Energy cultures: A framework for understanding energy behaviours

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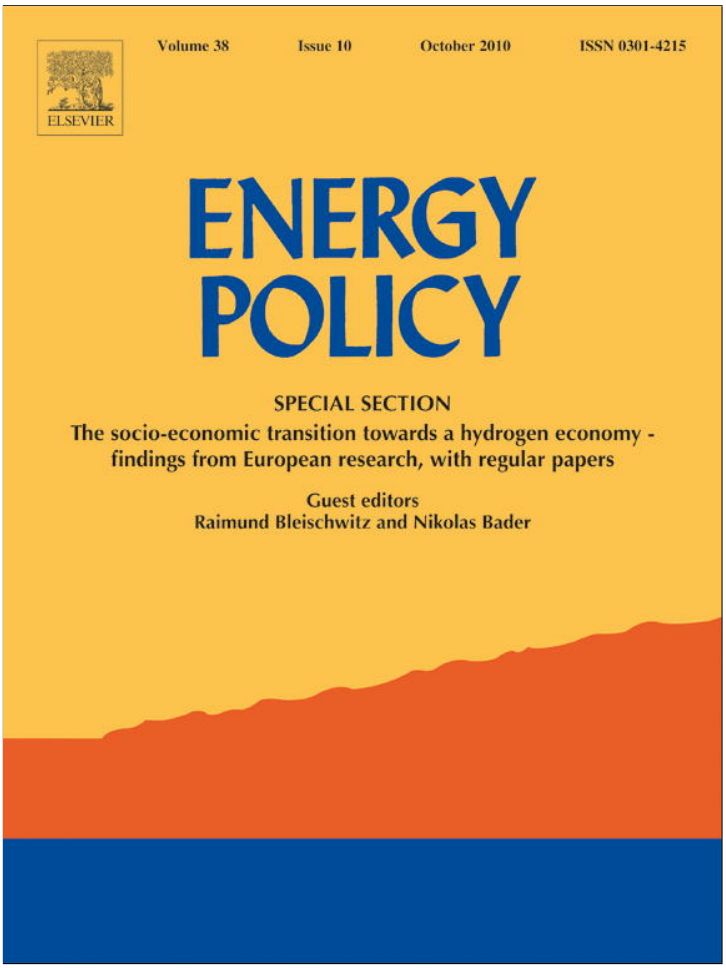

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Energy cultures: A framework for understanding energy behaviours

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ABSTRACT

Achieving a 'step-change' in energy efficiency behaviours will require enhanced knowledge of behavioural drivers, and translation of this knowledge into successful intervention programmes. The 'Energy Cultures' conceptual framework aims to assist in understanding the factors that influence energy consumption behaviour, and to help identify opportunities for behaviour change. Building on a history of attempts to offer multi-disciplinary integrating models of energy behaviour, we take a culture-based approach to behaviour, while drawing also from lifestyles and systems thinking. The framework provides a structure for addressing the problem of multiple interpretations of 'behaviour' by suggesting that it is influenced by the interactions between cognitive norms, energy practices and material culture.

The Energy Cultures framework is discussed in the context of a New Zealand case study, which demonstrates its development and application. It has already provided a basis for cross-disciplinary collaboration, and for multi-disciplinary research design, and has provided insights into behavioural change in a case study community. As the conceptual basis of a 3-year research project, the framework has further potential to identify clusters of 'energy cultures' – similar patterns of norms, practices and/or material culture – to enable the crafting of targeted actions to achieve behaviour change.

1. Introduction

In New Zealand, as is common elsewhere, inefficient practices in energy consumption have proved resistant to change and have made a mockery of government targets for increased consumer energy efficiency (EECA, 2006; Kern and Smith, 2008). Yet the need to use energy more efficiently is ever more pressing in the face of urgent calls to reduce greenhouse gas emissions (Stern, 2007) and to address current and anticipated constraints in energy resources (IEA, 2009). As noted by Stern (2007), "The technical potential for efficiency improvements to reduce emissions and costs is substantial" (p. xiii), having "the potential to be the biggest single source of emissions savings in the energy sector" by 2050, with "both environmental and economic benefits" (p. 219). The critical importance of improved energy efficiency – using less energy to achieve the same (or better) level of service (Wood and Newborough, 2007) – means that much of the investment required to mitigate future climate change will be made by energy consumers, rather than suppliers (IEA, 2009). The International Energy Agency has concluded that "a huge step-change in the attitudes to energy efficiency and consumer purchases by hundreds of millions of people worldwide is needed. Governments, through information provision, sound regulation and targeted fiscal incentives, have a key role to play in ensuring that, worldwide, the right decisions are taken to safeguard the future of the energy sector—and of the planet" (IEA, 2008: 501).

Thus improved consumer energy efficiency[1] is an attractive goal, but not, evidently, a straightforward and easily achievable one. For, despite ongoing attempts to encourage better energy efficiency, adoption rates globally lag far behind those that cost–benefit analyses would suggest reflect rational economic choices (McKinsey & Co., 2009). As Stern (2007) has observed, "It is difficult to explain low take up of energy efficiency as purely a rational response to investment under uncertainty"[2] and in this

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[1] For the purposes of this paper, we consider that efficiency is improved when the user achieves an equivalent or better service level, while using less energy. 'Energy' in this context could mean consumer energy, primary energy or fossil based energy.

[2] However, we do not concur that energy inefficient behaviour is necessarily "irrational", as Stern seems to imply. From the individual energy user's socio-cultural perspective, they are likely to consider their behaviour to be entirely rational.

context "systems and behavioural theories of decision-making" are particularly relevant (p. 378).

The purpose of this paper is to present a conceptual framework that utilises systems and behavioural theories, to assist in understanding the factors that influence the energy decisions of consumers, and their impact on the adoption of more efficient energy practices within society. The Energy Cultures framework is discussed in the context of a New Zealand case study, in which we demonstrate its development and application, and suggest its potential for further understanding and explaining behaviour.

