector energy efficient behaviours would set an example for the private sector and generate demand for lower cost energy friendly building products. Additional

Government intervention in the form of a carbon emissions tax based on a self-assessed carbon footprint is expected to generate demand for energy efficient materials. In turn this is expected to reduce prices and so further encourage their adoption in both domestic and non-domestic buildings.

In a similar proposal Kelly (2010) suggests that national and local Government renovations costing £10 billion per year could be used to drive changes that would develop the retrofit market by increasing demand for lower cost energy friendly building materials. As the Carbon Trust (2013c) predict, this increased demand for energy efficient materials would further reduce prices and encourage greater implementation. McAlllister, Quartermaine and McWilliams (2009) support this view and use their position with the Investment Property Forum audience to propose additional voluntary investment in energy efficiency as the best route forward. The research claims that bringing a non-domestic building up to market standards for energy efficiency achieves a considerable energy consumption reduction of c. 25%. Limited additional investment will increase these savings to c. 50%.

Whilst Ockwell, Whitmarsh and O'Neill (2009) support the importance of Government intervention they link this to the need for a greater regulatory approach. The researchers question the value of participatory approaches in response to the scale and urgency of carbon emissions reduction, favouring regulations that encourage permanent behaviour change. Ockwell, Whitmarsh and O'Neill (2009) suggest that using communication to encourage demand for additional regulations would generate energy users' engagement with energy reduction whilst facilitating acceptance of regulation. Routes to achieve this are not discussed. The use of regulations to motivate energy efficiency and conservation is explored further in this thesis.

DeCanio (1993) concludes the difference between energy efficiency improvements adopted and what could be is due to poor information and control. The research concludes that if Government policies are restructured significant improvements in investment for energy efficiency could be achieved and expects that Government attention will overcome organisational inertia. By providing additional information on energy technology the Government will encourage private investment to be made, reduce the principal-agent problem and eliminate internal barriers within organisations. However, hindsight has shown that in the two decades since this research was conducted the adoption of energy efficiency has not achieved the usage rate reductions required even with the increasing Government intervention experienced.

Lorenzoni, Nicholson-Cole and Whitmarsh (2007) conclude that both additional regulatory actions and communication are required to drive changes to energy behaviour. Current policies have failed to deliver energy conservation as personal and social barriers have been encountered. New policies to move people out of the "comfort zone of carbon-intensive living" are required (2007: 456). No further details of policy content, expectations of how they will generate different responses or suggestions to close the attitude-behaviour gap are proposed.

Although Roodhouse (2007) proposes further Government intervention, a different approach is taken. The research considers energy rationing is the only effective politically driven method of cutting consumption. Politically, consumption reduction is the least favoured opportunity to cut carbon emissions as it demands a change to people's lifestyle. Energy efficiency and low carbon energy are, however, politically acceptable. Taxation may be an option if time were not a critical issue but the speed with which carbon emissions must be cut leads Roodhouse (2007) to conclude that rationing is the only answer.

Improving users' energy awareness is proposed by a number of researchers as the key to reducing energy consumption. Clarke *et al.* (2008) consider that engaging energy users with the largest consumption within buildings through education and understanding of technologies is the most appropriate way to generate energy efficiency improvements. Technology focused solutions should be supported by a culture of energy awareness and widespread monitoring of the building's energy use for maximum impact. Without the cascade of information and a checking process to monitor progress, change is not likely to happen.

Janda (2011) proposes education as the key opportunity to deliver energy savings. Building users should be educated to take responsibility for energy conservation including using their buildings in ways that generate responsible consumption. The research concludes that increased understanding of how people use and expect to use buildings could lead to an education programme that would teach energy users how to save energy.

Brohmann *et al.* (2009) disagree with the importance of information for energy improvement. They consider that existing educational and information programmes have not driven reduction in energy consumption to date therefore new communication in a similar vein is unlikely to make a difference.

Both the UK Green Building Council (2011) and Smid and Neiboer (2008) propose a different route to achieve energy efficiency improvements, one that gives responsibility for energy conservation to building owners and tenants rather than just tenants as suggested by Janda (2011). In an attempt to encourage collaboration both research groups propose extending the use of EPCs and DECs to provide information that incentivises building owners and users to reduce energy consumption. Smid and Neiboer (2008) recognise the value of EPCs for professional landlords in providing knowledge of their assets' energy performance and opportunities to improve asset values. The researchers also see EPCs as a tool for energy communication with tenants. Although this view is developed from the perspective of housing landlords losing financial support from the Dutch Government, it may have value for UK non-domestic building owners. Collaboration between owners and tenants as an opportunity for energy improvement is explored further in this thesis.

The UK Green Building Council (2011) considers DECs the most appropriate way to incentivise building owners and users to collaborate to reduce energy consumption. This is justified through consideration of the advantages available to commercial landlords. If organisations measured and reported energy use there would be a level playing field to judge energy performance. Reputational benefits could be gained by organisations showing improved energy performance and the value of buildings would increase with periods of no occupation reduced through signalling the higher quality of energy efficient buildings. Whilst this will contribute to energy efficiency improvement it excludes the tenants' potential to contribute. As other researchers have identified the opposition to DECs the validity of this research must be questioned.

Axon *et al.* (2012) propose that improvement to the energy efficiency of commercial property is only possible through engaging the owners, managers and occupiers to work together to create environmental synergies. This is considered the only route to overcome factors at the organisational level that prevent the adoption of energy-saving technologies and practices.

Stephenson *et al.* (2010), however, propose collecting user information rather than providing it to generate energy improvements. They propose an Energy Cultures Framework to provide supply side opportunities and include the example of energy suppliers using the tool to understand customer behaviour and so better tailor tariffs for them. This is an opportunity not considered by the other research reviewed here.

A few of the opportunities described above have been taken up by the Government to extend information support for voluntary improvements and to strengthen the regulatory environment to incentivise change. However, none of them have delivered the energy efficiency improvements and behavioural changes that are hoped for. This thesis therefore takes a different approach.

2.7 Knowledge gaps identified from energy literature

This review of energy literature has identified a number of research gaps that support the scope of this thesis. Some of these have been recognised by the researchers themselves, others through the analysis of literature undertaken. The structure of approaches to research above is used to organise knowledge gaps to clarify where further research is required. These are: technology, behaviour and finance. In addition gaps in building ownership research and policy are also discussed.

Janda (2011; 2013) recognises that energy literature on existing buildings remains scarce. Like McAllister Quartermaine and McWilliams (2009), the research finds exploration of energy efficiency to date has largely ignored solutions to retrofit existing buildings as an opportunity to reduce energy consumption. This knowledge gap can also be identified within the work of Kelly (2010). The need to exploit energy saving from retrofitting existing buildings is a key driver for this thesis.

Janda (2009b) also recognises the need to increase awareness of drivers of energy consumption and consumption reduction. Of the 13 research initiatives reviewed, only three consider the factors controlling or influencing energy consumption and only one researches consumption reduction. This thesis aims to help close this knowledge gap in energy attitudes and behaviours.

From the review of the legal aspects of energy management and building ownership, Bright (2010) finds that energy research largely excludes attitudes and behaviours of building users, a research gap that has also been identified by other researchers including Stephenson *et al.* (2010) and Fleiter, Worrell and Eichammer (2011). Despite recognising the importance of understanding energy behaviour researchers have not contributed to closing this gap. This thesis attempts to do this.

Both Axon *et al.* (2012) and Janda and Killip (2010) recognise a research gap in the socio-technological approach to energy efficiency improvement. Both recommend further research is undertaken to establish how socio-technical frameworks, that is the relationships between landlords and tenants underpin the process by which new technologies are deployed in practice. Axon *et al.* (2012) target further research into multi-tenanted non-domestic properties and identify a need to understand the division of responsibilities around decision making to enact change. Janda (2011, 2014) extends this to recommend the inclusion of owner-occupier commercial premises. This thesis contributes to closing these gaps.

An understanding of energy behaviours above the scale of domestic users emerges as a knowledge gap from the research conducted by Stephenson *et al.* (2010). Greater knowledge of energy use and constraints to adopting activities to conserve energy within non-domestic buildings will give greater clarity to opportunities for SMEs to benefit from energy efficiency. Similarly de Groot, Verhoef and Nijkamp (1999) identify this information gap in small companies and consider it represents a significant barrier to investment in energy efficiency technologies. This thesis attempts to close this knowledge gap.

Revell, Stokes and Chen (2010) support the view that SMEs are important in the drive to increase energy efficiency. The need for further research into behaviours of small commercial organisations to help overcome their environmental inertia is highlighted. Further research is recommended to identify ways to overcome SMEs' resistance to energy change and incentivise them to participate in positive energy conservation. This thesis attempts to close this gap.

Ockwell, Whitmarsh and O'Neill (2009) acknowledge the limited value of their research and recommend further research is conducted into people's engagement with climate change to identify opportunities that could be used to improve the acceptance of energy conservation. Fleiter, Worrell and Eichammer (2011) also recognise this gap in understanding energy behaviours, particularly the need to further explore factors that influence decision-making. The researchers suggest the need to consider these factors that influence the behaviour of commercial organisations. This thesis aims to help close this knowledge gap through the analysis of SMEs' adoption of energy improvement opportunities.

Attari *et al.* (2010) consider that energy consumers' behaviour conforms to economic theories of rational choice when using energy. This fails to consider differences in decision-making between energy users and the variation of barriers faced by them. This literature review has identified the need for further investigation into potential drivers of energy conservation, which this thesis incorporates. Utilising this knowledge to design bespoke energy conservation activities will increase the engagement of individuals, groups and organisations.

McAlllister, Quartermaine and McWilliams (2009) consider research into actions that trigger landlords' energy efficiency investments and non-domestic buildings as energy investment opportunities have been neglected. The research highlights the need for further investigation of barriers to energy efficiency generated by the widely recognised adversarial relationship between landlord and tenant. Routes to close these investments and knowledge gaps using tried and tested technologies would allow landlords to directly benefit from energy enhancements. This thesis provides this.

A knowledge gap has emerged regarding barriers to energy efficiency. Only a few researchers for example the Carbon Trust (2013a), Schleich and Gruber (2008) and Smid and Neiboer (2008) adequately consider the wide variety of these barriers and the context they operate in or propose bespoke policies to overcome them. This thesis aims to deliver the additional research required to understand and explore the impact of these barriers and identify solutions to overcome them.

This literature review has also recognised a number of generic research gaps. Whilst the researchers agree there is a significant gap between energy improvements that are cost effective, technically possible and retrofit feasible, few have put forward practical solutions to close this energy paradox. Non-domestic buildings and their energy inefficiency have lagged behind residential properties as a target for research and where they are considered the focus is on intensive energy users. Despite SMEs offering a valuable pool of untapped conservation opportunities researchers have largely excluded them. Drivers of energy efficiency and barriers to adopting them are identified by many of the researchers although a gap in the understanding of how to address them remains. Together these leave a knowledge gap requiring further research to understand potential solutions and implementation plans. This thesis aims to deliver this.

CHAPTER 3: UK ENERGY POLICY LANDSCAPE

3.1 Introduction

Despite the adoption of long-term carbon reduction targets, Energy Policy based on provision of information and encouragement of voluntary good practice is implemented as a short-term Government objective. A timeline of UK Energy Policy is shown in Appendix 1. Since the first energy demand reduction policies were established in 1974 in response to oil price rises, layers of regulations and initiatives have been added leaving an Energy Policy landscape that is complex, confusing and cluttered. Harvey (2012) considers this has simply added to the cost burdens for organisations operating within it. These complexities, coupled with differences in policies between devolved Regional Governments, have contributed to the overall failure to cut carbon emissions in line with climate change mitigation pathways. Gault and Thompson (2014) calculate 2013 emissions are below 1990 levels but need to fall a further 73% to meet 2050 targets. Although 13% reduction in carbon emissions during the Carbon Budget period of 2007-2012 has been achieved this was largely due to the recession and the shift to less carbon intensive industry. Gault and Thompson (2014) estimate only 0.4% of this was achieved through energy conservation measures.

The large number of initiatives and regulations applying to non-domestic building owners and tenants, shown in Table 3.1, has been introduced in a piecemeal fashion creating a complex energy policy landscape of incentives and disincentives that operate independently. Spencer (2012) considers this has proved unsuccessful in significantly reducing energy use or carbon emissions as they have been implemented with a stealth strategy in an attempt to avoid conflict with Parliament, media and low carbon sceptics. As long as this continues energy efficiency and conservation will remain unconventional and unexploited business opportunities.

This review of Energy Policy will establish the regulations currently applicable to the UK SME population and those planned to be introduced in the next year in order to provide a legislative context for this research. Energy Regulations applying specifically to utility companies are excluded. It is then followed by a review of schemes and initiatives that have been established to encourage voluntary adoption of good practice in energy efficiency and conservation, the cornerstone of Energy Policy.

Table 3.1 UK Energy Policy Landscape

Energy Regulations and Incentives	Introduction	Mandatory or voluntary requirements?	Company Size			Building Type		Building Use			Property Ownership		Comments
			SMEs	Medium Organisations	Large Organisations	Existing Buildings	New Buildings	Commercial Buildings	Residential Buildings	Public Buildings	Building Owners	Tenants	
Energy Saving Opportunity Scheme	**Jun-14**	Mandatory	✓	✓	✓	✓		✓			✓	✓	Requirement for organisations employing >250 and/or turnover >£42m to conduct energy audit by December 2015.SMEs operating as branch of larger organisation will be required to comply.Aim is for companies to voluntarily act on information obtained. ESOS does not apply to public sector organisations.
Greenhouse Gas Reporting Scheme	**Oct-13**	Mandatory	✓	✓	✓	✓	✓	✓				✓	All UK incorporated companies listed on the main market of the London Stock Exchange, a European Economic area market or whose shares are deling on the New York Stock Exchange or NASDAQ are required to report on their greenhouse gas emissions as part of their annual Directors' Report.
Energy Act	**2011**												
The Green Deal	**Jan-13**	Voluntary	✓			✓			✓		✓	✓	Awaiting release of Green Deal for non-domestic buildings
Energy Company Obligation	**Jan-13**	Mandatory				✓			✓				Funded and administered by energy suppliers. Funding is provided for improvements to social housing and hard to heat properties in order to reduce fuel poverty.
Minimum energy efficiency standards	**Jul-05**	Mandatory	✓	✓	✓	✓	✓	✓	✓		✓		Imposed minimum energy efficiency standard for domestic and non-domestic rental properties from April 2018. Provisionally set at energy rating 'E'.This does not apply to public buildings.
Energy Act	**2008**												
Smart Meters	2015	Mandatory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Obligation for energy companies to fit smart meters to 80% of all properties by 2020.
Feed in Tariffs	Apr-10	Voluntary	✓	✓	✓	✓	✓	✓	✓		✓	✓	Payments for each unit of electricity generated.
Renewable Heat Incentive	Nov-11	Voluntary	✓	✓	✓	✓		✓	✓		✓	✓	Payments for each unit of heat generated.
Energy Performance of Buildings	**2008**												
EPCs / DECs	2008	Mandatory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DECs are required for public buildings over 1000m2 in area and need to be produced every year. EPCs are required for non-domestic buildings over 500m$^{2.}$
Air-conditioning inspection	Jan-11	Mandatory	✓	✓	✓	✓	✓	✓			✓	✓	Units >12kW require inspection and performance reports to be conducted by qualified assessors.
CRC Energy Efficiency Scheme	**2010**	Mandatory		✓	✓			✓		✓		✓	A mandatory carbon emissions reporting and pricing scheme to cover all organisations in the UK using more than 6,000MWh per year of fuel.
Building Standards													
Building Regulations	**2010**	Mandatory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Set out minimum standards for building energy efficiency for all new buildings and some renovations.
BREEAM	1990	Voluntary	✓	✓	✓		✓	✓		✓	✓		BREEAM is an environmental assessment method and rating system for building design, construction and operation.
Code for Sustainable Homes	2007	Voluntary					✓		✓				National standard for the sustainable design and construction of new homes to reduce carbon emissions.
Enhanced Capital Allowances Scheme	1997	Voluntary	✓	✓	✓						✓	✓	Discount against tax can be claimed for investmetn in energy efficient equipment.
Climate Change Levy	2001	Mandatory	✓	✓	✓						✓	✓	Tax on supply of electricity, gas and coal for use as fuel for heating, lighting and power by commercial customers.
Climate Change Agreements	2006	Voluntary			✓						✓	✓	Allows eligible energy-intensive businesses to receive up to 90% discount from the Climate Change Levy in return for meeting energy efficiency or carbon-saving targets.
EU ETS	2005	Mandatory			✓			✓			✓	✓	Limit ('cap') placed on total emissions from relevant installations. Installations obliged to surrender sufficient allowances to cover their emissions and could buy additional allowances or sell any surplus. 'Cap' will decline by at least 1.74% a year, so emissions in 2020 will be at least 21% below their level in 2005 (Carbon Trust: 2013).

3.2 Energy Regulations

3.2.1 Energy Act 2012

The Energy Act 2012 is the latest in a sequence of energy legislation that has been passed annually in the UK for almost 40 years. It is expected by the Department of Energy and Climate Change (2014b) to make a step change in the accessibility of energy efficiency measures to homes and businesses, make energy data publicly available, increase generation of low carbon energy and encourage rational economic competition within the energy market place.

The Act relies on traditional economic theory encouraging individuals to voluntarily undertake energy improvements in response to improved availability and understanding of energy data. However, the poor uptake of the Green Deal must question whether this long established approach is valid.

The Energy Act 2012 has introduced a number of key initiatives that may offer opportunities to SMEs. These are briefly discussed below.

3.2.1.1 Green Deal

The Green Deal, introduced on 1st October 2012, is the 'opt-in' framework for energy efficiency, which is planned as the core of both long-term and short-term energy policies for both domestic and non-domestic energy consumers in England and Wales. Spencer (2012) suggests the scheme can be seen as the biggest transformation of the UK's energy system since the 19th Century. However, it could also be seen as simply rebranding existing incentives and loans to promote increases in the adoption rates of established and proven energy efficiency improvements.

It aims to incentivise energy consumers to improve energy efficiency of domestic and, in the future non-domestic properties, by providing up front funding for approved energy efficient products such as loft and solid wall insulation. To ensure those benefitting from the improvement repay the loan, the Green Deal charge is attached to the building not the consumer. Repayments are made through a charge on the energy bill. This charge transfers to the new tenant if there is a change in occupancy or to the new energy bill if there is a change in energy supplier. Although this can be in place for up to 25 years the Green Deal holds the principle that charges will be less than the energy savings available.

Statistics to date suggest that the Green Deal is not addressing energy efficiency and conservation issues as expected. The Department of Energy and Climate Change

(2014b) confirm that despite increasing levels of cash back incentives the loan scheme implemented only 1180 of the 210,000 Green Deal Assessments undertaken in the first 14 months with only 20 Green Deal providers selling plans using Green Deal Finance. Greenwise (2014) estimate that if these rates of progress continue it will take 200 years to deliver targets to improve the energy efficiency of 14 million homes. Spencer (2012) believes this flagship energy efficiency scheme is unlikely to succeed as the Government is trying to achieve it by publicising it as little as possible.

As yet the Green Deal has not been released for non-domestic properties. Modern Building Services (2014) consider that compliance with the minimum energy property standards introduced by the Energy Act 2011 is unlikely to be achieved without it. These standards are discussed below. However, if the residential Green Deal is released for non-domestic properties it will be inappropriate as it applies long-term loans for energy efficiency improvements that are misaligned for the short-term tenures that increasingly apply to non-domestic building leases and rental contracts. The effectiveness of loans as a driver of energy efficiency and conservation within SMEs is discussed in detail in Chapter 5.

Although the Government are putting their full weight behind this policy it may be for political gain as much as for environmental benefit. From June 2014 the cash back incentives were increased, offering rebates of up to £7200 in an attempt to rejuvenate the programme, incentivise customers and improve rates of uptake. However, Green Deal loan rates remain higher than commercially available finance rates and are not to be released to SMEs for the foreseeable future.

3.2.1.2 Energy rating standards of rental properties

The Energy Act 2012 also attempts to promote energy efficiency within non-domestic and domestic rental properties by imposing minimum energy efficiency standards from April 2018. This is provisionally set at an Energy Rating of ‘E’. Without evidence of this minimum energy rating it will be unlawful to offer a property for rent. However, no details are released of how this is to be monitored or whether it will apply to new tenancies only.

There are a number of inconsistencies and conflicts that remain unresolved. For example, in an ‘E’ rated building where a tenant purchases their energy directly from the utility company the owner must upgrade the property before it can be let. If this is financed through the Green Deal the tenant will be responsible for repaying the loan through their energy bill.

Until 2018 there is nothing planned other than the Green Deal to incentivise non-domestic building owners to make voluntary retrofit improvements and there is no visibility of a release date for this. Overall this questions whether the 2020 and 2050 targets are likely to be achieved.

3.2.2 Energy Act 2008

The Energy Act 2008 implemented a number of initiatives to incentivise energy conservation within non-domestic buildings to deliver national emissions reductions targets of 80% below 1990 levels by 2050 with an interim target of 34% reduction by 2020. These incentives include Feed in Tariffs (FiTs), Renewable Heat Incentive (RHI) and installation of smart meters, which are examined in more detail below.

3.2.2.1 Feed in Tariffs and Renewable Heat Incentive

The FiT and RHI schemes offer financial support for low carbon electricity generation and renewable heat generation. FiTs guarantee payment for small projects up to 5 megawatts and the RHI supports heat generated in any domestic or commercial premises. The Government has recently reduced the FiT incentive following unexpected, and therefore unaffordable rates of uptake by private consumers and business investors. A legal challenge and subsequent negative publicity adds further to concerns over Government Energy Policy credibility.

3.2.2.2 Smart Metres

Under the Energy Act 2008 energy companies were required to install smart meters in all domestic and smaller non-domestic buildings by 2013. This was then deferred to 2018. Following the established approach of UK Energy Policy, the Department of Energy and Climate Change (2013b) believe that the provision of additional energy information from these metres is expected to deliver a change in energy behaviour and increase competitive pressure on energy costs. However, there is no evidence that this will happen. A number of issues have emerged, once again promoting negative perceptions for large energy companies and Energy Policy. For example, incompatibility of meters emerged within the first 12 months due to the lack of a standard meter specification. This effectively tied consumers to their energy supply, as meters will not operate on competitors' systems.

3.3 Building Regulations

Until 2010 the energy efficiency requirements of the UK Building Regulations excluded existing buildings; rather they influenced incorporation of energy efficient materials and systems into new buildings. However, an update in October 2010 to Part L2B introduced mandatory energy efficiency into refurbishment of existing buildings of greater than 1000m^2 of usable floor space. The Department of Communities and Local Government (2014) expect 25% improvement in energy utilisation from this and predict that this change will only cost £5 million if applied to all retrofit targets. However, this still does not address the need for energy actions within existing non-domestic buildings that are not undergoing refurbishment or the majority of premises occupied by SMEs that fall below the Building Regulations threshold.

Dixon, Britnell and Watson (2014) consider the ability of Building Regulations to deliver reductions in non-domestic buildings' energy consumption is affected by the lack of both a robust monitoring system and a standard rating system to measure energy use.

The 2010 updates to the Building Regulations also introduced additional requirements for all new homes built after 2016 and non-domestic buildings built after 2018 to be carbon neutral. This follows the application of the Building Regulations so is similarly limited in scope and applicability for SMEs.

3.4 Carbon Reduction Commitment

The Carbon Reduction Commitment (CRC) Scheme was introduced in 2007 to address CO_2 emissions not covered by other legislation. It established the requirement for organisations consuming large amounts of energy to measure and report consumption annually. SMEs within multisite organisations complying with the scheme will participate.

Operational cost benefits and reputation enhancement from improved energy performance were offered as the rationale for CRC. Participants are required to purchase allowances to cover emissions for the previous year theoretically encouraging energy consumption reduction. However, this effectively allows organisations to choose whether to continue to use existing levels of energy by purchasing carbon credits or invest in energy efficiency to reduce their expenditure on allowances. An annual league table of energy performance is published to encourage competition between participants. Overall though, energy consumption reduction remains a voluntary activity.

CRC has received criticism from the business community for its excessive bureaucracy and inconsistent inclusion of organisations as well as changes to the terms of engagement. Initially the money raised from the purchase of allowances to cover emissions was to be redistributed to participants as a reward for their reduction in energy use. However, in 2010 the plan to return funds was cancelled and effectively CRC became a tax on the use of energy. Kelly (2012) considers that this has done nothing to encourage businesses to invest in energy efficiency.

3.5 Financial incentives

A series of tax incentives have been introduced in an attempt to incentivise organisations to adopt energy efficiency improvements. These general initiatives can apply to the owners and tenants of smaller commercial properties if they fall within applicable taxation thresholds. Examples of these financial incentives are described below.

- The ReEnergise Smart Fund has been established to incentivise SMEs to improve energy efficiency through the provision of commercial loans of between £25,000 and £250,000. Bateman (2012) considers that £5 million set aside to be leant at commercial banking rates is unlikely to generate significant energy efficiency and conservation improvements for the UK population of 4.99 million SMEs.
- The Climate Change Levy, a levy on the cost of energy delivered to non-domestic buildings, was introduced 2001 to incentivise reduction in energy consumption in non-domestic users. The Department of Energy and Climate Change (2014c) consider this an industrial, commercial and agricultural energy tax that applies to all commercial organisations above the size of a 6-bedroom house.
- The Enhanced Capital Allowances Scheme is designed to encourage businesses to invest in energy efficient equipment as they can deduct its cost from their tax liabilities.
- Through a Climate Change Agreement a large energy intensive user is able to negotiate a discount on the Climate Change Levy in exchange for commitment to reducing carbon emissions or improving energy efficiency.
- Commercial building owners are able to claim the Landlord's Energy Saving Allowance for the costs of buying and installing insulation within their properties.

3.6 Conclusion

Despite the adoption of long-term carbon reduction targets, Energy Policy is managed as a short-term political objective with frequent changes to energy legislation. Increasing layers of initiatives has left the current energy policy landscape bureaucratic and complex which can be costly for businesses to meet their obligations. Although policy has focused on taxes for large carbon emitters and energy intensive industries and financial incentives for domestic property, owners and tenants of smaller non-domestic properties have been left largely without incentive to conserve energy. This has created an energy policy gap. Successive governments have left energy efficiency and consumption reduction for these 4.99 million SMEs to market influences and relied on additional information to incentivise change. However, Kennett (2012) believes that to date energy consumption and carbon emissions have not responded positively to this approach. This thesis offers an alternative approach to Energy Policy that is based on drivers of energy efficiency and conservation for SMEs. This is considered further in Chapter 7.

CHAPTER 4: METHODOLOGY

4.1 Introduction

The methodologies described here were chosen to test the research hypothesis that ownership of non-domestic buildings controls the ability and willingness of owners and tenants to adopt energy efficiency and conservation opportunities and deliver the research aims and objectives described in Chapter 1.

To simplify the description of research methodologies implemented this chapter is split into five sections. Each section represents an element of research undertaken and explains research processes and activities chosen to deliver it. These are: firstly, review of literature; secondly, design of the ownership segmentation model; thirdly, collection of primary data; fourthly, analysis of research participants' data and finally, creation and implementation of the Scenario Planning Model. Each topic also includes its relevance to the research, rationale for approaches used and tools chosen, benefits obtained and alternatives considered. Potential bias and constraints on the research are also included.

The flow chart shown in Figure 4.1 summarises the research steps and the order in which they were taken. These will be described in more detail below.

4.2 Research targets

Existing non-domestic buildings within the UK, their owners and tenants were primary research targets for this thesis. Building owners are defined as either owner-occupiers, owners of an individual building or commercial landlords with multiple properties. Tenants are small and medium organisations from all commercial sectors. The only stipulation is that tenants should not own the premises they operate from. Those SMEs that both own and use their business premises have been classed as owner-occupiers and have been included in the data analysis as building owners. The term 'owner' is used to differentiate between those who own the building and those landlords or managers who may be employed to operate it.

This thesis uses the classification of SMEs set by the European Commission's Directorate-General for Enterprise and Industry (2005); small and medium commercial organisations with less than 250 employees and a turnover of no more than €50 million.

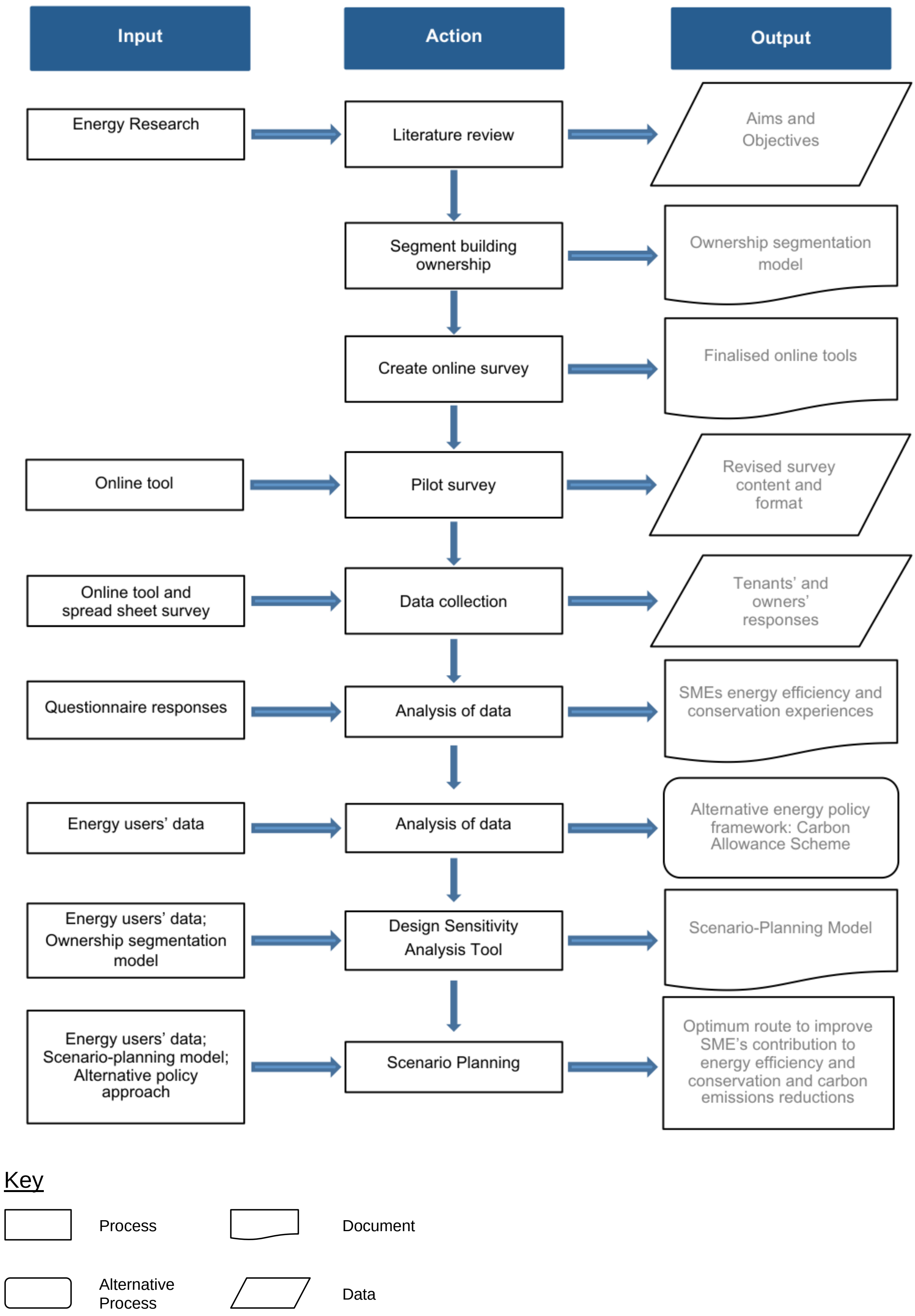

Figure 4.1: Flowchart summarising the order and relationship of research methodologies

The European Commission has established this sector on company size and turnover. However, this thesis excluded turnover, as it was not considered a significant characteristic of the organisations within this research, and used solely the size classification as the threshold for participation. Turnover was also excluded to protect confidentiality and encourage greater participation rates. Organisations with less than 250 employees were classified as an SME unless they operate from domestic premises. If they did, they were excluded, as they fall under the remit of residential Energy Policy that is outside the scope of this thesis.

Existing non-domestic buildings were targeted by this research as Energy Policy has largely ignored this sector as shown in Chapter 3, favouring energy reduction from energy intensive organisations, new buildings and residential properties to achieve national targets. Whilst energy efficiency of new and altered non-domestic buildings has been controlled by Building Regulations, the retrofit of smaller existing buildings has escaped Government attention so has remained a voluntary activity. As described in Chapter 2 the general agreement amongst energy researchers is that energy optimisation must be achieved in all buildings if national targets are to be met. This consensus supports the decision to focus on non-domestic buildings and UK SME sector that are affected by the energy policy gap.

4.3 Literature Review

The review of energy literature in Chapter 2 explored existing research into individuals' and groups' adoption of energy efficient technologies, behaviours and activities. Literature from a wide range of sources was examined to identify the extent of energy research undertaken by both academics and professionals to date. Articles, books, conference papers and reports were used to understand the extent of these behavioural, technological and economic analyses and to establish knowledge gaps left within the energy research landscape by these approaches.

Findings from the review of literature, particularly knowledge gaps identified, were used to develop the aims and objectives of this thesis. They have evolved since the research was originally designed as topics have become better appreciated and concepts validated.

In addition to the review of energy literature a critique of energy legislation was undertaken to provide a regulatory context for this research. The detailed historical development of Energy Policy was however, excluded as it has largely ignored SMEs and has been widely covered by other researchers.

A definition of the policy landscape was challenging. UK energy regulation and policy remains fluid with new European Commission Directives and national initiatives regularly being introduced. Legal challenges to initiatives added complexity and frustrated Government plans. Experiences gained from, and impacts of, these policies were considered in creating the alternative policy framework.

4.4 Design of building ownership segmentation

The research was designed to test the hypothesis that ownership controls the ability and willingness of non-domestic building owners and tenants to adopt energy efficiency and conservation. This implied participation rates in energy efficiency differed between owners and tenants, including varying levels of interest in energy management, willingness to invest in energy efficiency and ability to control building changes. A second implication was that different building ownership styles incurred different investment costs and obtained varying benefits from energy efficiency actions applied. Together these created a number of common energy characteristics that were demonstrated by building owners and tenants. These were used to identify homogenous groups within the overall non-domestic building sector.

This research sub-divided the buildings within this non-domestic sector into a number of distinct groups. However, unlike business sector used by Janda (2014) and building type used by Peacock *et al*. (2008) this thesis adopted a new criterion for segmentation; the shared characteristics of building ownership combined with the responsibility for the purchase of energy consumed.

Building ownership was selected as the criterion for the segmentation model as it is a driver of energy efficiency that has been excluded by other researchers and energy policy planners. Little progress to meet energy reduction targets had been achieved by existing policy approaches to date, suggesting an alternative approach was required. Ownership was hypothesised as holding the key to improving contributions to energy efficiency.

This new ownership segmentation model divided the UK SME population into 8 distinct segments characterised by features of building tenure and the purchase of energy to provide a detailed picture of UK building ownership and energy consumption. As each segment demonstrated similar characteristics members can be measured and targeted to obtain the best energy consumption and carbon emissions reduction return on investment. This was explored through scenario planning which is shown in Chapter 8.

Eight categories of non-domestic building ownership were identified:

a) **Building owner and tenant** – the tenant occupies the building as sole tenant in return for rental or lease payments; the tenant purchases energy from the utility company

b) **Building owner and user** – the owner is the user of the building; the owner purchases energy from the utility

c) **Building owner and franchisee** – the user occupies the building rent free providing a service on behalf of the building owner; the owner purchases energy from the utility

d) **Building owner and branch –** the building (owned or leased) is a separately managed unit within a larger, multisite organisation; head office purchases energy from the utility company

e) **Building owner and landlord –** the owner appoints a landlord to run the multi occupancy building and provide energy for common areas (recouped through service charge); the tenant purchases energy from the utility company

f) **Building owner, manager and tenant** – the manager runs the building on behalf of the owner(s); the building's manager provides energy for the communal areas (recouped through service charge); the tenant purchases energy from the utility company

g) **Building owner as the energy provider and user** – the tenant occupies the building as the sole tenant; the tenant purchases energy from the owner (recouped in the rental/lease payment)

h) **Building owner as a commercial investor** – the owners have no interest in the building other than as an investment; the tenant purchases energy from the utility company

Alternative analysis frameworks were considered. This included analysing each company individually or treating all SMEs as an homogenous group. These were discarded in favour of segmentation. The approach of ownership segmentation was selected as it allowed dominant factors influencing the adoption of energy efficiency and conservation to be identified and put energy management behaviours in the context of building tenure. It was also able to understand the ability of different groups to adopt energy efficiency and conservation opportunities. These are shown in Table 4.1.

Table 4.1: Impact of building ownership on energy consumption reduction

	Categories of non-domestic building ownership (energy bill payee shown in brackets)							
	'a'	*'b'*	*'c'*	*'d'*	*'e'*	*'f'*	*'g'*	*'h'*
	Building owner tenant (tenant from utility)	Building owner and user (owner from utility)	Building owner and franchisee (owner from utility)	Building owner and branch (head office from utility)	Building owner and landlord (tenant from utility)	Building owner, manager and tenant (tenant from utility)	Building owner as the energy provider and user (tenant from owner)	Building owner as a commercial investor (tenant from utility)
Low cost of energy as a business overhead	✓	✓	✓	✓	✓	✓	✓	✓
Split incentive for energy investment	✓		✓	✓	✓	✓	✓	✓
Lease terms restrict action possible	✓		✓	✓	✓	✓	✓	✓
Energy user does not see energy bill			✓	✓				
Competition for corporate investment funds	✓	✓		✓				
Corporate behavioural barriers		✓		✓				
Corporate financial barriers		✓		✓				
Lack of energy saving advocate				✓				
Disincentive to reduce energy use – energy provided to tenant			✓	✓		✓	✓	
Disincentive to reduce energy use – energy as labour replacement	✓	✓	✓	✓	✓	✓	✓	✓
Owner remote from day to day activities of building			✓	✓	✓	✓		✓
Access to energy efficiency information	✓	✓						

Treating all SMEs as a homogenous group was rejected, as they did not all respond in identical ways as would be required by this approach. A system of bespoke policies to improve adoption rates of energy efficiency and conservation was considered impractical. It was impossible to develop individual policies for each of the UK's 4.99 million SMEs. Grouping SMEs was a practical alternative allowing policies to be tailored to the common characteristics displayed by members of each segment.

