4. Four perspectives on energy efficiency barriers

> *"The change in thinking required of the sustainability agenda will never come to fruition within practical domains unless proper attention is given to the sources of individual and social resistance to change."*
>
> *(Hoffman & Bazerman 2007, p. 85)*

4.1 Introduction

Chapter 3 reviewed the energy efficiency literature examining energy management practices. The key research question that this thesis will consider emerged from that chapter; that is: *How* and *why* do energy management practices change?

The aim of Chapter 4 is to review the energy efficiency literature to inform the formulation of an appropriate theoretical 'approach' for this research.

Chapter 4 proceeds in the following way. First, the chapter will introduce the literature on energy efficiency barriers with reference to the range of barrier typologies that researchers have developed. Second, the barriers literature will be examined from four perspectives:

1. a neoclassical economic perspective
2. a behavioural perspective
3. an organisational-level perspective, and
4. an interorganisational perspective.

Third (and finally), the key findings from the review of the barriers literature will be discussed in relation to the selection and development of a theoretical framework to be formulated and applied in this research.

4.2 Barrier typologies explaining the energy efficiency gap

The dominant methodological approach to understanding the energy efficiency gap in the energy efficiency literature involves barriers analysis (Shove et al. 1998; Sorrell 2004; Trianni & Cagno 2012). According to Sorrell et al. (2000), a barrier is: "a postulated mechanism whose outcome is an organisations neglect of (apparently) cost-effective energy efficiency opportunities." Weber (1997) describes barriers analysis as being a methodology based on answering the following three key

questions:

1. *What* are the obstacles or barriers that limit the uptake of an energy efficiency initiative? (Examples include technical standards, regulations, economic interests, financial incentives and people.)
2. *Who* does the barrier hinder? (The 'who' may include firms themselves, government, or individual managers or other people and groups within or external to the target firm.)
3. *What* action is being constrained? (Examples of constrained actions might include difficulties associated with purchasing more efficient equipment, implementing a government policy or improving operating practices.)

The key research question explored through barriers analysis is then: "*What* is an obstacle *to whom* in reaching *what* outcome in energy efficiency?" (Weber 1997, p. 834).

Researchers have applied barriers analysis to develop typologies of energy efficiency barriers. A selection of prominent typologies is listed in Table 4.1.

Table 4.1: A selection of 'barriers' from the energy efficiency literature

Author/s	Barriers
Blumstein et al. (1980)	Misplaced incentives, lack of information, regulation, market structure, financing, custom
Brown (2001)	Misplaced incentives, distortionary fiscal and regulatory policies, unpriced costs, unpriced benefits, insufficient and inaccurate information, low priority of energy issues, capital market barriers, incomplete markets for energy efficiency
IEA (2003) Jollands et al. (2010)	Price distortion, information, buyers risk, transactions costs, bounded rationality, finance, inefficient market organisation, insufficient/excessive/inefficient regulation at a national or international level, capital stock turnover rates, uncompetitive market price, technology-specific barriers
IPCC (2001)	Technological innovation, prices, financing, trade and environment, market structure and functioning, institutional frameworks, information provision, social, cultural and behavioural norms and aspirations
Painuly and Reddy (1996)	Technical, institutional, financial, managerial, costs and information
de Almeida, Fonseca and Bertoldi (2003)	Awareness of the options, technical options, economic barriers, internal conflicts and market structure.
Stern (2007)	Financial and 'hidden' costs and benefits, multiple objectives, conflicting signals or information and other market failures, and behavioural and motivational factors
Sorrell, Mallet & Nye (2011) Sorrell et al. (2004) Sorrell et al. (2000)	Risk, imperfect information, hidden costs, access to capital, split incentives, bounded rationality

Barriers are postulated from a range of theoretical traditions (Palm & Thollander 2010; Sorrell et al. 2000). A neoclassical economic perspective is dominant in the

energy efficiency literature (Brown & Duguid 2001; Jaffe & Stavins 1994b; Rigby 2005; Sorrell 2004). Other theoretical traditions that have been applied to the examination of energy efficiency barriers include behavioural economics, psychology, various organisational theories, and sociological perspectives.

Despite the widespread adoption of the barriers approach, there are a number of important limitations have been identified. For example, differences in the classification and interpretation of barriers present a challenge for researchers and policymakers (Sorrell, Mallett & Nye 2011). As discussed, contributing to such differences is the range of theoretical perspectives that inform each of the various typologies (Lutzenhiser 1993; Wilson & Dowlatabadi 2007). Other limitations of a barriers approach include barriers not being directly observable (Weber 1997) and, where it is assumed that barriers are not interlinked, then there is a tendency for empirical research to adopt a reductionist perspective (Palm & Thollander 2010).

Some authors suggest that an interdisciplinary perspective is one way of addressing these limitations (Jollands & Patterson 2004; Palm & Thollander 2010). Surfacing the underlying theoretical assumptions that may become 'taken-for-granted' by researchers in particular disciplines can help to address some of the confusion and limits to collaboration currently apparent in the academic literature and policy discourse (Breukers et al. 2011; IEA 2003; Lopes, Antunes & Martins 2012; Shove 1998). Efforts to separate different disciplinary perspectives inevitably involve some blurring and overlap (Sorrell et al. 2004). However, critically examining these different perspectives can help to address the institutionalisation of knowledge which has the potential to reinforce ineffective approaches and limit the generation of new knowledge about the reasons for the energy efficiency gap and the actions that might be undertaken to address them (Shove 1998).

The following review adopts four broad perspectives to categorise the literature by taking account of underlying disciplinary perspectives together with the levels of analysis at which research and interventions are targeted. The four perspectives considered are:

1. neoclassical economics
2. behavioural

3. organisational, and
4. interorganisational.

The aim of this section of the chapter is not to examine each of the barriers in detail. Rather it is to examine the main barriers that are highlighted from a range of disciplinary perspectives and levels of analysis and to consider how the barriers perspective informs our understanding of energy management practices. The central assumptions, levels of analysis and limitations of each perspective will be discussed prior to conclusions being drawn that will inform the formulation of the theoretical framework to be applied in this research. Ultimately, the review will highlight the need for and value of a multidisciplinary focus in order to better synthesise the particular strengths of each of the various perspectives.

4.3 The neoclassical economic perspective on the energy efficiency gap

A neoclassical economic perspective is dominant in the energy efficiency literature (Brown & Duguid 2001; Jaffe & Stavins 1994b; Rigby 2005; Sorrell 2004). Within the energy literature, other terms used that are considered under the umbrella term of 'neoclassical' include 'conventional' (Paton 2001), 'orthodox' (Sorrell 2004), 'mainstream' (Gowdy 2004; Marechal & Lazaric 2010) and 'basic' (Horowitz 2001).

The main focus of neoclassical economics is the efficient allocation of scarce resources through markets which 'permit mutually advantageous exchanges' (Stilwell 2002, p. 147). The neoclassical economic perspective places a central emphasis on the influence of markets and prices to explain the energy efficiency gap. As Croucher (2011b, p. 5798) describes it:

> "With regards to energy efficiency the majority of the barriers ultimately come down to money ..."