2. The systemic context of behaviour

Since the oil shocks of the 1970s, there have been numerous studies of energy consumption behaviours from a wide range of disciplinary perspectives (reviewed by Lutzenhiser, 1993; Marechal, 2008; Wilson and Dowlatabadi, 2007). These perspectives include microeconomics (e.g. rational choice models, pricing, market structure); behavioural economics (e.g. bounded rationality, framing effects, decision heuristics); technology adoption models (e.g. diffusion theories, cognitive dissonance, theory of planned behaviour, self-efficacy, social communication); social and environmental psychology (e.g. the influences of information, pro-environmental attitudes, value-belief-norm characteristics, habits and external conditions); and sociological theories (e.g. social constructs, organisational behaviour, embeddedness, socio-technical systems and the energy decision-maker's cultural and social context). No single analytical approach provides a framework for analysing more than a small portion of behaviour, or for providing reliably successful interventions (Biggart and Lutzenhiser, 2007; Keirstead, 2006; Wilson and Dowlatabadi, 2007). Lutzenhiser, who has examined energy behaviour since the early 1990s, suggests that this failure is hardly surprising since, as he states, "we are trying to change a very complex system, with lots of moving parts. And it is not easily reduced to simple explanations (e.g. 'it's technology not people' or 'people are selfish') or simple policy approaches (e.g. 'just get the prices right' or 'it's just that financial incentives are needed')" (2008: 3).

Acknowledging these difficulties, Stern (2007) suggests that the barriers to 'rational' behaviour and motivation fall into three main groups: (i) financial and 'hidden' costs and benefits; (ii) multiple objectives, conflicting signals or information, and other market failures; and (iii) behavioural and motivational factors. However, Stern's analysis appears to overlook the importance of influences beyond the final consumer, which includes "producers, vendors, installers, regulators, financiers, a long-lived built environment and technology stock, and a range of ideas (right and wrong) and motivations (positive and obstructive)" (Lutzenhiser, 2008, p. 3).

Existing research into consumer behaviour that takes a systems perspective, incorporating a wide range of influences, has tended to focus on the concept of lifestyles. While the first use of the term 'style of life' is usually credited to the American psychologist Alfred Adler (1930), 'lifestyles' as a systems construct was introduced into the academic marketing literature in the 1960s (Lazer, 1963). In the 1970s, close links were made between lifestyles and values in the social psychology literature (SRI International, 1989). The values emphasis continued with further work in the 1990s that focused on particular domains such as food (Grunert et al., 1996) and travel (Lawson et al., 1999) but not on energy per se. The 1990s also saw a different approach to the idea of lifestyles developed by English sociologists such as Giddens (1991) and Chaney (1996), whereby lifestyles were seen as a modern form of social stratification that are 'constructed' by individuals as a mechanism for symbolic communication. This theoretical framework is used to explain how individuals select and use products and behaviours in order to portray themselves in social situations. Aspects of this approach are evident in the work of Shove (2003).

The concept of lifestyles is somewhat different and more restricted than the 'energy cultures' approach that we propose in this paper. The key difference is in the acknowledgement of the material world as a part of the structure that influences behaviours. Although products and services and other resources are considered as part of the profiles when describing lifestyle groups, these material elements are largely seen as the outcome of choices people make according to their values, needs and the social context. In contrast, we propose that material culture has a significant role in shaping outcomes—an approach that draws from Actor-Network Theory (ANT) (Latour, 1993; Law and Hassard, 1999) which suggests that the material world and its objects create a network of dynamic interactions which drive both stability and change. Latour coined the term 'actants' to express the idea that non-human 'actors' such as technologies play an important role in causation. Influenced by ANT, the concept of socio-technical system (STS) (Geels, 2004) or socio-technical regime (Smith, 2007) has emerged to describe the dynamics of the complex interplay between "artefacts, institutions and agents" and the "mutually reinforcing and entrenching cognitive, social, economic, institutional and technological processes that sustain existing trajectories of development" (Smith, 2007, p. 428). A key fundamental concept of STS, borne out in many studies, is that technologies themselves act to influence behaviours and expectations, so that "social practices and technological artefacts shape and are shaped by one another" (Smith and Stirling, 2007, p. 351). Development trajectories are also supported by the behavioural and cognitive norms of individuals, businesses, whole sectors, and governance institutions (Geels and Schot, 2007; Seyfang and Smith, 2007) which are conveyed and reinforced in patterns of language and communication (i.e., 'discourses') (Geels, 2004).

Much STS research is aimed at understanding how these "entrenched cognitive, social, economic, institutional and technological processes lock us into trajectories and lock out sustainable alternatives" (Seyfang and Smith, 2007, p. 588). STS helps explain why adoption of new technologies is not straightforward: it involves adjustments to many aspects of a self-reinforcing system, such as cognitive routines, design criteria, regulations and standards, markets, sunk investments and competencies (Geels and Schot, 2007; Smith and Stirling, 2007).

Insights can be drawn from an STS literature to understand the macro-picture of social-technological dynamics. However, we do not adopt its core theoretical position which is to de-centre causality, eliminating the role of individual decision-making. Our particular interest here is to characterise the behaviour of individuals and groups *in light of* these wider dynamics, rather than attempting to model the system as a melange of co-produced outcomes. Our aim in developing the Energy Cultures framework is to centre on the behaviour of individuals within the system, and to explore outwards from that point the aspects of the system that most strongly influence behaviour, and from there consider what interventions might be successful in achieving behaviour change.

3. Previous integrating models

Given the many influences on domestic energy consumption, it is hardly surprising that a number of integrating models have been developed previously. Generally these seek to identify the drivers of behaviour, and show relationships between these drivers. A relatively early example is Dholakia et al.'s

'macro-micro model of energy consumption behaviour' which was motivated by their interest in the relative unresponsiveness of individual behaviour to price signals and conservation campaigns (Dholakia et al., 1983). In their model, macro choices (socio-political processes) delimit and define the scope of micro (individual) choices. Van Raaij and Verhallen (1983) structure their 'behaviour model of residential energy use' by differentiating between influences on energy use and influences on energy-related behaviour, and focus on the interrelationships between these. Keirstead (2006) uses Actor-Network theory as a basis for his agent-based integrated framework for domestic energy consumption, and models the interactions between agents including government policies and standards, housing stock, market structure and households. Other models deal with consumption behaviour more broadly. Wilk (2002), for example, offers a 'multigenic' model where consumption is seen as a product of the dynamics between factors that individually impel or constrain consumption—these forces potentially being as varied as gender relations within a family to property development regulations. Barr and Gilg (2007) focus on attitudes towards environmental behaviour, particularly the gap between intention and behaviour, and propose a multi-factorial model of interactions between values, situational variables and psychological variables.