4.5 Primary Data Collection

4.5.1 Participants

To maximise opportunities to deliver research aims and objectives, potential participants matching the scope of the project were selected. SMEs within owned or tenanted single or multi-site non-domestic business premises were requested to participate along with owners of a single non-domestic buildings or larger property portfolios.

Potential research partners were contacted directly and indirectly. Those identified from web searches, network contacts and previous research participant partners were contacted directly. Indirect contact with potential participants was made through colleagues and associates of direct contacts and social media forums.

4.5.2 Questionnaires

In order to gather sufficient primary data to ensure the effectiveness of the research, data collection was undertaken via a survey of UK SMEs and non-domestic building owners. This survey process was chosen to enable a large quantity of information to be gathered as efficiently as possible. Issuing surveys via a web-hosted tool was initially chosen to enable a large quantity of both quantitative and qualitative data to be collected, collated and analysed efficiently.

As data analysis was undertaken at the level of non-domestic building owner and tenant, the questionnaires were designed for this level of implementation. This not only provides information for individual owner and tenant analyses but also offers the opportunity to scale the information up to the level of an ownership segment and to the segment's population at the UK level.

Two questionnaires were created, one each for building owners and tenants. These are included in Appendix 2. Each survey had one question that is specific to that audience. For tenants this requested the ownership structure of their business premises, to confirm whether they were owner-occupiers, tenants or franchisees. For those participants responding to the building owners' survey this question asked whether investments will be made to the property to improve its energy efficiency or conservation measures when it next becomes vacant or the lease is renewed. Although they retained maximum similarity it was recognised that each group needed to be asked different questions to capture the different energy attitudes and approaches displayed by them. A common questionnaire would not have been able to achieve this. More responses from tenants were expected than from building owners, as the numbers operating in the tenant group were considerably higher than the number of building owners.

The choice of research tool was determined by the need to balance demand for comprehensive and detailed quantitative and qualitative information against the need to use a simple collection tool able to engage participants. A questionnaire using web hosted survey software was considered most likely to achieve this.

Although the web-hosted survey offered advantages such as ease of distribution, collection of responses and simplified data analysis through the download of auto-collated information, a number of disadvantages were recognised. These included a survey limit of 10 questions and traditional low response rates. However, with appropriate planning, targeting of participants to increase the likelihood of response and thoughtful question design these were considered to be manageable. Survey Monkey[2] was selected as the web host as it was free of charge, technically well supported and likely to have provided on-going access.

The researcher was responsible for tool design, primary data collection and analysis of participants' responses described below. It was therefore recognised that bias could be easily incorporated so every effort was made to avoid this by using neutral wording when designing the questions and an objective interpretation of responses.

Upon receipt of the pilot responses to the surveys it was recognised that adjustments to the survey format and question content were required. The initial pilot survey was conducted using known contacts. A number of concerns were identified including the quality of questions and ease of access to the web hosted survey. The low response rate also gave cause for concern. It was discovered that not all pilot participants had access to the online survey. To overcome this, the survey was converted to a spreadsheet that could be used electronically or as a postal survey if the online survey was not accessible or an alternate version preferred. The option of interview was also offered.

The pilot survey responses received also indicated that some questions were misleading and therefore generated responses that did not meet research needs. These questions were rewritten to correct this. Pilot surveys are excluded from the analysis of responses in Chapter 5.

[2] Survey Monkey online survey software is available from https://www.surveymonkey.com

4.6 Data Analysis

Analysis of all responses from the research participants was undertaken. No information received was excluded. Responses were used to build up both quantitative and qualitative pictures of participants' activities, attitudes and energy cultures, which delivered the first two of the research objectives. The collation of these responses provided a pattern of energy efficiency within SMEs and the understanding of energy attitudes and behaviours gained from this has formed the alternative approach to energy policies proposed. Together, these delivered the third and fourth research objective described in Section 4.1.

The research collected firms' data within an organisational context. Energy users' intentions, patterns of technology use and organisational impacts cannot be separated from the technological and organisational contexts they occur in. Responses were therefore evaluated with this context in mind to ensure findings were treated objectively.

Quantitative data was analysed through a series of spread-sheets, the results of which are presented graphically in Chapter 5 and discussed in detail. The information gathered has been analysed at the level of individual participant and ownership segment as well as being collated into owner and tenant groups. This allowed the results to be scaled up to reflect the UK population of 4.99 million SMEs. Qualitative data from participants' responses have been quoted verbatim.

A commitment was made to all participants to treat their information confidentially and to protect their anonymity through the use of reference codes in data analysis. Responses are coded with the prefix 'O' for responses from owners and 'T' for responses from tenants. These codes are used throughout the data analysis and presentation of results to ensure that any form of bias unintentionally added by the researcher or research process is minimised.

4.7 Alternative energy policy proposal

An alternative approach to energy policy to improve rates of adoption of energy efficiency and conservation opportunities by non-domestic building owners and tenants was proposed. Qualitative and quantitative information on the drivers of change identified through the research was used to design a new approach to Energy Policy. The proposed framework was based on the key factors that will motivate non-domestic building owners and tenants to adopt energy efficiency and conservation activities and behaviours.

This alternative policy approach, termed the Carbon Allowance Scheme, is presented in Chapter 7 with its' potential impact on reducing energy consumption tested using a Scenario-Planning Model presented in Chapter 8. This is described in more described in more detail below.

4.8 Scenario-Planning Model

Following the analysis of research participants' information and proposal of an alternative energy policy framework, sensitivity analysis of this alternative approach was undertaken using scenario planning. This demonstrated how ownership segmentation might be used to focus on, and prioritise efforts to improve adoption rates of energy efficiency and conservation within the UK SME population and non-domestic building sector. A Scenario-Planning Model incorporating a framework based on ownership segmentation established by this research was designed to undertake this.

The researcher constructed the Excel spread sheet based Scenario-Planning Model to explore potential financial savings available from the proposed alternative energy policy framework, the Carbon Allowance Scheme. No existing framework was available to undertake the tests required consequently a new model was designed. This showed the results as both normalised and actual financial outputs in numerical and graphical form. These normalised outputs represent data as a change versus the base value rather than showing actual values and have been used to compare energy consumption reduction scenarios. This is discussed further in Chapter 8.

A series of ten scenarios, each applying a different combination of savings rates and grant funding, were used to establish the potential financial and energy savings from the implementation of the Carbon Allowance Scheme. These are described in detail in Section 8.4. Annual energy usage and cost figures estimated from the annual fuel consumption figures provided research participants and fuel costs calculated by the Department of Energy and Climate Change (2013c) were input into the model for each ownership segment. These are described in more detail in Section 8.3.2 and 8.3.3. The segment's consumption figure was generated from the data provided by the research participants scaled up to reflect the segment population at the UK level. A standardised energy cost based on the prices of fuels established Department of Energy and Climate (2013c) for non-domestic users was used. These figures were input into the model to establish how the alternative policy framework might impact UK SMEs' energy consumption and energy saving potential and prioritise the introduction of the Carbon Allowance Scheme.

4.9 Conclusion

The methodologies implemented were chosen because they were most likely to deliver the aims and objectives of this research. In addition they were designed to fill policy and knowledge gaps left by previous researchers, Energy Policy and Government Planners which were identified within the review of literature and evaluation of regulations. Together these allowed the objective creation and management of data, the details of which are explored further in the next chapter.

CHAPTER 5: ANALYSIS OF SURVEY RESPONSES

5.1 Introduction

To structure the analysis, the participants' responses are discussed by total participant population and by owner and tenant sub-groups. The input from the research participants is also allocated to the ownership segments defined in Chapter 4. Where findings are scaled up to reflect the UK population, the baseline figure of 4.99 million SMEs calculated by the Federation of Small Businesses (2014) is adopted. To provide the context for the data collected companies responding to the survey are initially described. An analysis of the segmentation of non-domestic buildings is then undertaken in Section 5.4 and followed in Section 5.5 by the analyses of participants' responses to the surveys.

A summary of the key findings of the research is shown in Table 5.1. References in the final column indicate where the analysis can be found in this chapter. The detailed analysis of the participant's responses below follows the order used in the table.

5.2 Survey participants

Twenty-eight survey responses were received from participants. All were included in the analysis. Of the responses received 7 (25%) from building owners and 21 (75%) from tenants. All responses from tenants come from within the UK SME population. As far as possible owners leasing or renting to SMEs were sought as research participants. However, not all building owners can be confirmed as owners of properties occupied by SMEs. The size of premises owned cannot be directly correlated to the number of employees housed within the building, which is the measure of an SME organisation used within this thesis.

Figure 5.1 shows the business sectors from which the participants in this research have been drawn. They were established from participants' survey responses. The majority of research participants (63%) are from the service sector with leisure and manufacturing having fewer representatives at 23%, and 14% respectively.

Table 5.1: Summary of key research findings

Energy factor	Key findings	Section reference
Participants	28 survey respondents: 7 building owners (25%); 21 tenants (75%) 3 largest ownership segments: 1) Segment '*a*' - building owner and tenant; tenant buys energy from utility 2) Segment '*d*' - building owner and branch; head office buys energy on behalf of site 3) Segment '*i*' - Building owner and franchisee; franchisee buys energy from utility	5.2
Responsibility for energy management/improvement	39% of tenants and 25% of owners are responsible for energy improvements 18% of properties have no one responsible for energy improvements	5.5.2.1
Required responsibility for energy improvement	Sharing of responsibility is the preferred scenario overall No tenants want their building owners to take full responsibility	5.5.2.2
Relationship between owner and tenant with regard to energy consumption	50% of participants have relationships with owner/tenant that prevent improvements to energy efficiency and conservation: 36% have "preventative" relationships; 14% choose no involvement1. 100% owner occupiers and building owners choose no involvement	5.5.3.1
Expectations of future relationships with regard to energy consumption	71% expect tenants to increasingly demand energy efficient properties 50% of tenants consider it unlikely owners will upgrade existing buildings 50% of owners are unlikely to upgrade their properties when they next become vacant	5.5.3.2
Incentives to adopt energy efficiency and conservation	31% of respondents receive no incentives to improve energy performance	5.5.4.1
Disincentives to adopt energy efficiency and conservation	88% of respondents have encountered disincentives to the adoption of energy efficient opportunities 79% experienced split incentives preventing improvement	5.5.4.2
Motivation of future energy improvement	3 key motivating factors for owners and tenants: Owners: 1) Regulations 2) Easier grant access 3) Customer pressure Tenants: 1) Regulations 2) Easier grant access 3) Energy price increases	5.5.6

The sample of companies surveyed is representative of the structure of the UK SME population; it identifies a similar distribution of businesses as that established by BMG Research (2013) in the 2012 Small Business Survey for the Department of Innovation and Skills. This identified 67% of SMEs is in the services sector (including manufacturing, retail, information and transport), 12% in manufacturing, 15% in leisure and 1% in agriculture. Although services, leisure and manufacturing are represented, no research participants from the agricultural sector were recruited within this research.

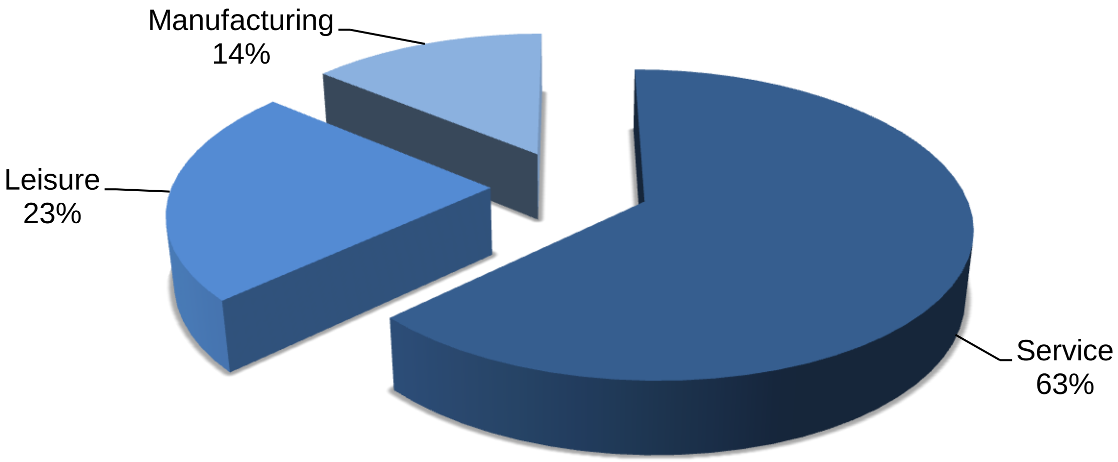

Figure 5.1: Research participants' business sectors

Figure 5.1 shows the business sectors from which the participants in this research have been drawn. They were established from participants' survey responses. The majority of research participants (63%) are from the service sector with leisure and manufacturing having fewer representatives at 23%, and 14% respectively.

The sample of companies surveyed is representative of the structure of the UK SME population; it identifies a similar distribution of businesses as that established by BMG Research (2013) in the 2012 Small Business Survey for the Department of Innovation and Skills. This identified 67% of SMEs is in the services sector (including manufacturing, retail, information and transport), 12% in manufacturing, 15% in leisure and 1% in agriculture. Although services, leisure and manufacturing are represented, no research participants from the agricultural sector were recruited within this research.

It is recognised that there are fewer organisations participating in this research than initially expected. The implications of this are discussed in detail in Chapter 6.

In addition survey responses indicate that 15% of building owners own a single non-domestic building with 85% of owners having portfolios of between 5 and 50 buildings. The survey responses indicate participating owners and tenants own or operate from both single and multi-occupancy sites. A significant majority (85%) occupy their business premises as individual occupants (Figure 5.2). Of those sharing premises, 4% are co-located with their clients and operate their business from part of their clients' premises.

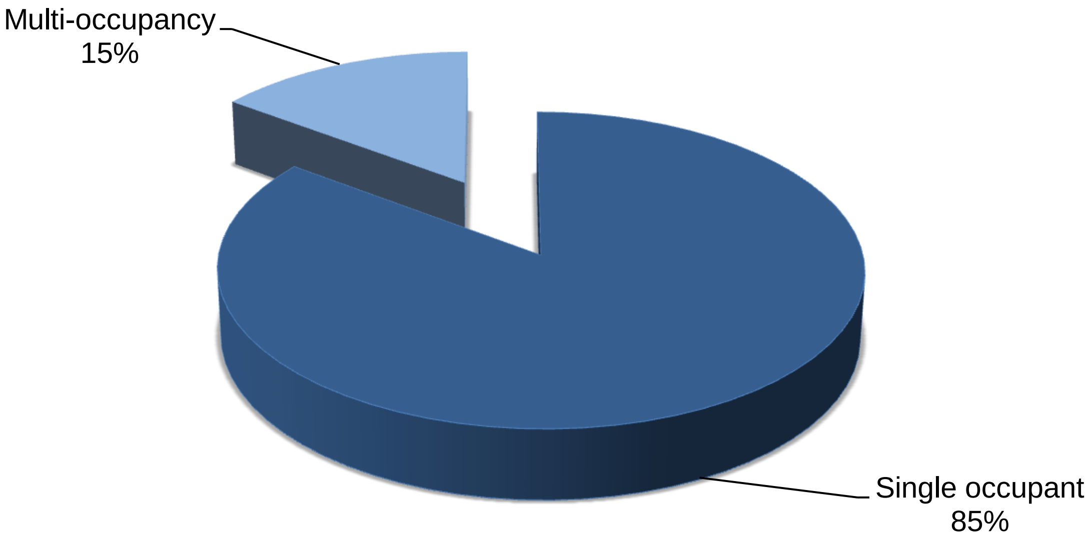

Figure 5.2: Owners' and tenants' occupancy profile

5.3 Purchase of energy

In order to verify the segmentation of building ownership and to understand patterns of energy purchases within non-domestic buildings, the participants are asked to confirm how energy is paid for in both the tenants' premises and, if appropriate, communal areas. Tenants are asked this directly, whilst owners are asked how their tenants obtain their energy.

As Figure 5.3 shows, the majority of participants (78%) confirmed that they or their tenants purchase energy for use in the business premises directly from the utility company. The remaining 22% obtained energy via their building owner as part of their rental/lease payment (11%), within the service charge (7%), or by direct payment (4%).

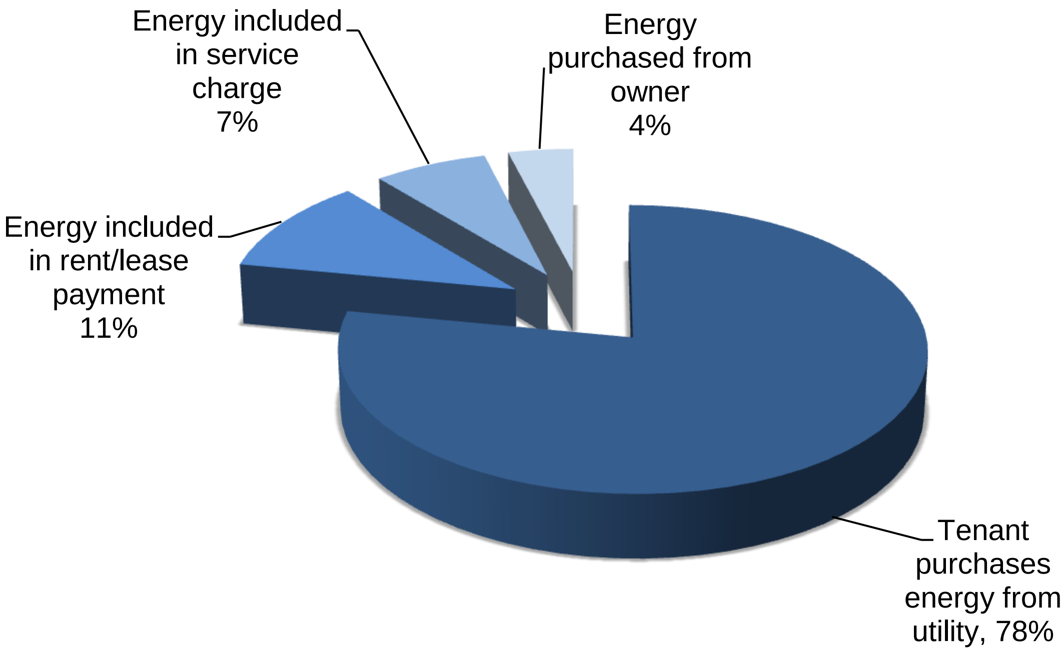

Figure 5.3: Purchase of energy - tenants' premises

Tenants controlling their energy purchases represent a significant disincentive for the building's owner to invest in efforts to reduce energy consumption as only the tenant will benefit financially and it is unlikely that the rental charges will be increased to reflect recoup the investment. Where energy is a fixed charge the tenant has little incentive to adopt energy efficiency and conservation measures, as only the owner will financially benefit. This finding confirms the presence of split incentives identified within Chapter 2.

As shown in Figure 5.4 all participants occupying space in multi-tenanted buildings confirmed that the building's owner provides the energy used in the communal areas.

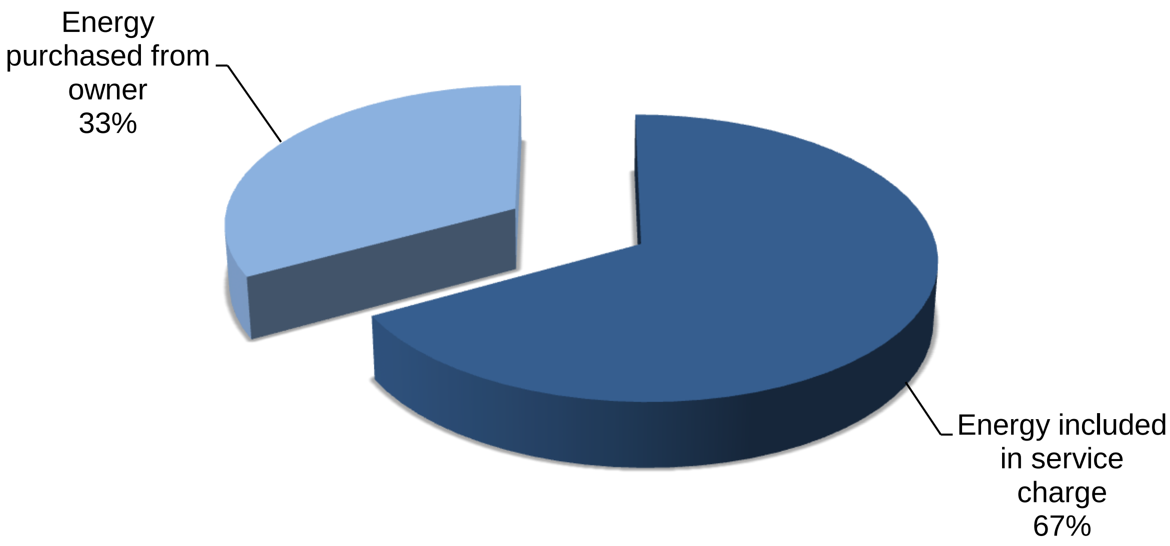

Figure 5.4: Purchase of energy - communal areas

5.4 Segmentation of participants in the surveys

The eight categories of ownership used to model the segmentation of non-domestic buildings at the outset of this research have been reviewed against participants' responses to questions regarding the tenure of their properties and their sources of energy supply. This tests the accuracy of this segmentation prior to its use in the analysis of other responses to ensure robust and accurate data interpretation. Research findings are shown in Table 5.2.

Three findings emerge from this review of segmentation: firstly 7 of the 8 categories are confirmed to exist; secondly, an additional ownership segment emerges; thirdly, sources of energy used to define the building ownership segments need to be adjusted for Segment '*h*'. This new segment is given the reference '*i*'.

For tenants in ownership Segment '*c*' where a non-domestic building user occupies their premises free of charge as a franchisee, it was initially assumed their energy is also provided free of charge by their clients as part of their service contract. However, the surveys have revealed that whilst this tenure structure exists for some franchisees a second franchisee' ownership segment exists.

Table 5.2: Segmentation of non-domestic building ownership segments

Segment reference	Segment details (and purchase of energy)	Revised segment details (and purchase of energy)
a	Building owner and tenant (tenant from utility)	Building owner and tenant (tenant from utility)
b	Building owner and user (owner from utility)	Building owner and user (owner from utility)
c	Building owner and franchisee (owner from utility)	Building owner and franchisee (owner from utility)
d	Building owner and branch (head office from utility)	Building owner and branch (head office from utility)
e	Building owner and landlord (tenant from utility)	Building owner and landlord (tenant from utility)
f	Building owner, manager and tenant (tenant from utility)	Building owner, manager and tenant (tenant from utility)
g	Building owner as the energy provider and user (tenant from owner)	Building owner as the energy provider and user (tenant from owner)
h	Building owner as a commercial investor (tenant from utility)	Building owner as a commercial investor (tenant from owner)
i		Building owner and franchisee (tenant from utility)

In this new segment the franchisee occupies the building free of charge but purchases energy direct from a utility company. This research adds knowledge to the understanding of the structure of non-domestic building ownership across the UK SME sector, including patterns of tenure and occupancy of non-domestic buildings and relationships between owners and tenants.

This additional segment has been identified within the leisure sector where a number of respondents operate sports centres, swimming complexes and golf courses for local authority clients. It covers 12% of the non-domestic building owners and tenants participating in this research. This segment has not been identified with private owners.

From the information provided by the research participants it appears that no owners or tenants can be placed within Segment ‘*e*’ in which the owner appoints a landlord to operate the building on their behalf. It cannot be conclusively established from this research whether the segment does not exist, whether it has not been populated as companies within this segment have not been recruited or whether it overlaps with Segment '*f*' in which a managing agent operates the building on behalf of the owner. It is recommended that further research be undertaken to determine this.

The participants' survey responses indicate that the ownership segmentation model requires adjustment to correct the purchase of energy in Segment '*h*'. The research finds tenants obtain energy for their premises from the owner with the cost included within the service charge (Figure 5.5) rather than purchasing it directly from the utility as originally proposed.

The survey responses from members of Segment '*a*' indicate that there is no single pattern of energy purchase within the segment. However a clear majority (80%) of tenants purchase energy directly from their utility company. This matches the segmentation model's assumption that tenants within Segment '*a*' control their energy purchases.

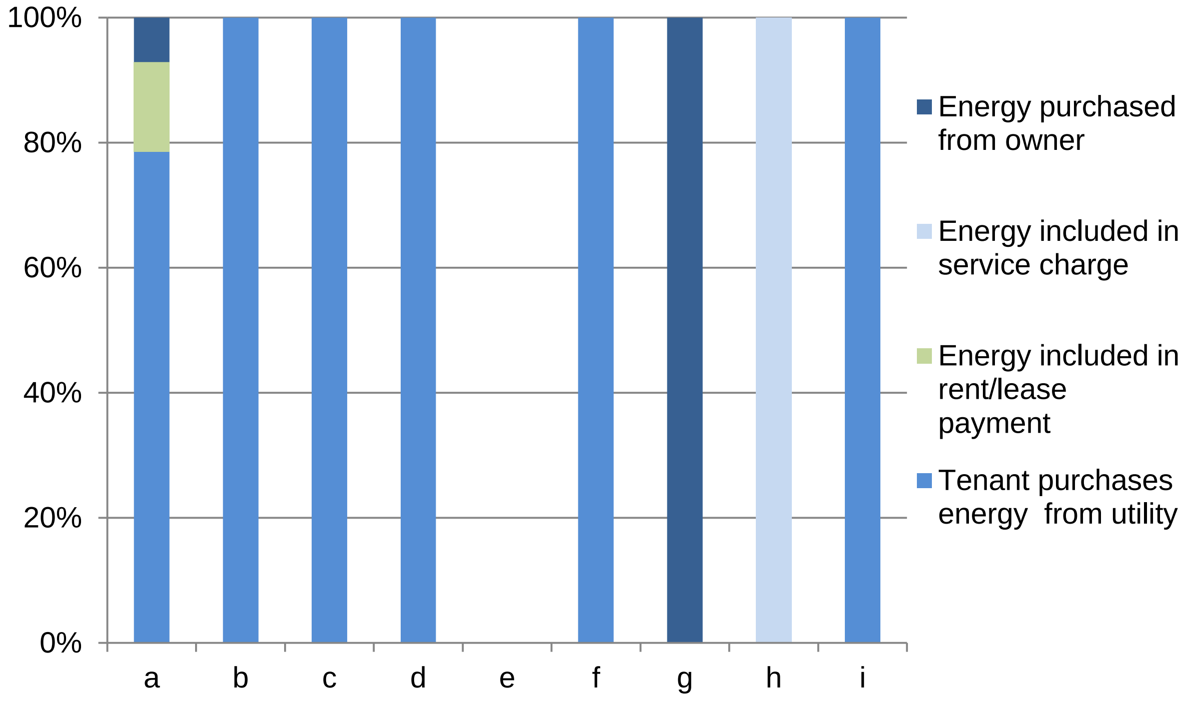

Figure 5.5: Purchase of energy by ownership segment

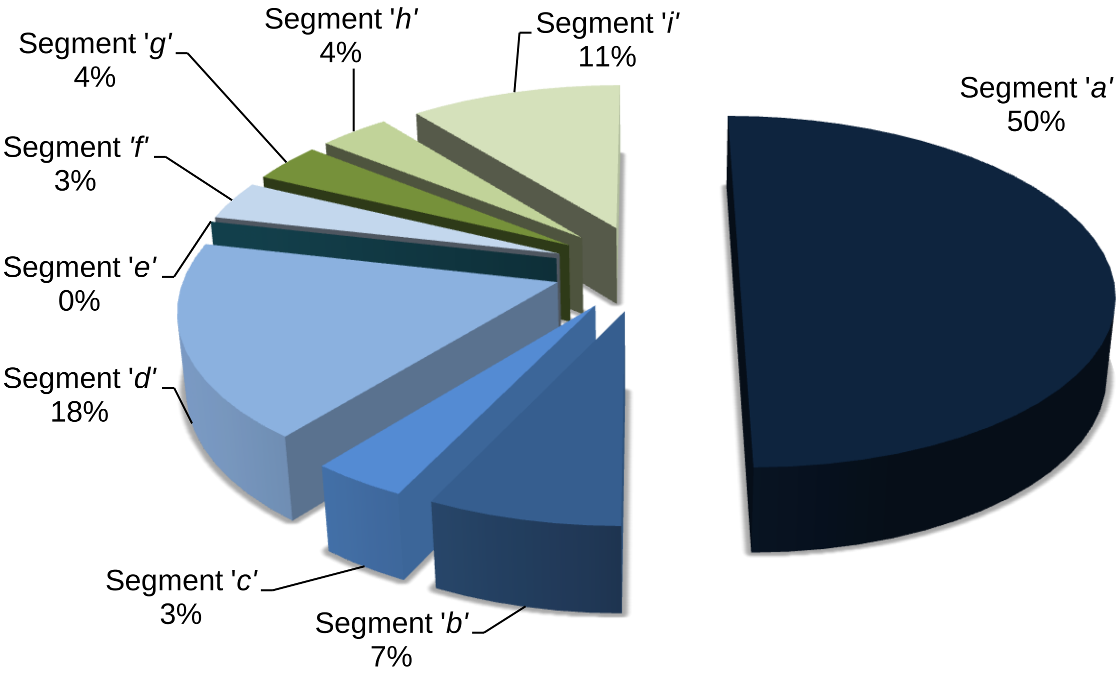

Figure 5.6: Survey participants by ownership segment

As shown in Figure 5.6, 50% of research participants fall within Segment '*a*' whereby non-domestic building users occupy their premises as tenants and purchase energy directly from a utility supplier. The second highest population (19%) falls within with Segment '*d*'. This represents branches of multi-site organisations with their head offices controlling energy purchasing. The new category of franchisees purchasing energy directly from a utility supplier, Segment '*i*', emerges as the third largest segment (12%).

5.5 Analysis of survey responses

This section contains the analysis of responses to the surveys received. To create an analysis framework it has been subdivided into themes: tenure; responsibility for energy efficiency and conservation; perceptions of relationships between owners and tenants within energy management; current incentives and disincentives for energy improvements and factors to motivate future improvements. Interrelationships between these topics are highlighted where appropriate.

5.5.1 Non-domestic building tenure

A question to establish the ownership structure of the respondents' business premises is asked of both tenants and owners. Six scenarios are offered. These categories are:

1. Owner occupier
2. Leased from a public authority
3. Leased from a private owner
4. Rented from a public authority
5. Rented from a private owner
6. Free of charge – building provided as part of a contract

Overall the research finds that leasehold or rental tenants occupy 72% of non-domestic properties. Responses shown in Figure 5.7 indicate the majority of SMEs (57%) occupy premises leased or rented from private owners, with premises leased or rented from public authorities comprising only 15% of tenancies. 14% of respondents are owner-occupiers with a further 14% occupying their business premises free of charge as part of their service contract. This latter category is all within the leisure sector.

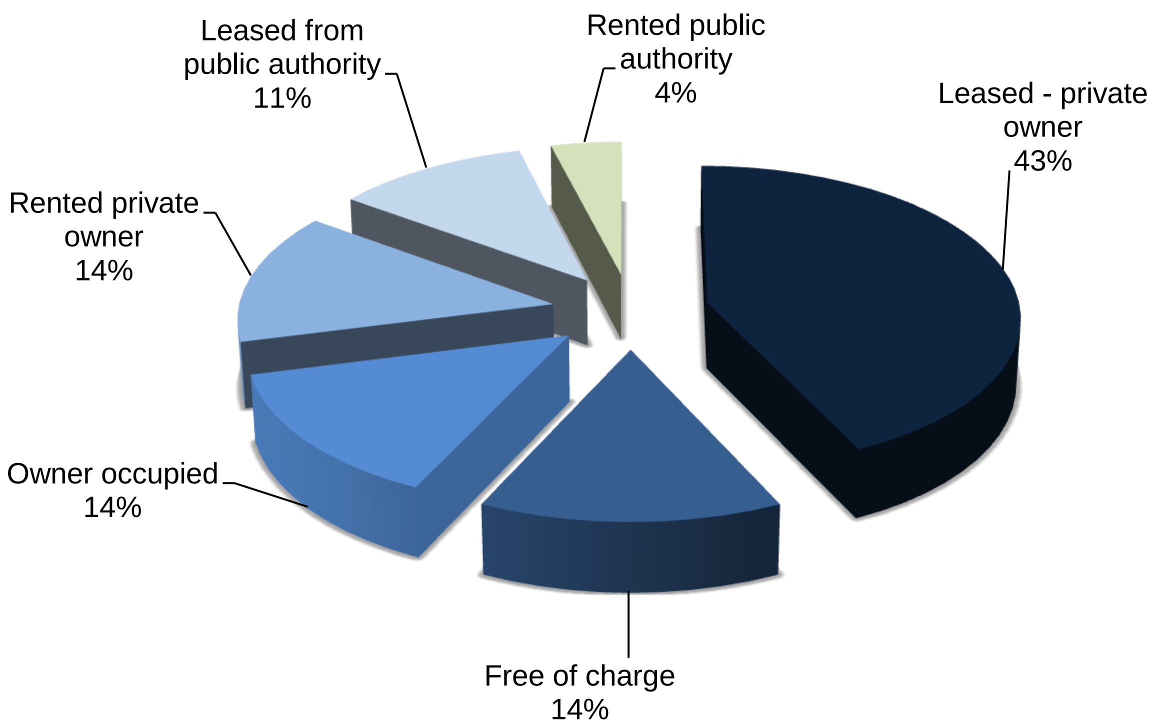

Figure 5.7: Ownership structure of survey participants' business premises

5.5.2 Responsibility for energy management, efficiency and conservation

5.5.2.1 Current patterns of responsibility

To gauge how energy management, efficiency and conservation activities are managed within non-domestic buildings, SME tenants and building owners were asked to identify who is responsible for energy management, efficiency and conservation within their business premises or buildings owned. A number of standard scenarios are proposed with the category of “other” available should none of the standard answers apply. Additional comments are also encouraged. These standard options are:

1. Tenant
2. Owner
3. Split between owner and tenant
4. Parent company
5. Managing agent
6. No one
7. Other

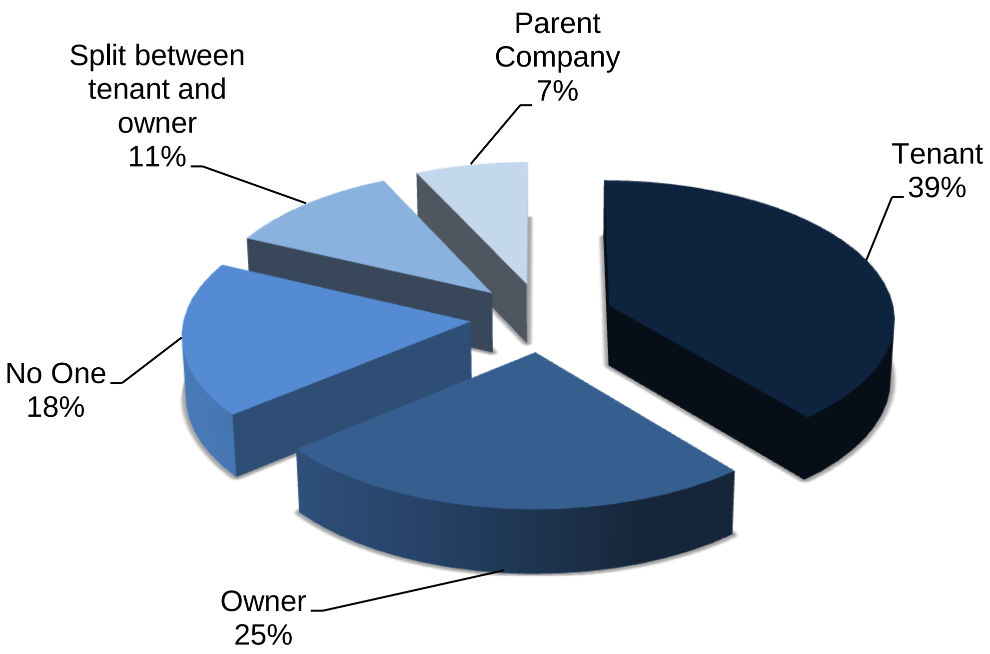

Figure 5.8: Responsibility for energy management, efficiency and conservation

As shown in Figure 5.8 in 82% of participants indicate an individual or group is allocated responsibility for energy management, efficiency and conservation. 60% have someone responsible within the building. However, it emerges that no one is responsible for energy management, efficiency and conservation in 18% of buildings surveyed; 60% of these responses are from tenants and 40% from building owners.

A significant difference in responsibility for energy management, efficiency and conservation emerges from tenants and owners. These are shown in Figure 5.9. 24% of participating tenants consider that no one is responsible for energy management, efficiency and conservation for their business premises although owners do not agree. 71% of owners consider themselves responsible. None consider their tenants responsible although 14% of owners think tenants are responsible through their parent company and 15% perceive joint responsibility.

However, 52% of tenants see themselves responsible and 10% see owners responsible for energy management, efficiency and conservation activities. 15% of owners and 10% of tenants consider responsibility is split between themselves and their tenants. Even though these responses do not come from the owners and tenants of the same buildings they indicate a potential gap in the ownership of energy improvement that causes energy inertia. Further research to investigate this gap within individual buildings is recommended.