In fundamental terms, when prices for energy are relatively low, then a neoclassical perspectives assumes that firms might be expected to increase their use. When energy prices increase, then the opposite might be expected to occur (Biggart & Lutzenhiser 2007). Howarth, Haddad & Paton (2000, p. 478) suggest that firms and the managers within them are assumed to operate as:

> "… well-informed, rational actors that systematically maximise profits subject to the constraints imposed by technology, public policy, and prevailing market conditions ..."

Where there is evidence that profitable energy efficiency projects are not being implemented within firms, adopting a neoclassical economic perspective leads to analysis of the market to identify reasons for market failures or imperfections. Then, to justify policy interventions, it is important to demonstrate that the costs of implementation do not exceed the overall benefits across the economy as a whole (Brown 2001).

Within the energy efficiency literature, attempts have been made to distinguish between market failures and market barriers. As defined by Brown (2001, p. 1199), market failures:

> "… occur when there is a flaw in the way markets operate. They are conditions of a market that violate one or more of the neoclassical economic assumptions that define an ideal market for products or services such as rational behaviour, costless transactions, and perfect information."

The category 'market barrier' is a much broader term which aims to capture all other barriers that are not deemed to be market failures, yet contribute towards the slow diffusion of energy efficiency improvements (Brown 2001; Jaffe & Stavins 1994a). Key market failures and barriers from a neoclassical economic perspective are defined in Table 4.2 and then discussed in the paragraphs that follow.

Table 4.2: Key barriers from the neoclassical economics perspective

Barrier	Description
Unpriced costs (externalities)	The price of energy does not reflect the full costs associated with the discovery, extraction, production, distribution and consumption of the energy.
Distortionary fiscal and regulatory policies	Tax and fiscal policies devalue the benefits of energy efficiency projects.
Misplaced incentives	The benefits from an energy efficiency project accrue to a person or group other than the person or group that provides the resources required to implement the project.
Insufficient and inaccurate information	The information required to make an informed investment decision is not available to the decision-maker/s.
Low priority of energy issues	Other business priorities are considered more relevant than energy saving initiatives, even where there are financial benefits.
Capital market barriers	Organisations may have difficulty in accessing the capital required for implementation of projects, even when projects are considered to be cost-effective.
Hidden costs	Costs associated with obtaining information and managing energy use are perceived to be greater than the expected benefits.
Risk	Factors other than cost-effectiveness may influence the decision to implement an energy efficiency project; for example, if a project presents technical or operational risk.

(Source: Adapted from (Brown 2001, p. 1199) and (Sorrell et al. 2000, p. xvi))

Unpriced costs (externalities)

Energy prices may not reflect the true cost of energy. A report by the American National Research Council found that many costs from the discovery, extraction, production, distribution and consumption of fuels were not taken into account within energy prices. As well as environmental costs, many social costs were identified,

including community health issues (National Research Council 2010). A recent report by the Australian Energy Market Commission highlighted a number of deficiencies in market signals that do not encourage energy efficient actions by energy consumers. These include a lack of visibility of the true costs of energy as it is supplied at different times of the day, limited access to consumption information and a lack of financial recognition for energy efficiency initiatives that benefit the market as a whole (Australian Energy Market Commission 2012). Even in large energy consuming businesses, information on energy use that is available from an energy retailer may be limited and difficult to obtain. For example, the price may not account for the different costs of generating energy over a 24-hour period. If this information was available, then it is expected that the market signal would encourage more efficient use at particular times (Eyre 1997; Hirst & Brown 1990; Steinfeld, Bruce & Watt 2011).

Distortionary fiscal and regulatory policies

Other influences on the market price of energy are tax and fiscal policies. For example, the taxation rules in the United States require the capital costs associated with commercial building investments to be depreciated over more than 30 years. In contrast, operating costs can be fully deducted from taxable income. Since energy efficient technologies typically have a higher capital cost, this type of tax arrangement penalises energy efficiency initiatives (Brown 2001). Tax and fiscal policies can also be used to *encourage* the uptake of energy efficiency. Taxes and fees increase the costs associated with energy use. Examples include energy and carbon taxes and pollution levies. Public benefit charges or energy efficiency standards in the electricity sector are commonly used in the United States. These require energy utilities to provide funds for programs aimed at improving the energy efficiency performance of their customers, including residential users and organisations. It is estimated that USD2.7b was allocated to encouraging the adoption of energy efficiency measures in 2007, and this will increase to USD5.4b in 2010 (Croucher 2012).

Misplaced incentives

Also referred to as the principal-agent problem or split incentives, misplaced incentives are said to: "occur when an agent has the authority to act on behalf of a consumer, but does not fully reflect the consumer's best interest" (Brown 2001, p. 1199). For example, a property owner is likely to be the decision-maker in determining whether to upgrade a building, yet the benefits of the upgrade will accrue to the tenant in the form of reduced energy costs (IEA 2007). A contributing factor is information asymmetry, which describes the situation where one party has more knowledge than another (Sorrell et al. 2000).

Insufficient and inaccurate information

From a neoclassical economic perspective, policy measures that increase the cost of energy or incentivise energy efficiency might be expected to increase the likelihood that firms will improve their energy efficiency performance. However, sufficient, accurate and cost-effective information is considered an essential characteristic of a functioning market (Brown 2001). If managers do not have all the information they need on energy efficiency options, as well as the approximate costs, benefits and information on how to deploy such options, then it is reasonable to assume that they may have difficulty deciding to invest in related projects (Garnaut 2008). Policy interventions that influence energy prices will not be optimised if such changes are not 'seen' by decision-makers in organisations due to a lack of information. Therefore, so-called 'information measures', such as energy auditing, may be considered to be policies that complement financial measures (Larsen et al. 2006).

The complexity of energy efficiency improvement options, including projects that involve significant capital expenditure, through to low and no-cost operational improvements, also present an informational challenge for managers. Furthermore, delivering energy efficiency improvements may require the purchase of products and services that are relatively unfamiliar to managers within a particular firm. Such purchases may come from multiple suppliers and intermediaries.

Information asymmetries may occur between purchasers and suppliers across the supply chain. For example, it can be difficult for a purchaser to verify the claims made by suppliers of energy efficient equipment without targeted monitoring

systems and analysis that accounts for the different variables that may affect the energy efficiency performance of a particular product (Sorrell et al. 2004). Frequently, managers have greater confidence in the information associated with upfront capital costs than information about operating costs. This situation creates an incentive to adopt less efficient options upfront where such decisions require less upfront capital (Eyre 1997). Another form of information failure is adverse selection. This describes the situation in which suppliers have more information about the energy efficiency attributes than a purchaser of the equipment. Purchasers will tend to select equipment based on price without having the knowledge of the full benefits associated with the more energy efficient equipment. This means that they may be less likely to pay a price premium for more efficient equipment (Sorrell et al. 2000).

Market barriers including priority, capital constraints, hidden costs and risk

Due to energy costs being a relatively small proportion of overall costs, businesses may have limited interest and concern to improve energy efficiency (relative to other opportunities in a business), making energy efficiency a low priority in the organisation (Brown 2001; Sorrell 2004; Trianni et al. 2013). The low priority for energy efficiency may be exacerbated by the difficulties an organisation may face in accessing the capital required to implement projects (Hasanbeigi, Menke & Pont 2009; Rohdin, Thollander & Solding 2007). The lack of investment in energy efficiency may also be due to perceptions of or actual risk associated with energy efficiency projects. This will particularly be the case where there is insufficient experience within the organisation or across an industry sector with a particular technology or practice that appears to have a good financial return, but for which there is limited corroboration of the results (Fleiter, Worrell & Eichhammer 2011; Sorrell et al. 2004; Trianni & Cagno 2012).