Inter-disciplinary studies are likely to offer enhanced insights into energy behaviours (DEFRA, 2008), and some models are designed to provide an integrated approach that takes advantage of contributions across different disciplines. Hitchcock (1993), for example, uses a systems-based framework to depict the 'human subsystem' and 'physical subsystem' of a household, each of which is generally studied from a social sciences and engineering sciences perspective, respectively. He notes that energy use is driven by behaviour but is also determined by a house's physical characteristics, and an integrated view is required. Wilson and Dowlatabadi (2007) review different models of behavioural drivers in residential energy use, and contrast the research traditions that centre on the individual as a decision-maker with those that focus on social and technological influences. They identify an "unexplored potential to reconcile the theoretical preferences of different research traditions" and consider that the "most significant challenge is to combine the economic and sociological bases for behaviour" (p. 194). Lutzenhiser's 'cultural model' of energy consumption (Lutzenhiser, 1992), which will be discussed in some detail later, is also driven by an attempt to integrate different disciplinary approaches.

Despite the value and existence of cross-disciplinary models, it appears they are little used, and in practice single-discipline studies dominate the literature (Keirstead, 2006). Keirstead concludes that such models have "failed to spark a significant debate within the literature as to how such an integrated approach might be structured or implemented" (p. 3075). Wilson and Dowlatabadi (2007) conclude that seeking an integrated approach "may be a quixotic simplification, idealized and with merit perhaps, but quite mad given its scant chance of success" (p. 191). Nevertheless, they remain committed to the idea of achieving an integrated approach, and suggest that a successful integrating model should have applicability to decision-making and behavioural research, as well as assisting to identify interventions. They conclude, from their analysis of current disciplinary approaches, that a successful integrating model would need to be relevant across three characteristics of energy behaviour—context, scale, and heterogeneity.

By *context*, Wilson and Dowlatabadi mean the wide range of conditions external to the individual that are significant determinants of behaviour, such as "regulations, economics, social norms, available technologies, and supply chains" (p. 192). Each of the many discipline-based approaches to understanding context addresses different aspects, in different ways or with greater or lesser emphasis. Different research traditions also work at different spatial and temporal *scales*, ranging from studies of the individual to societal level studies, and identifying short term through to long term (systemic) intervention strategies. Thirdly, they suggest there is a need to account for the wide variability that exists, even amongst households with similar demographics, housing stock and technologies in energy use behaviours and responses to interventions. Aggregate analyses mask the *heterogeneity* that exists within energy users, and can thus lead to the design of interventions that fail to be broadly effective. Thus, to be successful, an integrating framework should be functional for each of Wilson and Dowlatabadi's three characteristics.

4. Background to the framework

In developing the Energy Cultures framework, we were inspired in the first instance by an example of seemingly counter-intuitive behaviour—the dogged adherence of NZ timber businesses to existing drying technologies in the face of new more cost-efficient and energy-efficient systems that also promised enhanced product value (Van der Pal et al., 2005). This behaviour, which looked to exceed normal commercial risk aversion, was particularly striking because of the business context and its persistence. It would be expected that companies driven by commercial imperatives would behave in more economically rational ways than individual consumers or households. Musing on the problem together, from a variety of disciplinary viewpoints (engineering, consumer psychology, sociology, economics), we were struck by the apparently ingrained nature of firms' unwillingness to consider changes to their behaviours (Gourville, 2006). To learn more, we ranged out, individually and collectively, to review literature on energy-related behaviour more generally—a challenging task, as it is scattered across a wide array of disciplinary and topic-based journals.

Over the past two years, during which we have carried out pilot studies within the timber industry and in two residential communities, we evolved the concept of 'energy culture' as an integrating framework, which now forms the core of a 3-year inter-disciplinary research project. We have found this framework useful for identifying many of the potential influences on behaviour, designing research methodologies, and identifying potential interventions. It also 'made sense' to each of us from our different disciplinary perspectives, and created a kind of inter-disciplinary language that helped us understand other's positions without the confusion of discipline-specific terminology. The Energy Cultures framework[3] originates in a part seeking to understand what is meant by 'behaviour' in the context of energy consumption. Reading across a range of disciplines, it seems that 'behaviour' is sometimes characterised primarily in terms of the energy technologies acquired or adopted by the consumer (e.g. is the house well-insulated? does it have a heat pump?); sometimes in terms of the consumer's use of energy-related technologies (do they drive or walk to work? do they use a dishwasher?); sometimes in terms of the consumer's aspirations (e.g. cleanliness, a healthier environment), and also as various interrelationships between these factors (Shove, 2003; Keirstead, 2006; Wilson and Dowlatabadi, 2007). While the fuzziness of the term could be considered to be problematic, from our inter-disciplinary perspective the ability to consider all three characterisations of

[3] We use 'framework' rather than 'model' because it is pitched at an interdisciplinary level, whereas the usual application of 'model' is as a way of structuring intellectual process within a particular discipline.

behaviour – technologies, activities and aspirations – as interrelating aspects proved to be a key to the energy cultures concept.

We also wanted to be able to take into account the very broad range of factors that have been identified as affecting or driving behaviour, including the values, beliefs and knowledge of the consumer, the wider social and cultural values that impact on the consumer, the availability of technologies, the pricing and market conditions, the regulatory and policy environment, incentives and disincentives, and the many other influences. This contextual soup – the dynamic and complex 'system' referred to by Lutzenhiser (2008) and in the STS literature referred to above – is highly influential on consumers; and of particular interest to us is that different parts of this system might impact differently on each of the three aspects of 'behaviour' identified above. It also seemed to us that the problem of adopting more energy-efficient behaviours is not limited to individuals. It can equally be seen to be a problem at broader scales—in how families, or institutions, or firms, or entire economic sectors behave at a local, national, or even an international level. Any model relating to behaviour should be able to work at all of these scales.