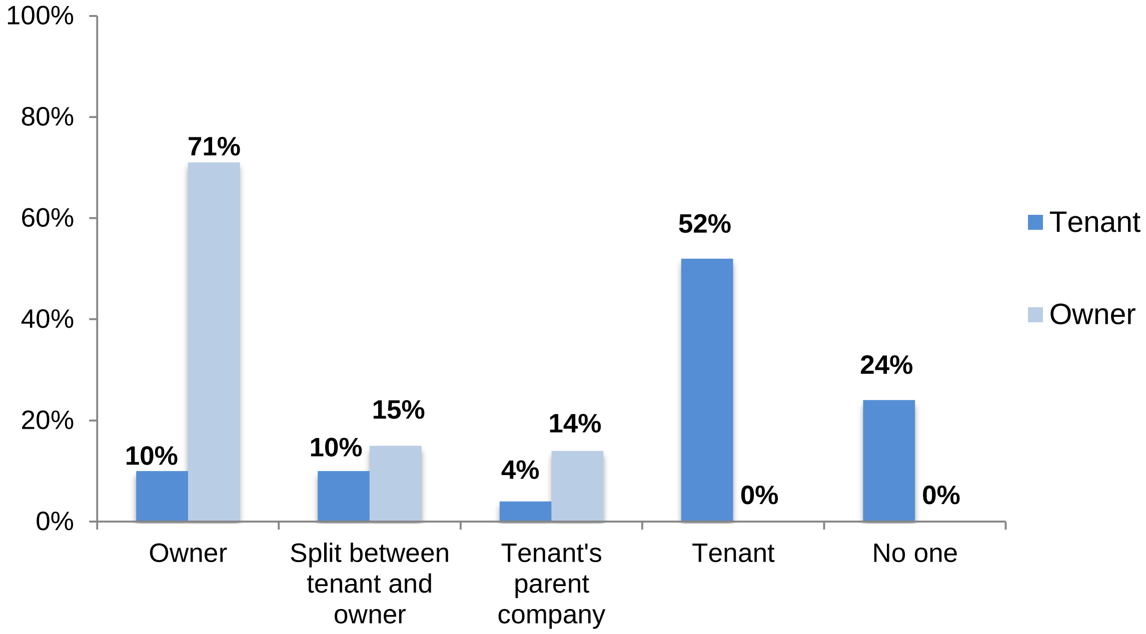

Figure 5.9: Responsibility for energy managment, efficiency and conservation – comparison of responses from owners and tenant

When these figures are scaled up to reflect the UK SME population, around 900,000 SMEs appear to be operating from premises where no one is responsible for energy efficiency improvements. If the estimated £2000 p.a. saving from simple energy improvements calculated by the Eon (2011) is applied, it appears the SME population is failing to obtain financial savings of almost £10 billion a year and emissions savings of over 1000 $mtCO_2$.

Responses analysed here highlight the difference of opinion that exists between owners and tenants as to how energy consumption is versus should be managed within non-domestic buildings. Owners report themselves responsible for energy improvements in the majority of their buildings and that each building has someone responsible for energy efficiency. However, tenants disagree. Over three quarters consider owners of their business premises have no involvement with energy improvements.

When survey responses are considered by ownership segment (Figure 5.10) a consensus on responsibility emerges in all but Segments '*a*' and '*d*'. SMEs purchasing energy from their building owner within Segment '*c*' agree that no one is responsible for energy management, efficiency and conservation which highlights the owner-tenant split identified within previous research by DeCanio (1993), Fawcett (2010) and Schleich and Gruber (2008) and discussed in Chapter 2.

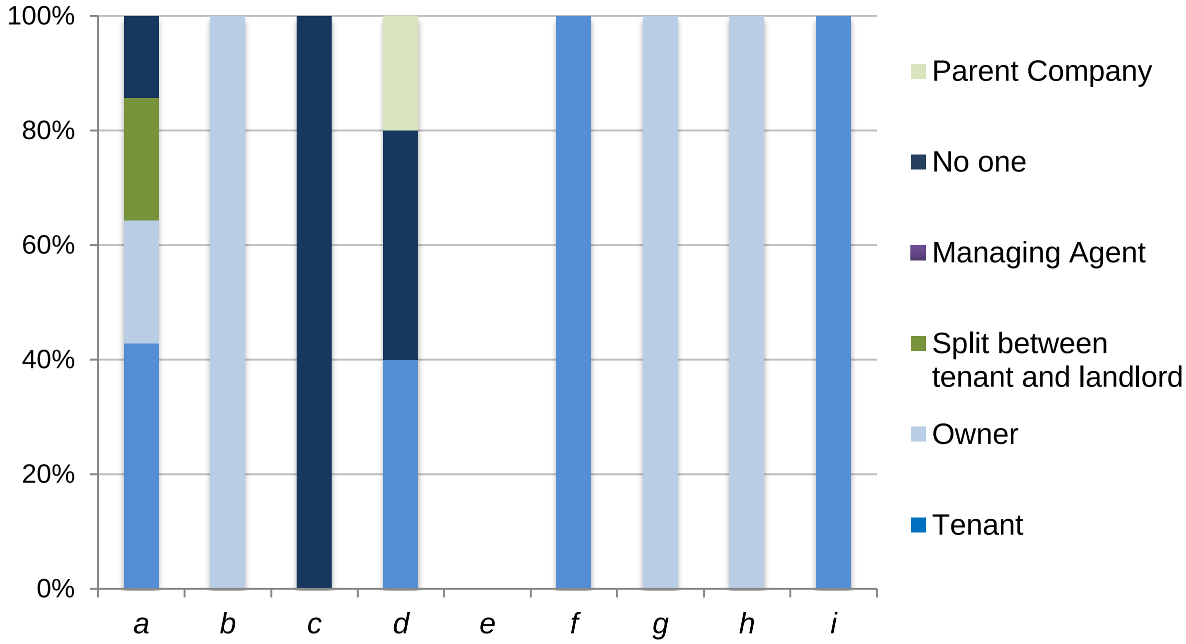

Figure 5.10: Responsibility for energy management, efficiency and conservation split by segment

Only Segment '*a*' shows responsibility for energy efficiency and conservation split between owners and tenants. However, the majority of responses indicate tenants are considered responsible for energy management.

5.5.2.2 Preferred allocation of responsibility

The surveys establish how participants believe responsibility for energy management and improvements should be allocated to exploit the benefits available. This information is included within the alternative approach to energy policy framework to maximise engagement in energy and carbon savings.

The participants are asked to place the owner and tenant on a scale between 0% and 100% according to their expectation of the responsibility they should take for implementing energy management and adoption of energy efficiency and conservation interventions. Responsibility is rated against three items:

1. Responsibility for funding energy improvements
2. Responsibility for carrying out improvements
3. Overall responsibility for energy efficiency and conservation

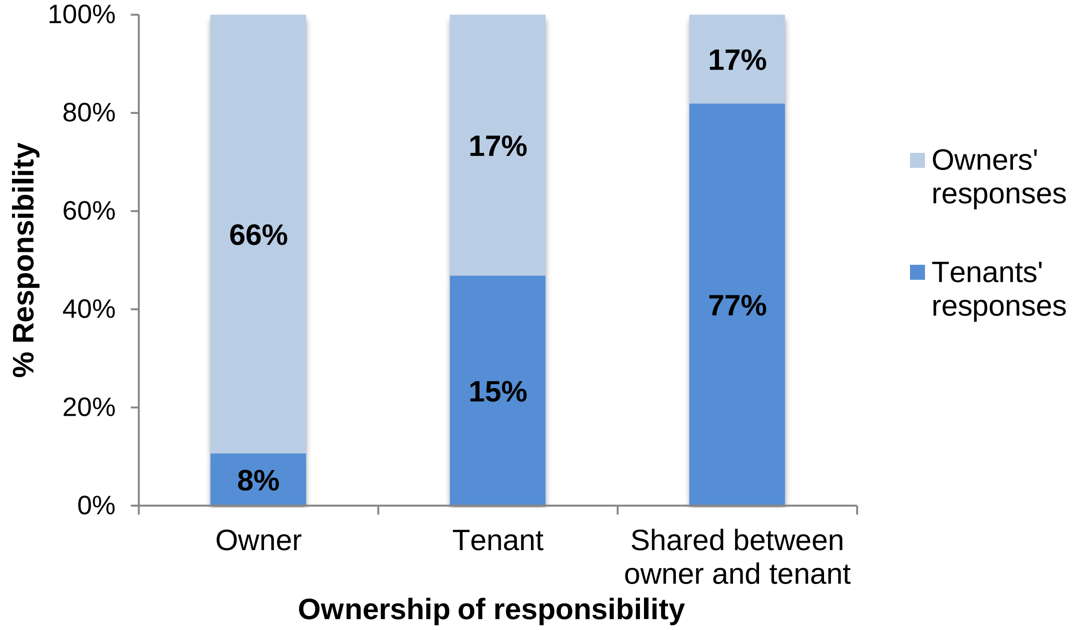

Figure 5.11: Expected ownership of energy efficiency

As shown in Figure 5.11 the majority of owners want to retain responsibility for funding and installing energy efficiency and conservation opportunities (66%). Only 17% would allow their tenants to install improvements or share responsibility to do so. This figure is slightly lesser than the number of owners currently taking responsibility for energy efficiency and conservation (71%) shown in Figure 5.9. This implies that to improve rates of the adoption of energy efficient technologies owners have to be targeted. This is considered further in Chapter 8.

Over three quarters of tenants want to share responsibility for energy consumption improvement with their buildings' owner. This is a large increase over the 10% of tenants who indicate that they currently share responsibility with their building owners.

Analysis of responsibility is also undertaken by ownership segment. Segment positions on the rating scale are shown in Figure 5.12. Responses indicate members of six of the nine ownership segments agree on responsibility for energy efficiency and conservation activities within their buildings (Figure 5.13). Participants in Segment '*d*' show a split, indicating that they would like responsibility allocated equally between owners, tenants or shared between the two. More than 80% of tenants in ownership Segment '*a*' and 100% in Segment '*i*' want to share responsibility with their building owners. Only participants in Segments '*f*' and 'g' want owners to take sole responsibility for energy improvement. These findings are taken into consideration in the proposal of an alternative energy policy framework.

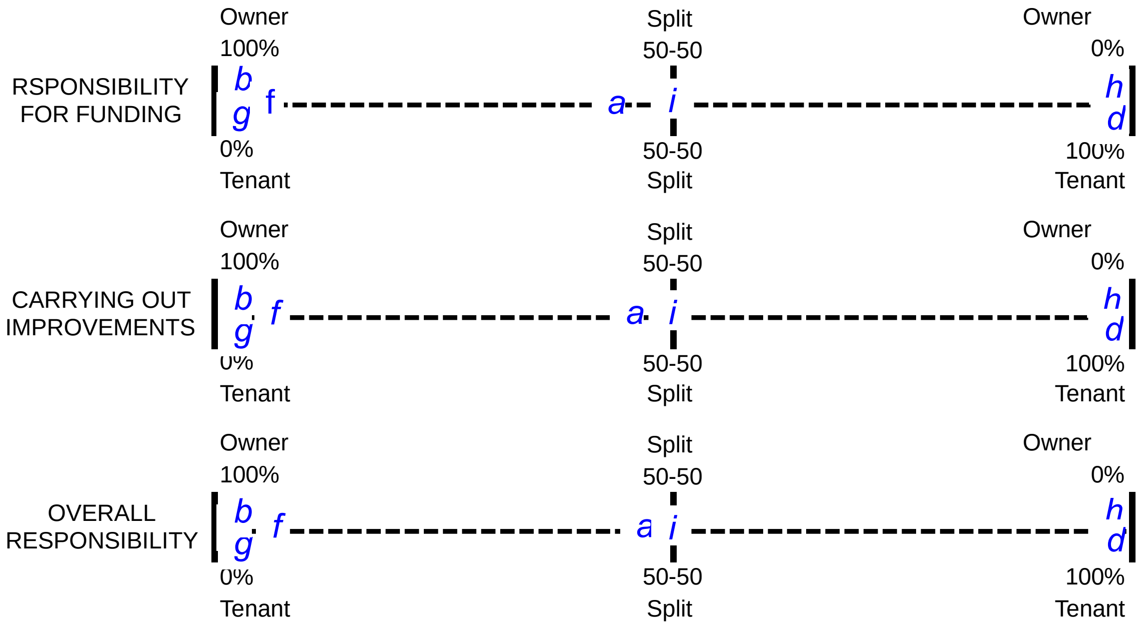

Figure 5.12: Analysis of current responsibility by segment - segment positions on the rating scale

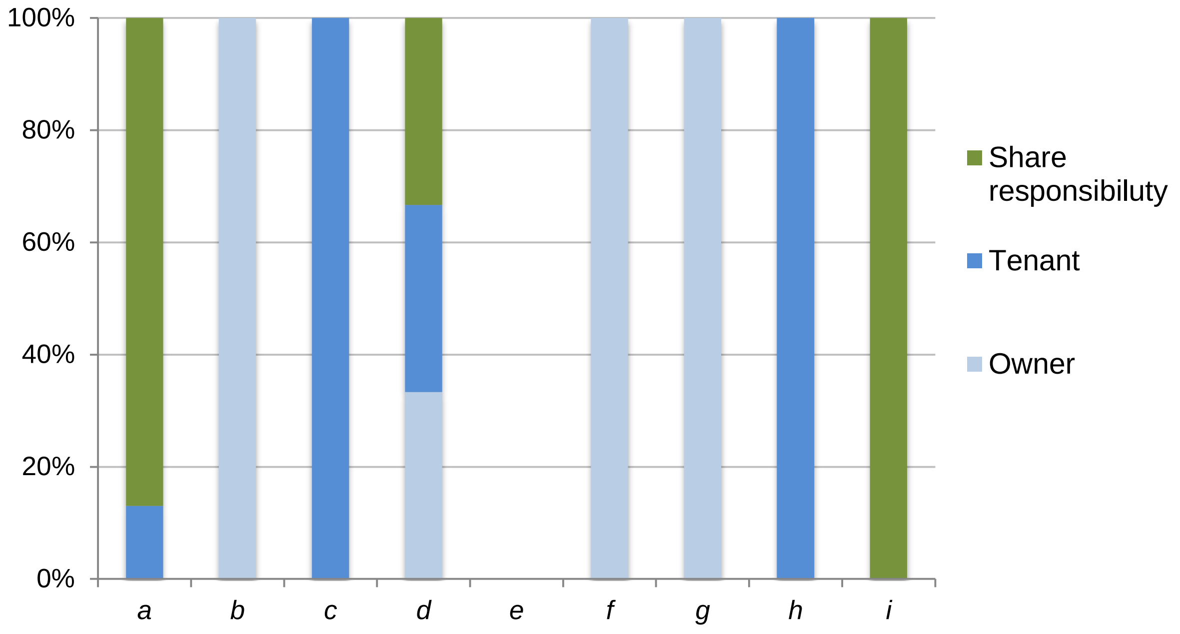

Figure 5.13: Preferred ownership of energy management, efficiency and conservation within ownership segments

The research participants are also asked for additional comments. In response T5, a member of Segment '*a*' operating in the IT services sector commented,

> *"Someone needs to take responsibility as at present there are no encouragements for tenants to be more energy efficient."*

5.5.3 Energy relationships between owners and tenants

In order to understand the type of relationships participants have with their owner or tenant regarding energy the surveys request both quantitative and qualitative responses to the question on owner-tenant relationships. In addition participants are asked to confirm their expectations of relationships in the future.

5.5.3.1 Current relationships

- Research participants are asked to categorise their relationship with the owner or tenant of their business premises by selecting the most appropriate description from a series of standard relationship scenarios:
- **Collaborative:** Tenant and building owner work together to reduce energy consumption; share investment costs and benefits

- **Cooperative**: Building owner encourages tenants to make changes to reduce energy expenditure; no financial support provided
- **Supportive:** Building owner implements energy conservation measures without tenants' involvement
- **Preventative:** Building owner prevents tenants making changes to reduce energy expenditure
- **No involvement chosen:** Owner or tenant chooses to have no involvement in improving energy efficiency improvement

These categories were designed by the researcher to reflect the relationships likely to be experienced by non-domestic owners and tenants. The titles used were taken from the descriptions of relationships used within the literature reviewed in Chapter 2.

As shown in Figure 5.14, "preventative relationships" emerge as the most common style of relationship between tenants and owners with 36% of participants confirming that their owner or tenant prevents improvements to the building's energy efficiency being undertaken. A further 14% of participants consider that owners choose not to get involved in energy efficiency and conservation improvements. Therefore 50% of participants have relationships that prevent energy improvements being undertaken.

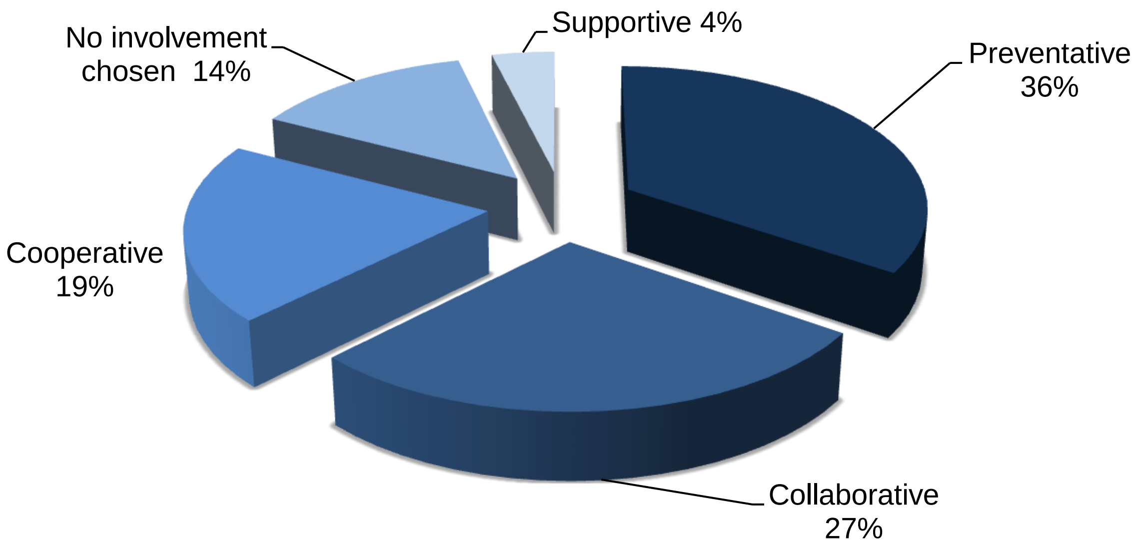

Figure 5.14: Perception of current relationships between tenant and owner with regard to energy efficiency and conservation

When the category of “preventative relationships” is combined with the scenario of “no involvement” approximately half of all respondents have a relationship with their owner or tenant that actively prevents either or both parties from benefitting financially from energy consumption reduction opportunities.

If this is scaled up to reflect the UK population, approximately 1.8 million SMEs occupy commercial premises in which there is little likelihood of energy efficiency and conservation improvement under the current relationship. Approximately a further 700,000 SMEs occupy premises in which the owners choose to have no involvement in improving the energy performance of the building. Together around 2.5 million companies are unlikely to be able to generate the financial and carbon emissions savings available.

On the positive side, 27% of participants indicate that they collaborate with their building’s owner or tenant to adopt opportunities to improve energy efficiency. A further 19% cite a cooperative relationship with their owner or tenant. This implies that in almost 50% of the non-domestic properties considered here there is a relationship between owners and tenant that allows them to benefit from energy efficiency and conservation opportunities. However, despite this positive relationship survey responses indicate that tenants have undertaken an average of only 0.9 improvement interventions in the last 2 years and owners 1.8.

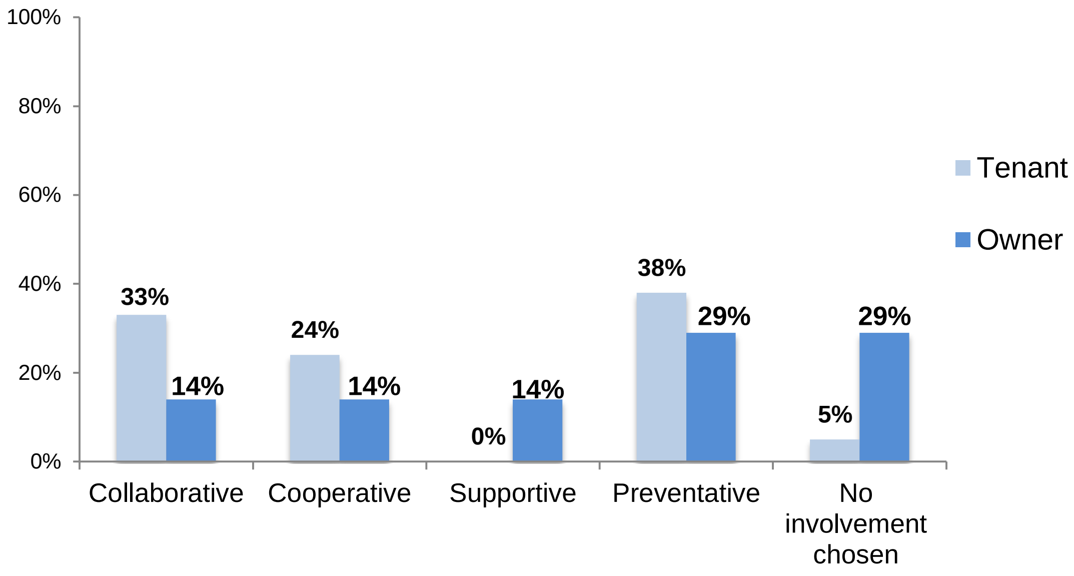

Figure 5.15: Relationships between tenant and owner with regard to energy efficiency - owners' and tenants' perceptions

When owners' and tenants' responses are considered separately the views of each group appear markedly different (Figure 5.15). It emerges that tenants consider their owners more preventative and less supportive than the vice versa. 38% of tenants consider that their relationship with their building's owner prevents them from making changes to reduce energy expenditure. However, only 29% of owners claim a similar relationship with their tenants. This implies that an alternative policy needs to engage owners to adopt energy efficiency and conservation opportunities. The alternative approach to Energy Policy proposed in Chapter 7 is designed to achieve this.

It is encouraging that only 5% of tenants believe that their building owners chose to have no involvement in energy efficiency and conservation activities. However, 29% of owners feel this is true of their tenants. This is indicative of the split of incentives identified by researchers including Fawcett (2010) and Bright (2010) and discussed in Chapter 2 exists within these research participants.

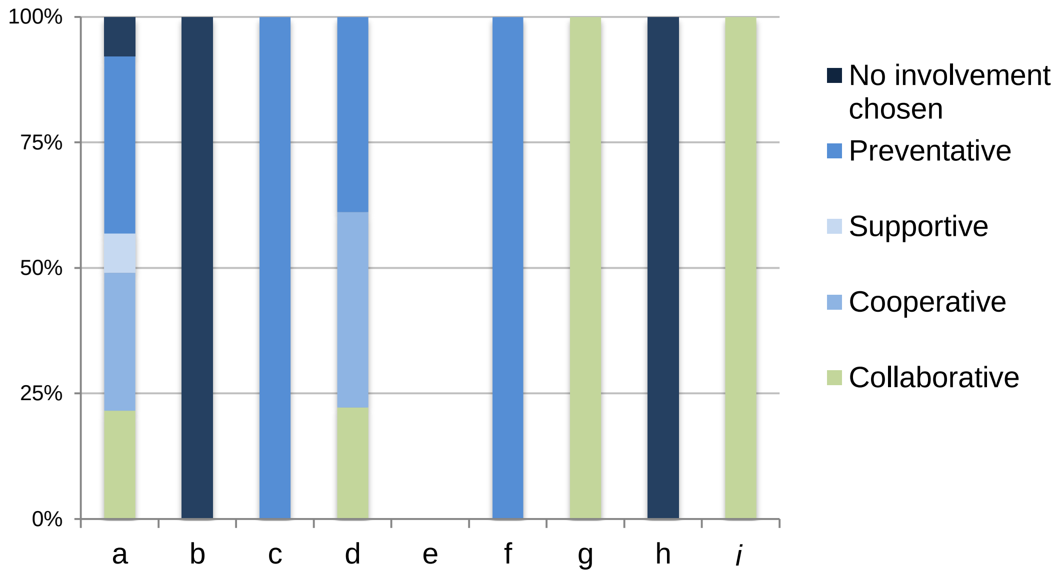

Figure 5.16: Perception of relationship between tenant and owner with regard to energy efficiency by building ownership segment

When relationships between owners and tenants are reviewed by ownership segment a number highlights emerge (Figure 5.16). These include:

- All owner-occupiers participating in this research choose to have no involvement in energy efficiency and conservation. Consequently they do not benefit from the financial and carbon savings available to them. If this is increased pro rata to reflect the UK SME population, around 343,000 owner-occupiers feel unwilling or unable to improve their energy efficiency.

- All participants within Segments ‘*c*’ and ‘*f*’ consider their relationship with their building’s owner or tenant prevents energy efficiency and conservation improvements. In Segment ‘*c*’ this may be due to the fact that the owner controls the purchase of energy. In Segment ‘*f*’ the relationship between owner, managing agent and tenant may be too confused to deliver energy improvement.100% of participants in Segment ‘*h*’ confirm that they, as building owners, choose to have no involvement in energy efficiency and conservation. This may be due to the fact that they are commercial investors and therefore remote from the occupants of the building and cost of energy.
- Overall only a few participants consider they have a ‘supportive’ relationship with their tenant or owner. These respondents are all from owners within Segment ‘*a’*, implying tenants within other segments do not receive support from the owners of their business premises to improve energy efficiency.

Research participants are asked to give additional information regarding their relationship with their owner or tenant. This contributes to understanding owner-tenant relationships and is used to frame an alternative Energy Policy that will increase the likelihood of SMEs adopting energy efficiency and conservation improvements in Chapter 7. These comments are considered here.

Respondent O2, a building owner with a portfolio of more than 10 single occupancy properties in Segment ‘*b*’, indicates they choose to have no involvement in energy efficiency and conservation. In addition O3, a building owner in Segment ‘*g*’ with 10 multi-tenanted properties, indicates that in the majority of properties,

> *“Energy costs aren’t a significant factor.”*

With this view there appears to be little or no incentive for owners to invest in energy improvements that will reduce energy consumption and energy costs.

Many tenants describe a similar description of energy inefficient relationships. For example, participant T16, in Segment ‘*i*, in the leisure sector describes the relationship with their building owner as “cooperative” although this is qualified,

> *“But only where the landlord permits and there are potential fiscal advantages for the landlord. Our landlord attempts at all times to avoid replacement of equipment that is his responsibility.”*

T14, from the ecology services sector in Segment '*a*', describes the relationship with their building's owner as 'functional' where,

> "*The only involvement they have is when something goes wrong*".

Participant T21, a management consultancy division of a larger multi-site organisation in Segment '*d'*, confirms,

> *"Our building owner has no interest in helping us to reduce energy costs. They have refused to replace oil-fired boilers. Our energy use has to be reported as part of CRC so it costs us twice as much to be energy inefficient!"*

T22, a management services company in Segment '*d*', indicates,

> *"Our building owners have nothing to do with energy efficiency. We had to insist on PIRs and an air source heat pump when they refurbished the building before we moved in. But there's something wrong with the settings so we're using more electricity than expected. Our bills are 50% higher than in our old premises which were a barn twice the size with single glazing and no insulation."*

The tensions in relationships highlighted here reflect those identified by Janda (2009b), de Groot Verhoef and Nijkamp (1999), and Schleich and Gruber (2008). They appear to prevent the adoption of energy efficiency improvements that would financially benefit both parties. Overall, it emerges that half of research participants identify a relationship with the owner of their business premises or tenant that actively or passively discourages the adoption of energy efficiency and conservation. These findings are used to develop the alternative energy policy framework proposed.

5.5.3.2 Future relationships

The research participants are also asked to identify how they expected relationships between non-domestic building owners and tenants to evolve over the next ten years.

Although 20% disagree, 71% of the tenants responding to this question indicate that they expect tenants to increasingly demand more energy efficient properties in the future. However, less than 10% of participants considered this likely to be driven by current energy policies such as the introduction of mandatory EPCs in 2018. Participant T1, a tenant in Segment '*a*', working in the renewable energy sector, summarized this,

> *"Tenants will increasingly expect more energy efficient properties going forward."*

O3 in Segment '*a*' expects,

> *"As energy costs rise and energy saving equipment becomes more common and cost effective more measures will be adopted"*

Participant T12, an organisation in Segment '*a*' supplying facilities management services, expects energy efficient business premises to become increasingly attractive in the future,

> *"We recognise that it would benefit current and prospective landlords to support energy efficient buildings as they will be more attractive to prospective tenants and will attract like-minded tenants that will support such measures. They are likely to be willing to pay a premium on occupancy charges if they realise reduced running costs and will also benefit from any kudos in occupying such a building."*

The owners' perspective of upgrading their properties is considered further in Section 5.5.3.3.

Despite the expectation of an increasing demand for energy efficient non-domestic buildings, 50% of tenants are doubtful it will happen and consider it unlikely that owners will upgrade existing buildings. This is largely due to owners being risk adverse and unwilling to invest if the return on their investment does not meet their business strategy.

Research participant T6, in the facilities services sector in Segment '*a*' writes,

> *"With respect to older premises I do not think the situation will change. It is a well-known fact that landlords assess the age of their stock and weigh up the cost of upgrading versus payback against time."*

5.5.3.3 Vacant building upgrades

An additional question is posed to the non-domestic building owners to establish whether they will implement energy improvement upgrades when their building is next vacant. Half of respondents indicated this was unlikely whilst the other half did not know.

The view emerging from the owners is that they will not automatically benefit from energy improvements so will not undertake building upgrades. However, this may prevent them from benefitting from the expected rise in demand for energy efficient properties highlighted by the tenants participating in this research.

Participant O2, a property owner in South Yorkshire in Segment '*f*', confirmed that upgrading is unlikely when their property is next vacant,

> *"Unless it is clear that either it's a barrier to or will help with letting".*

5.5.4 Incentives and disincentives to adopt energy efficiency and conservation

In order to establish which factors affect owners' and tenants' ability and willingness to adopt energy efficiency and conservation opportunities, research participants are asked to confirm which inducements and barriers have been encountered when attempting to implement energy improvements over the previous 2 years. Owners and tenants participating in this research are asked to select the factors they have experienced from a list of positive and negative scenarios that represent these incentives and disincentives.

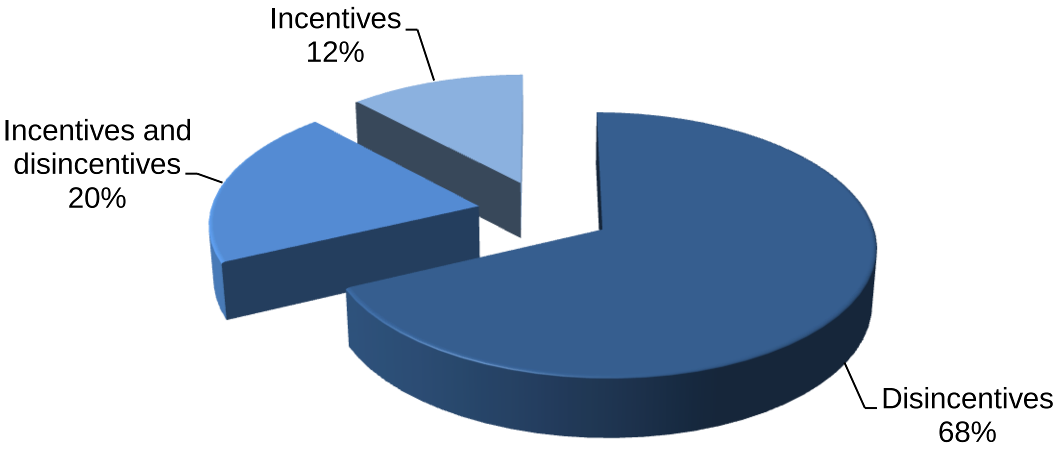

Figure 5.17: Incentives and disincentives encountered by research participants

As shown in Figure 5.17, despite some incentives being identified, over two thirds of participants indicate they only been faced with barriers when attempting to improve energy efficiency and conservation. These responses are examined in more detail below using the evidence provided in participants' comments.

5.5.4.1 Incentives encountered when adopting energy improvements

The incentives encountered by research participants are shown in Figure 5.18. Two key encouragements emerge from participants' responses: cost savings and legislative compliance. Almost one quarter of research participants confirm they have not been able to take advantage of these incentives. However, despite these opportunities being available almost one third of respondents confirm that they have received no incentives to improve energy performance.

The surveys requested further details of participants' experiences of incentives for the adoption of energy efficiency and conservation opportunities. Examples of their responses are included below.

T18, a leisure service operator in Segment '*a*', confirms that they have been encouraged to reduce energy consumption, as it was included as an obligation within their contract,

> *"As part of the service contract [the owners] expect the utilities onsite to be reduced year on year".*

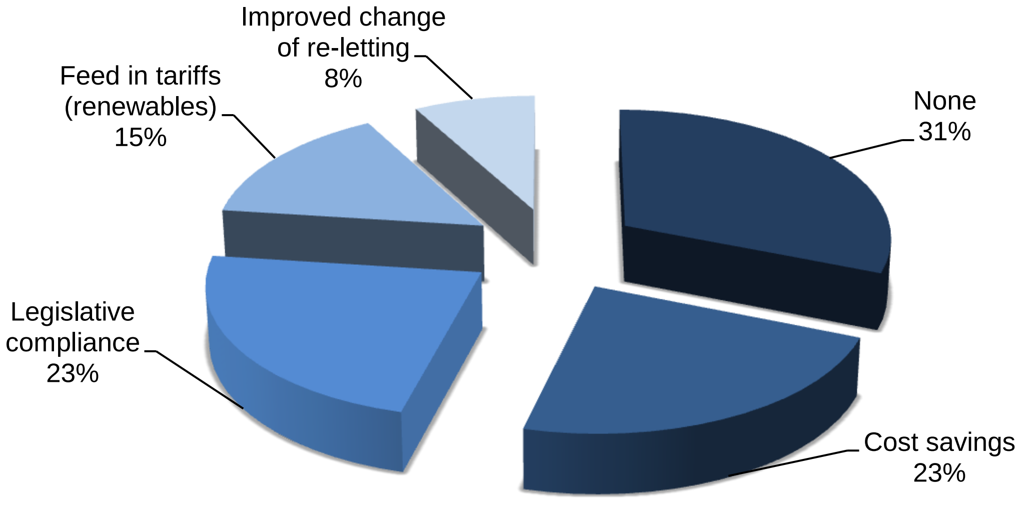

Figure 5.18: Incentives for energy improvement encountered by research participants

Participant O2, an owner with a portfolio of small properties in Segment '*f*', specifies,

> *"Cost saving and re-letting are the main incentive".*

However, participant T15 in Segment '*i*' is less positive and indicates,

> *"Only incentive is legal requirement to electrically test the aircon units in each office".*

Similarly T2, a facilities management company in Segment '*d*', confirmed,

> *"Feed in Tariffs have helped with the deployment of renewables but other than that there are no effective incentives".*

T21, a management services consultancy in Segment '*d*' highlights the significance of legislation,

"Our company owner will only pay for improvements that will ensure the company remains legally compliant"

5.5.4.2 Disincentives encountered when adopting energy improvements

The disincentives for adoption of energy efficiency and conservation opportunities offered by the research participants are shown in Figure 5.19. Although a wide variety of barriers have been encountered, a number of key themes can be seen:

1. **Financial constraints** e.g. the capital costs of energy efficiency are prohibitive
2. **Knowledge constraints** e.g. owners and tenants lack understanding of potential improvements
3. **Ownership constraints** e.g. the lease prevents energy improvements being made
4. **Regulatory constraints** e.g. planning permission has not been achieved for the improvements proposed

These key themes are used to provide a framework for the analysis of disincentives encountered with participants' responses collated into clusters of barriers with associated characteristics.

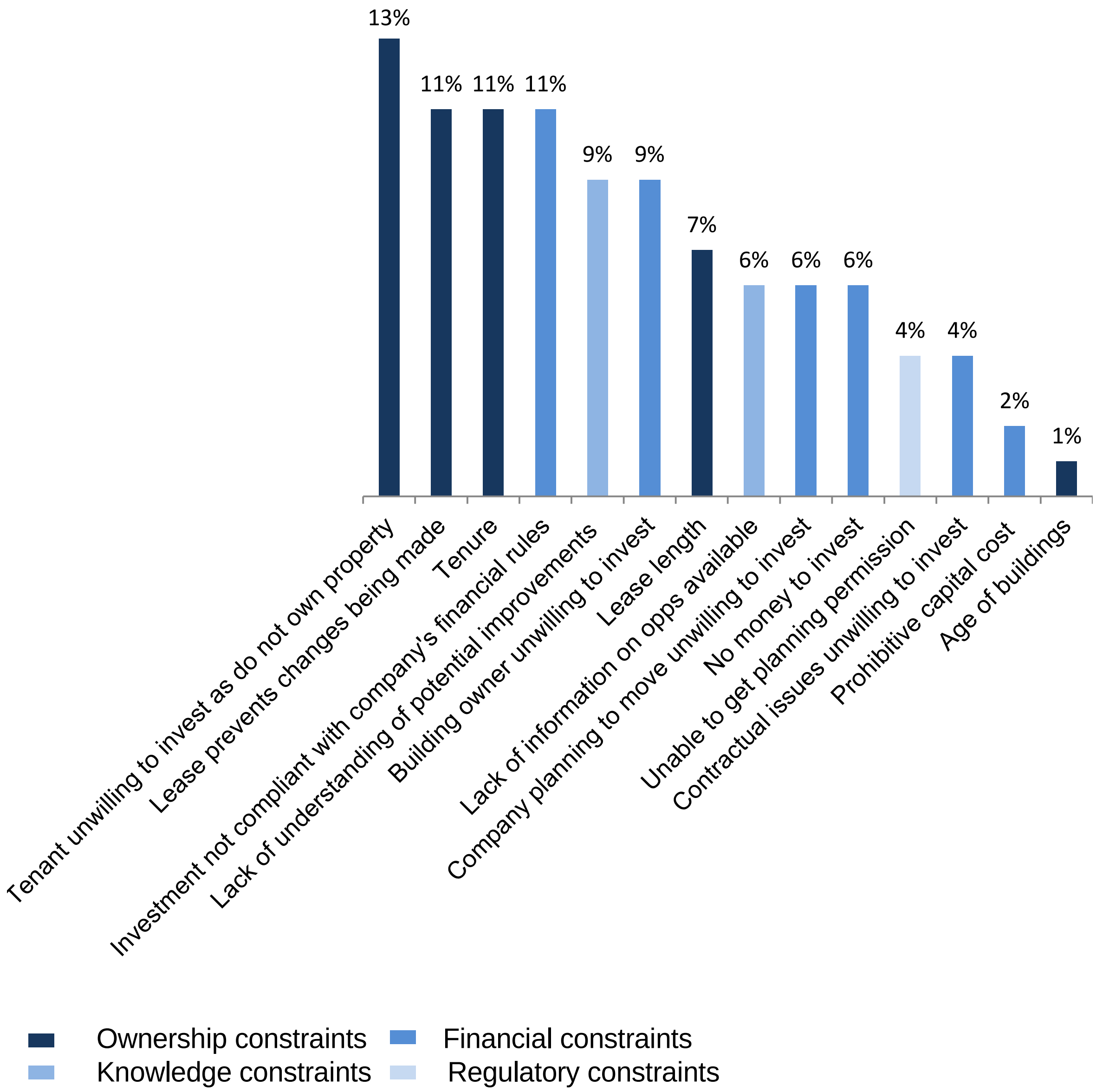

Figure 5.19: Disincentives for the adoption of energy efficiency and conservation

From the analysis of participants' responses, Ownership and Financial Constraints emerge as the key barriers to energy efficiency and conservation encountered by 43% and 36% of research participants respectively. The split of these is shown in Figure 5.20. Constraints from a lack of understanding of improvement actions available and regulations appear to be encountered less frequently than ownership and financial constraints. This supports the responses to questions on energy improvement motivators discussed in Section 5.4.7 that indicate access to additional information is of less significance than is assumed by current energy policy.