4.3.1 Limitations of the neoclassical perspective

Neoclassical economic perspectives have been criticised for their inability to explain and influence the behaviour of the multiple actors involved in energy efficiency decision-making (Cebon 1992). At the core of this critique is the presupposition of individual actors as: “autonomous and rational individuals unaffected by others” (Biggart & Lutzenhiser 2007, p. 1075). Research often depicts individual decision-makers within firms, as if they make decisions ‘in a vacuum’ without considering

social and institutional influences (Palm 2009; Shove et al. 1998). Jollands and Patterson (2004) highlight that the traditional economic focus on the direct effects of an action within closed systems means that wider flow-on effects are typically ignored.

DeCanio (1993) challenges the neoclassical economic assumption that firms are conceptualised as acting with: "a single mind … with its own consciousness". He points out that firms are a collection of individuals. DeCanio suggests that decisions are made by such individuals working together in ways that are influenced by a complex set of written and unwritten contracts. As well as being influenced through the interaction amongst the many different individuals comprising a firm, they are further influenced by the rules of government and the interactions amongst employees. Therefore, taken alone, there is a risk that attempts to address the barriers identified may not be sufficient to optimise energy use in an organisation.

Table 4.3 provides a summary of the neoclassical perspective. It considers central assumptions, key references, primary levels of analysis and limitations.

Table 4.3: Summary of the neoclassical perspective

Aspect	Description
Central assumptions	Functioning markets are the most efficient way of allocating scarce resources Individuals and organisations behave as 'rational actors'
Key references	Brown 2001; Croucher 2011b; Horowitz 2001; Patterson 1996; Sorrell et al. 2004; Sorrell et al. 2000; IEA 2003.
Primary levels of analysis	The market and individual decision-makers within organisations
Limitations	May not allow for consideration of the range of factors that may influence individual and organisational decision-making beyond 'rational' action – particularly wider organisational, social and institutional influences

4.4 The behavioural perspective on the energy efficiency gap

Behavioural perspectives in the energy efficiency literature seek to explain how individuals make decisions about and use energy. This understanding is then used to inform measures that are targeted at changing individual behaviour (Hoffman & Henn 2008). One of the fundamental questions that a behavioural perspective seeks to answer is: What are the systematic constraints and biases that influence individual decision-making on investments in and use of energy? (Hoffman & Henn 2008)

Two broad approaches are apparent in the behavioural energy efficiency literature:

1. behavioural economics
2. psychology-based theories.

Behavioural economics typically focuses on the way in which investment decisions are made. That is, researchers examine the factors that influence decision-makers towards investment in technologies and practices that deliver improved energy efficiency (Lopes, Antunes & Martins 2012; Sorrell et al. 2004). Psychology-based theories have been applied to understand how the habitual behaviours of energy users lead to the inefficient use of energy (Gynther, Mikkonen & Smits 2011; Lopes, Antunes & Martins 2012). Behaviour-related research on energy efficiency in organisations has been relatively limited. Estimates of the extent to which behavioural aspects contribute to the energy efficiency gap vary widely and are under-researched (Levine et al. 2007; Lopes, Antunes & Martins 2012). Three key barriers from the behavioural perspective are defined in Table 4.4
and then discussed in the paragraphs that follow.

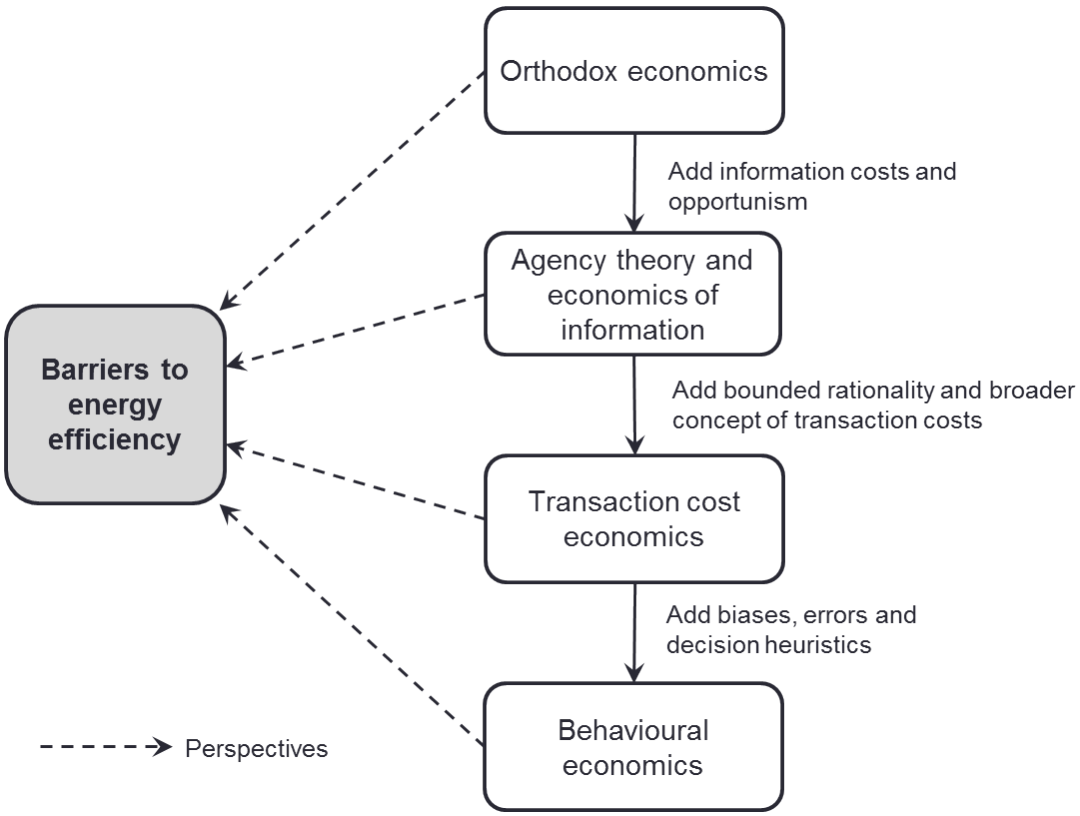
Table 4.4: Key energy efficiency barriers from a behavioural perspective

Barrier	Description
Bounded rationality	Decision-making is limited by the time, attention and resources available to individuals to process information
Personal values and beliefs	Information provided to and reviewed by decision-makers is filtered by the personnel involved and the decision-makers themselves based on their values and beliefs
Limited incentives	Even where there are perceived objective benefits, without a personal incentive to act, progress on energy efficiency improvement may not be forthcoming

It is important to note that behavioural perspectives typically share many of the assumptions of neoclassical economics. Figure 4.1 illustrates how different economic perspectives loosen particular assumptions about people and decision-making that are held within the neoclassical perspective (labelled as 'orthodox' economics in Figure 4.1). The following review will not detail each of these economic perspectives; rather, it will highlight the key barriers as they have been presented in the energy efficiency literature as 'behavioural' barriers. Figure 4.1 also presents a useful reminder of the challenges associated with categorising theoretical assumptions and barriers. Inevitably, there is a degree of overlap. However, the purpose of this review is to highlight the key strengths and weaknesses of each perspective, rather than to create a definitive categorisation of each barrier.