Our interest in energy behaviour lay ultimately in our desire to identify the 'levers' for change towards more energy-efficient behaviours. Both the literature (Wilk, 2002; Marechal, 2008) and our own observations indicate that habit has a large part to play in the continuation of energy-inefficient behaviours. We therefore felt that habit should be a core concept in the model.

Finally, it was clear from the literature (Wilson and Dowlatabadi, 2007) and from our own observations that there is surprising variability in energy-related behaviour, even across households or firms with apparently similar characteristics. We suspect that the lack of success with interventions might be related, in part, to their being designed to influence an imaginary typical consumer, rather than selected as 'best fit' for definable behavioural clusters. We wished to find some way to describe and characterise this heterogeneity, so as to be in a better position to match interventions to the situation.

5. Conceptual underpinnings of the framework

The framework itself is conceptually founded in the concept of 'culture', in the sense of a relatively distinctive and integrated system of knowledge, belief and behaviour that both creates and is reinforced by its material objects. We use the term 'culture' as a usefully broad concept that brings to the fore the dynamic that we feel is missing from an STS literature—the role of the individual or group and their socio-culturally influenced behaviours in both resisting change and causing change. While 'culture' is usually applied to describe the defining characteristics of ethnic groups (Māori culture, Aboriginal culture), social groups (youth culture, middle class culture), spatially defined groups (British, American or European culture) or even the way a business, family or community or recreation group operates, for our purposes, we are not using the term to refer to any particular pre-defined culture group. Instead we use the term 'culture' to signal our hypothesis that distinctive clusters of knowledge, belief, behaviour and material objects (as held by individuals and groups) will have some bearing on the way energy is used, along with the more decentred influences that are the focus of much STS literature. The term 'energy cultures' brings this dynamic to the fore.

Our approach is also strongly influenced by 'soft systems' thinking—ways of understanding a particular context in a holistic way through considering interactivities between its attributes. We use 'system' not in the sense of a real-world entity, but as a construct to aid an understanding (Checkland, 2000; Midgley, 2003, 2007). Systems thinking attempts to address the shortcomings of reductionist approaches, recognising the complexity of the real world. Particular influences on the model from systems thinking have been the importance of multi-methodology in understanding these complexities (Mingers and Brocklesby, 1997) and the usefulness of a systems approach in identifying intervention opportunities to achieve change (Flood and Jackson, 1991).

The concept of energy cultures also draws from Bourdieu, who theorises that the practices that make up a social life are largely generated and regulated by 'habitus' – persistent patterns of thought, perceptions and action – which themselves are a response to the objective conditions within which the individual exists (Bourdieu, 1992). (Wilk (2002) also uses Bourdieu's theory of practice as a foundation for his 'multigenic' model of consumption.) Habitus is acquired through the social and physical milieu of an individual, is self-generative and constrains an individual's aspirations so that practices that lie outside their habitus may be excluded from consideration as unthinkable. This is not to say that we believe cultures are fixed and immutable (nor does Bourdieu, who discusses the possibilities of strategic action to alter habitus). On the contrary, as is evident everywhere in society, cultural groups change their characteristics and membership, cultural traits are mutable, and they can be rapidly adopted by new groups in conducive conditions. For our purposes, it is *how* culture groups shift from the self-replicating stasis of habitus into the adoption of new practices, new beliefs and aspirations, and new technologies, that are the core of our interest.

Within the energy literature, the concept of culture has generally been more implied than overt. The key exception is in the work of Lutzenhiser. In *A Cultural Model of Household Energy Consumption*, 1992, he suggests that an energy consumption is embedded in cultural processes. Material culture (buildings, furnishings, technologies, etc.) interweaves with "roles, relationships, conventional understandings, rules and beliefs into the cultural practices of groups" (p. 54). An individual's behaviour, he argues, is heavily influenced by his or her culture group "as the entity primarily responsible for deploying technologies, practices and meanings in what can be called 'styles' of life".[4] In many ways, our 'energy cultures' framework replicates and builds on Lutzenhiser's insights, and we are surprised that there has not been a greater uptake of his model, particularly in the design of research methodologies. While his model has been cited some 15 times (not counting reviews or self-citations) most of these occur in the 1990s and none appear to have used the model in the way that Lutzenhiser intended—hat is, by first obtaining empirical data to describe and differentiate culture groups, then developing explanations of behavioural patterns, and then using this to predict the likely success of energy-efficiency interventions. A possible explanation is that Lutzenhiser's 'model' is more a description of an idea than a theoretical model, in the sense of providing a core pared-down set of interrelated ideas that capture the essential characteristics of a phenomenon (Gudeman and Penn, 1982). We hope that our refinements and extensions to these core ideas will prove fruitful and thereby encourage its wider adoption.

6. The energy cultures framework

The Energy Cultures framework suggests that consumer energy behaviour can be understood at its most fundamental level by examining the interactions between cognitive norms

[4] Authors following this line of thought within lifestyles and consumption literature include Shove, 2009, Palm, 2009, Aune, 2007 and Wilhite and Lutzenhiser, 1999

(e.g. beliefs, understandings), material culture (e.g. technologies, building form) and energy practices (e.g. activities, processes).

As indicated in Fig. 1, these components of behaviour are highly interactive. Cognitive norms strongly influence people's choice of technologies and the practices that they undertake. Material culture itself has a strong effect on cognitive norms and on the range of people's potential energy practices. Energy practices determine how technologies are used, and also partly shape people's beliefs and understandings.