If the incidence of the two most widely experienced barriers to energy efficiency is increased pro rata to reflect the UK SME population, it emerges that 2.9 million companies may encounter barriers to energy efficiency related to the ownership of their business premises and 1.9 million SMEs experience financial disincentives. This prevents them from benefitting from £3.8 billion of cost savings each year and the country by more than 750,000 tCO_2 emissions savings.

These two largest disincentives encountered by research participants are discussed in more detail below.

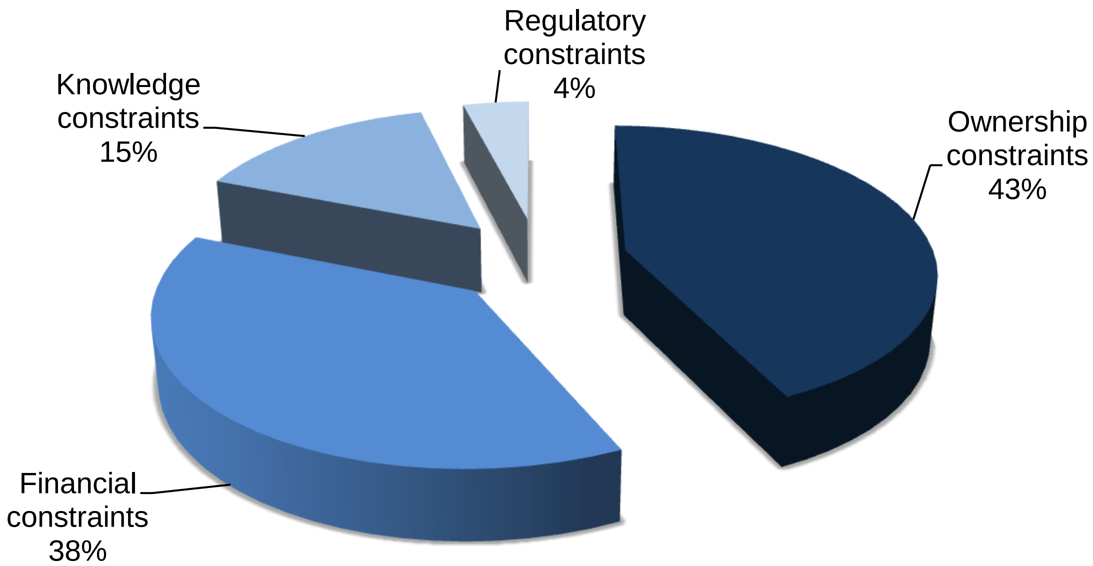

Figure 5.20: Summary of disincentives for energy efficiency and conservation

5.5.4.2.1 Disincentives for energy efficiency and conservation based on ownership

When impacts of ownership disincentives are analysed in more detail (Figure 5.21) the effect of lease clauses and ownership structures of business premises emerge as the most frequently encountered barriers to adopting energy efficiency and conservation improvements. They have been experienced by 82% of participants. One quarter of participants cite the tenure of their business premises as one of the two key disincentives to energy improvement. The effect of the second key barrier, the content and structure of leases is discussed further in Section 5.4.6.

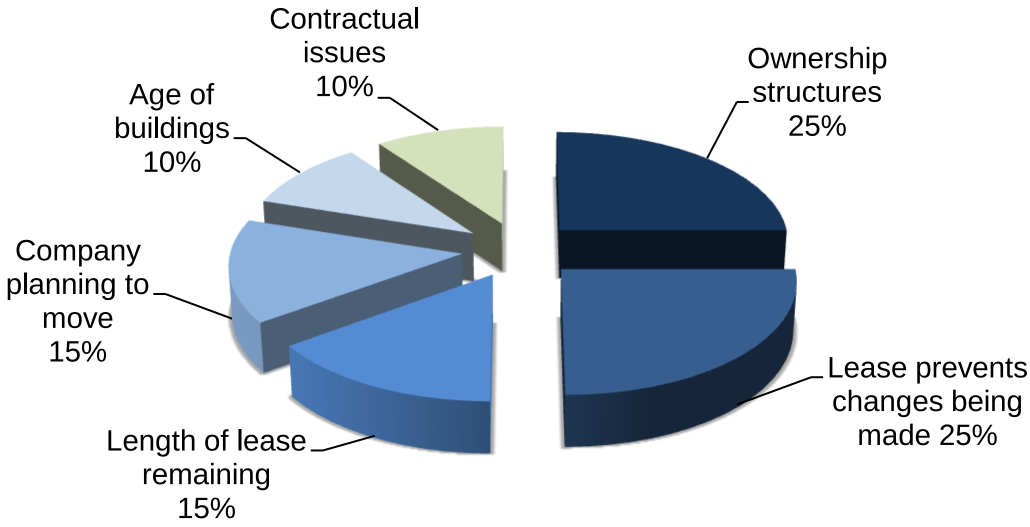

Figure 5.21: Ownership constraints to the adoption of energy efficiency and conservation

Qualitative responses given by participants provide further details of disincentives for the adoption of energy efficiency and conservation related to building ownership. For example, participant T7, a tenant sharing their business premises in Segment '*b*', indicates,

> *"As tenants we are unable to change the fabric of the building and we are very much dependent upon the other tenant company and the landlord".*

Similarly T8, a tenant in Segment '*a*' in a multi-occupancy building highlights this reliance on co-located organisations as well as the building owner to improve energy performance,

> *"As one of 2 tenant companies, investment will be dependent upon landlord and other tenant's buy in"*

T3, an independent retail company in Segment "*a*" explained,

> *"We are [on the] ground floor with flats above, the Local Authority is the owner and rent them out. If we want to put solar panels up we would have to go through tenants and the Local Authority before we could carry out [the work]".*

Participant T17, a company in Segment "*i*", running a leisure centre on behalf of a local authority, are constrained by contractual issues,

> *"All areas of the building have to comply with Sport England recommendations. As such we are limited in the changes (lux levels, heating etc.) that we can make".*

T19, a leisure centre operator in Segment "*a*", confirms they have encountered disincentives of,

> *"Red tape and contractual politics"*

This participant also illustrates the impact of contractual issues,

> *"There are 2 tenants, one responsible for operations, the other maintenance. The operator has responsibility for utility costs but little or no authority to change structure or equipment without the consent of the maintenance partner. This can be very problematic when the operators would like to change something that may end up costing its maintenance partner long term".*

T16, an SME within the service industry in Segment "*i*", supports the view that contracts can be a disincentive for energy improvements and confirms that energy improvements are laborious to implement,

> *"Improvements can only be undertaken with all party agreement and a Notice of Change to the Contract".*

As this is a legal change it appears unlikely that many changes will be pursued.

Research participants also describe more general disincentives for improving energy efficiency within their buildings. For example, respondent T6 in Segment "*a*", in the facilities services sector, describes a general disincentive,

> *"There is probably a great deal of tenants that would like to have a more energy saving building unfortunately their hands are tied. Most tenants would like the freedom to choose the best energy available or have metered energy but again they get no help to do so."*

O6, an owner-occupier in Segment "*b*", confirms,

> *"I am selling the business so will not invest in improving the office. That is for the new owner to address".*

5.5.4.2.2 Disincentives for energy efficiency and conservation based on financial investment and return

As shown in Figure 5.19, participants of this survey also consider financial constraints a significant barrier to making energy improvements. This is broken down further in Figure 5.22 to provide more details.

Over 70% of respondents consider the split of financial incentives arising from building ownership negatively impacts the ability and willingness of both owners and tenants to adopt energy efficiency and conservation opportunities. The research indicates the serious impact of split incentives previously with 39% of tenants and 33% of owners unwilling to improve energy efficiency, as they do not directly benefit.

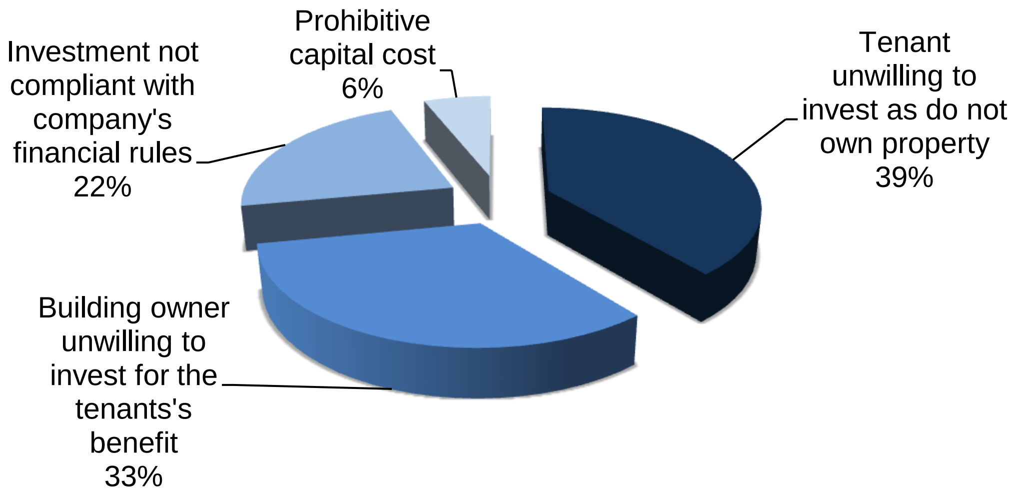

Figure 5.22: Financial constraints to the adoption of energy efficiency and conservation

For example, participant O1 a property owner in the East Midlands in Segment '*h*' summarised this widely held opinion as:

> *"Investment money is limited so [the building] will be tidied up. But we don't benefit long-term so we won't invest in energy efficiency for tenants".*

Responses also indicate more than a fifth of participants feel their company's financial rules e.g. payback periods or rates of return on investment act as barriers to the improvement of energy efficiency. 6% of the participants see the scale of the capital cost required to invest in energy improvements prevents them doing so.

If these figures are increased to represent the UK SME population, approximately 1 million small businesses would be unwilling to invest in energy efficiency, or unable to, as it conflicted with their financial rules.

Participants also provide illustrations of these financial barriers encountered. For example, T11, a grounds maintenance contractor in Segment '*c*', indicated,

> *"There has been no investment in any building with regard to reducing energy consumption. This is mainly due to lack of funding".*

T22, a management consultancy in Segment '*d*', confirmed,

> *"The cost of energy improvements does not meet the company's financial rules - e.g. payback periods'.*

T6, a facilities services company in Segment 'a' indicated,

> *"We have not been offered any incentives to improve energy efficiency or conservation or costs measures. It is very frustrating when the company I run is operating in facilities services and I can see obvious areas of improvement"*

O2, an owner in Segment '*h*' with a portfolio of small buildings in the Yorkshire, indicates,

> *"The main barrier is capital cost".*

In a similar manner, T17, a leisure centre operator in Segment '*i*', indicated,

> *"Sourcing capital funding for energy projects is a challenge".*

When disincentives to energy efficiency and conservation are considered by ownership segment distinct patterns of barriers emerge and the impact of ownership of the business premises on energy improvement is highlighted. These are reviewed in detail below.

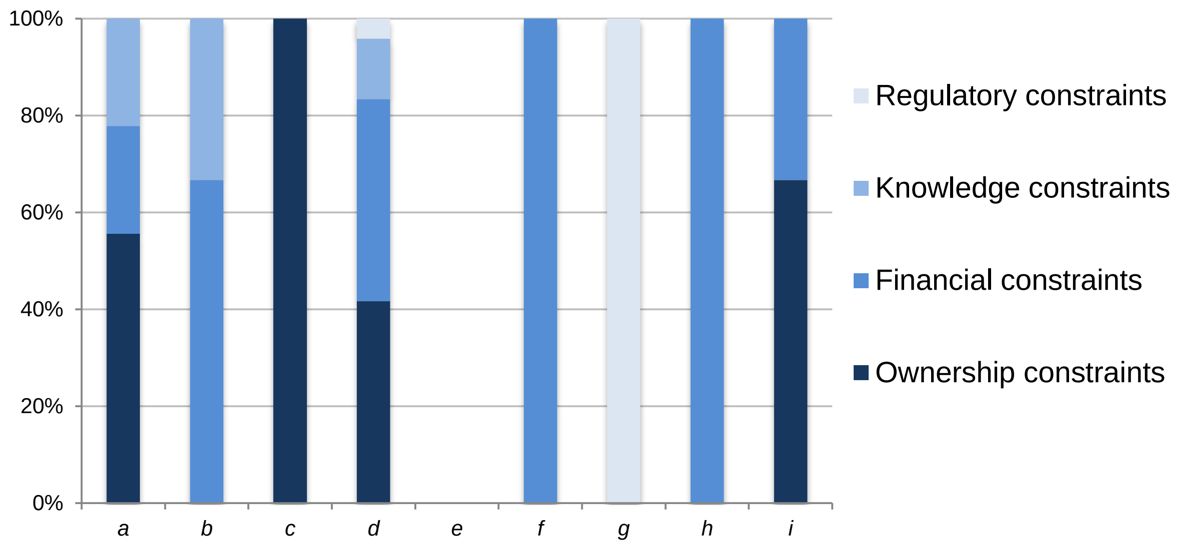

Figure 5.23: Disincentives by ownership segment

As shown in Figure 5.23, research participants within Segment '*a*' appear to be significantly affected by the impact of the ownership structures of their premises. This may be due to the split of incentives between owners and tenants limiting the ability and willingness to invest in energy efficiency and conservation. Segments '*c*' and '*i*' also demonstrate this. However, unlike members of Segment '*a*' companies in both of these segments are franchisees and indicated by participants' responses, are likely to have limited ability to make energy improvements.

Financial constraints appear most significant in Segment '*b*' where the owner of the building occupies it, Segment '*f*' where the owner and tenant are separated by the presence of a managing agent and Segment '*h*' where the owners are commercial investors. For owner-occupiers the investment required for energy improvements may have to compete with other investment opportunities.

However, for participants in the other segments there appears to be a common theme of separation between the building user and its owner that may be influencing investment in energy efficiency and conservation. For example, T22, a management consultancy in Segment '*d*', described their experience:

> *"The lease has only 12 months to go so we've given up trying to get the owners to improve the building fabric. We have made 5 requests for energy efficiency improvements to our building over the last 3 years but nothing was ever forthcoming. In fact only one response was received to the 5 requests made. The building's owner refuses to invest in the property."*

Lack of knowledge of opportunities regarding energy efficiency and conservation appear only significant to the owner occupiers in Segment '*b*', and to a lesser extent to tenants in Segment '*a*' and the branches of multisite organisations in Segment '*d*'. However, in all cases these are of lesser importance than other disincentives encountered and of lesser importance than assumed within current Energy Policy.

5.5.5 Impact of lease agreements on adoption of energy efficiency improvements

The literature review in Chapter 2 suggested that tenancy agreements may have a significant influence on the ability and willingness of owners and tenants to adopt energy efficiency and conservation measures. This thesis tests this view and concludes that leases remain a significant disincentive to improving energy efficiency. As shown in Figure 5.21, 25% of research participants own or occupy business premises with leases that restrict their ability to make energy improvements.

57% of the tenants surveyed indicate that they are restricted from making changes that will improve energy efficiency whilst owners indicate that they restrict 61% of tenants from doing the same. Owners and tenants participating in this research may not own and occupy the same buildings yet, as show in Figure 5.24, their responses offer similar patterns of restriction suggesting that the use of lease clauses to control changes to the business premises is widespread.

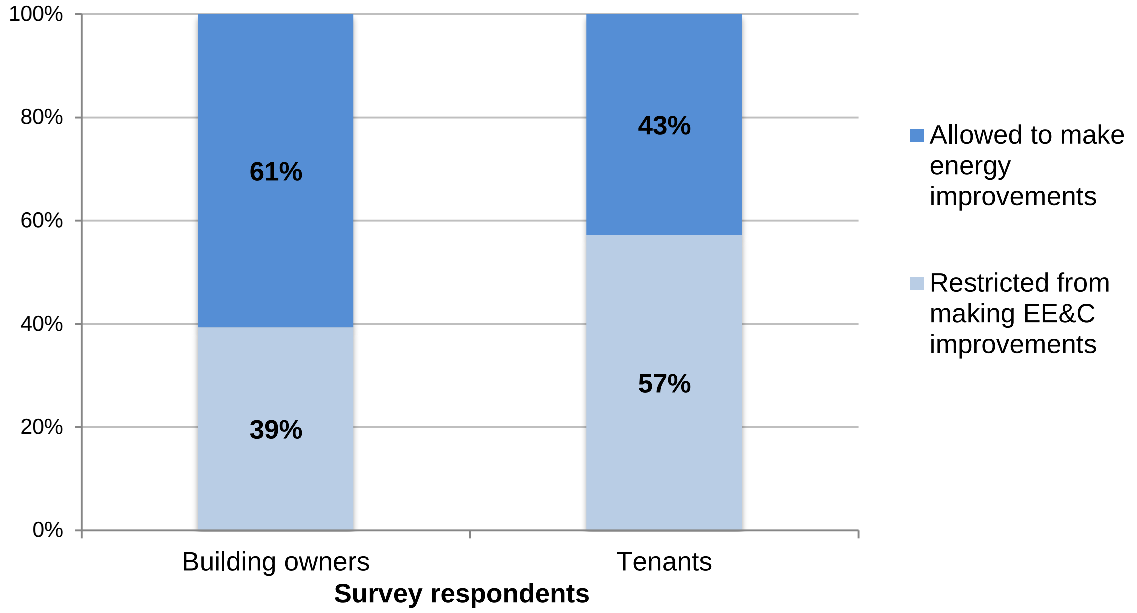

Figure 5.24: The impact of lease clauses on owners' and tenants' ability to improve energy efficiency

If these figures are scaled up to reflect the UK SME population over 2.8 million companies are restricted from improving energy efficiency by their tenancy contracts.

The participants' qualitative responses also illustrate how leases affect the ability of building owners and tenants to improve their energy efficiency. These range from simple restrictions caused by the remaining length of the lease to more complex scenarios. For example T3, a retail outlet in Segment '*a*', confirmed,

> *"The length of the lease can restrict the amount of investment".*

However, T5 an IT facilities organisation in Segment '*a*' provides an example of the impact of a specific lease clause,

> *"Clauses are prohibitive and encourage waste…especially under dilapidations e.g. you have to put the place to a shell. When you leave you rip everything out even*

though it is in fine condition and replace with cheap items such as cheapest lighting and carpets which are not energy efficient".

T11, a grounds maintenance contractor in Segment '*c*', confirmed investment in energy improvements,

"Would very much depend on return of investment as we do not own the buildings and only 6 years of the contract left".

T14, an ecology services provider in Segment '*a*', confirms,

"The lease clauses prevent us as the tenant from making alterations to the exterior of the building or any part of the interior of the property. The owner is not restricted from making changes but does not get involved in energy improvements"

When considered by ownership segment (Figure 5.25) a similar picture of restrictive lease clauses emerges in all except Segments '*a*', '*b*' and '*g*'. The only segments in which participants have no restrictions on energy improvements are Segments '*b*' and '*g*'. This is expected of owner-occupiers in Segment "*b*". It is not understood why Segment "*g*" experiences this.

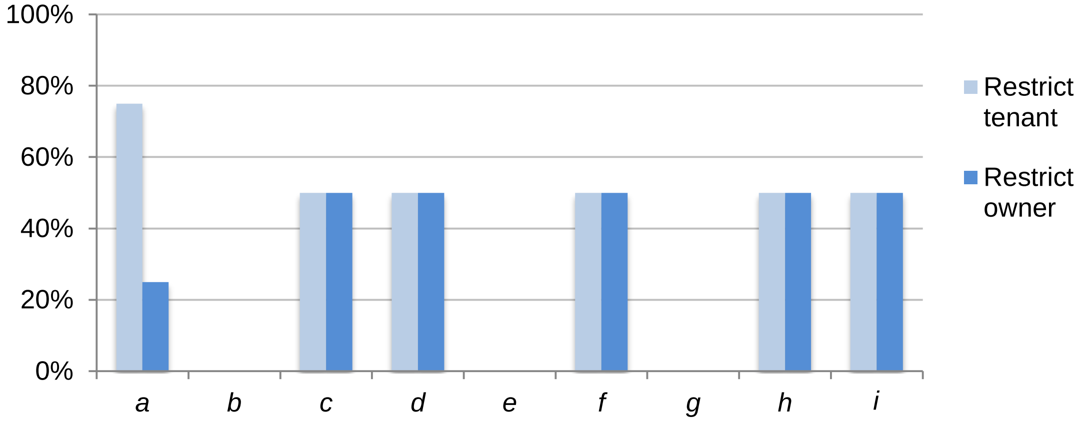

Figure 5.25: Lease clauses restricting owners' and tenants' ability to improve energy efficiency by building ownership segment

In segment '*a*', 75% of the tenants are bound by lease clauses that constrain their ability and willingness to reduce energy consumption. If this is scaled up to reflect the UK SME population, up to 1.85 million companies are restricted from adopting technologies that will improve energy efficiency and energy conservation. If the saving of £2000 per year from simple changes calculated by Eon (2011) is applied, these organisations are unable to benefit from the £3.7 billion in energy savings that are readily available and the country is missing an opportunity to reduce carbon emissions by 450 $mtCO_2$ in one year alone.

5.5.6 Factors that will motivate future improvements

Having established that 88% of non-domestic building owners and tenants have encountered some form of disincentive when attempting to reduce energy consumption, this research now seeks to establish what would motivate research participants to adopt energy efficiency and conservation opportunities.

This review of potential motivators of energy change is undertaken to test the validity of expected drivers of energy efficiency entrenched within current energy policy and research and identifies the factors most likely to be successful drivers of change. Findings from this analysis will be incorporated in the proposal for an alternative policy approach in Chapter 7.

The surveys ask participants to rate a series of potential driving factors according to how strongly they would be motivated by them to invest in energy efficiency and conservation measures. The motivational effect of these factors is collected using a simple scale between 1 and 10, where 1 is “unlikely to be motivated” and 10 “will be motivated”. A score of 7 or more indicates a significant driver of change. Research participants are also encouraged to provide additional information. The factors presented are listed below and are followed by an explanation of why these items are included:

1. Changes to regulations and legislation
2. Increase in cost of energy
3. Easier access to grants
4. Easier access to low cost loans
5. Easier access to information on energy efficiency opportunities
6. Social pressure
7. Customer pressure
8. The appointment of an energy champion
9. Voluntary adoption of good practice
10. Recognition as a leader of sustainability
11. Changes to lease clauses
12. Other

These motivational factors offered to research participants represent key features and gaps within current Energy Policy, findings of previous energy research and accepted drivers of sustainable behaviour. Regulatory change is included as energy regulation is a current policy gap for SMEs. As described in Chapter 3, Energy Policy focuses on large carbon emitters and domestic energy consumers with SMEs falling into the policy gap between the two.

Low cost loans, the provision of information on energy efficiency and energy price manipulation are key features of current Energy Policy. Grants for energy efficient interventions are a former improvement incentive offered by government organisations such as the Carbon Trust. Funding of grants has now been cancelled in favour of low cost loans. Voluntary good practice is the expected outcome of current policies.

Other potential motivators are also taken from energy research findings reviewed in Chapter 2. RWE Npower (2013) included the appointment of an energy champion as a potential motivator for SMEs' energy behaviours. The opportunity to be seen as a leader of sustainability is a motivator proposed by the CBI (2013). Bright (2010) and Hinnells *et al.* (2008) recommended changes to lease clauses to improve the adoption of energy management within businesses.

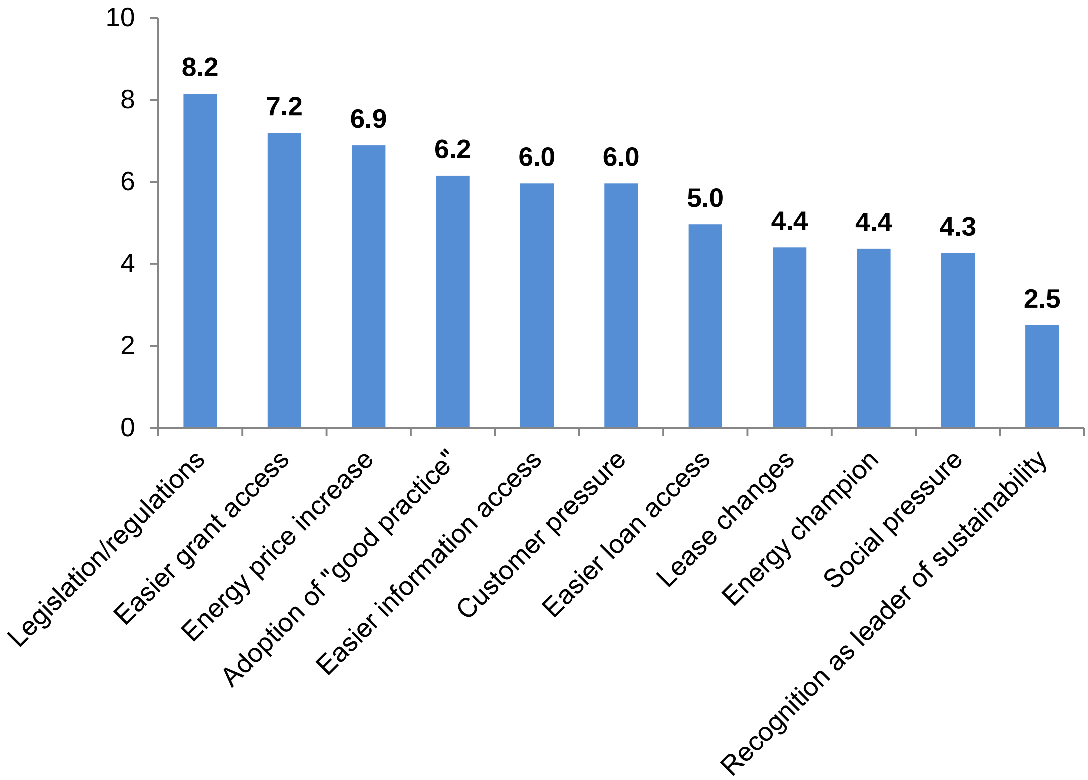

Figure 5.26: Factors that motivate non-domestic building owners and users to improve energy efficiency and conservation (average score)

The average ratings of the motivational factors given by respondents are shown in Figure 5.26. Legislative and regulatory change with an average score of 8.2 out of 10 is the most significant factor that will drive improvement in the adoption rate of energy efficiency and conservation opportunities for owners and tenants of smaller non-domestic properties. This is followed by easier grant access with a rating of 7.2 out of 10 and energy price increases with a score of 6.9. The implications of this for future policies are explored further following the comparison of responses received from building owners and tenants.

Both owners and tenants consider regulatory and legislative pressure to be the strongest factor to motivate them to adopt energy efficiency and conservation measures to improve the energy performance of their buildings (Figure 5.27). Tenants, however, have allocated this greater priority than owners, scoring it almost one point higher. Regulation is rated as 8 or more by 62% of tenants whereas only 50% of owners have given the same rating. This implies that non-domestic building owners are slightly more remote from regulatory activities, possibly as they consider their tenants to be responsible for compliance. This supports the view from research participants in Section 5.5.3.1 that owners consider energy costs an insignificant factor for tenants. Despite this, owners believe regulatory change is likely to motivate them to improve energy efficiency, with an average rating of 7.4 out of 10.

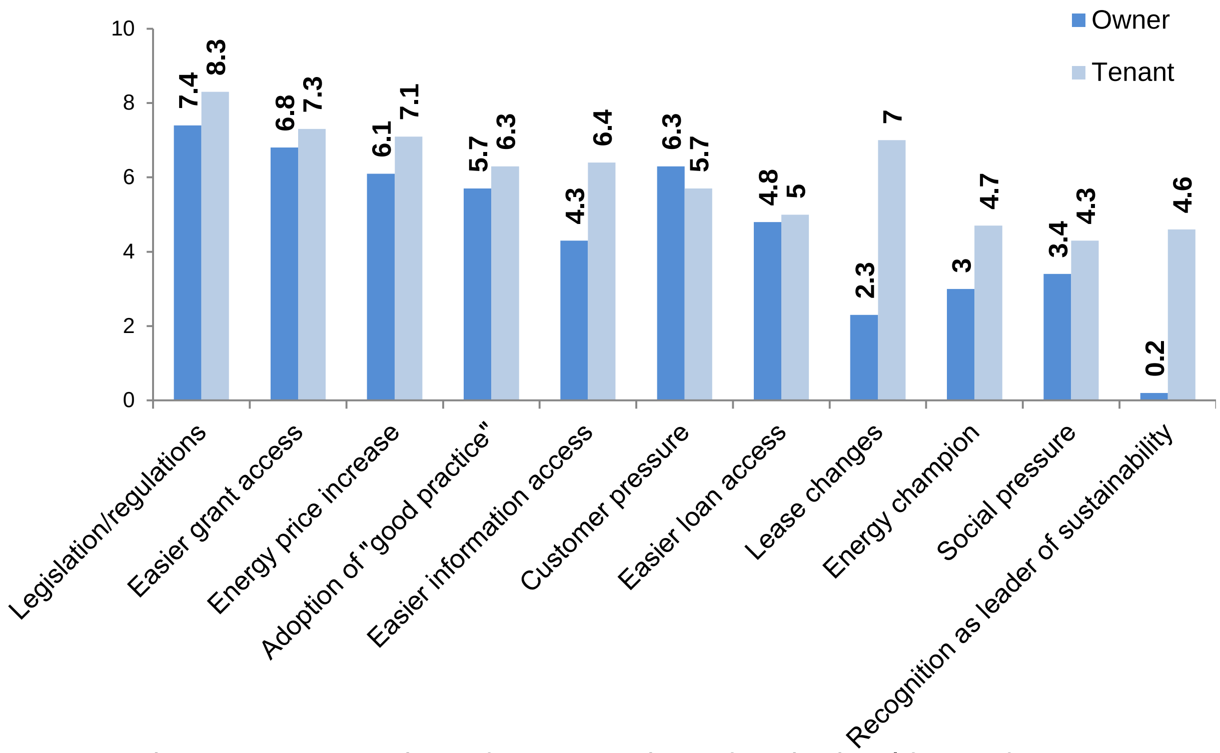

Figure 5.27: Comparison of average ratings of motivational factors from owners and tenants

The importance given to regulatory change indicates that investment in energy legislation for UK SMEs is likely to achieve a greater contribution to energy consumption reduction and consequently to carbon emissions reduction than current Energy Policies based on encouraging voluntary good practice.

Both owners and tenants consider easier access to grant funding for energy improvements the second most important factor to motivate change. Again, tenants have scored this higher than the owners. This indicates provision of additional grant funding will encourage SMEs to adopt energy efficiency and conservation measures.

Energy price increases appear more important for tenants than owners with a rating difference of one point, i.e. a difference of 10%; tenants rate energy price increases as 7.1 out of 10 whilst building owners rated it only 6.1. The maximum score from a tenant is 10 whilst from an owner it is only 8. This may be due to the fact that most tenants are responsible for their own energy purchases as shown in Section 5.3. As the majority of participating owners (88%) do not provide energy for tenants there is less incentive for energy price rises to drive them to instigate energy improvements.

Customer pressure emerges as the third most important driver of energy efficiency for owners with a rating of 6.3 out of 10 although less so for tenants (5.7). This may be an early indicator of increasing demand for energy efficient business premises identified by participants in Section 5.5.3.2. This motivational factor may be achieved as an outcome of regulatory change and energy price increase as tenants will seek to lease energy efficient buildings to comply with regulations and reduce energy consumption.

Easier access to information has proved to be of considerably lower importance to owners than to tenants specifically and to commercial organisations in general than is expected by current energy policy approaches. Tenants will be considerably more motivated to improve energy efficiency and conservation as they have scored easier access to information as 6.4 out of 10 than owners who rated this as 4.3. Neither these scores, nor its' 5th and 6th position suggest that large investment of public funds in the provision of information will achieve the energy efficiency and conservation improvements required to meet Government targets. This finding challenges the current policy approach applied.

For both groups the adoption of good practice is been rated significantly less motivating. Both groups have scored it at least 2 points lower than regulations, the most significant driver of change. This indicates that regulatory change or grants will achieve a better rate of return than encouraging good practice.

There is a difference in more than 4 points in the scores for changes to lease clauses as factors that will drive energy efficiency and conservation activities. Tenants score this as 7 out of 10 whilst owners consider this significantly less important, rating it as only 2.3. This supports the findings in Section 5.5.5 whereby owners do not consider that lease clauses prevent improvements to the energy efficiency of their buildings.

Both groups consider the appointment of an energy champion, recognition as a leader of sustainability and social pressure as unlikely to motivate them to improve energy efficiency and conservation. In each case tenants rate them significantly higher implying that they may consider their customer-facing image as more important than the tenant-facing image by the building owners. This supports the view in Section 5.5.3.1 that non-domestic building owners only get involved in energy when something goes wrong.

Neither group rates easier access to low cost loans as a significant driver of change. This suggests that Government provision of funding for loans could represent lower value for money than if the funding is used to provide grants. Indeed, this finding appears to contradict the approach taken by UK Energy Policy. Grants have been removed in favour of low cost loans provided under the Green Deal scheme.

When analysed at the ownership segment level (Figure 5.28) the 3 highest rated motivational factors described above, i.e. regulatory change, easier grant access and energy price increases emerge as motivators for members of all segments to adopt energy efficiency opportunities.

With the exception of Segment '*h,*' regulatory change is considered a significant motivator with participants rating this greater than 7 out of 10. For commercial property investors in Segment '*h*', regulatory compliance is less significant as it is considered the tenant's responsibility. Owner–occupiers in Segment '*b*' and franchisees directly purchasing energy from utility companies in Segment '*i*' have rated the motivational factor of regulations with an average score of more than 9 out of 10. For owner-occupiers this may be because they are directly responsible for legislative compliance and franchisees for contractual compliance.

Easier access to grants will drive change in all segments. Although for branches of a multi-site organisation (Segment '*d*') and commercial property investors (Segment '*h*') it is considered of lower motivational importance than by members of other segments. This may be because they are more detached from the actual costs of energy consumption.

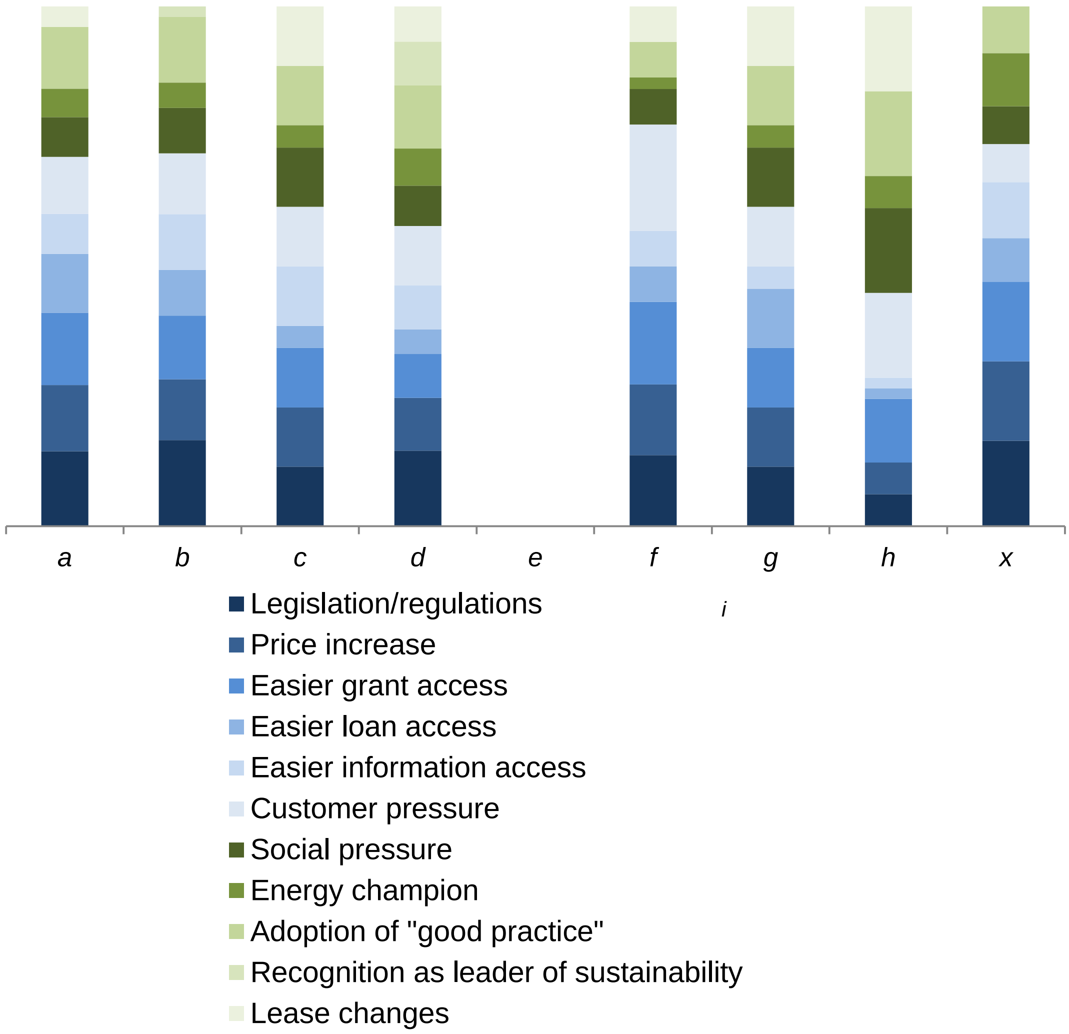

Figure 5.28: Comparison of importance of factors that motivate the adoption of energy efficiency and conservation building ownership segment

Energy price change appears to motivate participants in all segments with the exception of Segment '*h*'. This may be because energy costs for participants in Segment '*h*' are remote from daily overheads, as energy overheads are paid within the service charge will not be affected by price changes.