Figure 4.1: Extending the orthodox (neoclassical) economic model applied to energy efficiency barriers

(Source: Adapted from Sorrell et al. 2004, p. 51)



Bounded rationality

Unlike neoclassical economic perspectives, behavioural economics assumes that there are limits to the ability of individuals to process information and that decisions and decision-making may be influenced by personal values and beliefs as well as incentives. The notion of bounded rationality explains the influence of limited time, attention and resources on the ability of individuals to process information (Foss 2003; Simon 1959; Sorrell et al. 2004). Simon (1979) argues that the notion of bounded rationality is particularly relevant for situations in which decision-making occurs under conditions of uncertainty. Acknowledging that individuals have cognitive limits allows for consideration of systematic biases, errors and politically-influenced behaviour. These are not typically considered in traditional economic approaches (Hoffman & Henn 2008; Paton 2001).

One important behavioural bias identified in the literature is the tendency for decision-makers to over discount the future. As Bazerman (2008, p. 4) puts it: "Would you prefer $10,000 today or $12,000 in a year?" Tversky and Kahneman (1991) demonstrated that uncertainty has an important influence on the tendency towards short-term gains and that people have a tendency to prefer avoiding loss than acquiring gains. The uncertainties associated with energy efficiency projects include:

- the future price of energy (Schleich 2004b)
- whether a project will be successfully implemented (Thollander, Rohdin & Moshfegh 2012)
- whether the projected savings will actually be achieved (Rohdin, Thollander & Solding 2007), and
- hidden costs (Sorrell, Mallett & Nye 2011; Sorrell et al. 2004).

The influence of uncertainty and the tendency for managers to over discount the future has been identified in a number of empirical studies as a barrier to energy efficiency (e.g. Anderson & Newell 2004; Harris, Anderson & Shafron 2000; Schleich 2004a). The perceived risk associated with a new, untested or unfamiliar technology, which may impact on product quality and cost, has been found to be a strong deterrent to implementing energy efficiency projects (U.S. DOE 1996). The implications of these studies are that simple financial measures alone do not determine the decision to invest in energy efficient technologies, and that a lack of familiarity of a decision-maker with energy efficiency projects and limited time to obtain the background and knowledge required, can contribute towards under investment in energy efficiency projects.

Personal values and beliefs

Personal values and beliefs have also been shown to influence decision-making on energy efficiency projects. These may work to the advantage of or against decisions on energy efficiency projects. For example, Rohdin & Thollander (2006) found that personal beliefs may prejudice decision-makers *towards* the implementation of energy efficiency projects. In one of the interviews undertaken as part of a qualitative study of eight Swedish industrial firms, the executive director at one firm explained that: "We do not work with this (investment criteria); we implement

the things we believe in" (Rohdin & Thollander 2006, p. 1841). This suggests that formal investment criteria were not as important in influencing the decision as underlying management beliefs in some cases.

One powerful belief that has been extensively considered in the literature is that projects that deliver an environmental benefit must have a negative impact on a company's profitability. The term 'Mythical fixed-pie' was coined by Bazerman (1983) to describe negotiated agreements in which the interests of two parties lead to a joint benefit. Despite the joint benefit, the parties believed that win-win outcomes are simply not achievable because they think their interests directly conflict with the interests of another party. Hoffman and Henn (2008) discuss the notion of 'mythical fixed-pie' in the context of energy efficiency. They highlight that deeply held beliefs by managers that environmental benefits must directly conflict with profits mean that energy efficiency projects framed in this way may be rejected.

Porter and van der Linde (1995) describe the influence of individual beliefs in relation to regulation on environmental and energy issues. They suggest that environmental regulation can deliver net benefits to companies in certain circumstances. Benefits occur when the regulation acts as a catalyst for innovation. Porter and van der Linde describe these benefits as 'innovation offsets', in that the benefits to the firm offset the administration and resources required to achieve compliance. The strength of the debate around whether or not environmental regulation can deliver net benefits may in part be due to fundamental beliefs about the role of government and the nature of innovation in business (Palmer, Oates & Portney 1995).

The implication of this discussion is that a manager's underlying beliefs may influence the extent to which they support energy efficiency initiatives. This means that the way in which energy efficiency improvement is framed to managers by policymakers and energy efficiency practitioners (e.g. as environmental initiatives versus business improvement or productivity initiatives) may influence the extent to which action is taken within firms (Paton 2001). There is also the potential for managers to perceive energy efficiency legislation as a compliance matter, rather than as an opportunity to improve their business performance (Shen, Price & Lu

2012).

Limited incentives

Limited incentives may also play a role in constraining the uptake of energy efficiency projects. Rhodin and Thollander (2006) found that – where a decision to invest in or use energy in a more effective way is perceived a 'hassle' to an individual – then more energy efficient behaviour may be avoided. More significant than 'hassle' is that failure to implement a project successfully might have personal risk to the person responsible. With reference to a data centre, Glanz (2012) explains that – if the data centre fails to operate, then an individual may be at risk of losing their job. Organisational priorities around core business functions may provide a powerful disincentive for individuals and managers to implement energy efficiency initiatives.

Perceptions of responsibility and individual rewards may influence the ways in which employees use energy. Masoso (2010) analysed the energy audits of six buildings in Botswana and South Africa and found that more energy is used during non-working hours than during working hours. The greatest contributors to energy use were found to be air conditioning systems and equipment, such as computers and lights, being left on overnight. Other research has identified a high degree of variability by which tenants interact with control systems of lighting systems (Lindelof & Morel 2006) and office equipment (Jean-Sébastien et al. 2008; Kawamoto, Shimoda & Mizuno 2004).

4.4.1 Limitations of the behavioural perspective

The behavioural perspective expands on the limitations inherent in a neoclassical economic perspective on the barriers to energy efficiency by highlighting that decision-making and action taken on energy efficiency in organisations may be influenced by bounded rationality, personal values and beliefs and limited incentives. However, the behavioural perspective has been criticised because it implies that individuals themselves are a barrier to implementing particularly technologies – an approach still based on notions of rationality; that is, of implementing energy efficiency because it is a cost-saving initiative that supports the profitability of the firm. This notion does not account for the social meanings that may be attributed to action on energy – meanings that are both influenced by and influence cultural

practices and shared expectations (Shove et al. 1998). This perspective informs the important need for organisational structures, culture and wider societal influences on the energy efficiency gap to be examined (Breukers et al. 2011; Bye & Bruvoll 2008; Lopes, Antunes & Martins 2012)

Table 4.5 provides a summary of the behavioural perspective. It considers central assumptions, key references, primary levels of analysis and limitations.