As an example, behaviour relating to home heating can be characterised in part by the values, aspirations, beliefs and understandings of the consumer; in part by the construction of the house, the presence of insulation, types of heating devices and fuel types; and in part by such things as how many rooms are heated, heat control settings, times that heating is used, and maintenance of technologies (see Fig. 2) (note only a few characteristics have been portrayed here for the sake of simplicity). The interactions between these factors might include whether people have sufficient understanding to maintain their heating equipment; how their aspirations affect their choice of heating method; and how the presence (or an absence) of an insulation affect heat control settings. One example of how interaction between these elements tends to achieve consistency and reinforce each other is the relationship that occurs between pricing and consumption of electricity in New Zealand households. Most New Zealanders have a choice between paying either a higher fixed daily charge with a smaller variable cost or a smaller daily charge and a higher charge per kilowatt hour. The first arrangement is designed for households with higher power consumption and the second for those with lower levels of demand. Selection of the appropriate scheme is based on existing practices and technologies, but once this aspect of material culture is set, it serves to reinforce established behaviour. The high-consuming user has little immediate financial incentive to reduce consumption and may not be inclined to switch plans because of the perceived risk associated with the low fixed cost alternative. The energy cultures framework should provide energy supply companies with a clearer picture of clusters of actual behaviours, recognising the interaction of norms, material culture and practices. That will allow companies to tailor their tariff schemes better to accommodate and to shape the energy use patterns of different sets of customers.

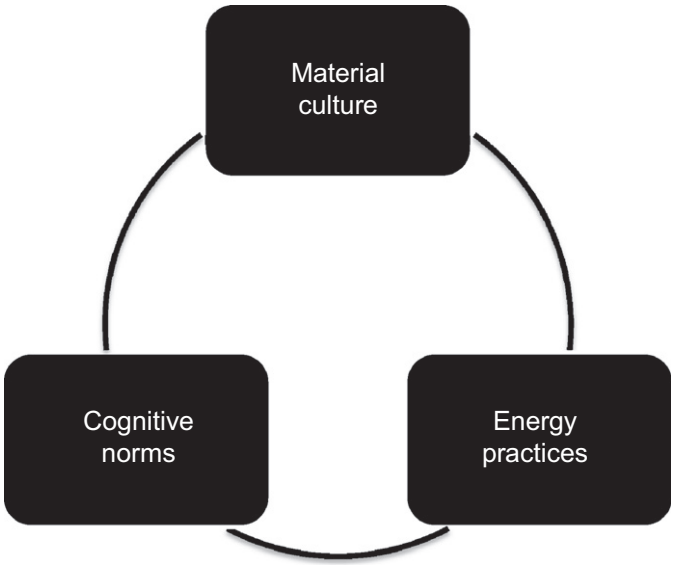

Fig. 1. The core concept of the Energy Cultures framework: the interactivity between cognitive norms, material culture and energy practices.

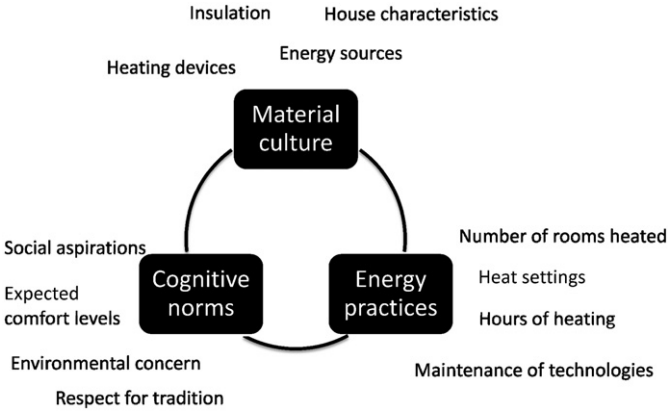

Fig. 2. Using the Energy Cultures framework to characterise some home heating behaviours.

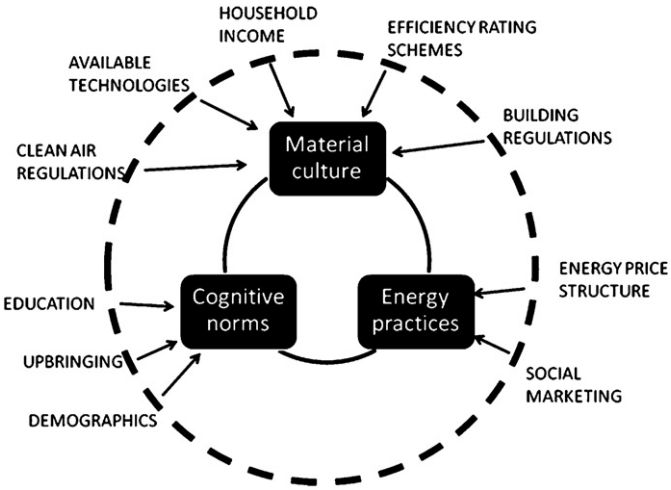

Fig. 3. Using the Energy Cultures framework to depict some of the wider systemic influences on behaviour. The diagram reflects that these wider influences are not exogenous to the energy culture, but exert influence and are in turn influenced by it—for example, law and policy are affected by values, aspirations, beliefs and understandings, and in turn affect them.

Each of these three core concepts can itself be understood as an interacting system. The *material culture* of a household or an industry can be understood as a technical system in its own right; *energy practices* can be systemically understood the interactions between individual, social and institutional behaviours and *cognitive norms* can be understood as an attitude/value/belief system. As a whole, these are co-constitutive of behavioural outcomes.

The three concepts and their interactions form the core of the Energy Cultures framework, but there are also wider systemic influences on behaviour—the 'contextual soup' referred to earlier. Each aspect of material culture, energy practice or cognitive norm is impacted in some way by these wider influences—for example, cognitive norms around home heating will be affected by such things as upbringing, demographics and education; choice of home heating technologies may be impacted by such things as income level, availability of technologies, law and regulations and efficiency rating schemes; and heating control settings (if any) may be impacted by such things as the energy price structure and social marketing campaigns. These influences form an 'outer ring' of the interacting system, as in Fig. 3.