Customer pressure has emerged as a significant factor that will motivate building owners and tenants to improve energy efficiency in Segments '*c*', '*d*', 'f' and '*h*'. Participants in Segment '*f*', where the owners employ managing agents to operate their buildings have rated this as their most significant motivator, and Segment "*h*" has allocated customer pressure their highest ratings of 9 and 8 out of 10 respectively.

Overall this analysis demonstrates that if Energy Policy focuses on regulations, easier grant access and energy price manipulation it will make a significant impact on improving adoption rates of energy efficiency and conservation within non-domestic buildings. According to the participants' scores these three factors will motivate 92% of the building owners and tenants to adopt energy efficiency and conservation measures. If this is scaled up to the UK SME population more than 4.5 million SMEs would be driven to improve rates of energy efficiency and reduce consumption and carbon emissions. In comparison, current policy based on information encouraging good practice will motivate less than 50% of research participants or 2.3 million UK SMEs. These results have delivered the second of the four objectives for this research.

The perception of the importance of these motivating factors offered by non-domestic building owners and tenants offers significant insight into how alternative approaches could be applied to energy policy to improve rates of energy efficiency and conservation within SMEs. This contributes to the delivery of the final of the four objectives of this research, an alternative energy policy framework. Utilising this knowledge will deliver greater rates of SME engagement, financial return and carbon emission reduction than is currently experienced. This research suggests that encouraging voluntary good practice and providing funding for easier access to information will motivate neither SME tenants nor their business premises owners to adopt energy efficiency and conservation measures. Regulatory change and the provision of grants will generate a greater energy reduction return on investment for owners and tenants in all non-domestic building ownership segments. The potential levels of energy savings and CO_2 emissions able to be achieved are explored through scenario planning in Chapter 8.

5.6 Data analysis conclusion

This research finds that an energy-efficiency gap exists caused by non-domestic building ownership within the UK SME sector. Analysis of the research participants' survey responses provides sufficient evidence to confirm that the research hypothesis is correct; ownership of non-domestic buildings does have a significant impact on the ability and willingness of owners and tenants to adopt energy efficiency and conservation opportunities. This not only has direct control through ownership structures, lease clauses and relationships, but also provides a financial constraint as well. 36% of survey responses indicate that tenants and owners have a relationship that prevents the adoption of energy efficiency measures. In addition 5% of tenants confirm their building owners choose not to get involved in energy efficiency; 29% of owners confirmed this is their choice as well. 33% of non-domestic building owners and 39% of tenants highlight the influence of split incentives and confirm they are unwilling to invest to improve energy performance as the other party would benefit from them doing so.

In addition potential factors that will motivate both tenants and building owners to adopt energy efficiency and conservation are also investigated. Research findings highlight regulation, the provision of energy efficiency grants and energy price increase as key drivers of change. Analysis shows that current policy approaches of access to information and voluntary good practice are not the most effective way to engage owners and tenants. Regulations and grants are a more cost efficient route to improving adoption rates of energy efficient technologies. This adds significant knowledge to energy research and delivers the first three of the four objectives set for this research shown in Section 5.1. The fourth objective, an alternative energy policy approach is delivered in Chapter 7.

CHAPTER 6: DATA COLLECTION CONCERNS

6.1 Introduction

A key feature of data analysis collection for this research was the difficulty in engaging non-domestic building owners and users. Whilst this has limited the quantity of primary data available, it is recognised this lack of engagement has contributed to the research in a number of other ways and has added knowledge to the issue of what motivates SMEs to adopt energy efficiency and conservation measures. This is included in the development of an alternative approach to Energy Policy proposed in Chapter 7.

As described in Chapter 4, surveys are sent to more than 100 non-domestic building owners and users directly and more than 5000 potential research participants via social media and networking groups over a two year period. The target audiences contacted are shown in Table 6.1.

Table 6.1: Surveys issued to support data collection

	Source of potential research partners	Date sent	Potential respondents	Response rate	Comments
Professional contacts	Various	09/04/13	50	20%	
		15/11/13	40	23%	
		05/12/13	2	50%	
Secondary contacts	Sustainable Buildings Group (Coventry University)	24/10/13	1000+	0	
	Warwick Manufacturing Group	24/10/13	3000+	0	
Networking groups	RETA	31/05/13	100+	1%	Issued via Coventry City Council
	3P	01/11/13	30	0	
	Enterprise Rockers	03/12/13	1000+	0	
Government agencies	Chambers of Commerce	26/08/13	1000	0	9 CoCs - responses from Cannock and Birmingham
Social media forums	2 Degrees	28/03/12	500	0.4%	Environmental Forum
	LinkedIn	07/06/12	2000	0.2%	15+ business/environmental groups

The highest percentage response rate was from professional contacts. However, as surveys are sent to almost 100 SMEs and building owners the total number of surveys returned was small. Use of social media to access a wide pool of potential research partners proved unproductive. 2 Degrees (a forum for energy professionals), Enterprise Rockers (an organisation of micro businesses with less than 9 employees) and LinkedIn (a professional networking online forum) resulted in a response rate of less than 0.5%. Contributions to the research project were requested from members of fifteen LinkedIn groups, including local business forums such as West Midlands Business Network and Stratford Business Forum and more specialised groups such as Energy Efficiency Building Network and Commercial Landlord and Tenant Professionals focused on non-domestic building ownership and use.

Two research groups agreed to provide access to their members: the Sustainable Business Group at Coventry University and the Warwick Manufacturing Group. Both issued surveys via newsletters. This failed to elicit any responses.

Research partners were sought from the members of networking groups Renewable Energy Technology Alliance (RETA) and 3P. Response rates were 1% and zero respectively.

Members' contact details were requested from nine Chambers of Commerce within the Midlands region. Only one responded to this request. Due to the confidentiality of data held, Birmingham Chamber of Commerce members could only receive a request for research participation via a quarterly newsletter. The links to the online surveys received no responses.

More than 95% of the survey responses received were obtained from professional contacts recruited through personal requests for research support. Less than 5% of responses were obtained from speculative requests for help from professional networking groups and social media forums. The direct requests for research participation made to professional contacts and at the RETA networking meetings proved to be the most successful recruitment approach. This is likely to be because the purpose and content of the research were personally explained and participation agreed in advance.

6.2 Data concerns

The difficulty of engaging research partners raised a number of concerns over the quantity and quality of data collected. These include the source of research participants, the low response rate producing low levels of primary data, inability to access publicly held non-domestic building data and lack of connectivity between survey responses. Each of these concerns is discussed in more detail below.

6.2.1 Source of research participants

The choice of research participants for any research project will influence the data collected. Due to the subject under consideration only those having a particular interest in the subject of energy efficiency and conservation may have answered the surveys. This could have added a bias into the information obtained.

This potential for influencing the data collected could have been exacerbated by engaging research partners through social media forums. As they are established as groups of individuals with common interests or backgrounds, clusters could have developed within certain business sectors. Participants have been engaged from a number of sources. Responses received are not clustered within ownership segments established.

Where a number of responses have been received from a specific business sector such as leisure services, the ownership segment distribution of respondents could be distorted. The analysis of the responses contained in Chapter 5 demonstrates that there is no significant clustering of research partners and that an appropriate spread of both respondents and their ownership segments have been achieved.

Although survey responses have been received from non-domestic building owners and tenants, the number of responses received from tenants outweighs those from owners in a ratio of 3:1. This ratio is considered to accurately represent the tenure profile of the UK non-domestic building sector established by Dixon (2009) where many buildings have multiple occupants and many owners own a number of buildings. Over 70% of building owners participating in this research have identified that their commercial building portfolios contain more than one building.

6.2.2 Low survey response rates

The low survey response rate experienced within this research programme has provided a limited quantity of primary data. Although the number of surveys obtained does not provide a significant sample in pure statistical terms it is sufficient to provide a realistic view of energy efficiency and conservation activities and behaviours currently being experienced by UK SMEs and the owners of their premises.

Extensive energy efficiency information has been made available in increasing quantities to businesses over the last decade in attempt to encourage them to adopt voluntary energy efficiency and consumption reduction activities. However, this has failed to engage them. This research has experienced a similar lack of engagement, which may be symptomatic of SMEs' low levels of engagement in energy efficiency and conservation. A number of hypotheses are suggested for this lack of participation and are examined in detail below. Additional information is presented to support the hypothesis where appropriate. It is recommended that these be considered in future research projects to improve participation rates

- **Hypothesis 1**: There is a general lack of engagement in energy management by non-domestic building owners and tenants so they are less likely to participate in energy research. Accounting and strategic business practices create a culture of short-termism, which may reduce the attractiveness of energy efficiency and conservation actions. Kennett (2012) believes that business owners must divert resources from more tangible savings, which requires them to take a leap of faith to implement energy investment. Wynde and Lane (2010) suggest energy savings being less tangible than material saving opportunities causes this lack of engagement.
- **Hypothesis 2**: Businesses are immersed in a risk adverse culture and have not wanted to be made aware of their energy risk by responding to this research. Sullivan and Sullivan (2009) consider investment of resources including time and money in energy efficiency and conservation opportunities is a risk for many commercial property owners and tenants as the potential energy saving available cannot be proven absolutely. Avoidance of energy efficiency opportunities may reinforce the company's culture of energy inertia, whereby they become better off by doing nothing.
- **Hypothesis 3**: Building owners do not expect their tenants to consider the operational energy costs and emissions implications of their energy consumption and therefore have no interest in energy research. In a review of advertisements offering vacant Government owned commercial property for lease conducted to support this research only 15% contained the Energy Performance Certificate for the premises advertised. This is indicative of owners' and agents' lack of consideration of operational energy costs expected by the potential user in the rental decision-making process. Additionally, if owners do not provide Energy Performance Certificates to potential tenants they too are unlikely to drive energy cost opportunities forward during the tenancy period. de Jong (2013) considers

> this failure to highlight future running costs could also prevent owners from exploiting opportunities for rental price differentiation. If tenants are willing to move into a new business premises without consideration of future energy consumption they are unlikely to consider energy as a key overhead worthy of financial investment or energy research worthy of participation.

The unwillingness of non-domestic building owners and users to voluntarily engage in energy research supports the proposal that an alternative approach to energy policy requires mandatory action is required to unlock the culture of energy inertia. This is explored further in Chapter 7.

6.2.3 Lack of survey connectivity between building owners and tenants

The commitment to anonymity and confidentiality does not facilitate the collection of data from owners and tenants of the same buildings. Only one owner of the building occupied by a tenant participating in this research is known to have also completed a survey. The responses from a building owner and their tenant can therefore not be linked and compared. It is suggested that this be incorporated within future research into opportunities to improve the energy efficiency and conservation of non-domestic buildings.

6.2.4 Inability to access nationally held benchmark data

This research planned to use data on the UK stock of non-domestic buildings and their tenure from the Valuation Office Agency as the baseline for examples of the impact of ownership constraints on the UK SME population. Although tenure details are collected for each property they are not made available online. Requests for it are subject to special consideration. As it was estimated to take more than 3.5 working days to collate the tenure data into a usable format the Valuation Office Agency declined to provide it.

In the absence of this centrally held data on non-domestic building tenure a pro rata calculation has been substituted in order to calculate figures for ownership segments at the UK level. This allows the details of tenure established from the surveys completed by research participants to be related to the national non-domestic building stock. This survey-based data has provided the benchmark for the scenario planning conducted in Chapter 8.

6.3 Conclusion

Despite the difficulties experienced in obtaining information, sufficient research participants have been engaged to accurately provide a robust view of the energy efficiency and conservation environment currently experienced by the owners and tenants of smaller non-domestic properties. And the energy efficiency gap caused by ownership structures. The research has also avoided the clustering of participants within certain ownership segments as may have occurred with the number of professional contacts and previous research partners engaged.

Despite the number of tenants' responses outweighing owners' responses the split reflects the UK non-domestic building sector's tenure profile estimated by the Federation of Small Businesses (2014) and the sample of companies surveyed is representative of the UK structure SMEs established by BMG Research (2013). Therefore using this data to describe the impact of ownership on energy efficiency at ownership segment and UK SME population levels, as the baseline for the creation of an alternative approach to energy policy described in Chapter 7 and for scenario planning undertaking in Chapter 8 is considered appropriate.

CHAPTER 7: AN ALTERNATIVE APPROACH TO ENERGY POLICY

7.1 Introduction

This research identifies a considerable gap between the initiatives implemented by current UK Energy Policy in an attempt to encourage good practice ted into clusters of barriers with associated characteristics and the factors that will actually motivate building owners and tenants to adopt energy efficiency and conservation opportunities. This can be seen as an energy policy gap. Consequently this research proposes that an alternative approach to Energy Policy is required.

As shown in Chapter 3, UK Energy Policy relies on energy users displaying rational economic behaviour whereby decisions are made and actions taken based on best financial return or optimum self interest. Policy Planners widely believe that, in line with economic theory, commercial energy users are sensitive to energy price changes and will act rationally in response to increases in the cost of energy. This rational response is expected to take the form of investments in energy efficiency technologies and behaviours that will reduce consumption and minimise energy costs.

However, despite the recognition that energy efficiency and conservation can save money and reduce carbon emissions the research participants identify that little has been done to improve their energy efficiency or energy conservation. The analysis of the data collected suggests that ownership of non-domestic buildings prevents or discourages owners and tenants them from investing in energy efficiency and conservation improvements.

The research identifies that energy regulation is the key motivator of change so is consequently the most likely method of closing the energy-efficiency gap caused by non-domestic building ownership. This knowledge is used to construct an alternative energy policy framework that delivers the fourth of the four research objectives: to understand the opportunity for an alternative framework for energy policy in order to improve rates of energy efficiency and conservation within UK SMEs. Through this it also contributes to the aim of this thesis: to encourage SMEs to contribute further to national carbon reduction policies. This proposed alternative energy policy framework is the Carbon Allowance Scheme that is based on the change motivators highlighted by participants within this research rather than the expectation of rational economic behaviours and voluntary action that have come to dominate successive Governments' Energy Policies over the last 40 years.

In this chapter the proposed alternative policy framework of bespoke Carbon Allowances is presented. It is then used as the basis of scenario planning that uses the ownership segmentation established by this research to identify and prioritise energy efficiency and conservation actions that might be achieved.

7.2 The Carbon Allowance Scheme

The proposed Carbon Allowance Scheme is a system of bespoke allowances or non-tradable energy quotas that operate as energy efficiency drivers tailored for each non-domestic energy user. These are proposed to apply to all individuals and organisations responsible for the consumption of energy in non-domestic buildings. The scheme is based on three principles; firstly, users of non-domestic buildings consume too much energy; secondly, non-domestic building tenure frequently prevents owners and tenants from adopting energy efficiency and conservation opportunities and thirdly, organisations should manage energy efficiency improvements within the constraints of their own businesses and for their own benefit if there is to be sustainable consumption reduction.

The scheme proposed combines two of the top three drivers of consumption reduction identified by the research participants: legislations/regulations and energy price controls. The incorporation of the third of the 3 key motivators, improved access to energy efficiency grants, could also be introduced as part of this alternative policy approach and is described later in the chapter.

Within the proposed Carbon Allowance Scheme each commercial energy consumer would be allocated an annual energy quota, the Carbon Allowance. The energy provider would calculate this. It would comprise the total kWh of fuel (electricity and gas) available to the organisation for the year and would be calculated from an estimate of the total energy required within the premises covered by the fuel bill minus a realistic consumption reduction target. Transport fuel would be excluded. The proposed annual energy quota would be in operation for a 12-month period, the Carbon Allowance Cycle, which is described in the following section.

Consumption reduction would be driven through capping the quantity of energy available on a standard price tariff to each user. To incentivise the non-domestic building owners and tenants to make energy conservation improvements, a usage penalty would be incurred if they exceed their energy quota. This penalty would be paid as a fuel cost premium and would be applied from the following Carbon Allowance Cycle. Each fuel company would collect these penalty payments and pay them into an independently administered central account to fund additional energy improvements through the provision of energy efficiency grants to non-domestic consumers. This usage penalty and the central improvement fund are discussed separately.

The scheme, which could reduce the complexity and confusion of current Energy Policy, is designed to ensure that all those consuming energy are responsible for reducing their consumption. In return they could benefit directly from the energy savings available. All non-domestic building owners and tenants are responsible for their energy use directly or indirectly and therefore all contribute to CO_2 emissions. This accountability could deliver a key concept of the 'polluter pays principle' and the elements of fairness considered significant by the Environmental Audit Committee (2011). These principles of accountability and responsibility could be further enhanced, as the Carbon Allowance would not be a tradable commodity. The quota would remain with the bill payee as the polluter.

This framework of Carbon Allowances is designed to close the energy efficiency gap caused by the impact of building ownership on the owners' and tenants' ability and willingness to adopt energy efficiency opportunities identified by this research by implementing mandatory energy reduction policies. Unlike the current relationships discussed in Section 5.5.3 in which owners do not consider energy costs as significant, this proposed alternative energy policy could actively drive energy consumption reduction by both owners and tenants, which in turn could contribute to carbon emissions reductions. This is discussed further in Section 7.3.

7.2.1 The Carbon Allowance Cycle

The proposed process to apply and administer the Carbon Allowance Scheme is designed to be a series of sequential annual activities. Each sequence is cyclical and would lead into the following year's Carbon Allowance to maintain continuity of energy efficiency and conservation improvements. This is termed the Carbon Allowance Cycle. Figure 7.1 describes the cycle that forms the framework for the proposed Carbon Allowance Process and its connectivity in more detail. This is then explored in more detail below.

7.2.2 The Carbon Allowance Calculation

To ensure all members of the energy supply chain are fully engaged energy companies would take responsibility for calculating each non-domestic building customer's Carbon

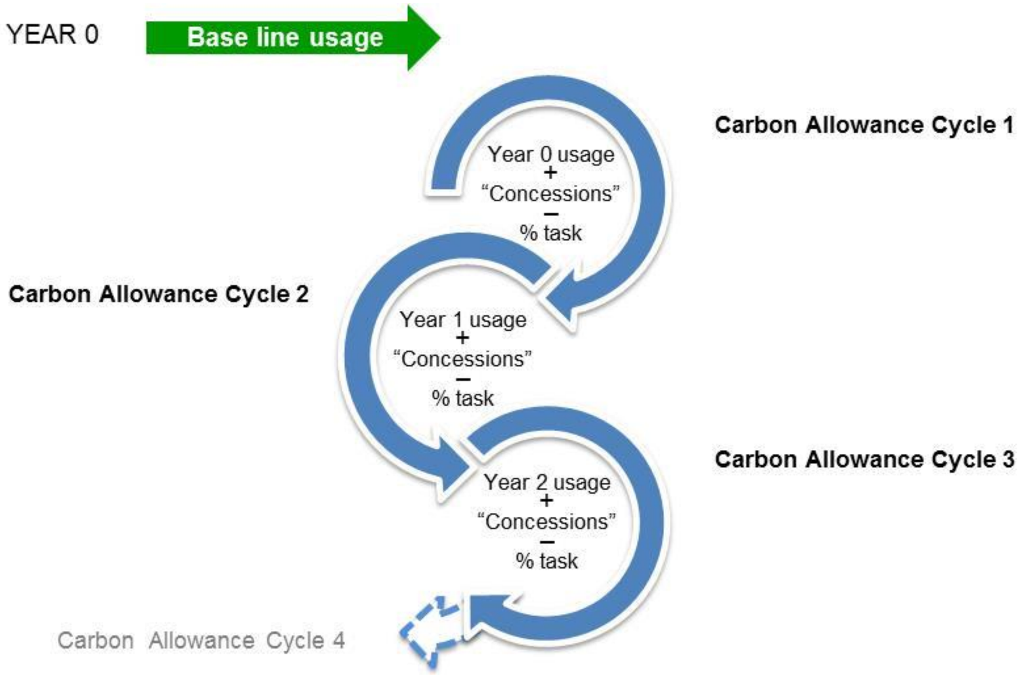

Figure 7.1: The Carbon Allowance Cycle

Allowance. Their costs would be covered by the part of the grant fund set aside to cover administration costs described in Section 7.2.3. Each energy quota, a consumer's bespoke allowance, would be calculated by taking the Year 0 fuel consumption as the baseline usage and applying a task to reduce fuel consumption. The resulting figure would represent the fuel available to the owner or tenant at the standard pricing structure, i.e. the Carbon Allowance.

Example:	Baseline usage	= 900,000 kWh
	Carbon Allowance task	= 5%
	Energy quota	= 855,000 kWh

The Carbon Trust (2009) propose a series of potential energy efficient interventions that will reduce an organisation's energy consumption with little or no up front financial investment. By adopting some or all of these energy conservation opportunities, shown in Table 7.1, an organisation could achieve the proposed 5% Carbon Allowance task.

Table 7.1: Potential energy efficient interventions (Carbon Trust: 2009)

Energy use	Percentage of total energy consumed within non-domestic building	Potential energy saving interventions available	Potential energy saving available
Heating	46%	• Programmable thermostats • Optimise on/off times • Reduce room temperature • Thermostatic radiators • Energy-efficient boiler • Roof/wall insulation, double glazing • Heat recovery	Up to 70%
Lights	23%	• Timers to switch off when building not in use • Presence detectors • Energy efficient bulbs/ fixtures equipment	Up to 90%
Cooling and ventilation	11%	• Building management systems • Natural ventilation • Chill beams	Up to 30%
Catering	8%	• Energy efficient equipment • Water boilers ILO kettles	Up to 30%
Hot water	4%	• Programmable thermostats • Low water/water saving taps	Up to 40%
Office equipment	3%	• Energy efficient equipment • Timers to switch off what not in use • Communication	Up to 75%
Other	4%	• Energy efficient equipment	Up to 30%

The Carbon Allowance task suggested to be applied initially is a standard percentage reduction. This would remain fair to all commercial energy users and would protect their competitiveness. The proposed target reduction is based on the figures within the carbon reduction pathway established by Department of Energy and Climate Change (2010).

Once their Carbon Allowance has been calculated each non-domestic customer would be able to declare ‘Concessions’ to reduce the task applied. This Concession would be based on actions over the previous year that have reduced their use of carbon intensive fuel such as installation of solar water heating or wall insulation. A list of materials and technologies that generate concessions would be published along with the rate to be applied. This would ensure that these benefits are standardised for all fuel users.

Example:	Baseline usage	= 900,000 kWh
	Carbon Allowance task	= 5%
	Energy quota	= 855,000 kWh
	Concession 1: wall insulation	= + 450 kWh
	Concession 2: solar water heating	= + 300 kWh
	Carbon Allowance	= 855,750 kWh

The researcher’s experience of organisations suggests that a formal recognition of good practice motivates further adoption of improvement, for example the Business in the Community Awards or CRC league tables. Offering Concessions could provide this motivation and recognition. It could also encourage existing tenants to urge building owners to upgrade their property’s energy efficiency and encourage a tenant seeking new premises to favour those buildings that offer efficiencies to provide Carbon Allowance Concessions. This incorporates the research findings that 71% of tenants expect that in future they will increasingly demand energy efficient properties. As the Carbon Allowance Scheme could drive this increasing demand, owners are likely to respond by providing properties that facilitate compliance. These properties could attract a premium on occupancy charges in return for reduced running costs thus helping to overcome the influence of split incentives in preventing energy improvements.

During each Carbon Allowance Cycle structural changes made within an organisation, can be declared at any time, for example reduced output or workforce. As the proposed Carbon Allowance Scheme would be enacted by legislation these changes would represent a legal declaration as is undertaken to comply with the current CRC and EU ETS Schemes. These will be incorporated into the following Carbon Allowance Cycle and the organisation’s Carbon Allowance adjusted accordingly.

7.2.3 Implementation of the Carbon Allowance Scheme

The proposed process to handle the Carbon Allowance Scheme is shown in Figure 7.2. Each activity is given an owner to clarify the sequence of events and interrelationships that could maximise their effectiveness. This will not be described in detail here although a few of the key features of the scheme are highlighted.

This proposed alternative policy approach would be implemented through energy legislation. The Carbon Allowance Scheme therefore would incorporate one of the key motivators of change for both owners and tenants discussed in Chapter 5: Regulation. This Regulation is proposed to be the Commercial Energy Saving Obligation and, as with other energy policies, it would be implemented by the Department of Energy and Climate Change. It would place the obligation to administer the Carbon Allowance Scheme with energy suppliers and the obligation to reduce energy consumption with the commercial energy bill recipients. This could be the building owner or tenant or both according to the tenure and energy supply structure of the building.

Carbon Allowances would not be prescriptive and only the energy cost penalty would be fixed should the energy user not meet their energy quota. Each company would therefore retain the ability to meet their obligation as would best fit their business. This flexibility has been incorporated as it could encourage greater engagement from SMEs to reduce energy consumption than current Energy Policy and incentives have achieved.

The proposed scheme would be administered through the existing billing system thus minimising the need for a new energy organisation or new complex implementation systems. Familiarity with the billing process could also reduce the fear of the unknown and perception of the Carbon Allowance as an administrative burden. If a company has two or more energy suppliers an energy quota would be applied against each bill received. The researcher’s experience suggests that this would apply to a minimum number of companies. The Department of Energy and Climate Change (2013a) identify a trend towards single provider fuel contracts for consumers within non-domestic buildings. Use of the billing system could also support the transfer of an organisation’s Carbon Allowance should they choose to move energy supplier. This would adopt a precedent set by the Green Deal in which loan repayments are administered through the domestic billing system.

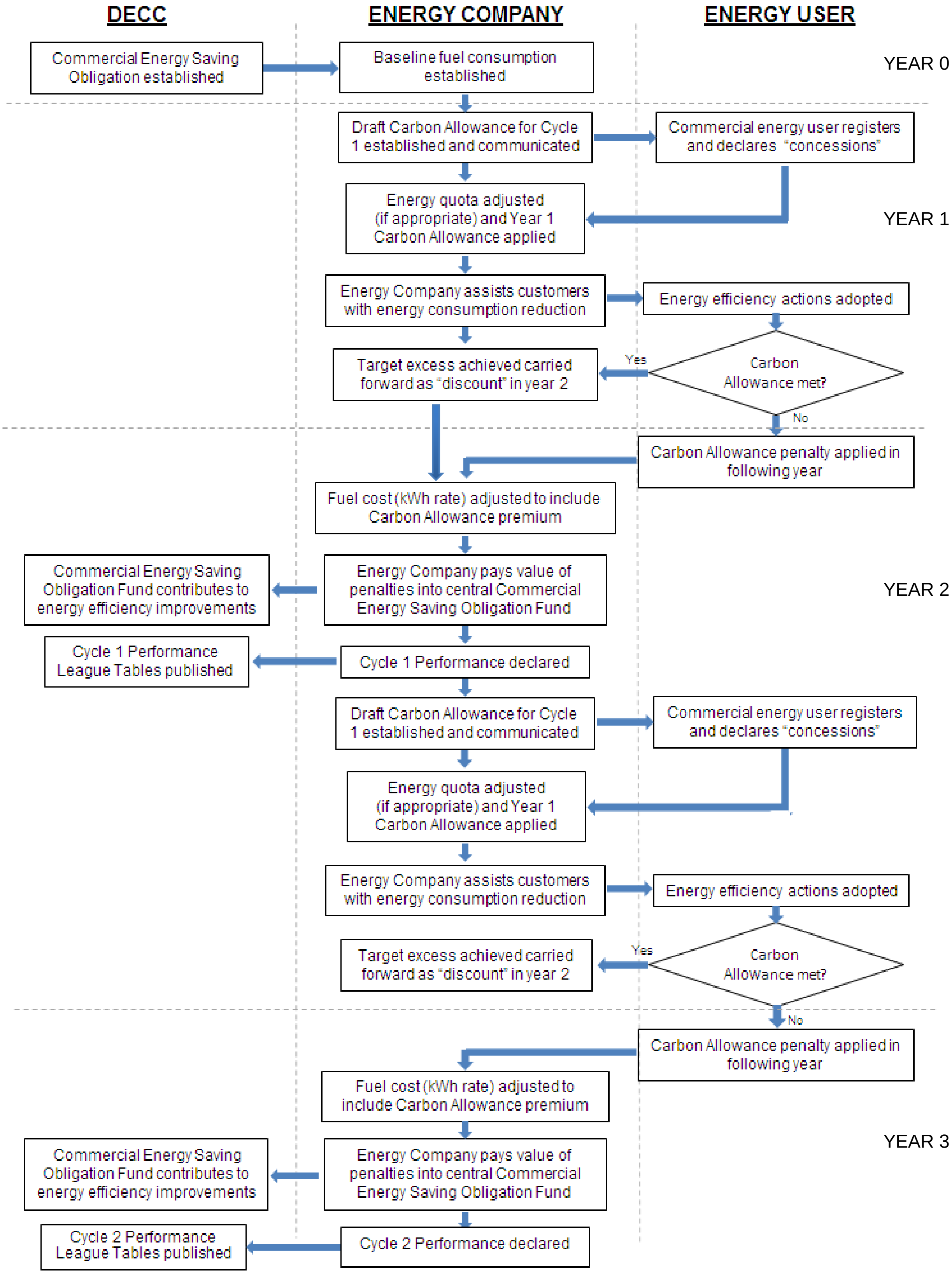

Figure 7.2: The proposed operation of the Carbon Allowance Scheme

It is proposed that a penalty called the 'Carbon Allowance Premium' should be incurred if a non-domestic owner or tenant does not meet their Carbon Allowance within a Carbon Allowance Cycle This would be applied during the following cycle as a percentage increase to the kWh fuel cost. To prevent claims of profiteering by the energy companies the value of their customers' cost premiums could be re-invested to improve energy efficiency by SMEs. It is proposed to establish a Commercial Energy Saving Obligation Fund to contribute to energy efficiency and conservation initiatives, including the provision of grants to SMEs for energy efficiency improvements. 5% of the Carbon Allowance Premiums will be reserved to fund the Carbon Allowance Scheme's operating costs, for example energy companies' and Department of Energy and Climate Change operating costs and marketing and publicity. .

The proposed Commercial Energy Saving Obligation Fund, held and administered by the Department of Energy and Climate Change, would be independently administered to ensure impartiality. Money raised could be used to fund energy efficiency grants with surplus funds supporting energy audits and organisational energy culture change, for example through training. The fund could prioritise help for SMEs. In addition to providing commercial energy users with help to save energy, the fund could also exploit a market driven opportunity. If an organisation sees its penalty payments being used to help competitors it may be predisposed to save energy to meet the Carbon Allowance. The re-distribution of Carbon Allowance Premiums would allow the proposed alternative energy framework to deliver easier access to grants which is the second of the key factors identified by this research as motivating non-domestic building owners and tenants to adopt energy efficiency and conservation opportunities.

7.2.4 Role of energy companies

The Commercial Energy Saving Obligation would also obligate the energy companies to help their commercial customers save energy. This could offer opportunities to demonstrate to potential customers their commitment to helping organisations meet their Carbon Allowance. The success rate of customers' meeting their Carbon Allowances would also be calculated. It is proposed that from Carbon Allowance Cycle 2 performance figures would be published as a league table.

7.2.5 Communications and reporting

Unlike current Energy Policy approaches that give energy companies responsibility for publicity campaigns, the Carbon Allowance Scheme could adopt a simple, yet effective alternative centrally driven communications strategy. This would follow the approach used by successful campaigns such as "get set for digital" and "Fire Kills". Phillips and Scott (2012) consider these successful as they feature a single message from trusted sources and are Government backed. This is proposed to help overcome one of the potential barriers to the Carbon Allowance Scheme; the lack of trust in energy suppliers.

It is proposed that the Department of Energy and Climate Change publishes energy company performance league tables showing non-domestic consumers' achievement of energy quotas and the number of users moving energy supplier. This would encourage energy companies to work with commercial consumers to deliver Carbon Allowances to improve performance in league tables.

7.3 Rationale for the Carbon Allowance Scheme

The proposed Carbon Allowance Scheme offers a new approach to energy efficiency and conservation as it converts policies that reduce emissions into policies that reduce energy consumption so that a financial value can be placed against compliance. This is the factor that resonates most closely with business managers and building owners. An analysis of the proposed Carbon Allowance Scheme's applicability is included in Chapter 8.

Carbon Allowances could have a number of advantages over the current complex and confusing energy policy components. These can be summarised as ten key benefits:

1. ***One size fits all:*** as the proposed Carbon Allowance Scheme would be administered through energy bills it could target owners and tenants of non-domestic buildings; single site and multi-site organisations; multi-tenanted buildings and owner-occupiers.
2. ***Overcomes ownership constraints:*** the scheme would not be constrained by influences of building ownership e.g. split incentives. In fact it could actively work towards closing the Landlord-Tenant Divide through tenants seeking energy efficient buildings to avoid energy cost premiums. To retain competitiveness owners would have to upgrade rental properties. In a scheme that would apply to all equally, the rental market could be influenced by the search for energy efficient properties that could reduce the cost of compliance. More frequent business relocation identified by de Jong (2013) and Delay (2013) within the trend for short-

term tenancy agreements could encourage greater demand for energy efficient properties.

3. ***Overcomes payback conflicts:*** the Carbon Allowance Scheme could close the gap between a commercial organisation's requirement for short-term payback of financial investments and the medium to long-term payback periods frequently realised by energy investments. If they receive a grant, companies could improve energy performance without having to comply with internal investment strategies or utilise their working capital.
4. ***Active intervention:*** the scheme could actively engage all non-domestic consumers in energy conservation. The proposed Carbon Allowance Scheme incorporates the factors which have been shown by this research to motivate owners and tenants to reduce energy consumption; regulations, grants and energy price manipulation.
5. ***Delivers business priorities*****:** the Carbon Allowance Scheme is based around the key business priority of increasing profits so can resonate more closely with commercial organisations than existing policy, which relies on rational economic responses to energy price increases. The Carbon Allowance Scheme links a simple system of 'carrots' and 'sticks'. Increased business profitability as the result of energy conservation is offered as a 'carrot' whilst the consequent charge if energy consumption is not reduced is the 'stick'.
6. ***Energy efficiency driver:*** the Carbon Allowance Scheme could drive energy improvement to the highest levels of efficiency by imposing on going reductions through energy quotas. This introduces the concept of continuous energy continuous improvement.
7. ***Limits the rebound effect:*** the on-going requirement to deliver annual energy consumption reductions, to achieve Carbon Allowances and avoid premium payments, may limit the rebound effect of energy saving. Within the rebound effect companies use the money saved from reducing energy use to fund additional energy intensive equipment that results in a subsequent increased use of energy.
8. ***Simple application:*** the Carbon Allowance Scheme can overcome the complexity and confusion of current Energy Policy and would be less bureaucratic than the current CRC and EU ETS programmes as it does not include a requirement for declarations or tradable allowances.
9. ***Polluter pays:*** As Carbon Allowances are not tradable the proposed scheme does not offer organisations the ability to purchase the right to pollute. Instead it is

based on the equitable polluter pays principle, the cornerstone of sustainability and international environmental legislation.

10. ***Provides adaptability:*** the scheme could be upgraded in the future. It could be extended to include domestic properties and/or public sector buildings. The proposed scheme could also be used to create accurate benchmarks of energy use per square metre of floor space, establish commercial sector standards or implement scalable discounts to prioritise the adoption of certain technologies.

For non-domestic building tenants the scheme could offer a driver of energy efficiency and conservation that financially rewards SMEs for reducing energy consumption. It could also provide an opportunity to increase demand for energy efficient buildings that would reduce the cost of compliance and reduce the split of incentives widely experienced. The Carbon Allowance Scheme would offer those tenants who pay for energy through rental payments or service charges (Segments '*c*', '*g*' and '*h*') an incentive to improve their relationship with the building's owner to increase transparency in the energy management process. SMEs that receive energy free of charge (Segment '*c*') as part of their service contract would not directly benefit financially from the proposed energy policy although they could benefit from improvements made by the building's owners.

Overall the proposed Carbon Allowance Scheme could work to reduce or eliminate the disincentives for energy efficiency and conservation experienced by the research participants and drive shared responsibility for energy improvement required by tenants. Leases would have to become more flexible to accommodate the needs of owners and tenants to reduce energy consumption, for example through improvements to lease clauses preventing minor change to the structure of buildings to install energy efficient interventions. Investment would be required by both owners and tenants to deliver obligations. Grant funding could be made available to overcome the financial constraints reported by 38% of respondents including the unwillingness of owners (9%) and tenants (13%) to invest in energy efficiency.

Within multi-tenanted buildings the owners would have to work with all tenants to ensure that the energy cost premiums applied under the Carbon Allowance Scheme are avoided for common areas. This could help develop supportive energy relationships currently identified as missing by this research.