Table 4.5: Summary of the behavioural perspective

Aspect	Description
Central assumptions	Individual behaviour is influenced by systematic constraints and biases that limit 'rational' decision-making on investments in and use of energy
Key references	Anderson & Newell 2004; Breukers et al. 2011; Bye & Bruvoll 2008; Glanz 2012; Harris, Anderson & Shafron 2000; Lopes, Antunes & Martins 2012; Schleich 2004a; Gynther, Mikkonen & Smits 2011; Sorrell et al. 2004; Sorrell et al. 2000.
Primary level of analysis	The individual level
Limitations	Does not typically account for the range and complexity of broader social processes that may influence individual behaviour

4.5 The organisational perspective on the energy efficiency gap

> *"Dynamic competition is characterized by changing technological opportunities coupled with highly incomplete information, organizational inertia and control problems reflecting the difficulty of aligning individual, group and corporate incentives. Companies have numerous avenues for technological improvement, and limited attention."*
>
> *(Porter & van der Linde 1995, p. 99)*

Research that attempts to explain the energy efficiency gap from neoclassical economic and individual behavioural-level perspectives typically does not attempt to account for the organisational-level characteristics of firms and the influence of those characteristics on the uptake of seemingly profitable energy efficiency projects. Even similar firms in the same sector exhibit different levels of energy efficiency performance (Cooremans 2012; DeCanio & Watkins 1998). While this may be explained to some extent by the underlying beliefs of individual managers, this finding challenges the neoclassical economic view that assumes away such differences and also highlights the limits to behavioural perspectives when they are focused on individual behaviour (Gillingham & Palmer 2013; Paton 2001). The organisational perspective on the energy efficiency gap aims to identify the factors within organisations that limit the uptake of profitable energy efficiency projects.

A study by DeCanio and Watkins (1998) has been influential in highlighting the influence of firm characteristics on energy efficiency performance. The authors compared the energy efficiency performance and firm characteristics of 268 companies that were participants in the U.S. Environmental Protection Authority (EPA) Green Lights program and found a number of firm-level variables that were statistically influential. Variables such as the number of employees, earnings per share, historical rate of growth of industry earnings, expected future earnings growth, price/earnings ratio and location were all found to be statistically significant. Although the analysis did not show causality between each characteristic and firm's performance, the study highlights the relevance of examining firm-level differences as a way of understanding barriers and opportunities to improved energy efficiency

performance. Table 4.6 lists the key organisational-level barriers presented in the energy efficiency literature. Each of these barriers are then discussed in the paragraphs that follow. It is important to note that many of these organisational perspectives may relate to a variety of other initiatives beyond energy efficiency; that is, they relate to organisational challenges in general.

Table 4.6: Key energy efficiency barriers from an organisational perspective

Barrier	Description
Organisational structure	Organisational structure influences the level of attention to and priority placed on energy efficiency improvement.
Limited collaboration across organisations	Lack of information sharing and collaboration across functional and professional groups within an organisation may limit the improvement options identified and implemented. This may be exacerbated by 'split incentives' in which the benefits from improvement do not accrue to the group responsible for funding implementation.
Visibility of energy use	In the absence of appropriate monitoring systems, energy use and waste may not be visible to managers.
Routines	Established routines may be difficult to change – even when market forces and other business drivers make existing practices ineffective.
Capability	The skills and knowledge required to improve energy management may not be available within an organisation

Organisational structure

Cebon (1992) compared the energy efficiency performance of two universities and found that organisational structure had an important influence on energy efficiency performance. The first university had formed a centralised energy group that had the authority to improve energy efficiency across all university buildings. This structure was influenced by the availability of a high level of fund and a culture of 'inhouse, centralised facilities management' and outsourcing where sufficient expertise was

not available internally. In the second university, responsibility and management of energy efficiency was decentralised (i.e. it was allocated to each faculty). There was limited funding and internal expertise available for energy management at this second university. Cebon found that the university with a centralised structure was more likely to undertake projects that involved major capital expenditure. That university also made more use of external resources, such as government and utility-based energy efficiency programs, to support their aims. The university with the decentralised structure was more likely to undertake low and no-cost initiatives that involved working with energy users to modify their behaviour. This university undertook few projects requiring significant capital expenditure. One external provider that worked with one of the faculties assumed that, because one faculty had implemented successful initiatives, then other faculties would do the same. In reality, however, there was limited communication and experience-sharing across faculty groups on energy efficiency issues.

Cebon's study highlights that the organisation culture, availability of funding and structure of an organisation can influence the type of projects that are identified and implemented; that is, the university with a central, expert group with responsibility for driving energy efficiency implemented more large capital projects than the other university. A contributing factor was their experience in project management and the technical knowledge available within the team. In the second university, responsibility for energy efficiency was dispersed and pushed down to the faculty level. With fewer resources and technical expertise, the response was more focused on low cost projects that involved modifying behaviour. The study highlights that the level of resourcing, availability of skills and structure of an organisation can all help to explain differences in energy efficiency performance. These findings also explain differences in organisational performance more generally. They are not just limited to energy management.

Limited collaboration across functional and professional groups

Information sharing and collaboration across internal groups and departments has been highlighted as a common barrier by a number of researchers. Neoclassical economic perspectives assume that as long as information is available in the market, then it will be used by the managers who require that information. Organisational

perspectives highlight how internal professional and functional boundaries can be barriers to the selection of and decisions made on energy efficiency projects.

Drawing on the work of Edgar Schein (1997), Hoffman (2001, p. 135) describes the challenge of working across 'occupational communities', which he defines as "groups of constituents that cut across organizations and share common language, perspectives, and assumptions about the nature of business". These communities vary from firm to firm, but typically include engineering, marketing, health, safety and environment, accounting and finance. Each community has its own incentives, priorities and language, which create barriers to the identification, funding and implementation of energy efficiency projects (Paton 2001).

The need to engage with and work across these 'occupational communities' is illustrated by Cebon (1992) by using the example of an energy efficiency project that involved the installation of energy controls on fume hoods in laboratories. Cebon explains that fume hoods in the laboratories at the university were controlled manually. This meant that they were often left on continuously – even though, for much of the time, these fume hoods were not contributing useful work. A member of the energy team identified an opportunity to install a controller on the fume hoods. The specialist had the technical expertise required to estimate the costs and benefits of the project and also came to understand the specific needs of the users. However, halfway through installation of the fume hoods across the university laboratories the safety officers in the Health and Safety Department became aware of the project for the first time and the installation of the fume hoods were stopped on the basis of safety concerns.

The project highlights the importance of what Cebon calls 'connected information'. Connected information draws on perspectives from individuals and groups across professional and functional boundaries within an organisation. These participants may have a direct interest in the outcome, but they may not be energy users.
In the case of the fume hoods project, the technical/maintenance personnel who had been involved in the approval and installation process had not consulted with the safety officers to obtain their input. As a consequence, the project was discontinued. This provides an insight into the implementation of energy management, suggesting

that greater consultation across the organisation would be useful. However, the research does not inform what difficulties are associated with such consultation, how such communication can be encouraged and the extent to which the wider organisational context may influence how such communications occur. These are all issues that will be examined in the case study developed in this thesis.