7. Potential applications of the energy cultures framework

The energy cultures framework, therefore, characterises energy consumption behaviour as the interactions between cognitive norms, material culture and energy practices. We hypothesise that clusters of similarly interacting norms, material cultures and/or practices will be observable in a given population, enabling segmentation of the population in terms of reasonably distinctive 'energy cultures'. Characterising these different 'cultures' will assist in both understanding the range and nature of consumer behaviour, and in identifying what sorts of interventions may be effective in achieving a move towards greater energy efficiencies for any given 'culture', while meeting the needs and aspirations of an individual consumer.

Furthermore, we suggest that distinctive 'energy cultures' can be identified at different scales and in different sectors—for example, at the level of individual households or businesses, within neighbourhoods or industries, between regions and even between nations. For example, New Zealand is renowned for its cold houses (not simply because of the poorly insulated housing stock, but because of an acceptance of lower indoor temperatures as being normal (Lloyd, 2006; Lloyd et al., 2007; Shannon et al., 2003), while Americans and Europeans typically heat their homes to higher temperatures. In our view, this represents a difference in 'energy cultures'.

The energy cultures framework may also assist in understanding entrenched behaviours. We hypothesise that stabilisation of behaviour occurs, where norms, practices and technologies are aligned—that is, where the dynamics between the three components are self-reinforcing. Potential for behaviour change arises when one of these components becomes misaligned or shifts—for example, a change in belief as to the importance of energy efficiency; or the acquisition of a more efficient heating device, or an external shock such as a rapid rise in the price of electricity. In some instances, a change to more energy-efficient behaviours may be held back because of a limitation in one or more of these components—for example, a household may be strongly motivated, but may lack the financial capacity to insulate their house. In our opinion, it is important to consider all three components in seeking to understand both the nature of behaviour and the key barriers to change. Some of these aspects will be touched on in our case study below.

For our purposes, one of the most interesting possibilities offered by the framework is as a conceptual structure for the design of research methodologies. We have embarked on a 3-year multi-disciplinary study of household heating behaviours, and have used the framework as the basis for the research design. As indicated in Fig. 4, material culture will be identified through householder questionnaires and physical surveys of houses. Energy practices will be explored through householder questionnaires and also through the use of smart electricity meters (which measure electricity usage at half-hourly intervals). The questionnaires will probe into some aspects of cultural norms, but in-depth interviews will also be used to inquire more deeply into underlying values. Choice modelling will examine the interactivity of cognitive norms with both material culture and energy practices. Desktop studies will identify some aspects of the wider legal and policy context affecting behaviour. Law and policy instruments have a direct effect (forbidding one thing, demanding another) or they can have indirect effects, such as by affecting price signals or the availability of information. In turn, law and policy emerge from changing cultural norms. The interactions between norms, material culture and practices will be explored with community focus groups using soft systems methodologies, and these groups will also assist in identifying systemic barriers to changing behaviour. The framework has thus enabled us to determine how different disciplines and their methodologies may contribute to a holistic understanding of household heating behaviours.

A further potential of the framework is as an integrating tool. In our research, we intend to use the framework as the basis for staging the streams of the multi-method research project so that one informs the other—for example, findings from values research (cognitive norms) is then used to design the choice

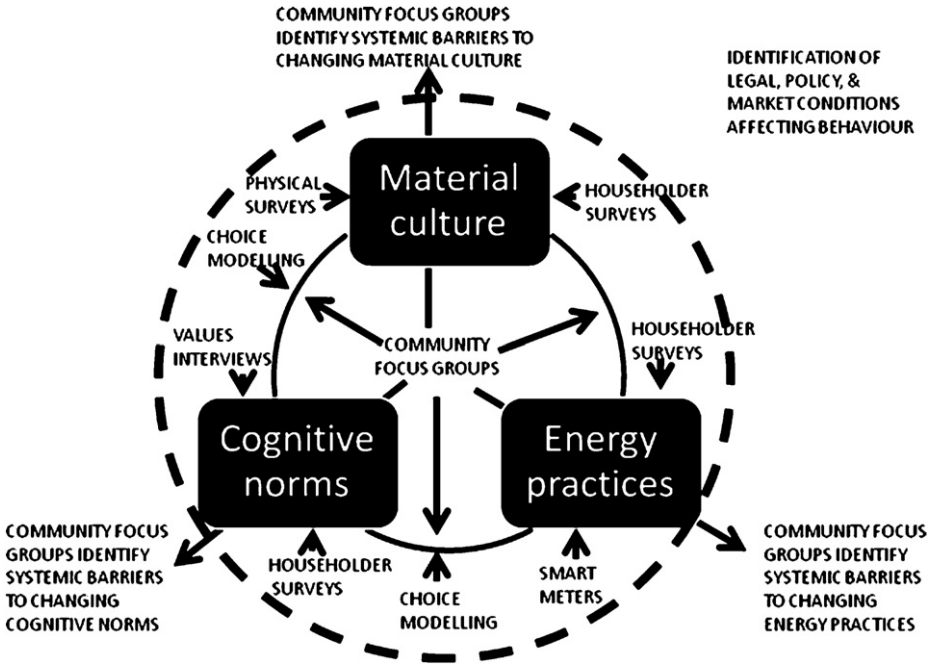

Fig. 4. Using the Energy Cultures framework as the basis for designing multi-method research project to investigate household heating behaviours and barriers to behaviour change.