As the proposed Carbon Allowance Scheme operates within an annual cycle it could encourage year-on-year energy consumption reductions. Improvements in energy efficient technologies currently outstrip the needs of the scheme so building owners and tenants will be able to meet obligations under the Regulation. Grants could be provided on an on-going basis to fund these improvements as shown in Chapter 8.

7.4 Conclusion

In spite of rising energy prices and a growing awareness of the financial benefits of reducing energy consumption this research shows that little benefit of this is obtained by SMEs. The majority of non-domestic building owners and tenants receive few incentives to improve energy efficiency and conservation. This research shows that the tenure of non-domestic buildings creates an environment that prevents adoption of energy efficiency and control.

To date Energy Policy has been unable to deliver energy or carbon savings in sufficient quantity to meet Government targets or hopes of an energy efficient property sector. A new approach is now needed if the energy efficiency-gap caused by non-domestic building ownership is to be closed and climate change mitigation targets are to be achieved.

At the SME level participation rates in energy efficiency, activities and behaviours are largely unrelated to the mitigation of climate change. However, by achieving energy usage reduction in response to a financial disincentive scheme, emission reductions could be achieved.

The proposed Carbon Allowance Scheme could create a balance between providing flexibility and ensuring the standards are sufficiently strict to deliver energy reduction requirements. It could exploit the key motivators of energy efficiency and conservation identified by participants in this research and delivers the fourth research objective; an alternative policy approach in order to improve rates of energy efficiency and conservation within SMEs. This simple scheme of Carbon Allowances would operate within the current pattern of non-domestic building ownership and as it would operate at the level of the energy consumption within a business it could focus on the most tangible aspects of energy use for the business; the cost of energy consumption.

Carbon Allowances could combine both ‘push’ and ‘pull’ drivers of energy efficiency within a simple and fair scheme of energy quotas and financial disincentives that have been designed to change energy behaviours and drive the responsibility for energy consumption reduction into all non-domestic users. By converting policies that reduce emissions into policies that reduce energy consumption a financial value could be placed against compliance, a factor that resonates most closely with business managers and building owners.

CHAPTER 8: SCENARIO PLANNING

8.1 Introduction

The key aim of this thesis is to identify how SMEs can be encouraged to take full advantage of the financial benefits available from energy efficiency and in turn contribute further to national carbon reduction targets. The Carbon Allowance Scheme proposed in the previous chapter has the potential to deliver this but is un-tested. In this chapter sensitivity analysis through scenario planning is used to estimate the alternative energy framework's potential to deliver energy savings.

8.2 Scenario-Planning Model

Relationships between Carbon Allowances and energy savings are tested through spreadsheet modelling using the Scenario-Planning Model created by the researcher. Existing commercial software and scenario planning tools were sought to conduct this modelling but nothing suitable was available. A new tool was consequently developed utilising Microsoft Excel. This is sufficiently flexible software to operate the model and has the added advantage that should other users wish to follow this modelling approach they are able to do so easily, at little or no cost. This tool is chosen as it applies information provided by research participants to predict the outcome of the Carbon Allowance Scheme on SMEs' energy consumption. An example of the Scenario-Planning Model, which incorporates the framework of ownership segmentation established by this research, is shown in Appendix 3.

There are two assumptions within this scenario planning; firstly, there is a limited fund for investment in energy efficiency and conservation and secondly the allocation of this fund must be prioritised to maximise the rate of energy saving impact. The model incorporates fixed values for energy cost, energy consumption and segment population, which are discussed in Section 8.3, whilst modelling changes to values of grant funding and grant allocation. This highlights the impact of each scenario and allows comparison between scenarios and across segments, which together prioritise the introduction of the Carbon Allowance Scheme.

The Scenario-Planning Model is able to show the results as both normalised and actual financial outputs. Normalised graphs that represent the data as a change versus the base value rather than showing actual values. These are used for the comparison of energy consumption reduction scenarios in Section 8.4. This removes the effect of segment population size to allow direct comparison of segment results. A full set of normalised Scenario-Planning Models is included in Appendix 4. Financial modelling assists in prioritising ownership segments for a pilot study or staged rollout. This is explored further in Section 8.5.

As it models the influence of the Carbon Allowance Scheme the Scenario-Planning Model utilises energy consumption figures from Year 0 to provide the energy baseline. In this first year no owners or tenants pay an energy premium although some companies will begin to adopt energy efficiency opportunities. This group of SMEs is shown in the model as ‘*ns*’ i.e. the number saving energy in order to save money and potentially avoid incurring a penalty in subsequent years.

In Year 1 the model assumes that 75% of the owners and tenants of non-domestic buildings do not meet their energy quotas and will therefore incur energy cost premiums. This assumption is based on the traditionally slow rates of response to new legislative obligations experienced in the UK. The group of SMEs incurring premiums is shown in the model as ‘*np*’, that is the number of companies paying the energy cost premium, which is discussed further in Section 8.3.4. It is assumed that an increasing number of companies will adopt energy saving opportunities to avoid paying the premium; therefore ‘*np*’ is set at a standard declining rate within the model. These premiums are used to provide the Grant Fund.

Grants are issued from Year 2 onwards and achieve energy savings. The number of companies able to obtain a grant, termed ‘*ng*’ within the model, is dependent upon the capital available within the Grant Fund and the percentage of the fund to be allocated. Each grant is standardised as either £10,000 or £20,000 and the fund allocation set as either 50% or 95% according to the Scenario applied. SMEs within ‘*ng*’ are assumed to be unable or unwilling to make savings without a grant to fund it. Between Years 3 and 10 grants continue to be issued in line with funds available. Limiting the allocation of the Grant Fund to 95% or 50% allows for the provision of 5% of the fund to cover administration costs of the Carbon Allowance Scheme. For scenarios in which 50% of the Grant Fund is allocated the remaining 45% will be redistributed to other ownership segments or to other energy efficiency schemes.

It is recognised that the model may have a number of limitations based on the small sample of research participants. For example, it uses figures that have been increased pro rata from the primary research data, as actual population data is not available. However, as discussed in Chapter 6 the responses are sufficiently representative of the UK SME population to be considered acceptable for this sensitivity analysis.

8.3 Inputs for the Scenario-Planning Model

8.3.1 Ownership segmentation population

The Scenario-Planning Model utilises the ownership segmentation framework established by this research. Segment populations input into the model are increased pro rata from data obtained from research participants to reflect the UK SME population of 4.99 million. The population, energy consumption and energy cost inputs are shown in Figure 8.1.

Table 8.1: Scenario-Planning Model inputs

Segment	Ownership Characteristics	Population	Annual Energy Consumption/SME	Annual Energy Cost/SME
‘*a*’	Building owner and tenant (tenant from utility)	2,450,000	0.745 GWh	£80,000
‘*b*’	Building owner and user (owner from utility)	343,000	1.12 GWh	£108,000
‘*c*’	Building owner and franchisee (owner from utility)	196,000	1.19 GWh	£110,000
‘*d*’	Building owner and branch (head office from utility)	882,000	2.4 GWh	£190,000
‘*f*’	Building owner, manager and tenant (tenant from utility)	196,000	0.98 GWh	£65,000
‘*g*’	Building owner as the energy provider and user (tenant from owner)	196,000	0.14 GWh	£13,000
‘*h*’	Building owner as a commercial investor (tenant from owner)	196,000	0.18 GWh	£16,000
‘*i*’	Building owner and franchisee (tenant from utility)	539,000	2.04 GWh	£112,000

8.3.2 Energy costs

The energy cost input to the model is 4.475 pence per kWh, which represents the weighted average of gas at 3.173 pence per kWh and electricity at 10.933 pence per kWh consumed by members of each segment. This approximates to 5:1 in the use of one unit of gas to one unit of electricity. This figure is calculated from the average fuel prices paid by the UK’s 4.99 million SMEs during the first 3 quarters of 2013 published the Department of Energy and Climate Change (2013c). They are used within the model to calculate the cost of energy consumed and the potential financial savings available.

8.3.3 Energy consumption figures

Energy consumption inputs to the model are obtained from research participants, which when normalised will apply to any range of figures. The inputs of average energy consumption per SME within the segment and are shown in Figure 8.1. These are combined with the standardised energy cost figures described above to provide the average annual energy cost per SME.

8.3.4 Grant funding

Participants in this research identify that easier access to grants will provide a significant stimulus for energy improvement. In order to ensure that this opportunity is maximised, the premium payments incurred under the proposed Carbon Allowance Scheme are used to create the Grant Fund.

The Carbon Allowance Scheme applies an energy quota to all non-domestic building owners and tenants, which represents a task against the previous year's energy consumption. For this scenario planning an initial 5% reduction requirement is applied. This is considered a realistic target for the model as potential energy saving with minimal investment has been calculated for small offices as 38% and retail warehouses as 52% (Anon: 2013). This also exceeds the 3% reduction required to meet 2020 and 2050 carbon reduction targets identified by the Committee on Climate Change (2012). In turn, if non-domestic consumers exceed their quota a 5% premium will be applied to their energy costs in the following Carbon Allowance Cycle. In reality, however, by complying an SME will save 10% of energy costs with this approach i.e. they will achieve an actual saving of 5% plus they will avoid paying the 5% premium cost payment.

Scenario planning undertaken here considers how reinvesting these premium payments in the form of energy efficiency grants may drive further energy consumption reduction. The optimum allocation of grant funding is proposed.

8.4 Energy consumption reduction scenarios

Ten scenarios are input into the Scenario-Planning Model, each of which tests potential impacts of energy efficiency grants. Each scenario applies a different combination of savings rates and grant funding to establish potential savings available within the ownership segment. These scenarios are shown in Table 8.2 and examined in more detail below.

Table 8.2: Scenarios used within the Scenario Planning Model

	Value of Grant	Grant Fund Allocation	‘*ng*’ Saving	‘*ns*’ Saving
Scenario 1	£10,000	50%	5%	5%
Scenario 2	£20,000	50%	5%	5%
Scenario 3	£10,000	95%	5%	5%
Scenario 4	£20,000	95%	5%	5%
Scenario 5	£10,000	95%	8%	8%
Scenario 6	£10,000	95%	8%	5%
Scenario 7	£20,000	50%	8%	5%
Scenario 8	£20,000	95%	8%	5%
Scenario 9	£20,000	50%	20%	5%
Scenario 10	£20,000	95%	20%	5%

The rationale for each scenario is illustrated with the model’s output for Segment ‘*a*’, the largest ownership segment in which tenants lease their business premises and purchase energy. A full set of normalised graphs, showing the outputs of the Scenario Planning Model, are shown in Appendix 4.

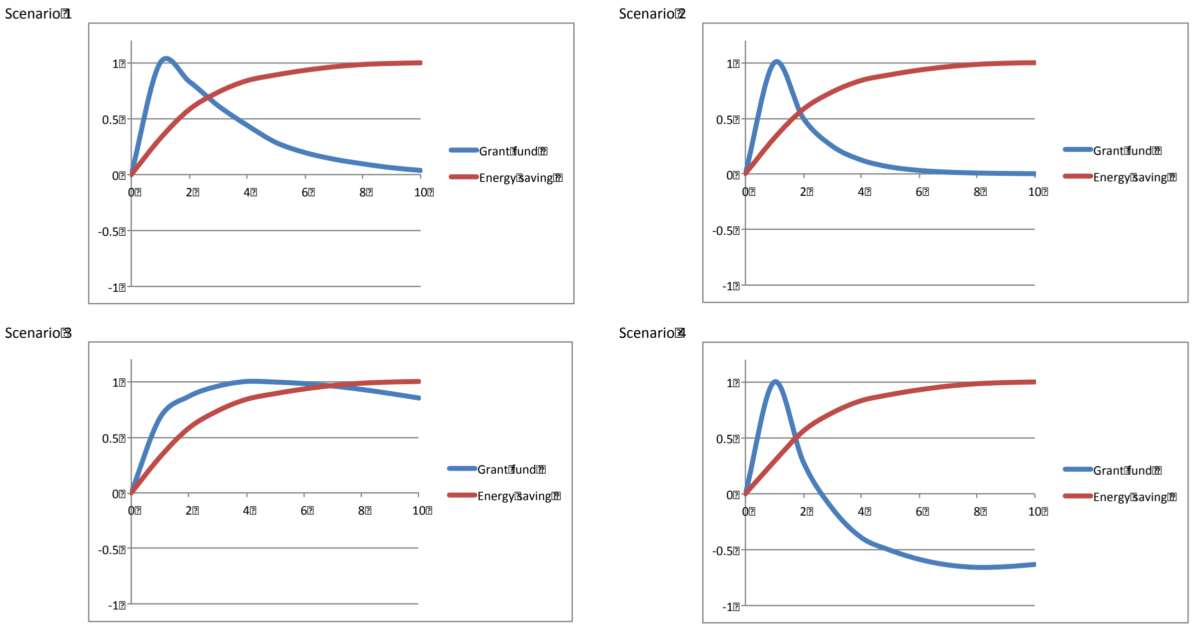

Figure 8.1: Scenarios 1-4

Scenarios 1 to 4, apply the combinations of grant value and percentage allocation shown in Table 8.2. The results are shown in Figure 8.1. Scenario 3 generates the maximum Grant Fund over the 10-year programme and delays peak grant funding until Year 4 giving time for engagement to grow. Scenario 4 is unable to maintain grant funding over the 10-year scenario-planning horizon.

As the Scenario-Planning Model indicates that these scenarios offer similar energy saving potential even though the inputs change, Scenario 5 is added to consider whether an 8% saving by '*ns*' and '*ng*' is able to deliver additional savings in return for £10,000 grant with 95% Grant Fund allocation (Figure 8.2). Whilst this scenario will generate an increase in financial saving it is considered unlikely that the '*ns*' group would achieve an 8% reduction without grant funding. It is not proposed for adoption.

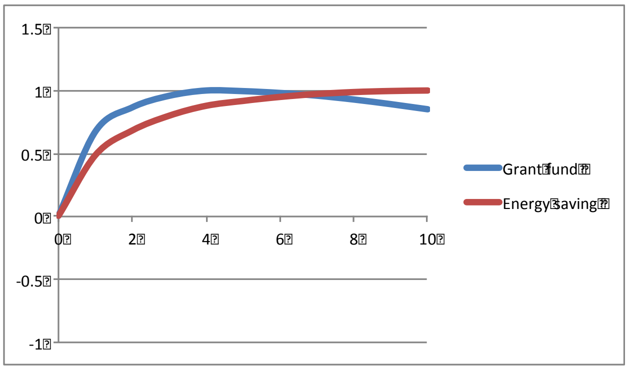

Figure 8.2: Scenario 5

Scenario 6 (Figure 8.3) is then added to reduce the expectations on '*ns*' and limit savings to 5% (the minimum required to avoid premium payments under the Carbon Allowance Scheme) whilst retaining the higher rate of savings for '*ng*'. This shows some loss of energy saving with the 3% reduction in target but is considered a more realistic scenario. Scenario 6 offers an incentive over Scenario 3 as it adopts an energy saving target greater than the penalty incurred. Overall this will deliver 13% savings for SMEs obtaining a grant (8% saving and 5% avoidance of premium energy costs in the following year). However, it does not offer additional savings over Scenario 3.

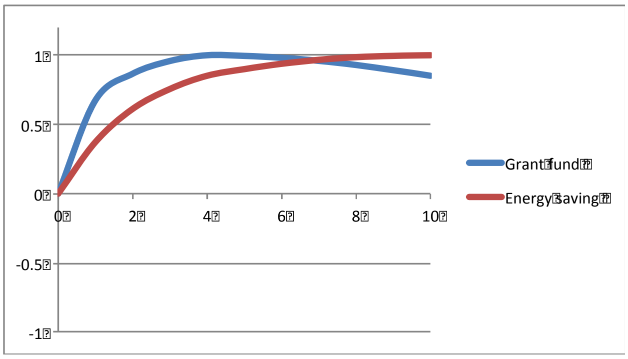

Figure 8.3: Scenario 6

Scenarios 7 and 8 are then added to test whether an increase to the higher rate grant of £20,000 will increase the savings available with either 50% or 95% allocation of the Grant Fund. The output of the model shows no additional benefit in normalised levels of energy saving from funding increased grants (Figures 8.4 and 8.5). However, actual savings will be increased within Scenario 8 although there is only a short-term availability of grants.

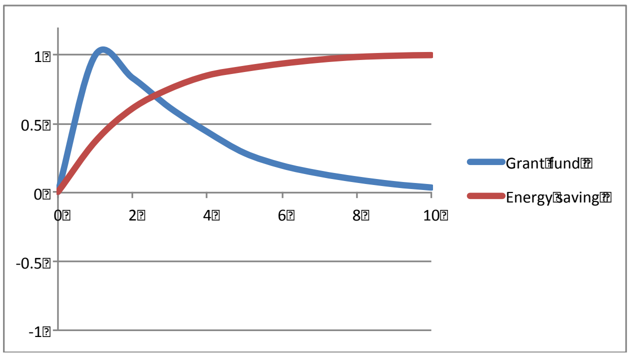

Figure 8.4: Scenario 7

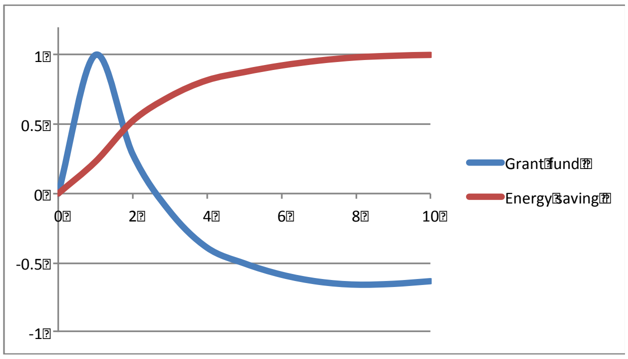

Figure 8.5: Scenario 8

To consider the opportunity to further increase savings Scenarios 9 (50% allocation) and 10 (95% allocation) are created to test the impact of a £20,000 grant generating 20% savings from improving energy efficiency and conservation within the '*ng*' group of SMEs (Figures 8.6 and 8.7). The higher rate grant is applied, as this level of saving is unlikely to be achieved without significant levels of investment.

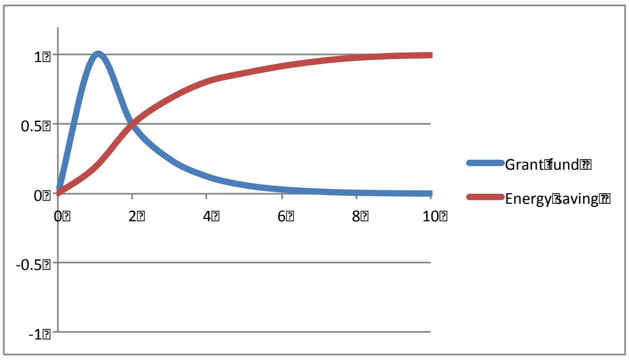

Figure 8.6: Scenario 9

As shown in Chapter 5 research participants indicate that they are unlikely to fund this investment from their own capital or using a low rate loan. Neither Scenario 9 nor 10 adds significant energy saving benefit above Scenarios 3 or 6, which are the most cost effective as they allocate £10,000 grants. The early peak of grant funding in Scenario 9 will not support the long-term aims of the Carbon Allowance Scheme. Scenario 10 results indicate only short-term availability of grants.

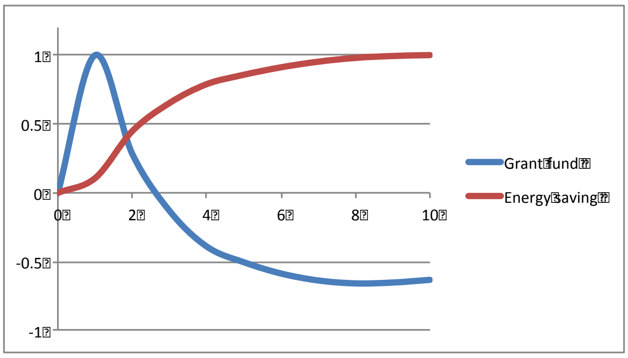

Figure 8.7: Scenario 10

8.5 Findings from scenario planning

The normalised graphs generated by the Scenario-Planning Model suggest the application of each scenario results in a similar energy saving profile for each segment. The response of owners and tenants to each scenario can therefore be used to establish the combination of grant value and percentage Grant Fund allocation that could achieve the greatest energy saving impact. A summary of these potential responses, the prioritised scenario and the rationale is shown in Table 8.3. The likely responses of owners and tenants to the proposed Carbon Allowance Scheme used in Table 8.3 are taken from the survey responses received, the segmentation model and the researcher's experience of organisational behaviour. These have been categorised using product adoption life cycle terminology proposed by Beal, Rogers and Bohlen (1957) that describes the adoption of a new product or service according to demographic and psychological characteristics of defined adopter groups.

The number of grant applications from Early Adopters within Segments '*b*', '*c*' and '*i*' is likely to be high as their energy costs are a high proportion of overheads so there is a greater incentive to save energy. This suggests the optimum scenario to be applied will be either 3 or 6 where the largest Grant Fund is available at the lowest cost to the scheme. To maximise the savings generated Scenario 6 should be adopted as it incorporates a higher target. For example the small population of 343,000 owner-occupiers with high average energy expenditure of £108,002 within Segment '*b*' will generate an opportunity to save £1.8 billion over 10 year scenario-planning horizon. As members of Segment 'b' own and occupy their buildings there will be fewer ownership barriers to the adoption of energy efficiency.

Members of Segments '*c*' and '*I*' are identified within this research as Local Authority non-domestic building owners. They are likely to have knowledge and resource to adopt energy efficiency opportunities and are expected to avoid risks from regulatory change.

Despite the slower growth of the Grant Fund with maximum funds available 3 years later than Scenario 1, Scenario 6 (£10,000 grants with 95% of the fund distributed in return for 8% savings) offers grants over the 10-year scenario-planning horizon and the greatest energy saving impact.

The high population of 2.45 million tenants and owners categorised as Late Majority/Laggards within Segment '*a*' have a medium average energy expenditure of £80,182, a lower proportion of overheads than Segment '*b*'. This will generate an opportunity to save in excess of £100 million over 10-year scenario-planning horizon.

Table 8.3: Scenario planning findings

Segment	Description	Likely response to the Carbon Allowance Scheme *(Energy Life Cycle)*	Suggested Scenario Strategy	Rationale
‘*a*’ *Pop'n: 2.45m* *Energy/p.a: £80,182*	Building owner and tenant (tenant from utility)	***Late Majority/Laggards*** • SMEs traditionally slow to respond to regulatory change • Split incentives of building ownership limit compliance • Owners likely to leave compliance to tenants	Scenario 6 Target owner and tenant	• Slow initial uptake of grants allows lower proportion of fund to be allocated; remainder of fund can be redistributed • Medium energy expenditure; likely lower proportion of overheads • Strategy exploits cooperative and collaborative relationships and overcomes split of incentives identified by research
‘b’ *Pop'n: 343,000* *Energy/p.a: £108,002*	Building owner and user (owner from utility)	***Early Adopters/Early Majority*** • Owner occupiers likely to adopt grant funding opportunities to reduce financial risk • Easy to access and target owner-occupiers	Scenario 6 Target owner	• Research finds owners occupiers choose to have no involvement in their building's energy performance • High energy expenditure; likely to be higher proportion of overheads • Segment has fewer ownership barriers to energy efficiency • Realistic target 5% saving in return for grant likely to be attractive
‘c’ *Pop'n: 196,000* *Energy/p.a: £110,434*	Building owner and franchisee (owner from utility)	***Innovators/Early Adopters*** • Local Authority owners likely to have resource/knowledge of energy management to engage early in scheme • Local Authorities owners likely to avoid additional cost and comply with regulation early (budget/PR constraints)	Scenario 6 Target owner	• Research finds energy relationships discourage adoption of energy efficiency and conservation opportunities • Tenants do not receive energy bill; owner controls purchase of energy • High energy expenditure; likely to be higher proportion of overheads • Realistic target of 5% energy saving likely to be attractive
‘*d*’ *Pop'n: 882,000* *Energy/p.a: £190,267*	Building owner and branch (head office from utility)	***Early Majority*** • Multi-site organisations likely to have greater resource and knowledge for energy saving • Multi-site organisations tend to have structure for identifying/providing early response to regulatory change	Scenario 7 Target head office	• Opportunity to demand greater energy saving (20%) in return for grant through energy experience • High energy expenditure; likely to be higher proportion of overheads • Surplus can be redistributed • Branch does not receive energy bill; head office controls purchase of energy
‘*f*’ *Pop'n: 196,000* *Energy/p.a: £63,619*	Building owner, manager and tenant (tenant from utility)	***Laggards*** • Owners likely to leave compliance to tenants • Leases likely to prevent tenants improving energy efficiency • Managers unlikely to have responsibility for energy • SMEs traditionally slow to respond to regulatory change	Scenario 1 Target owner and tenant	• Ownership structure will exacerbate impact of split incentives and delay compliance; research finds energy relationships prevent change • Slow initial uptake of grants allows lower proportion of fund to be allocated; remainder of fund can be redistributed • Medium energy expenditure; likely to be a lower proportion of overheads • Small population; minimal loss of funds for redistribution
‘*g*’ *Pop'n: 196,000* *Energy/p.a: £13,160*	Building owner as the energy provider and user (tenant from owner)	***Laggards*** • Owners and tenants likely to be slow to comply; no incentive to do so • Leases likely to prevent energy efficiency improvements	Scenario 1 Target owner	• Ownership structure will exacerbate impact of split incentives and delay compliance • Research finds owners choose to have no involvement in their building's energy performance • Small population; minimal loss of funds for redistribution
‘*h*’ *Pop'n: 196,000* *Energy/p.a: £15,704*	Building owner as a commercial investor (tenant from utility)	***Laggards*** • Owners likely to leave compliance to tenants • Leases likely to prevent tenants improving energy efficiency	Scenario 7 Target owner	• Low energy expenditure likely to be small proportion of overheads • Large grants most likely to engage investment owners • Long term availability of grant funding to incentivise investors • Research finds owners choose no involvement in their building's energy performance
‘*i*’ *Pop'n: 539,000* *Energy/p.a: £111,783*	Building owner and franchisee (tenant from utility)	***Early Adopters/ Early Majority*** • Local Authority owners likely to have resource/knowledge of energy management to engage early in scheme • Local Authorities owning buildings are likely to avoid additional cost and comply with regulation early (budget/PR constraints)	Scenario 6 Target owner	• High energy expenditure; likely to be higher proportion of overheads • Tenants providing service on behalf of building owner • Large uptake of grants likely be occur early in the life of the scheme • Strategy exploits cooperative and collaborative relationships and overcomes split of incentives identified by research

However, there is likely to be a slow initial compliance with the Carbon Allowance Scheme as the premium payment will initially be a risk as it is a low proportion of business overheads. Scenario 6 provides long-term grant availability with the opportunity to redistribute the surplus Grant Fund to Early Adopters in other ownership segments to deliver increased savings in the early years of the scheme. This will also publicise the financial opportunities available through compliance and encourages the cooperative and collaborative relationships identified by the research in Segment '*a*'. Targeting both owners and tenants will help overcome the split incentives experienced by research participants.

The 882,000 branches of multi-site organisations within Segment '*d*' have the highest energy expenditure and are likely to comprise the Early Majority as they have greater experience of regulatory compliance and knowledge of energy efficiency through central functions. These organisations are likely to be able to deliver 20% savings if allocated higher rate grants. Scenario 7 will provide the opportunity to save in excess of £2.5 billion over the 10-year scenario-planning horizon at the lowest cost to the Carbon Allowance Scheme. This scenario is adopted in preference to Scenario 10, which delivers higher financial savings but is unable to maintain grant funding across the scenario-planning horizon. The structure of these organisations suggests head offices should be targeted with higher rates of saving.

Members of Segments '*f*', '*g*' and '*h*' with low energy expenditure and split incentives for energy improvement arising from their ownership styles are likely to show the slowest uptake of energy efficiency opportunities. Commercial investors owning non-domestic buildings within Segment '*h*' are most likely to respond to higher rate grants over the longest period. Scenario 7 will offer this at lowest cost to the scheme.

Owners within Segment '*f*' are remote from the energy performance of their buildings as they employ building managers with no responsibility for energy. The research finds these owners choose to have no involvement with their building's energy performance. This ownership structure will exacerbate the split incentives and relationship barriers to energy efficiency identified by research participants. Uptake of the Carbon Allowance Scheme is therefore likely to be slow. As this segment has a small population, Scenario 1 will provide sufficient grant funding to drive change at lowest cost to the scheme.

Within Segment '*g*' the building's owner provides tenants' energy, which creates little incentive for tenants to become energy efficient. The research finds owners choose to have no involvement in their building's energy performance. Low average expenditure on energy further exacerbates this. The owners are therefore targeted through Scenario 1, which will provide a high level of grant funding early in the programme to drive change at the lowest cost to the scheme. The surplus funding can be redistributed to Early Adopters.

Overall Scenario 6 (£10,000 grants, 95% allocation, 8% target for '*ng*') offers the best opportunity within most segments to encourage SMEs to adopt energy saving opportunities, which in turn contributes to national carbon reduction targets. The 8% target for '*ng*' will improve adoption rates of energy efficiency and conservation opportunities over the 5% target included in Scenario 3. The capital available in the Grant Fund is able to support grants over the 10-year scenario-planning horizon.

Scenario 1, which offers the same size of grant with the lower rate of allocation, is proposed for smaller segments '*f*' and '*g*' in which owners and tenants are likely to be slow to comply with the Carbon Allowance Scheme. However, if Scenario 6 is substituted to standardise the regulatory approach there will be little cost implication for the scheme. As Segments '*d*' and '*h*' are unlikely to respond well to lower rate grants Scenario 7 should be retained if maximum energy saving impacts are required. However, adopting Scenario 6 for these segments may be more politically acceptable.

8.6 Implementation of the proposed Carbon Allowance Scheme

The findings from this scenario planning can be used to identify which ownership segment should be used to either pilot the Carbon Allowance Scheme or prioritise a staged roll out. The prioritisation is based on actual financial benefit to the segment and ease of SME engagement. A set of Scenario-Planning Model outputs showing actual financial savings are included in Appendix 5.

Segments '*a*', '*d*' and '*i*' offer the greatest potential for financial savings from the adoption of energy efficiency and conservation activities due to the size of their population and high levels of energy expenditure. In addition Segment '*a*' provides an opportunity to address the issue of split incentives that was identified as a problem by over 50% of research participants within this ownership segment. Owners and tenants within Segment '*a*' rated the importance of grants, as a motivator for energy improvement, 8.4 out of 10. Prioritising this segment should therefore generate significant energy savings. However, the scale of the ownership segment suggests that it could be unmanageable for a pilot study or initial programme rollout.

Although Segment '*d*' is more than 60% smaller in population than Segment '*a*' it's members have an average annual energy cost that is more than double. This results in a 3% greater opportunity for energy saving. This high level of saving opportunity coupled with the smaller number of companies to be addressed suggest that Segment '*d*' could be prioritised for the phased roll out of the Carbon Allowance Scheme. However, these SMEs are part of a larger multi-site organisation and may be a politically unattractive group of companies for which to prioritise grant funding.

Although members of Segment '*i*' are offered a significant saving opportunity they may be difficult to identify as they occupy their non-domestic building free of charge whilst providing a service on behalf of the building's owner. As many of these non-domestic building owners are Local Authorities this could be a politically unacceptable group to benefit from grant funding. This, coupled with the lower level of saving than either Segment '*a*' or '*d*' suggests that prioritisation of this group is not be appropriate.

When considered from the perspective of ease of access to the SMEs within the segment and initial political response to the Carbon Allowance Scheme an alternative prioritisation may be considered more appropriate. The estimated 343,000 owner-occupiers within Segment '*b*' will be an easier group to engage in a pilot study or phased roll out of the scheme. The disadvantage of this is that it will only generate around 20% of the financial saving available form Segment '*a*' and '*d*'.

Overall it is recommended that members of Segment '*b*' should be prioritised to pilot the implementation of the Carbon Allowance Scheme, followed by Segments '*a*' and '*d*' to generate the large financial saving for SMEs and energy consumption and carbon emissions reductions available. The group of owner-occupiers within Segment '*b*' would also be a politically acceptable target to support when introducing the proposed Carbon Allowance Scheme legislation.

8.7 Conclusion

The Scenario Planning Model is designed to identify how the saving rate applied can be balance d against the level of grant provided to achieve the greatest rate of financial saving for SMEs from energy efficiency and conservation activities. As all scenarios generate a similar normalised level of energy saving the likely response of the owners and tenants is taken into account in identifying the scenario likely to adopt the optimum energy saving impact. For Segments '*a*', '*b*', '*c*' and '*i*' this is Scenario 6, which maximises the benefits of lower targets attractive to SMEs and an increased rate of saving coupled with the availability of grant funding over the 10 year scenario-planning horizon. The ownership structure of Segments '*d*' and '*h*' are likely to show more engagement if larger grants of £20,000 are offered. In return these will achieve higher levels of energy saving. Scenario 7 is therefore most appropriate for these segments.

If the introduction of the Carbon Allowance Scheme is prioritised by ownership segment, the Scenario-Planning Model suggests that members of Segment '*a*' and '*d*' should be prioritised if financial savings available from energy efficiency are the priority. Benefits from the larger saving available from Segment '*d*' may be outweighed by the politically unattractive approach of giving grants to sites within larger multi-site organisation. Segment '*a*' should be therefore be prioritised. However, Segment '*b*' should be selected as a pilot scheme. This segment will be more easily engaged as it offers a smaller, discrete group of owner-occupiers with high costs of energy and lower ownership barriers to energy efficiency and conservation. Support for owner-occupiers would also be a politically acceptable target when introducing the proposed Carbon Allowance Scheme legislation.

CHAPTER 9: DISCUSSION AND CONCLUSIONS

Today the central role energy plays in the emission of carbon is widely accepted by the UK Government, politicians and energy intensive businesses with energy concerns high on political agendas. Despite this smaller businesses continue to work within historically developed economic infrastructure that have built up around the availability of low cost energy and do not consider energy concerns a threat. Consequently, without a new approach to energy efficiency and consumption reduction, Janda (2008) and Kelly (2010) consider it unlikely that national carbon reduction targets will be met. This thesis offers this new perspective on energy research and proposes an alternative approach to Energy Policy.

As shown in Chapter 2, energy research has largely mirrored Energy Policy and consequently focuses on residential properties, carbon emissions from large energy intensive commercial organisations and the energy efficient technologies available. This research has adopted an alternative scope and perspective. It examines the owners and occupiers of existing smaller non-domestic buildings who together contribute 20% of the UK's annual carbon emissions. Greenwise (2012) considers that this sector is one of the least successful in terms of energy efficient improvements. However, as indicated by Kelly (2010) buildings in existence today are likely to contribute 70% of the building stock in 2050, the deadline for the UK's 80% carbon emissions reductions target. Without improvements in their energy performance SMEs will continue to forego savings of £10 billion per year and will not contribute further to carbon emissions reduction targets. As indicated in Chapter 3 this SME sector is largely excluded from Energy Policy.

To date the majority of building energy research has taken a technological approach, establishing the building type as the driver of energy performance. However, this thesis considers that owners and users of buildings have greater influence on energy efficiency and conservation than building type and hypothesises that the tenancy structures of non-domestic buildings control the ability and willingness of owners and tenants to adopt energy efficiency and conservation opportunities. The key aim of this thesis is to identify how SMEs can be encouraged to maximise the financial benefits offered by widely available, financially beneficial and retrofit feasible energy efficient technologies and behaviours.

The aim and objectives of this thesis have been delivered through a new framework for energy research, the segmentation the non-domestic building sector into cohesive groups based on the ownership of the building and provision of energy. A segmentation model containing 8 categories of ownership is created and tested. The research confirms the existence of 7 of the original 8 segments. No research participants fitted into Segment '*e*' whereby the owner employs a landlord to manage the building and the tenant purchases their own energy. It is not known whether the segment remains unpopulated as it does not exist, companies within this segment have not been recruited or it overlaps with Segment '*f*' in which a managing agent operates the building on behalf of the owner. Further research to conclude this is recommended.

An additional segment of non-domestic building ownership is identified, Segment '*i*'. This is a group of SMEs occupying their business premises free of charge as franchisees and purchasing their own energy. The building owners are the organisations for which they are providing their franchisee service. Research participants indicate that the owners within this segment are Local Authorities.

A survey of non-domestic building owners and users is undertaken to collect primary data with which to test the hypothesis established and understand the extent to which building ownership influences the ability and willingness of both non-domestic building owners and tenants to adopt energy efficiency and conservation opportunities (Objective 1).

Although this research engages only a small number of research participants it has provided new understanding of the rationale for, and barriers to, the adoption of energy efficiency opportunities. The energy-efficiency gap caused by the ownership structures of non-domestic building has been highlighted and has significantly added knowledge to academic and business research and understanding of energy behaviours. This thesis also presents an opportunity to overcome current poor rates of energy efficiency and conservation caused by this gap by proposing an alternative approach energy policy framework based on the actual factors that will motivate SMEs. Research participants have identified these in their survey responses.

The findings of the surveys indicate that features of non-domestic property ownership raise a significant barrier to the adoption of energy efficiency and conservation. 50% of respondents indicate that their relationship with their owner or tenant blocks change. 36% describe their relationship as 'preventative' whilst 14% say their owners choose to have no involvement in energy management or efficiency. Tenant T14 sums this up as, "*the only involvement [the owners] have is when something goes wrong*". Overall 43% of research participants indicate that they have experienced restrictions on improving energy efficiency based on their tenancy structure.

In addition to these ownership barriers research participants indicate that they have also encountered financial barriers to improving energy efficiency and conservation linked to building ownership. For example, 88% of respondents have encountered disincentives such as lease clauses preventing change and 79% experienced a split of financial incentives resulting from the properties' ownership.

When the barriers to energy efficiency and conservation identified by this research are increased pro rata to reflect the UK population of 4.99 million SMEs it emerges that almost 2.5 million businesses are unable to benefit from the financial savings available from energy improvements due to barriers related to the tenure of non-domestic properties and 700,000 SMEs occupy premises where the owners choose to have no involvement in energy improvement. If this is considered alongside the easily accessible savings of £2000 per year from simple energy usage improvements established by Eon (2011), together they are foregoing savings of more that £10 billion per year.