Visibility of energy use

Information on energy use and associated financial and other business costs may be 'invisible' to management. Organisations find it challenging to justify investment in energy information systems (e.g. sub-metering), to make energy usage more visible and provide the data required to analyse energy use to identify potential opportunities, prepare a business case proposal and to monitor the outcomes from implemented projects (Rohdin, Thollander & Solding 2007). A lack of information can, in turn, make it difficult for firms to create accountability for energy use. Even in cases where energy efficiency is communicated as an organisational priority and performance targets are set, without the right level of data and appropriate measures, accountability is difficult to enforce (Bor 2008; Pérez-Lombard et al. 2012; Rietbergen & Blok 2010).

Routines

Cooremans (2011) has examined the influence that different investment procedures and routines in firms can have on energy efficiency projects. Investment procedures include the analytic and capital budgeting tools used, profitability requirements, the different steps a project has to follow and whether a particular project is categorised as a capital or operational investment (Russell 2008). Established routines may create inefficiencies if an organisation is unable to modify them in response to market and other forces. Therefore, organisations may continue to apply particular routines that were once efficient, but for which surrounding conditions have changed (Paton 2001).

Capability

The skills and knowledge of personnel within a firm is another important factor. In relation to presenting business case proposals, Cooremans (2011) highlights the importance of framing proposals in terms of the strategic benefits to the organisation.

Proposals may also not account for the full benefits to the organisation. Worrell et al (2003) reviewed 52 publicly available energy efficiency projects. They found that the average payback on those projects could be reduced from 4.2 years to 1.9 years by including productivity and other project benefits, rather than just direct energy-related benefits. The skills, knowledge and experience of personnel involved in energy efficiency can have a significant influence on firm energy efficiency performance (IPCC 2001; Rigby 2005; Russell 2008). These perspectives also challenge the arguments that have been made about hidden costs – an argument that is often made without reference to hidden or unaccounted benefits (Cooremans 2012).

Cooremans (2012) examined decisions on energy efficiency projects in 25 companies in Switzerland. Semi-directive interviews were undertaken with each of the company managers responsible for energy management as well as the most senior finance manager. The research demonstrated that energy efficiency investments that were focused on increasing the productivity of existing means of production were more effective that those that were based on energy cost savings alone. Cooremans contributes a perspective that highlights the extent to which a project is considered 'strategic'. This can have a strong influence on whether the project is selected for funding and implementation. According to Cooremans, the strategic nature of an investment is made up of three components:

1. risk
2. value, and
3. the costs associated with implementation.

The implication is that more 'strategic' energy efficiency projects are more likely to attract investment.

Cooremans (2012) research raises a number of important questions for future research. For example, it is assumed that the strategic nature of an investment is 'known' to decision-makers. However, a project may be considered 'strategic' to an individual, but individual interest may not necessarily align with the organisation's strategic goals. Further, the definition of 'strategic' does not seem to apply for low and no cost projects, which represent a significant opportunity for improving energy efficiency performance in organisations. There is scope to further examine the

different influences on decision-making associated with projects and the processes that support such decision-making. This includes the different perceptions of how the term ‘strategic’ is understood at different levels of an organisation, and how the level at which decisions are taken might influence the extent to which a project is considered to be ‘strategic’. Cooremans model also highlights the potential for individual and collective influence in decision making based on ‘perceived’ value, risk and costs. This presents an important contrast with approaches that assume the evaluation of projects to be an objective phenomenon.

Interactions between barriers

In commercial buildings, building managers are in a unique position to influence energy efficiency performance because they manage the operations of a building on a day-to-day basis. However, the varied level of influence that building managers may have may be explained by the diversity of their experience and skills (IPCC 2001; Marans & Edelstein 2010), the extent to which they are expected by management to act on energy efficiency and the level of remuneration they receive (Aune, Berker & Bye 2009; Lewis, Elmualim & Riley 2011; Yik, Lee & Ng 2002).

This discussion highlights how a number of different barriers to energy efficiency may act to reinforce one another. The interaction amongst barriers can create negative feedback loops that can reinforce organisational barriers and make energy efficiency even more challenging to address (Reyna et al. 2012). This highlights the need for research that examines how such feedback loops occur and the practices that are successful in transforming negative feedback loops into positive ones that encourage rather than create barriers to energy efficiency improvement.

4.5.1 Limitations of the organisational perspective

The organisational perspective helps to explain barriers to energy efficiency improvement that go beyond those identified through individual and market-level analyses conducted from a neoclassical economic and behavioural perspective. While the organisational perspective goes some way to addressing the critique of the behavioural perspective by accounting for organisational-level factors that influence individual and group behaviour on energy efficiency, it does not address wider societal influences, including the influence that stakeholders external to a firm may

have on the energy management practices adopted and the energy performance of organisations (Breukers et al. 2011; Lopes et al 2012). The next section considers the influence that external organisational stakeholders may have on barriers to energy efficiency. Table 4.7 provides a summary of the organisational perspective. It considers central assumptions, key references, primary levels of analysis and limitations.

Table 4.7: Summary of the organisational perspective

Aspect	Description
Central assumptions	The priority placed on energy efficiency improvement within an organisation can be influenced by a range of interrelated organisational factors, including structure, collaboration across interorganisational boundaries, information about energy use, existing routines and organisational capability.
Key references	Cooremans 2012; DeCanio & Watkins 1998; Hoffman 2001; Paton 2001; Pérez-Lombard et al. 2012; Rohdin, Thollander & Solding 2007.
Primary level of analysis	The organisational level
Limitations	In the energy efficiency literature, there has been limited consideration of the role and influence of an organisation's external stakeholders and the manner in which the actions of these stakeholders influence energy management practices and performance within organisations.

4.6 The interorganisational stakeholder perspective on the energy efficiency gap

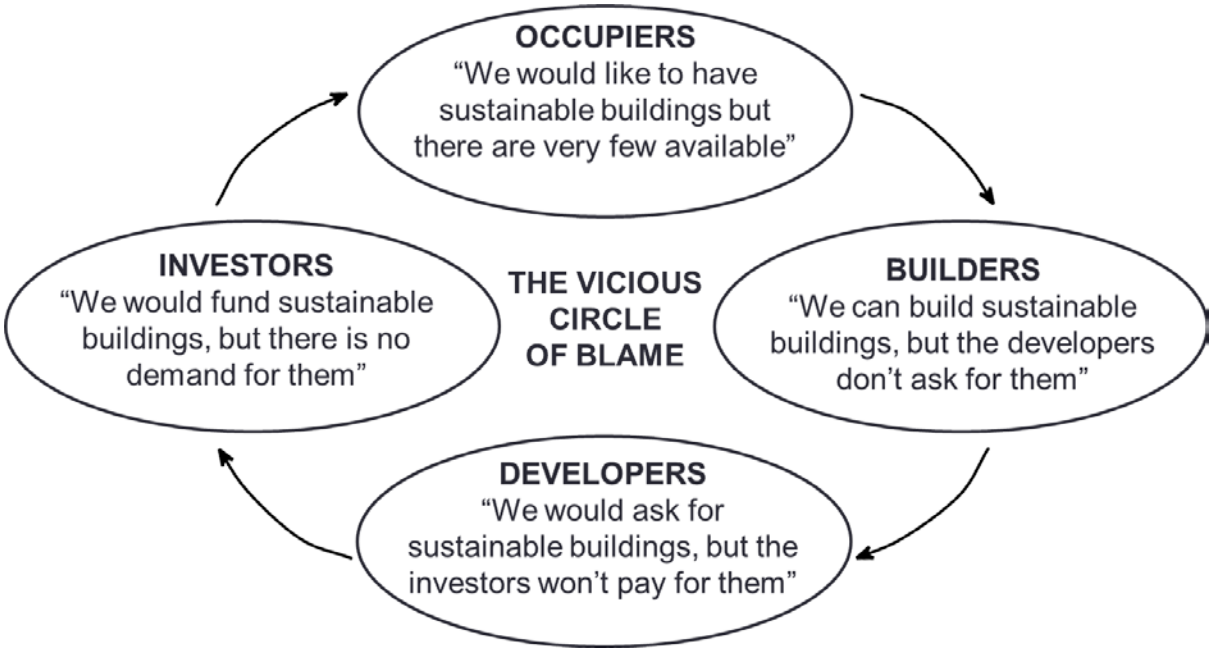
Barriers have not typically been framed in the energy efficiency literature from an interorganisational perspective and there has been limited attention placed on the dynamic interactions between organisations and the way in which these dynamics influence the adoption of energy management practices. The following quotation from Biggart and Lutzenhiser (2007, p. 1082) highlights the importance of examining the interactions between multiple organisational stakeholders and the ways in which these interactions influence the energy performance of organisations:

> "Some real successes in improving the energy performance of the commercial and institutional built environment have taken place. But they generally have not come about as a direct result of economic inducements or economic self-interest. They have resulted from the actions of charismatic state and local leaders, pressures from citizen movements, the initiatives of semiautonomous federal agencies, … and highly visible signature building projects by private firms to house their headquarters operations (and contribute to their branding efforts)."

A key question that informs consideration of interorganisational barriers to energy efficiency is: How do organisations interact to establish social norms and standards which influence the energy efficiency performance of organisations? For example, Warren-Myers (2012) examines the interactions amongst stakeholders in the property sector that have an interest in sustainability (an important component of which is energy efficiency). Figure 4.2 illustrates how particular stakeholders may create barriers to others stakeholders. Overall, this can create a situation that has been termed the 'cycle of blame' (Cadman 2000; Warren-Myers 2012).

Figure 4.2: Interactions amongst stakeholders in the commercial sector

(Source: Adapted from Warren-Myers 2012, p. 120)



The purpose in presenting this diagram is to illustrate the way in which the attitudes and actions of a range of organisational stakeholders may influence each other to create barriers to energy efficiency and sustainability (Hoffman 2001; Newell 2008; Sayce, Ellison & Parnell 2007). The drivers for sustainable commercial property, a large component of which is energy efficiency, include government legislation, changing landlord tenant relationships and perceptions of enhanced returns and increased value. These drivers influence changes across a number of different stakeholders, including investors, business, government, tenant and community (Newell 2008). Therefore, the interactions between these organisations can be seen to create barriers to the uptake of energy efficiency projects. The range of stakeholders examined in the literature is presented in Table 4.8.

Table 4.8: Stakeholders with an interest in organisational management of energy

Stakeholder	Key references
Government	Schmidt (2012); Pizer (2008); Palm(2010); IEA (2003); Schmidt (2012); Wiel (2003); Morsink (2011); Bazerman (2008)
Shareholders/investors	Harrison (2011); Warren-Myers (2012); Popescu (2012); Newell (2011); Clark (2005); Hamilton (2011)
Industry associations	Hamilton (2011); Newell (2008); Hoffman (2008)
Customers	Newell (2008); Pellegrini-Masini (2011); Miller (2008); Miller (2009); Hinnells (2008)
Electrical utilities	Croucher (2011a); Levine (1994); Satchwell (2011); Vine (2010)
Researchers	Warren-Myers (2012); Shove (1998)
Consultants	Vine (2005); Painuly (2003); Duplessis (2012); Marino (2011)
Insurance companies	Vine (2000); Mills (2009); Mills (2003)
Non-governmental organisations	Gullberg (2008)

As previously discussed, governments have played a fundamental role in developing policies and programs that are designed to address the energy efficiency gap. This is particularly important where issues are of an immediate and short-term nature to have maximum effect (e.g. slowing the negative impacts of climate change requires significant greenhouse gas emission reductions in the short-term). 'Business as usual' approaches are unlikely to be sufficient to address the urgency of the problem (Pizer & Popp 2008; Schmidt et al. 2012).

Various energy efficiency policies were discussed in Chapter 3. Government policies are, however, influenced by the underpinning frameworks and beliefs systems applied by government personnel (IEA 2003; Palm & Thollander 2010), and policies may create unintended consequences or have limited effect (Morsink, Hofman & Lovett 2011; Schmidt et al. 2012; Wiel & McMahon 2003). The internal machinations of bureaucracies and political influences are another variable that can

influence the effectiveness of government policies (Bazerman 2008). Government interactions extend to international cooperation, which can reduce costs for the design and testing of more energy efficient equipment and improved opportunities in relation to trade and technology transfer (IEA 2000). A lack of cooperation may also have an influence (e.g. through diverse fiscal and tax incentives across national and regional boundaries (Barla & Proost 2012)).

Policymakers are part of the systems which they seek to influence. In contrast to 'command and control' perspectives, in which policymaking is seen as a task that involves coercing individuals to act in particular ways, policymaking as an activity can be conceptualised as a: "reflexive process of social learning and network building" (Shove, Pantzar & Watson 2012, p. 25). According to this view, policy is developed and implemented through the interactions between government and non-government actors, rather than through the actions of the government alone (Smith, Stirling & Berkhout 2005). An important contribution of system-level analyses is that they can help provide an understanding of the interaction and trade-offs that occur between different policy approaches. In some cases, these may be complementary, but in others, they may lead to unintended outcomes (Grünewald et al. 2012). This discussion reiterates the finding from the previous chapter of the importance of examining how policies interact to influence energy management practices. Such interaction may be between policies themselves as well as through the interactions amongst the many different organisational stakeholders that may be affected by these policies.

Theoretical approaches applied to the interorganisational perspective

There have been a number of recent applications of sociological-based theories and empirical techniques towards understanding the energy efficiency gap from the point of view of the interactions between multiple stakeholders. Verbong and Geels (2010) examined the application of sociotechnical systems in the context of the transition towards renewable energy supplies. They explain that sociotechnical transitions involve interactions between:

1. technical elements, such as generation plants
2. networks of actors and social groups, such as large industrial energy users, and

3. formal, normative and cognitive rules that guide the activities of actors.

The authors argue that it is the interaction between these three elements that encourages 'lock-in' to the existing system. Path dependency is another important characteristic that limits the options available as the actions of critical actors combined with existing technology encourage maintenance of the status quo. Co-evolution is also an important consideration in that social systems are changed by technology and technology itself is shaped by society (Geels, Hekkert & Jacobsson 2008; Schot & Geels 2008).

Palm and Thollander (2010) examine the social networks associated with energy efficiency in the Swedish industrial sector. They consider the information sources that practitioners use to access information about energy efficiency finding that the sources of information that are considered to be credible very from one sector to another. The researchers suggest that a reliance on information sourced within a sectoral group may limit the generation of new ideas and potential lock-in to existing energy management practices. They suggest that new sources of information and dialogue with practitioners and experts from outside a particular industry sector may provide an important opportunity to address limited uptake of energy efficiency projects within a particular sector. Palm and Thollander conclude that further examination of social networks can provide an important and unique contribution to the energy efficiency literature.