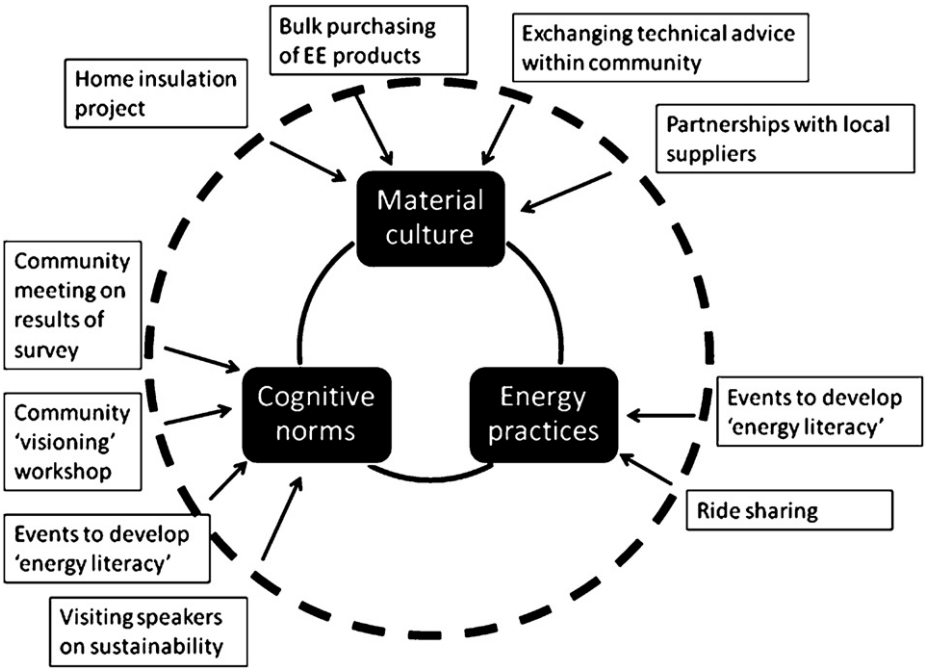

Fig. 5. Using the Energy Cultures framework to illustrate some of the external influences which enabled behaviour change in Waitati. Changes in any aspect of material culture, cognitive norms or energy practices may directly or indirectly influence other aspects.

modelling. By using common case studies (where relevant) for all of the research, data from different research streams can be contrasted across households or groups of households, building up a rich picture of household behaviours. This compiled data will be used for the identification of 'energy cultures'—that is, distinctive clusters of households that share certain characteristic sets of norms, practices and/or material cultures Fig. 5.

Findings can be used to identify opportunities to modify the influences on behaviour to achieve greater efficiencies, and designing these around the different characteristics of different energy culture groups. Opportunities may arise where, for example, an energy culture group's cognitive norms are aligned with greater efficiency, but they are held back though lack of supporting material culture; or alternatively where they have energy-efficient material culture, but inefficient practices. By targeting the misaligned component through culture-specific interventions, we anticipate that their 'energy culture' may be successfully shifted. Behaviour change may also be held back by other aspects of the wider socio-technical system, which may impact differently on different energy cultures. This might include improving the way law, policy and regulation affect energy behaviour, or the way the market operates, or the information or feedback mechanisms on which households base their decisions. By identifying the parts of the system that are creating the lag (for example, pricing mechanisms, lack of information, regulatory barriers), smart and effective intervention strategies should be able to be targeted to specific energy culture groups.

As a research team, we are also aware that we are part of the socio-technical system. As we have already observed through our prior research activity in Waitati (discussed below), the process of inquiry is itself a form of influence on behaviour. By asking questions, we cause our participants to reflect on their own behaviour, and thus potentially change it. By recognising that we cannot carry out our research as external observers to the system, but rather are integral to and active within the system, we hope to more faithfully represent the range of influences at play in the lives of our participants.

8. Illustrating the energy cultures framework

As an example of one of the many ways the framework can be applied, we discuss a Transition Town through the lens of Energy Cultures. The Transition Town movement is a 'vibrant international grassroots movement that brings people together to explore how we – as communities – can respond to the environmental, economic and social challenges arising from climate change…' (Transition Towns New Zealand Aotearoa, n.d.(a)). They are thus a great place to learn about the process of behaviour change towards greater energy efficiency and more use of renewable energy.

Waitati is a small settlement in the South Island of New Zealand, comprising approximately 200 households, located about 20 km north of the city of Dunedin. It lies at about 46° south of the equator in one of the cooler parts of New Zealand. There are few jobs in the Waitati community, apart from at the primary school and in small enterprises such as a garden centre and an art gallery, so most of the working residents travel to Dunedin for employment. The community has long been active socially, running its own film society and neighbourhood support, but over the past three years community members have increasingly pursued a range of sustainability initiatives. In 2007, Waitati realised its activities were closely aligned with the 'Transition Town' movement. Renewable energy and energy efficiency are considered to be an integral to the response needed to address climate change challenges, and collective local action is required to alter the ways of life.

Possibly, the most prominent and far-reaching 'transition' activity that community members are engaged in is known as the Waitati Energy Project (WEP). This is a multifaceted set of proposals to move the community to more sustainable patterns of energy consumption and supply. Their vision is "to facilitate a positive, healthy, secure and resilient future for Waitati, Blueskin Bay and linked communities and promote sustainable resource use". In striving for this they describe themselves as "engaged in an active transition to a lower energy future and seek to lower our

carbon footprint while developing an energy resilient system'' (Transition Towns New Zealand Aotearoa, n.d. (b)).

The Waitati Energy Project had its beginnings when a small group of enthusiasts invited a prominent Green politician to speak to the community on sustainability issues. Building on interest aroused by this meeting, they organised over the next year a series of well-attended events to help develop 'energy literacy' in the community, including a day-long fair with speakers, stalls and hands-on activities like a cycle-powered television.

In terms of the Energy Cultures framework, these activities helped shift the cognitive norms of the community towards an improved awareness of global and local imperatives for greater energy efficiency and more renewable energy supplies, a better self-awareness of the community's own characteristics, and improved energy literacy. This shift paved the way for changes in practices and material culture. A community-wide survey conducted by members of the research team also identified the material culture and energy practices of households, providing a baseline against which future changes can be assessed.

To date, the most significant change in material culture has been the securing of government subsidies for a home insulation project in 2009. Most of Waitati's homes are poorly insulated because they were built before mandatory insulation standards were introduced in the 1970s, so there are ready opportunities for improvements energy efficiency. The WEP organisers facilitated the 'retrofit rollout' not only for Waitati itself, but also for some neighbouring villages and a northern suburb of Dunedin. As a result, 53 of the 200 houses in Waitati received insulation upgrades. WEP's success in gaining the funding, and the significant level of uptake, would have been unlikely if the community had not been cognitively 'primed'. The high level of community engagement enabled the WEP to show that there was widespread support for improving energy efficiency, so their application for funding was taken seriously by the government agency involved, and also ensured a very high level of uptake of the offer of subsidised insulation retrofits. Other changes in material culture have been enabled through genuinely cooperative activities such as the exchange of technical advice, the organisation of bulk purchasing to secure discounts and the establishment of partnerships with local suppliers and builders.