Even though 50% of the research participants indicate that they co-operate or collaborate with their owners or tenants to improve energy performance there is evidence that little is actually being delivered. Tenants indicate that they have benefitted from an average of 0.9 and owners 1.8 interventions to reduce energy consumption in the past 2 years. This lack of focus on energy efficiency will have significant implications in future as 71% of participants expect that non-domestic building tenants will increasingly demand energy efficiency properties.

Tenants perceive that owners represent a greater barrier to adopting energy efficiency opportunities than vice versa. They want to share responsibility for energy efficiency and conservation rather than leave responsibility with their building owner. Owners, however, overwhelmingly want to retain control for energy efficiency. This supports the view of both owners and tenants. 50% of tenants consider it unlikely that owners will upgrade the energy performance of existing buildings and 50% of owners confirm that they are unlikely to make performance improvements when their building next becomes vacant.

Non-domestic owners participating in this research consider that energy costs are not a significant factor for their tenants. They therefore have little or no incentive to invest in consumption reduction improvements. This exacerbates the split incentives relating from building tenure experienced by 79% of research participants.

Despite this negative picture of energy efficiency within existing non-domestic buildings the research identifies that there are drivers of change that will motivate owners and tenants to improve their energy performance (Objective 2). Both owners and tenants will respond to regulatory change and easier access to grants. Regulatory change is given an average motivational rating of 8.2 out of 10 and grant access a score of 7.2. 92% of participants see regulatory change as the most significant driver of energy efficiency and conservation.

Non-domestic building owners also consider customer pressure a motivator for change. Although this will drive change it is considered of lesser importance with a rating of 6.3 out of 10. For tenants energy price control emerges as the 3rd most significant factor for driving energy improvements with a score of 7.1.

Understanding research participants' actual motivators of change adds significant new knowledge to energy research and is used to develop an alternative framework for energy policy that will increase the adoption rate of energy efficiency and conservation opportunities (Objective 4).

To date Energy Policy has been constructed on the premise that organisations will treat energy efficiency and conservation as a rational economic business decision. However, this research has proved that this is not the case.

This research challenges the traditional approach to current Energy Policy, identifying that current policy drivers are less effective in delivering change than expected. For example, Energy Policy is based on the provision of information, voluntary good practice and low cost loans which research participants have rated as 6.0, 6.2 and 5.0 out of 10 putting them in 5th, 4th and 7th places in the table of factors that will motivate change. This gives them lower motivational value than regulations, grants and price manipulation.

Energy Policy has been delivered in piecemeal fashion, which has delivered a policy framework that Janda (2009a) and Kelly (2010) consider complex, confusing and remote from day to day business activities. This complexity is recognised by the Environmental Audit Committee (2011) as having reduced the effectiveness of policies in raising awareness and delivering change.

This research indicates that this approach is flawed and that businesses will only become engaged in energy improvement if there is sufficient incentive to do so. As energy comprises only 1-2% of overheads, Bright (2010) and Delay (2013) consider it insufficient to drive change. To achieve the re-prioritisation of energy efficiency and conservation the benefits of change must outweigh the cost of intervention. The research findings indicate that this alternative approach should be a simplified Energy Policy framework based on regulatory pressure and grant funding for improvement. This would be more likely to deliver energy savings for SMEs, which in turn could contribute greater carbon savings for the UK. This alternative approach therefore delivers the key aim of this research; to identify how SMEs can be encouraged to maximise the financial benefits offered by energy efficiency and energy conservation.

This proposed alternative approach is the Carbon Allowance Scheme, a mandatory system of non-tradable energy quotas that would be applied to each non-domestic energy consumer through the existing utility billing system. Consumption reduction could be driven by capping the amount of energy available to the user at the standard energy price with all energy consumed above this quota incurring a price penalty. In turn these penalty payments could be used to provide grant funding for SMEs' energy efficient interventions. As it is would be introduced by legislation, with grants provided through the redistribution of premium payments, it incorporates the 2 key motivators of energy change: regulations and access to improvement grants. The use of pricing premiums introduces the 3rd motivator for tenants; price manipulation.

The proposed alternative energy policy framework is based on three principles: firstly, owners and users of non-domestic buildings use too much energy; secondly, non-domestic building tenure frequently presents barriers to owners and tenants when considering the adoption of energy efficiency and conservation opportunities; and thirdly, organisations should manage energy efficiency improvements within the constraints of their businesses and for their own benefit. The proposed Carbon Allowance Scheme could ensure that all those consuming energy are responsible for reducing their consumption and consequently their carbon emissions. In return they could benefit directly from financial savings available. This follows the key concept of the polluter pays principle and the principles of fairness that the Environmental Audit Committee (2011) consider fundamental for energy change.

The scheme could also work to reduce ownership barriers to the adoption of energy efficiency identified by research participants. The need to avoid proposed premium energy costs could drive non-domestic building users to seek energy efficient properties to reduce the cost of compliance and owners to improve their buildings' energy performance to meet this customer pressure and demand. The scheme proposes to allocate annual energy quotas therefore energy improvements would need to be applied as a continual improvement process. Technical improvements delivering energy consumption opportunities continue to outstrip the needs of the Carbon Allowance Scheme so non-domestic building owners and tenants would be able to meet their obligations under the proposed regulation.

As the proposed scheme is based around the key business priority of making profits it would resonate closely with commercial organisations. It would link a simple system of 'carrots' and 'sticks'. Increased business, profitability as the result of energy conservation, would be offered as a 'carrot' that could be implemented within existing business systems whilst the consequent premium energy payment if consumption is not reduced would be the 'stick'.

It is recognised that it would have been beneficial to test SMEs' views of the alternative energy policy framework proposed. However, to protect confidentiality and anonymity of research participants as described in Chapter 4 it has not been possible to re-contact participants for further input. It is proposed to obtain SMEs' input through further research.

Scenario planning is undertaken to assess the potential outcome of this Carbon Allowance Scheme. A series of scenarios testing various combinations of inputs (grants) and outputs (financial energy savings) are modelled to establish the optimum benefit for UK SMEs using ownership segmentation implemented within this research. In turn this modelling identifies a potential prioritisation for a staged introduction of the proposed regulation using the non-domestic ownership segmentation.

Several alternative prioritisation routes for different opportunities are identified. These depend on the chosen programme objective; maximum energy savings over the life of the programme; an early peak in grant funding or ease of political and business acceptance of the Carbon Allowance Scheme. The scenarios that deliver each of these objectives will overcome the limitations of existing energy policy.

Scenario planning suggests Segments '*a'* and '*d*' will offer the greatest rate of energy impact over the 10-year scenario-planning horizon. This will generate financial benefits for the maximum number of SMEs and greatest reduction in carbon emissions for the country in the medium to long-term. However, if efficiency, ease of SME engagement and political acceptance of the Carbon Allowance Scheme is the main objective of a phased introduction, prioritising members of Segment '*b*' is most the appropriate strategy. Owner-occupiers are a smaller, discrete group of non-domestic building users for whom energy costs represent a significant proportion of business overheads. As they both own and use their business premises there will be also fewer ownership barriers to energy efficiency.

This thesis adds knowledge to academic research, business strategy and Energy Policy making and closes knowledge and research gaps identified in the review of literature in Chapter 2. The recognition of the significance and scope of barriers to energy efficiency and conservation improvement emanating from the ownership structures of non-domestic buildings proves the hypothesis of this research and assists in closing the ‘Energy-Efficiency Paradox’ identified by DeCanio (1993) and the energy-efficiency gap caused by non-domestic building tenure identified by this research.

The impact of non-domestic building ownership is shown not only to discourage but more frequently to prevent SMEs from benefitting from the financial savings that are easily accessible from widely available, financially viable and retrofit feasible energy efficient technologies and behaviours (Objective 1). The impact of this on Energy Policy is established (Objective 3) and an alternative approach to Energy Policy to overcome this is proposed (Objective 4). Policy direction is changed from encouraging voluntary good behaviour through the expectation of economically rational responses to price stimuli to a framework based on delivering energy consumption reduction driven by the avoidance of risk (Objective 2).

This single policy for all non-domestic energy consumers, which delivers the research aim of this thesis, is based on the key factors that SMEs and building owners have identified as their drivers of change. It will reduce the current complexity and bureaucracy so that UK SMEs can obtain financial benefits from energy efficiency whilst increasing their contributions to carbon emissions reduction targets.

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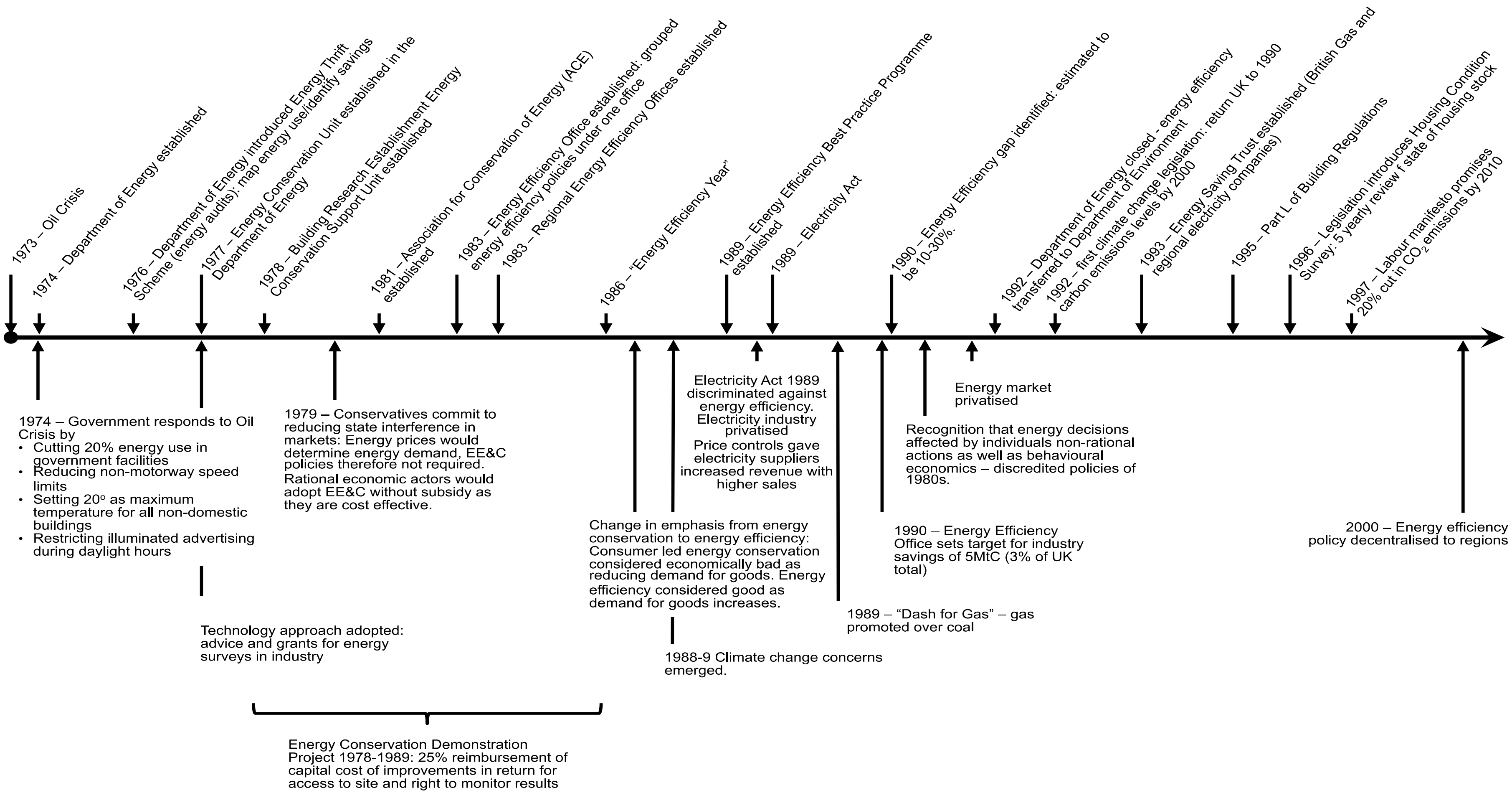
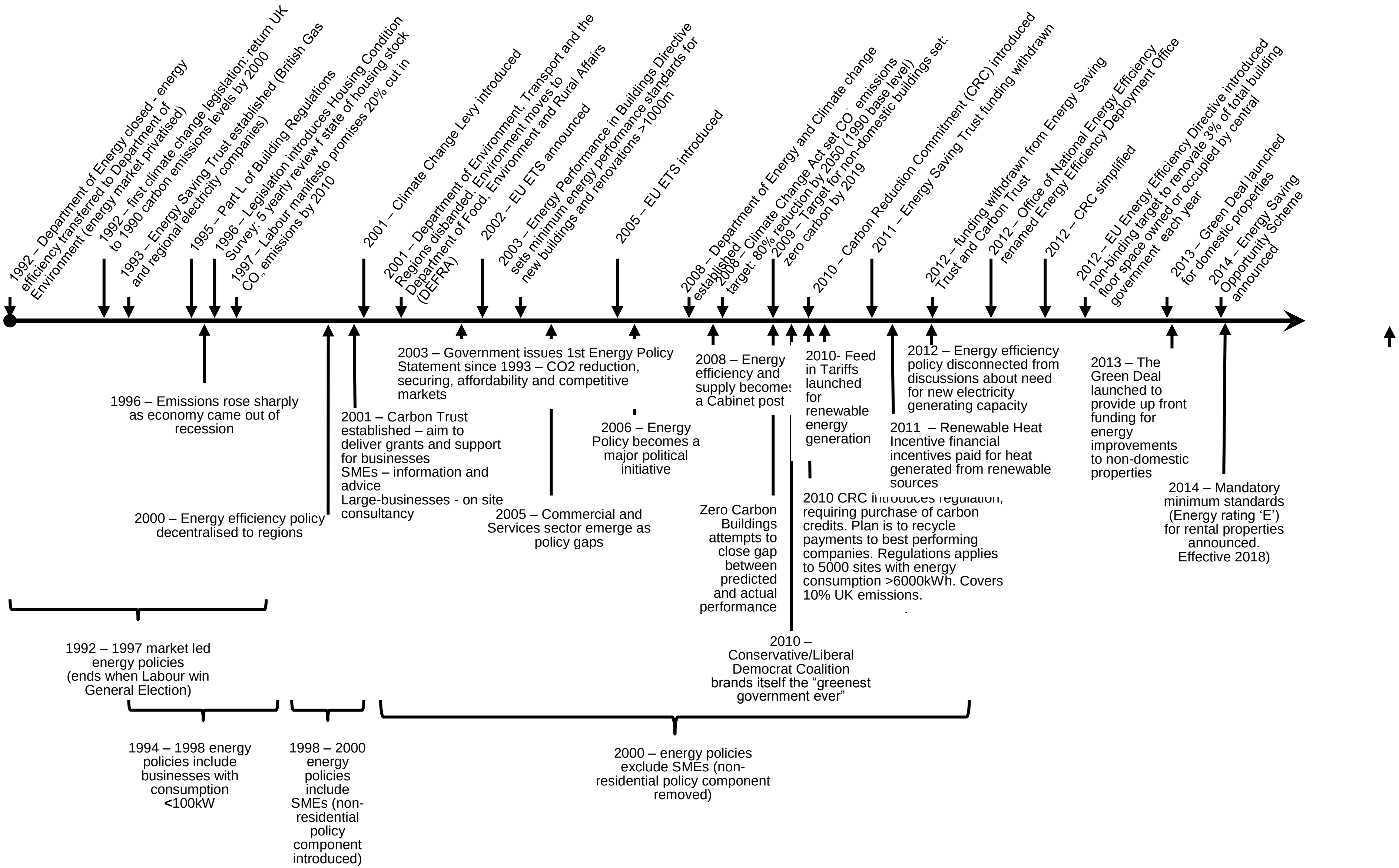
APPENDICES

APPENDIX 1

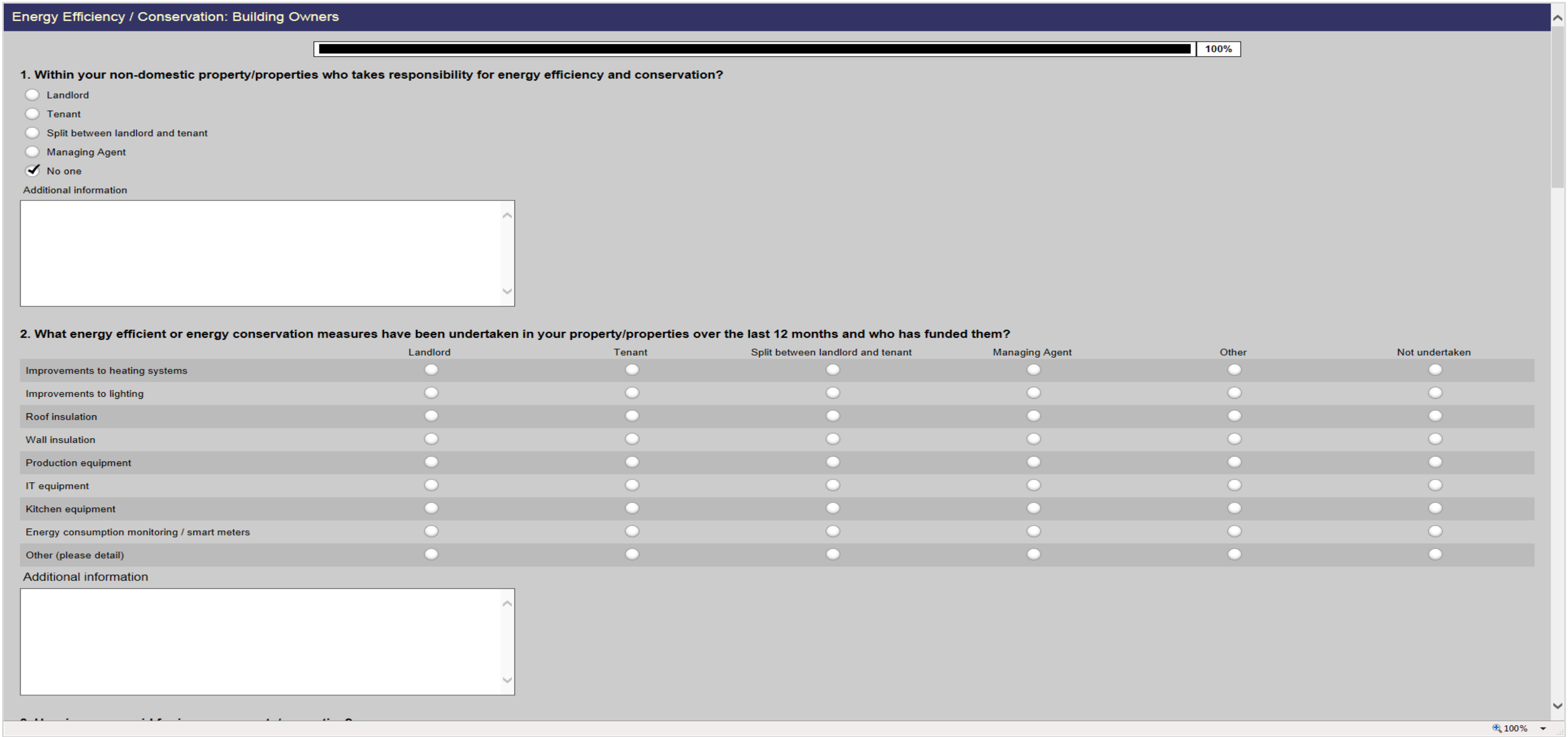
Figure A1: UK Energy Policy Timeline




1992 – Department of Energy closed - energy efficiency transferred to Department of Environment (energy market privatised)
1992 – first climate change legislation: return UK to 1990 carbon emissions levels by 2000
1993 – Energy Saving Trust established (British Gas and regional electricity companies)
1995 – Part L of Building Regulations
1996 – Legislation introduces Housing Condition Survey: 5 yearly review f state of housing stock
1997 – Labour manifesto promises 20% cut in CO₂ emissions by 2010
2001 – Climate Change Levy introduced
2001 – Department of Environment, Transport and the Regions disbanded. Environment moves to Department of Food, Environment and Rural Affairs (DEFRA)
2002 – EU ETS announced
2003 – Energy Performance in Buildings Directive sets minimum energy performance standards for new buildings and renovations >1000m²
2005 – EU ETS introduced
2008 – Department of Energy and Climate change established
2008 – Climate Change Act set CO₂ emissions target: 80% reduction by 2050 (1990 base level)
2009 – Target for non-domestic buildings set: zero carbon by 2019
2010 – Carbon Reduction Commitment (CRC) introduced
2011 – Energy Saving Trust funding withdrawn
2012 – funding withdrawn from Energy Saving Trust and Carbon Trust
2012 – Office of National Energy Efficiency renamed Energy Efficiency Deployment Office
2012 – CRC simplified
2012 – EU Energy Efficiency Directive introduced non-binding target to renovate 3% of total building floor space owned or occupied by central government each year
2013 – Green Deal launched for domestic properties
2014 – Energy Saving Opportunity Scheme announced
2003 – Government issues 1st Energy Policy Statement since 1993 – CO2 reduction, securing, affordability and competitive markets
1996 – Emissions rose sharply as economy came out of recession
2001 – Carbon Trust established – aim to deliver grants and support for businesses SMEs – information and advice Large-businesses - on site consultancy
2000 – Energy efficiency policy decentralised to regions
2006 – Energy Policy becomes a major political initiative
2005 – Commercial and Services sector emerge as policy gaps
2008 – Energy efficiency and supply becomes a Cabinet post
Zero Carbon Buildings attempts to close gap between predicted and actual performance
2010- Feed in Tariffs launched for renewable energy generation
2010 CRC introduces regulation, requiring purchase of carbon credits. Plan is to recycle payments to best performing companies. Regulations applies to 5000 sites with energy consumption >6000kWh. Covers 10% UK emissions.
2012 – Energy efficiency policy disconnected from discussions about need for new electricity generating capacity
2011 – Renewable Heat Incentive financial incentives paid for heat generated from renewable sources
2013 – The Green Deal launched to provide up front funding for energy improvements to non-domestic properties
2014 – Mandatory minimum standards (Energy rating 'E') for rental properties announced. Effective 2018)
1992 – 1997 market led energy policies (ends when Labour win General Election)
2010 – Conservative/Liberal Democrat Coalition brands itself the "greenest government ever"
1994 – 1998 energy policies include businesses with consumption <100kW
1998 – 2000 energy policies include SMEs (non-residential policy component introduced)
2000 – energy policies exclude SMEs (non-residential policy component removed)

APPENDIX 2a

Figure A2.1: Screen Print of Survey 1 – Non-domestic building owners


Energy Efficiency / Conservation: Building Owners

100%

1. Within your non-domestic property/properties who takes responsibility for energy efficiency and conservation?

- Landlord
- Tenant
- Split between landlord and tenant
- Managing Agent
- No one

Additional information

2. What energy efficient or energy conservation measures have been undertaken in your property/properties over the last 12 months and who has funded them?

	Landlord	Tenant	Split between landlord and tenant	Managing Agent	Other	Not undertaken
Improvements to heating systems						
Improvements to lighting						
Roof insulation						
Wall insulation						
Production equipment						
IT equipment						
Kitchen equipment						
Energy consumption monitoring / smart meters						
Other (please detail)						

Additional information

100%

http://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=Z%2fHbm7Z4KwzdWnIRvtaA1FQCoHIm2kbzifcbVyK%2fGbw%3d

3. How is energy paid for in your property/properties?

	Tenants premises	Communal areas
Tenants purchase energy directly from utility supplier	○	○
Energy included in service charge	○	○
Energy included in rental charge	○	○
Landlord purchases energy direct from the utility supplier	○	○

Additional information (please include the owner's annual cost and consumption of electricity and gas)

4. How do your lease clauses affect the energy efficiency or conservation measures able to be adopted?

	Yes	No
Lease clauses restrict the LANDLORD from making changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses restrict the TENANT from making changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses allow the LANDLORD to make changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses allow the TENANT to make changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○

If lease clauses restrict landlord/tenant from making changes, how do they affect the adoption of energy conservation measures? (please give examples)

5. When your properties next become vacant will you improve their energy performance?

○ Yes

100%

http://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=Z%2fHbm7Z4KwzdWnIRvtaA1FQCoHIm2kbzifcbVyK%2fGbw%3d

5. When your properties next become vacant will you improve their energy performance?

- Yes
- No
- Don't know

Additional details - if you answered "yes" what improvements will you undertake and why; if you answered "no" please confirm why not

6. What incentives/disincentives have you encountered in implementing energy efficiency and conservation measures over the last 5 years? How did you overcome them?

7. On a scale of 1 to 10 (where 1 is the lowest and 10 the highest) how likely would the following items be to motivate you to implement energy efficiency and conservation measures in the future?

	1	2	3	4	5	6	7	8	9	10
Customer pressure										
Regulatory changes to energy legislation										
Increase in fuel prices										
Easier access to grants										
Easier access to low cost loans										
Easier access to information on options available										
Social pressure										
Appointment of an energy champion										
Voluntary adoption of "good practice"										
Other (please detail)										

Other (please specify) / Additional information

100%

http://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=Z%2fHbm7Z4KwzdWnIRvtaA1FQCoHIm2kbzifcbVyK%2fGbw%3d

8. What percentage of the responsibility should landlords and tenants take for implementing energy efficiency improvements in non-domestic properties?

Funding - tenant %

Funding - landlord %

Carying out work - tenant %

Carying out work - landlord %

Overall responsibility - tenant %

Overall responsibility - landlord %

9. Please provide some general information on properties do you own and lease to commercial users?

Number of properties in your portfolio?

What size are these properties?

Where are they located?

10. How do you see your relationship with your tenants regarding energy management?

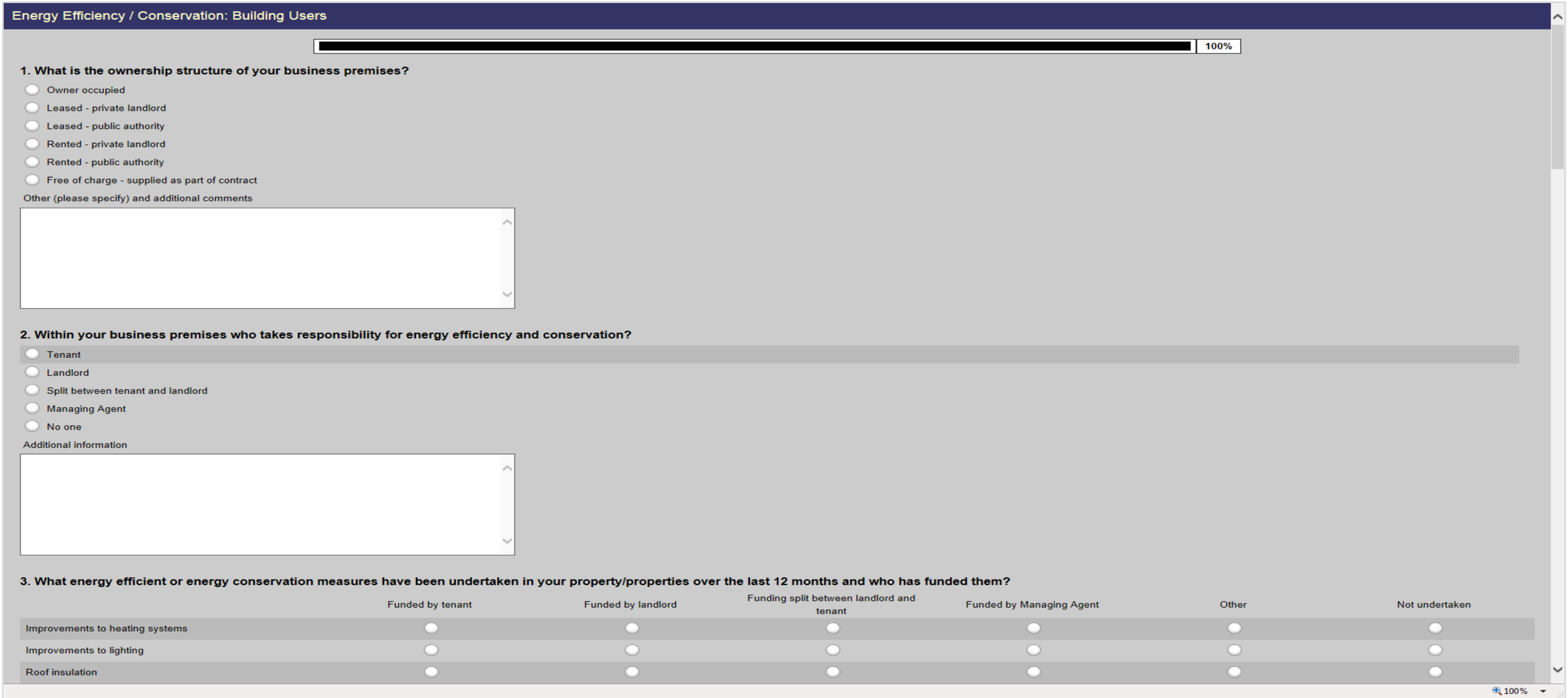
- Collaborative - landlord and tenant work together to reduce energy consumption; share investment costs and benefits
- Supportive - landlord implements energy conservation meassures without tenants' involvement
- Cooperative - landlord encourages tenants to make changes to reduce energy expenditure; no financial support provided
- Preventative - tenants prevent landlord making changes to improve energy performance within their premises
- Landlord chooses to have no involvement in energy management

In the box below please confirm how you see tenants' expectations of the energy performance of rental properties changing over the next 10 years? (please give examples if possible)

100%

APPENDIX 2b

Figure A2.2: Screen Print of Survey 2 – Non-domestic building tenants



Energy Efficiency / Conservation: Building Users

100%

1. What is the ownership structure of your business premises?

- Owner occupied
- Leased - private landlord
- Leased - public authority
- Rented - private landlord
- Rented - public authority
- Free of charge - supplied as part of contract

Other (please specify) and additional comments

2. Within your business premises who takes responsibility for energy efficiency and conservation?

- Tenant
- Landlord
- Split between tenant and landlord
- Managing Agent
- No one

Additional information

3. What energy efficient or energy conservation measures have been undertaken in your property/properties over the last 12 months and who has funded them?

	Funded by tenant	Funded by landlord	Funding split between landlord and tenant	Funded by Managing Agent	Other	Not undertaken
Improvements to heating systems						
Improvements to lighting						
Roof insulation						

100%

http://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=0B2MvuyT1KhqNOoDuc0vwQog4Tm9GHZKwDd0ChMb2AI%3d

3. What energy efficient or energy conservation measures have been undertaken in your property/properties over the last 12 months and who has funded them?

	Funded by tenant	Funded by landlord	Funding split between landlord and tenant	Funded by Managing Agent	Other	Not undertaken
Improvements to heating systems						
Improvements to lighting						
Roof insulation						
Wall insulation						
Production equipment						
IT equipment						
Kitchen equipment						
Energy consumption monitoring / smart meters						
Other (please detail)						

Other (please specify) / Additional information

4. What incentives/disincentives have you encountered when implementing energy efficiency and conservation measures over the last 5 years?

5. How is energy paid for in your business premises?

	Tenant's premises	Communal areas
Tenant purchases energy direct from utility supplier		
Energy included in service charge		
Energy included in rental charge		

100%

http://www.surveymonkey.com/s.aspx?PREVIEW_MODE=DO_NOT_USE_THIS_LINK_FOR_COLLECTION&sm=0B2MvuyT1KhqNOoDuc0vwQog4Tm9GHZKwDd0ChMb2AI%3d

5. How is energy paid for in your business premises?

	Tenant's premises	Communal areas
Tenant purchases energy direct from utility supplier	○	○
Energy included in service charge	○	○
Energy included in rental charge	○	○
Tenant purchases energy direct from the landlord	○	○
Landlord purchases energy from utility supplier	○	○
Other	○	○

Other (please specify) / Additional information (please include the annual cost and consumption of electricity and gas)

6. How do your lease clauses affect the energy efficiency or conservation measures able to be adopted?

	Yes	No
Lease clauses restrict the LANDLORD from making changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses restrict the TENANT from making changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses allow the LANDLORD to make changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○
Lease clauses allow the TENANT to make changes to building fabric, heating, lighting etc. within the tenant's premises?	○	○

If lease clauses restrict landlord/tenant from making changes, how have they affected the adoption of energy conservation measures? (please give examples)

100%

APPENDIX 3

PROPORTION OF GRANT FRUND DISTRIBUTED	0.5
TOTAL NUMBER OF COMPANIES IN SEGMENT	2450000
PREMIUM RATE (ENERGY PENALTY)	5%
AVERAGE COST OF ENERGY PER YEAR (£)	80000
AVERAGE GRANT (£)	10000

ENERGY SAVING RATE 5%

The exact number of companies within the segment is not known. As explained in Chapter 6 the lack of engagement in energy management has led to a paucity of energy data available. The model is therefore always going to be approximate.