Biggart and Lutzenhiser (Biggart & Lutzenhiser 2007) argue that economic sociology can provide a useful contribution to understanding energy inefficiency as a social problem. In particular, the authors highlight the opportunity to examine the social structure of the market and the interactions amongst the multiple stakeholders within that market – as a potential contribution that institutional economics and sociology can play in providing new perspectives on the energy efficiency gap and how it can be addressed.

4.6.1 Limitations of the interorganisational perspective

There has been limited empirical work that examines energy efficiency in organisations from the perspective of social theories and networks (Biggart & Lutzenhiser 2007; Thollander & Palm 2013). Shove (Shove 1998) argues that a contributing factor may be the perception by policymakers and others who commission research that sociological approaches do not generate results that can be widely generalised.

This perspective may reinforce preferences amongst those commissioning such research for the use of particular methodologies and approaches (e.g. those who utilise qualitative data or justify outcomes in terms of neoclassical economic frameworks). Further, such research requires a different set of skills than has been traditionally applied to the problem of the energy efficiency gap. As Shove (1998, p. 111) describes:

> "… different sorts of expertise would be needed to map sociotechnical opportunities for energy conservation, evaluate the social transferability of building technology, or figure out how actors might be re-aligned and new techno-economic networks pieced together in the interests of energy efficiency ..."

The interorganisational perspective is not usual within the energy efficiency literature. However, as this concise review has identified, it is an important perspective that may provide novel explanations for the energy efficiency gap and explain the process by which organisations adopt more effective energy management practices. In particular, this perspective can help to address the research gap identified in Chapter 3 in relation to better understanding the effects of multiple energy efficiency policies and the complex interactions between multiple organisational stakeholders that may impact on the effectiveness of energy efficiency policies. Therefore, this is an important perspective to be examined in this research.

Table 4.9 presents a summary of the organisational perspective. It considers central assumptions, key references, primary levels of analysis and limitations.

Table 4.9: Summary of the interorganisational perspective

Aspect	Description
Central assumptions	Organisations interact to establish social norms and standards, which influence the energy performance of organisations.
Key references	Biggart & Lutzenhiser 2007; Hoffman 2001; Palm 2009; Palm & Thollander 2010; Warren-Myers 2012.
Primary level of analysis	The interactions between multiple organisations.
Limitations	Since the interactions are expected to be complex and involve multiple stakeholders this presents some challenges for designing research that informs the action of policymakers.

4.7 Implications for researching energy management practices

In Chapter 3, it was argued that in order to better understand how energy management practices are adopted by organisations, there is a need for research that examines the energy management practices as a dynamic phenomenon. That is, rather than simply examining the extent to which energy management practices are adopted by organisations at a particular point in time, an alternative approach could be to examine the dynamic processes by which new energy management practices develop and are adopted by organisations over time. This perspective reflects the emergent and process-based view of change (Dawson 1997, 2003; Van de Ven 2010) –discussed in Chapter 3 (see 3.3). This chapter has argued that adopting such a view could address knowledge gaps in the energy efficiency literature and provide important insights into the actions that policymakers and practitioners can draw on to accelerate the adoption of effective energy management practices in organisations.

The aim of the present chapter has been to examine the comprehensive literature on the barriers to energy efficiency in organisations in order to identify what is known about barriers, and to inform the selection and development of an appropriate theoretical framework for this research. This review has examined the main barriers

to energy efficiency improvement that researchers have identified and the underlying assumptions that inform the identification of these barriers. Three key conclusions can be drawn from the review that have implications for this research:

1. **A focus on energy management practices can address limitations of existing research on barriers to energy efficiency.**

Researchers have identified a number of limitations of the focus on energy efficiency barriers (Shove et al. 1998; Sorrell 2004; Trianni & Cagno 2012). This body of research has enabled a comprehensive list of barriers to be developed (as presented in this literature review). However, for researchers, policymakers and practitioners, this presents a challenge. For example, it has been acknowledged that these barriers are defined in different ways and are difficult to compare (Sorrell, 2011). As Sorrell, Mallett & Nye (2011, p. vii) lament:

> "The concept of a barrier to energy efficiency is both confused and contested. Although the term is widely used, there is little consensus on how barriers should be understood, how important they are in different contexts, and how (if at all) they should be addressed."

Other limitations of the barriers approach include that barriers are not directly observable (Weber 1997) and where it is assumed that barriers are not interlinked, then there is a tendency for empirical research to adopt a reductionist perspective (Palm & Thollander 2010). This finding further reinforces the relevance of the focus in this research on effective energy management practices – an area that has received much less attention in the literature than the 'barriers' to energy efficiency reviewed in this chapter. A focus on successful practices can likely provide both theoretical and practical insights that may not be obtained through a focus on barriers.

2. **There is a need for research that examines the dynamics of change in an energy efficiency context.**

This chapter has further reinforced the need for research that examines the dynamic nature of change, both in terms of the readiness and capability of energy consuming organisations and the changing interests of external stakeholders in the energy performance of organisations. There is currently limited examination or appreciation evident within the existing energy efficiency literature of the dynamics associated

with changing energy management practices in organisations over time.

3. **There is a need for a more integrated model to examine changing energy management practices.**

Understanding of the energy efficiency gap and the actions that can be taken to resolve it are linked to the underlying assumptions that inform the research conducted (Biggart & Lutzenhiser 2007; Shove 1998). Whilst there are advantages to having a broad range of theoretical perspectives, this approach can present a piecemeal view of the phenomenon of the energy efficiency gap and the potential solutions that could be applied to address it. This review has highlighted the need for theoretical approaches that are able to provide a more holistic and integrated perspective on the energy efficiency gap and the energy management practices practitioners and policymakers adopt to address it. The early work that has been conducted in applying sociological theories at the interorganisational level shows significant promise in providing new and important insights into the reasons for and actions that can be taken to address the energy efficiency gap. An important contribution to the literature could be made by building on the early work at the interorganisational level, while also developing a theoretical model that supports a more holistic and integrated consideration of the energy efficiency gap and the energy management practices that can be applied within firms to accelerate energy efficiency improvement. Such a model should support comparison across multiple levels of analysis and account for the wider social context that influences energy management practices.

4.8 Summary and conclusions

To better understand the role that improved energy management practices can play in resolving the gap between actual and optimal energy use in businesses, this chapter has drawn on the existing literature which explains the barriers that limit the uptake of seemingly cost-effective energy efficiency projects. The aim of this chapter has been to inform the research design by reviewing the range of theoretical perspectives applied by researchers in seeking to understand the energy efficiency gap. The literature review has been structured into four categories to support examination of both the disciplinary perspectives and the typical levels of analysis adopted. This approach highlights the need for the development of integrated models to analyse

changing energy management practices. Such a model should be multidisciplinary and examine the process of change over time at multiple levels. Further, research that examines energy management practices as a process of change over time can provide a more dynamic and comprehensive perspective that will generate new knowledge to inform the actions that policymakers and practitioners take to accelerate the uptake of effective energy management practices. Chapter 5 draws on contemporary perspectives in institutional theory to develop the theoretical framework that will be applied in this thesis.