On the energy supply side, the Waitati Energy Project proposes to build a community owned wind turbine to provide a power for the district and feed surplus electricity into the distribution grid. While community owned turbines are not uncommon in other countries, this would be a first in New Zealand. It represents a significant change in thinking at the local community level, but it also requires changes to the cultural infrastructure and practice at a national level. Current industry norms are not supportive of locally distributed generation, and the legal and financial structures for ownership and operation of such a venture are untested. Based on the Energy Cultures framework, we suggest that progress in this area will require harmonisation of community members' cognitive norms and practices, prior to being able to achieve a shift in material culture and an overall transition to a new energy system 'habitus'. Steps have been taken to develop the turbine project with a community planning exercise, the identification of sites, initial evaluation of the generation potential, discussions with the lines company and a turbine manufacturer, and gaining Government funding to develop a financial model and business plan take this proposal to the next stage. The fact that the community is prepared to take on such a challenging proposal represents a significant shift in the 'energy culture' of individuals and of the community as a whole.

Organisationally, the Waitati Energy Project is concerned mainly with the demand and supply of household electricity, but the community has separate initiatives relating to transport which are a good illustration of the 'practices' component of the Energy Cultures framework. As explained earlier, many of the residents face a daily commute of about 20 km to Dunedin. While the City Council runs a local bus service, it is infrequent (three services daily) and there is a heavy dependence on private motor vehicles. The WEP behavioural response to this has been to develop their own Rideshare Scheme to coordinate travel into the city, reduce personal costs, and reduce an energy usage. While the Rideshare Scheme has been operating since mid-2008, the organisers admit to some disappointment with the take-up rate, indicating that the cognitive norms and practices elements of the cultural framework are presently not well aligned. Our household survey and other interactions with the community tell us that the residents of Waitati do not need information, or any sort of promotion and publicity to persuade them that the Rideshare option is a good idea, but need instead to shift their transport practices, for which it is likely that some different form of intervention is necessary. Clearly, both the material culture (public transport) and practices (Rideshare behaviours) lag behind cognitive norms in this case.

These are all simple examples that illustrate the ways, in which energy behaviours are influenced by the interactions between cognitive norms, material culture and energy practices, and that these interacting components can be examined at both a personal and community/social level. We consider that visualising, and analysing, the system as an interconnecting set of attributes helps to reveal the need, the options and the staging for change strategies. Understanding how Waitati has achieved a significant shift in the direction of household energy efficiency can offer clues as to how change might be initiated in other contexts.

9. Conclusion

There is no doubt that energy-related behaviour is hugely complex, shaped by many factors, some of which are intrinsic to the person and their situation, and others that are more removed but nonetheless influential. The Energy Cultures framework builds on a history of attempts to offer models to help in understanding these influences in an integrated way.

Among the points of difference from previous models are, firstly, that it takes a culture-based approach to behaviour, while drawing also from lifestyles, systems and an STS thinking. In this way, it attempts to bridge the divide identified by Wilson and Dowlatabadi (2007) between research traditions centred on the individual (economics, behavioural, technology diffusion) and those centred on wider social and technological constructs. Secondly, the framework provides a structure for addressing the problem of multiple interpretations of 'behaviour' by suggesting that it is influenced by the interactions between cognitive norms, energy practices and material culture. By not prescribing how these factors should be characterised or measured, it is open to the contributions of many different disciplines. Thirdly, the framework is change-oriented rather than deterministic—that is, we propose that wider social, environmental and economic forces *structure* but do not *determine* people's cognitive norms, practices and material cultures. Fourthly, the framework is designed to identify clusters of 'energy cultures' – similar patterns of norms, practices and/or material culture – as a tool for understanding the potentials and possibilities for sites of action to achieve behaviour change, whether these are at a general policy level, or targeted at a specific group or a household characteristic.

As a systems construct, the Energy Cultures framework is highly adaptive, displaying Wilson and Dowlatabadi's three requirements for a successful integrating model (2007). It

accounts for the *context*—the wide range of drivers of behaviour, through its modelling of the interactivities between the three core components of behaviour, and between these and wider societal and structural influences. It works at different *scales*, being applicable to understanding a single household, or a community (such as Waitati), or an industrial sector, or conceivably at a national level (as in potentially considering the difference in 'energy cultures' between one nation and another). And it is particularly designed to characterise *heterogeneity* – the wide variability in behaviours – through the identification of different energy cultures.

While it is fundamentally a conceptual framework to help articulate a particular class of problems, relating to why individuals and groups use energy in the way they do, we believe it also has a number of potential applications, some of which we are only beginning to explore. At an applied level, the Energy Cultures framework has already provided a basis for cross-disciplinary collaboration, and for multi-disciplinary research design. It enables identification of the relative roles of different disciplines in contributing to exploring the research problem, and the linkages between findings, and thus facilitates cross-disciplinary interactions. We intend to use it as a common point of reference and a tool for integration of research findings from our multi-stream research project.

Achieving the 'step-change' in energy efficiency behaviours called for by the IEA (2008, 2009) will require enhanced knowledge of behavioural drivers, and translation of this knowledge into successful intervention programmes. Three decades' experience in a number of countries reinforces that energy efficiency programmes can have an influence on behaviour, but that they must be carefully designed (Geller and Attali, 2005). The Energy Cultures framework has been developed in part to assist in policy development, regulation and market design to achieve greater energy efficiency through improved understanding of the interactions between context and behaviour. In particular, by identifying clusters of people or households with similar behavioural patterns, it can assist in the crafting of more effective interventions and incentives targeted to specific energy cultures. We also note its potential to help energy supply companies understand different behavioural clusters among their customers, so as to better tailor their tariff schemes and products. However, only further application of the approach will show whether it has real utility in helping to understand energy behaviours in a holistic way, and in guiding the development of projects and programmes to achieve greater adoption of energy-efficient behaviours.

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