Carbon Allowance Cycle	Grant fund at start of Carbon Allowance Cycle	np	ng	ns	Grant fund at end of Carbon Allowance Cycle	Total energy saved in £/a
0	0	0	0	612500	0	0
1	0	1837500	0	612500	3675000000	7350000000
2	3675000000	1225000	245,557	-1470557	3059713125	13232229500
3	3059713125	735000	147,334	-882334.4	2263184438	16761567200
4	2263184438	490000	98,223	-588223	1620477469	19114459000
5	1620477469	245000	49,111	-294111.5	1054681359	20290904900
6	1054681359	196000	39,289	-235289.2	722894779.7	21232061620
7	722894779.7	147000	29,467	-176466.9	508112964.8	21937929160
8	508112964.8	98000	19,645	-117644.6	351833532.4	22408507520
9	351833532.4	49000	9,822	-58822.3	224805291.2	22643796700
10	224805291.2	24500	4,911	-29411.15	136846908.1	22761441290

NORMALISED GRAPH

Carbon Allowance Cycle	Grant fund at start of Carbon Allowance Cycle (Normalised)	Energy saving (Normalised)
0	0	0
1	1	0.32291452
2	0.832575	0.5813441
3	0.6158325	0.73640184
4	0.44094625	0.83977367
5	0.286988125	0.89145958
6	0.196706063	0.93280831
7	0.138262031	0.96381986
8	0.095737016	0.98449423
9	0.061171508	0.99483141
10	0.037237254	1

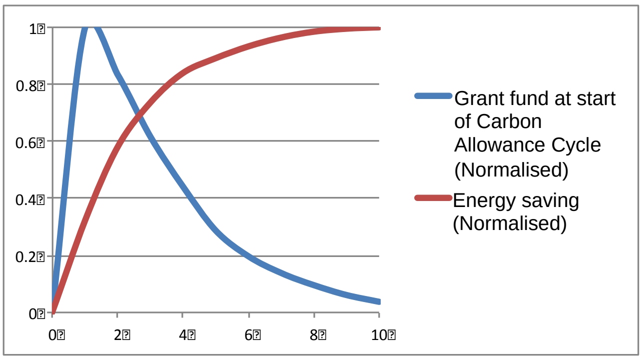


Figure A3.1 Example of Scenario Planning Model

KEY

np The number of companies paying the premium rate for energy as a penalty for not meeting energy quota

ng The number of companies able to receive a grant for energy efficiency improvements

ns The number of companies saving energy in order to save money and potentially avoid incurring a penalty in subsequent years

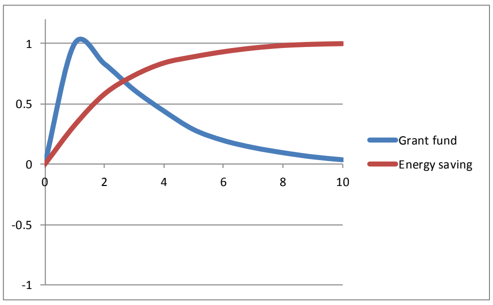
Total Energy saved in £/a Estimated total financial value of energy that could be saved by companies within the segment

Grant Fund at start of cycle Funding available for grants at the beginning of each Carbon Allowance Cycle

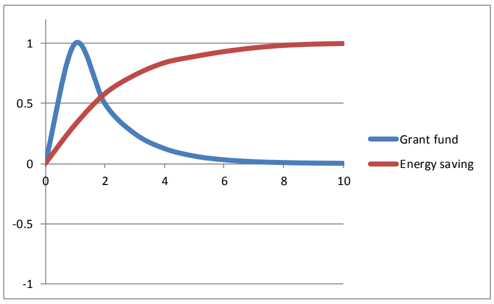
Normalised inputs to the model represent data as a change versus the base value and are used to explore potential energy consumption reduction rather than absolute values of savings

APPENDIX 4

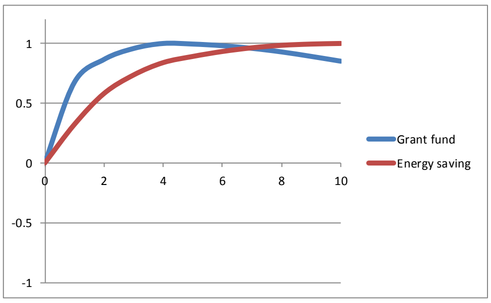
Scenario 1



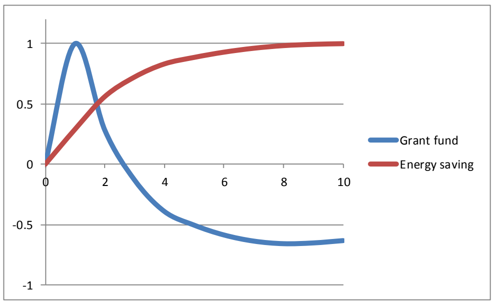
Scenario 2



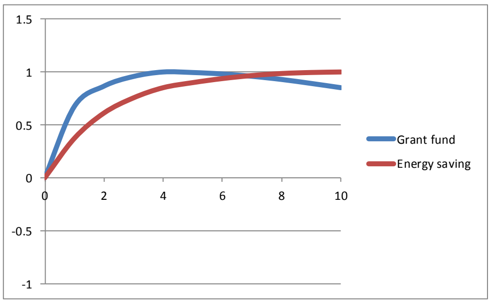
Scenario 3



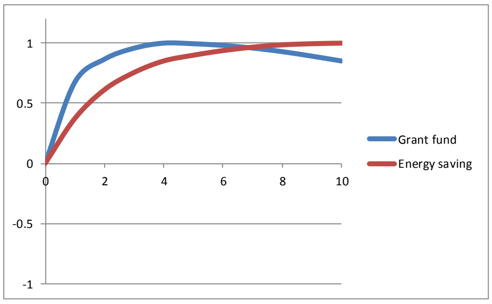
Scenario 4



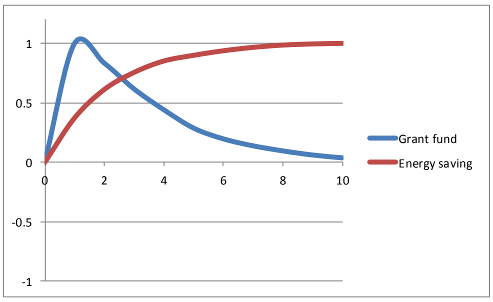
Scenario 5



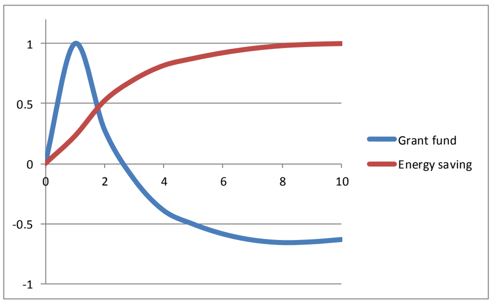
Scenario 6



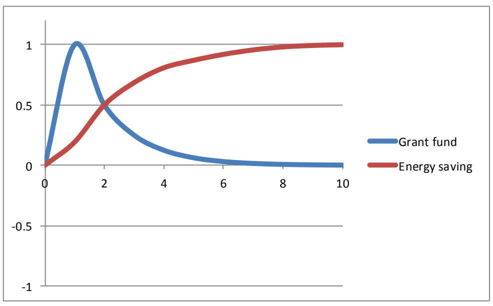
Scenario 7



Scenario 8



Scenario 9



Scenario 10

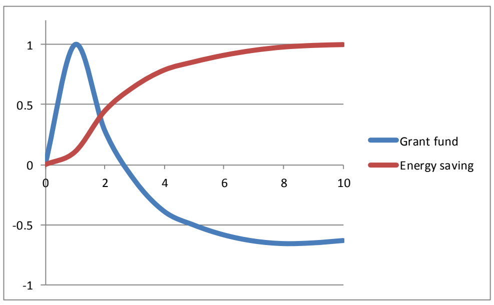


Figure A4.1: Scenario planning models: Segment ‘*a*’

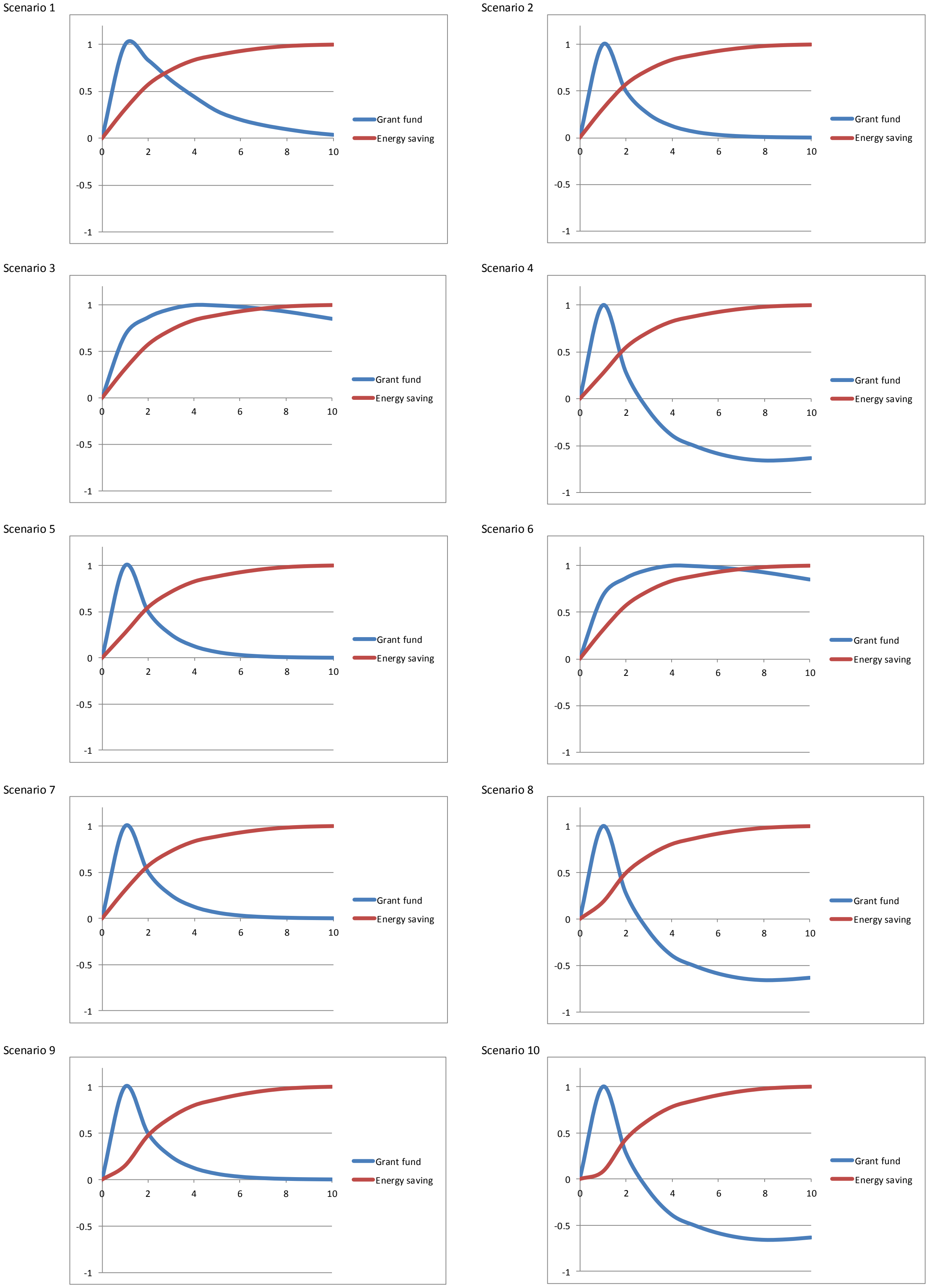


Figure A4.2: Scenario planning models: Segment '*b*'

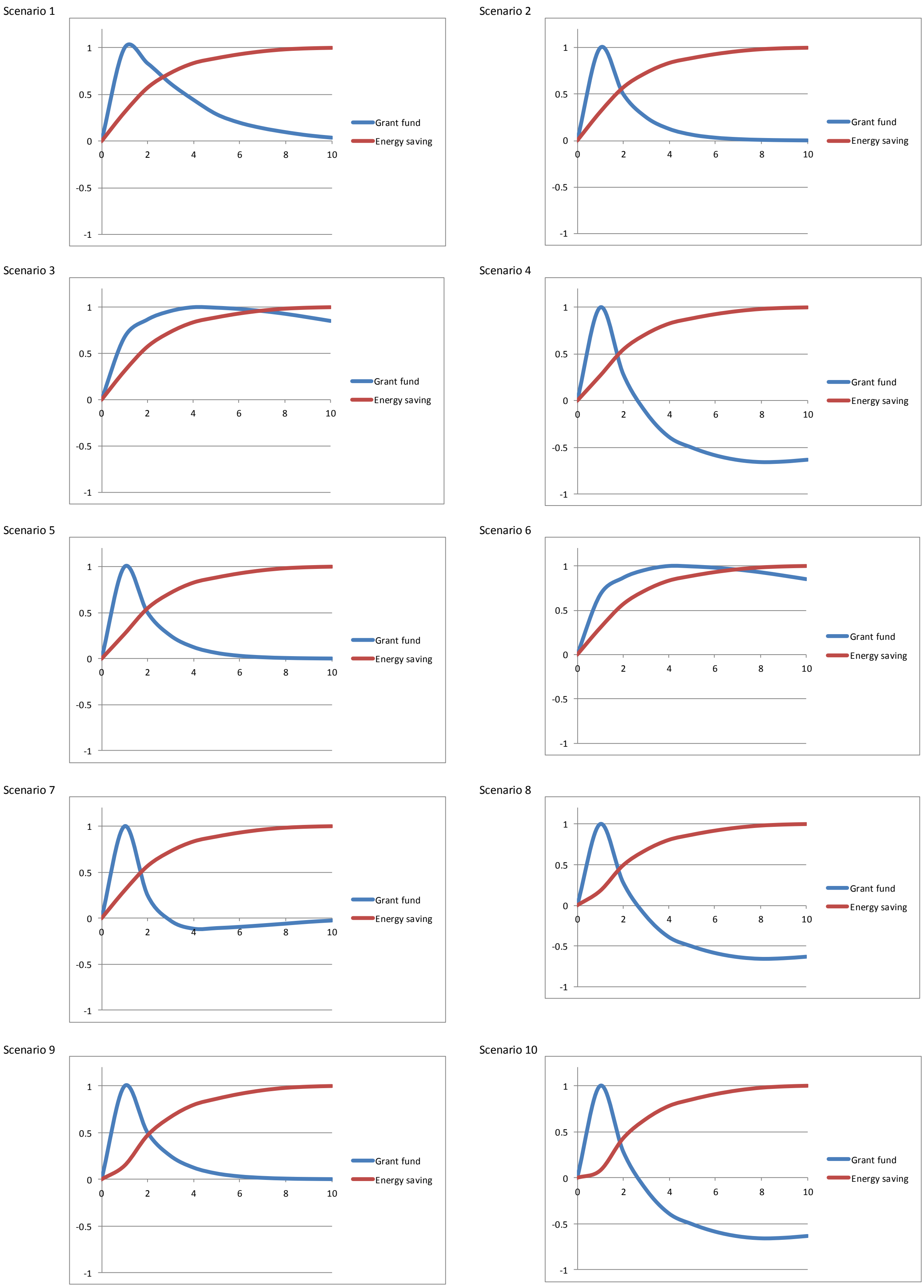


Figure A4.3: Scenario planning models: Segment ‘*c*’

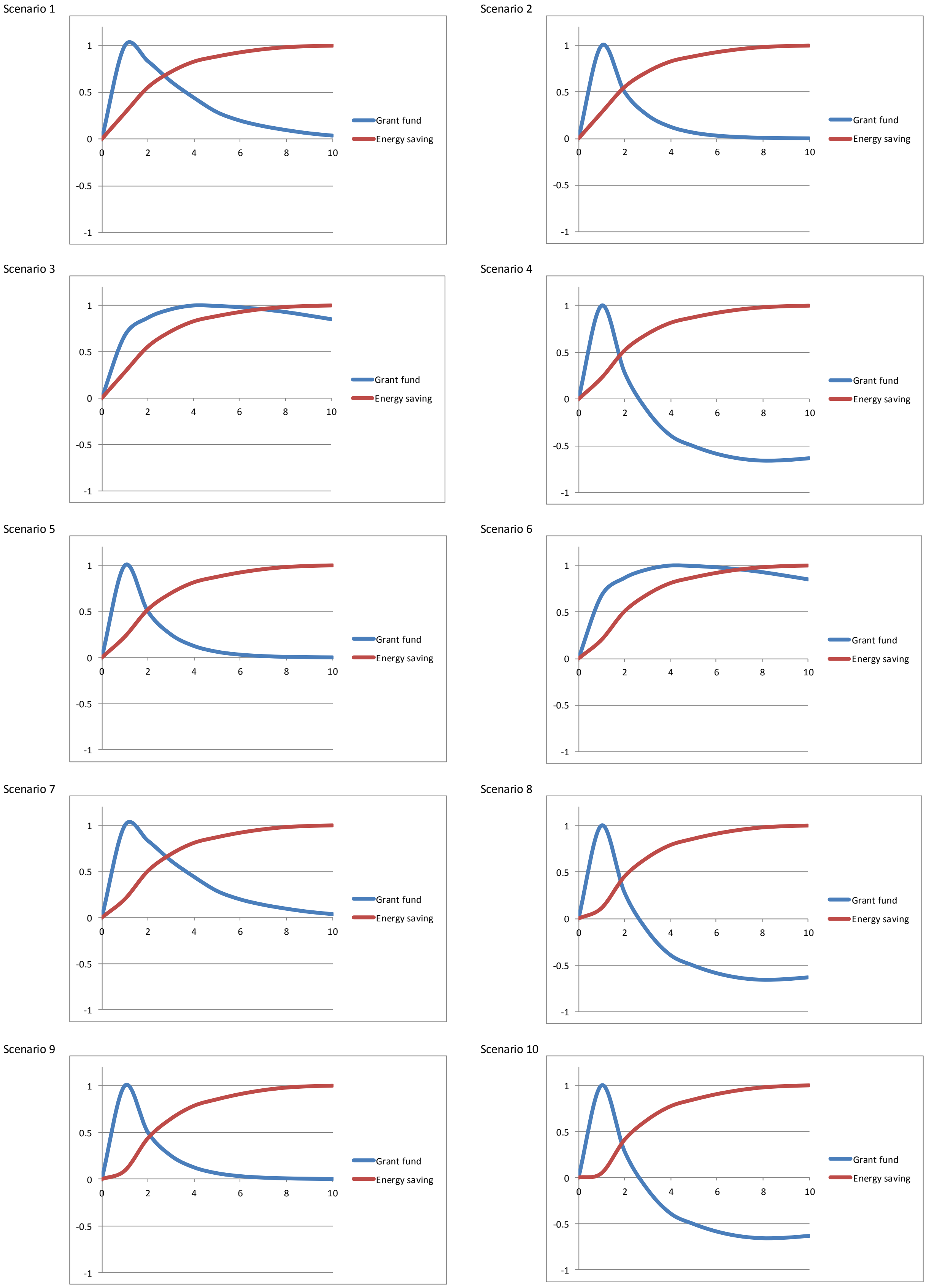
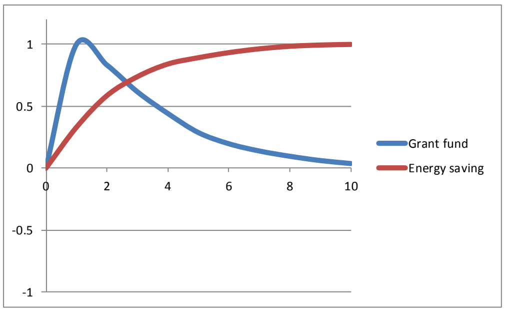
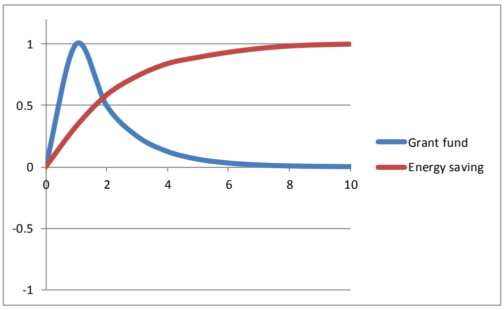


Figure A4.4: Scenario planning models: Segment ‘d’

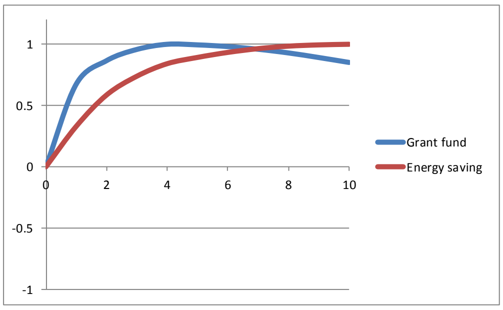
Scenario 1



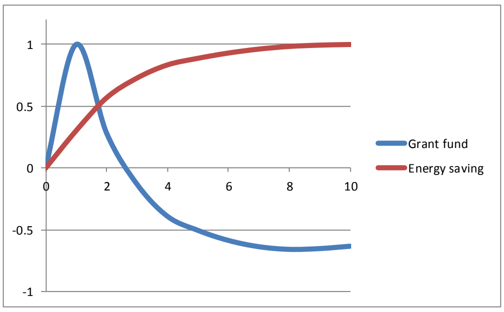
Scenario 2



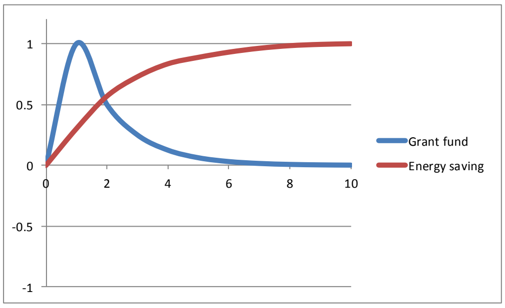
Scenario 3



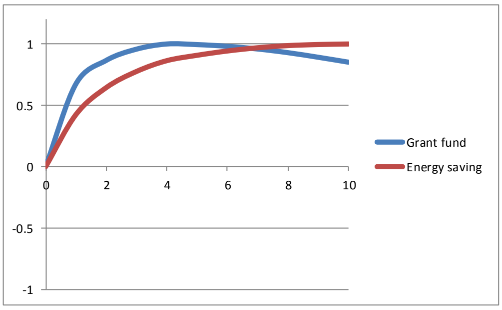
Scenario 4



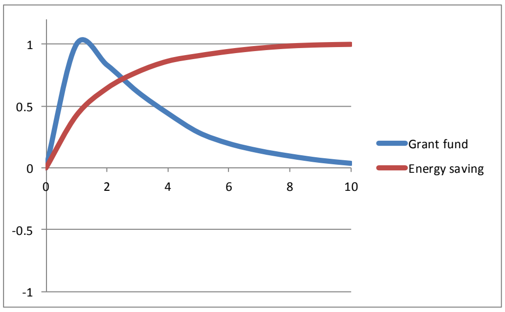
Scenario 5



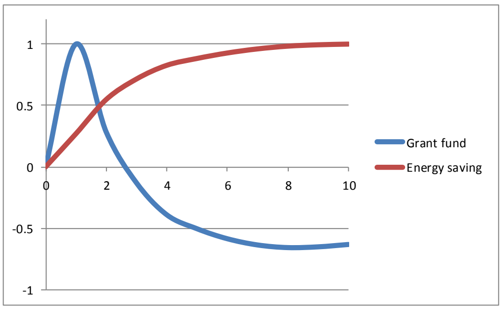
Scenario 6



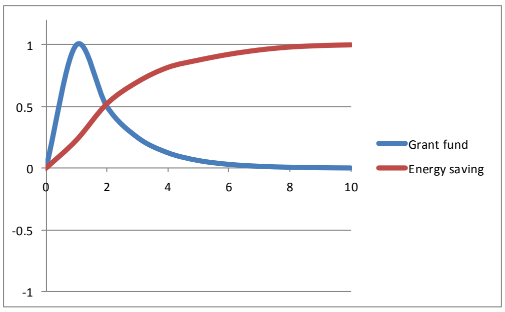
Scenario 7



Scenario 8



Scenario 9



Scenario 10

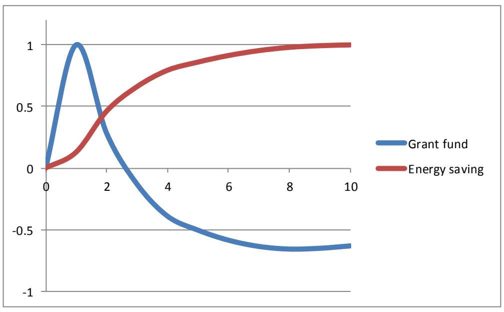
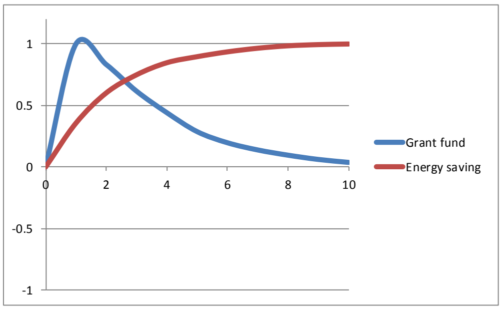


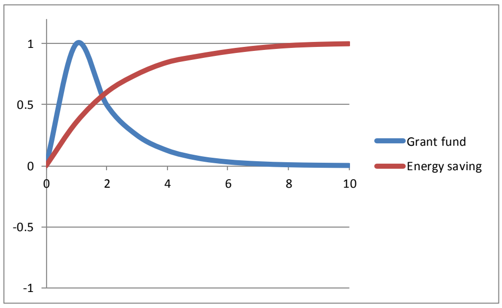
Figure A4.5: Scenario planning models: Segment '*f*'

Scenario 1

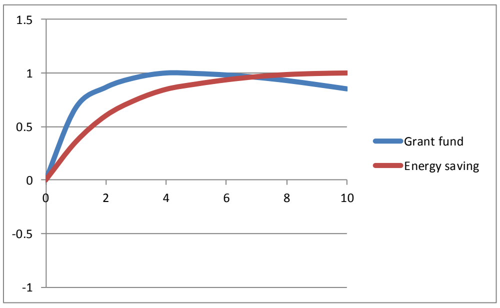
95%
Allocation



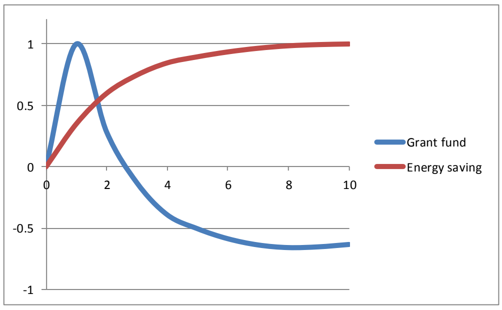
Scenario 2



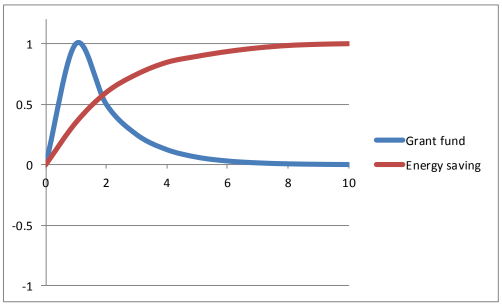
Scenario 3



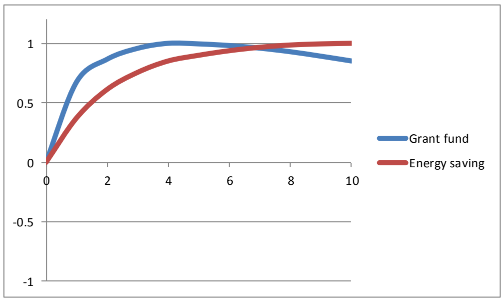
Scenario 4



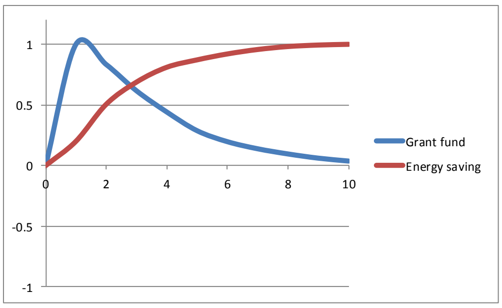
Scenario 5



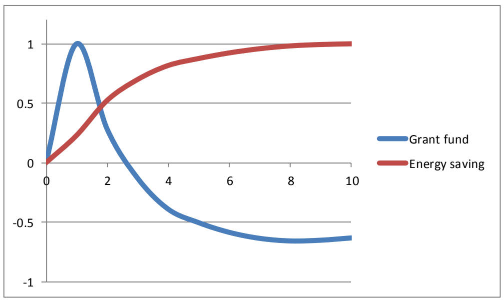
Scenario 6



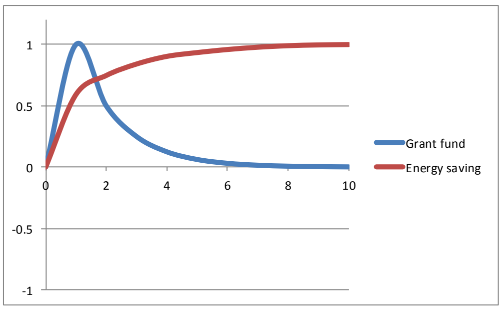
Scenario 7



Scenario 8



Scenario 9



Scenario 10

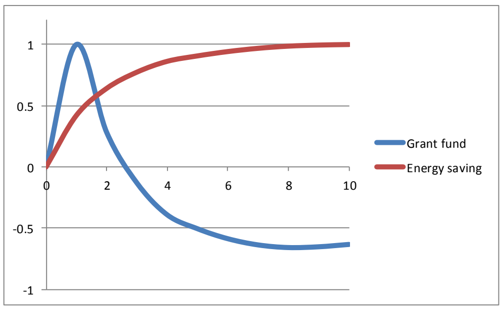
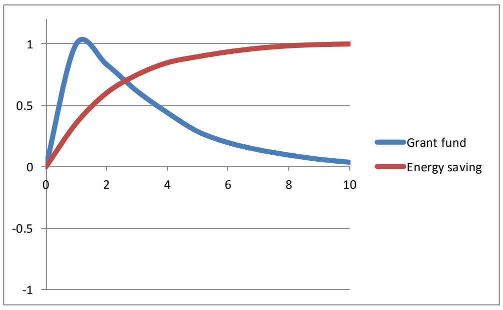
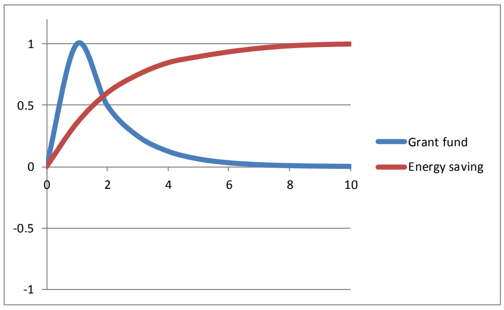


Figure A4.6: Scenario planning models: Segment ‘*g*’

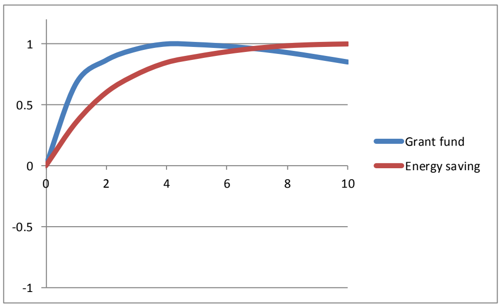
Scenario 1



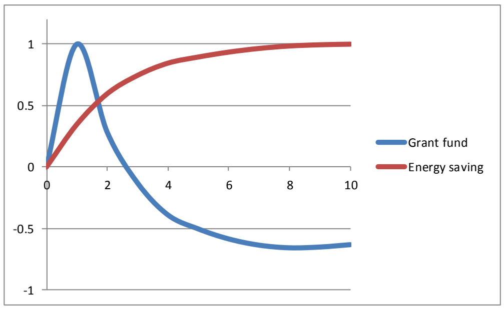
Scenario 2



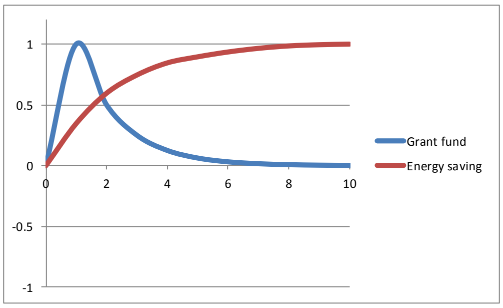
Scenario 3



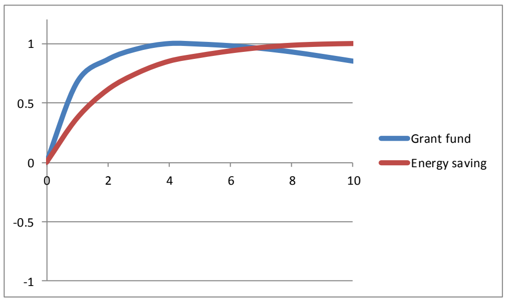
Scenario 4



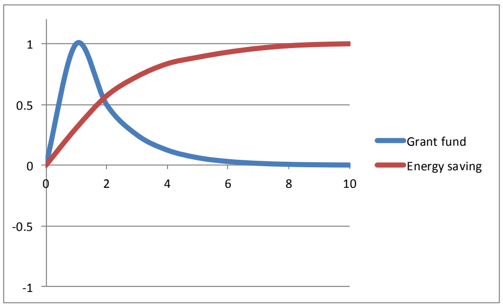
Scenario 5



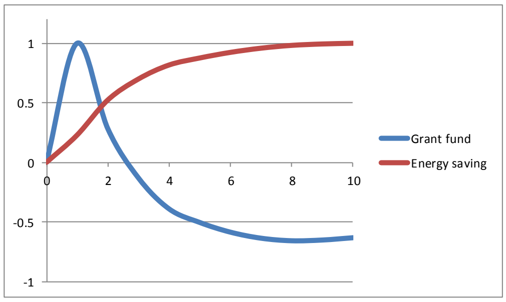
Scenario 6



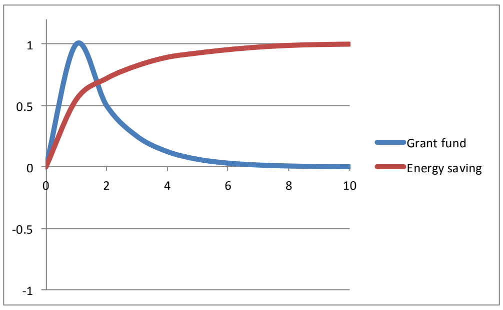
Scenario 7



Scenario 8



Scenario 9



Scenario 10

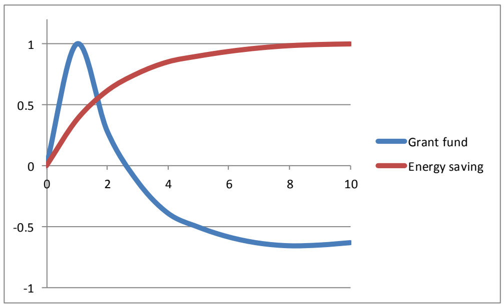


Figure A4.7: Scenario planning models: Segment ‘*h*’

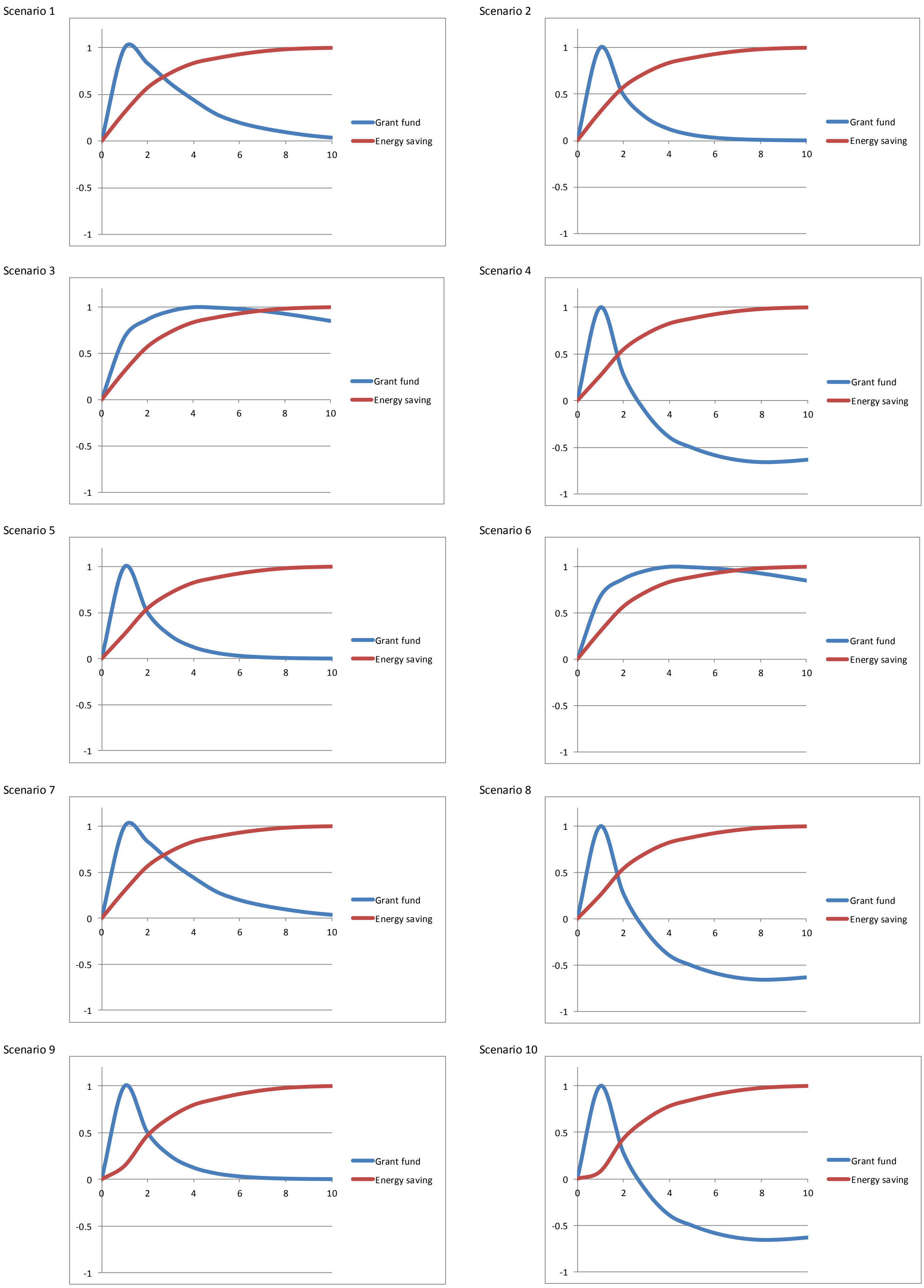


Figure A4.8: Scenario planning models: Segment '*i*'

APPENDIX 5

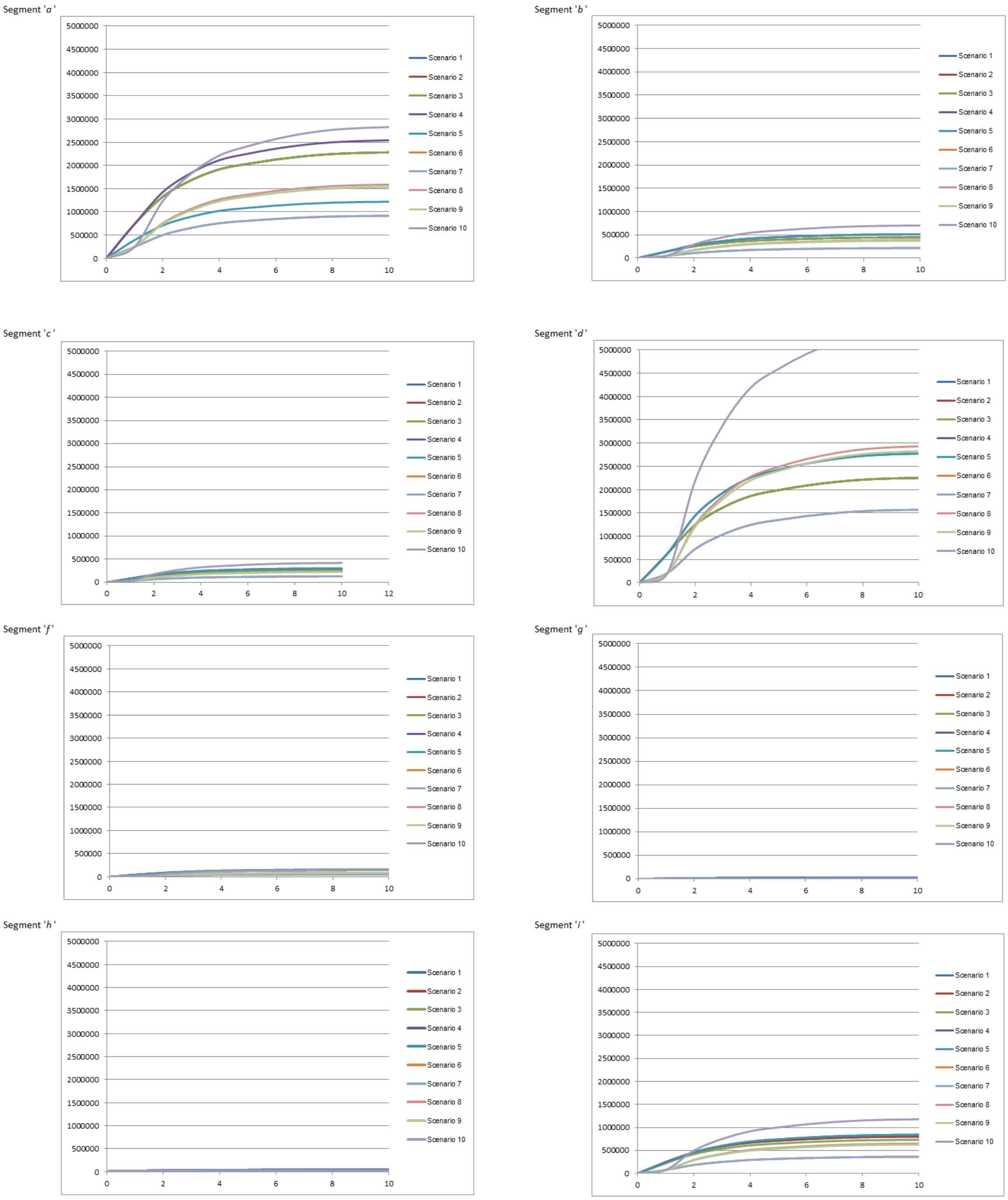


Figure A5.1: Financial Savings resulting from the Carbon Allowance Scheme