

## Energy Cultures - a framework for interdisciplinary research

Janet Stephenson<sup>1,\*</sup>, Rob Lawson<sup>2</sup>, Gerry Carrington<sup>3</sup>, Barry Barton<sup>4</sup>, Paul Thorsnes<sup>5</sup>

<sup>1</sup>Centre for the Study of Agriculture, Food and Environment, University of Otago, Dunedin, New Zealand

<sup>2</sup>Marketing Department, University of Otago, Dunedin, New Zealand

<sup>3</sup>Physics Department, University of Otago, Dunedin, New Zealand

<sup>4</sup>School of Law, University of Waikato, Hamilton, New Zealand

<sup>5</sup>Economics Department, University of Otago, Dunedin, New Zealand

\* Corresponding author. Tel: +64 3 479 8779, Fax: +64 3 479 5266, E-mail:janet.stephenson@otago.ac.nz

---

**Abstract:** The Energy Cultures 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 cultural theories, actor-network theory, socio-technical systems, and lifestyles literature. 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 conceptualising the research arena, the framework creates a common point of reference for the multi-disciplinary research team. The Energy Cultures framework has proven to be unexpectedly fruitful. It has assisted in the design of the 3-year research programme, which includes a number of different qualitative and quantitative methodologies. In application to a given example, it helps to position the complex drivers of behaviour change. Although the framework has not yet been fully tested as to its ability to help integrate findings from our various research methods, we believe the Energy Cultures framework has promise in furthering interdisciplinary studies of energy behaviours in a wide variety of situations, being relevant to different contexts and different scales.

**Keywords:** Household energy behaviour, Theoretical framework, Multi-disciplinary, Research design

---

### 1. Introduction

There is huge potential for greater efficiencies in consumer energy behaviour, but achieving the necessary behaviour changes is proving exceedingly difficult. The International Energy Agency (IEA) advises that energy efficiency improvements across the end-use sector have the potential to achieve 52% of the CO<sub>2</sub> emissions reduction required by 2030 to contain atmospheric CO<sub>2</sub> concentrations at 450 ppm. This is more than the combined contributions of renewable energy systems, biofuels and carbon-capture-and-sequestration. The IEA calls this transition the 'energy environmental revolution', and notes that many nations face challenges in achieving behavior change in the demand-side area [1]. It is well accepted that interdisciplinary studies are likely to offer enhanced insights into the vexed question of energy behaviours [2], but interdisciplinary research itself can be highly challenging especially in the absence of common conceptual agreements.

Our 3-year research programme, 'Energy Cultures' [3], is attempting to achieve an integrated understanding of household energy behaviours, and to identify promising opportunities for behavior-change interventions, by bringing together an interdisciplinary team. The core members are five university-based researchers with backgrounds in consumer psychology, economics, sociology, law and engineering. We share an interest in the behaviour of energy consumers, but approach the concept of behaviour through very different disciplinary lenses. In order to bring some coherence to our interactions and to the research programme as a whole, we developed a theoretical model - the 'Energy Cultures framework'. Here we describe the framework, and how, while it was initially developed to depict the nature of the problem, it has proven to be unexpectedly fruitful in supporting collaboration, designing the research programme, and characterising the complexity of household behaviour.

## 2. Designing the Framework

Since the 1970s there have been numerous studies of energy consumption behaviours from a wide range of disciplinary perspectives, including microeconomics; behavioural economics; technology adoption models; social and environmental psychology; and sociological theories. No single analytical approach provides a framework for analysing more than a small portion of behaviour, or for providing reliably successful interventions [4-6].

There is clearly value in developing a framework to support more integration across disciplines, but despite a number of attempts to establish unifying models [5-12] they are little used, and in practice single-discipline studies dominate the literature [5]. Wilson and Dowlatabadi [6] suggest that a successful integrating model would need to be relevant across three characteristics of energy behaviour—context, scale, and heterogeneity. In other words the model would need to be applicable to a wide range of determinants of behavior; to different scales (for example from a single household to an industry sector); and would need to be able to account for the wide variability in energy behaviours and responses to interventions.

In developing the Energy Cultures Framework, the initial purpose was to create a model that incorporated all of the potential drivers of household energy behavior as perceived by the Energy Cultures team members, so that we had a commonly agreed notion of the problem and its potential influences. This was crucial because different disciplines have quite different notions of what ‘behaviour’ actually is, as well as what its drivers are. Behaviour is sometimes characterised 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 [5, 6, 13]. From our inter-disciplinary perspective, we felt it was important to include all of these notions of behaviour – technologies, activities and aspirations, and their interrelationships. 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 many other influences.

We were influenced by several theoretical streams. Socio-Technical Systems (STS) theories consider the role technologies play in influencing behaviours and expectations, and suggest that “social practices and technological artefacts shape and are shaped by one another” [14, p. 351]. We also draw 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. Habitus is self-generative and can constrain 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 individuals and 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. 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. Systems thinking attempts to address the shortcomings of reductionist approaches, recognising the complexity of the real world. We use ‘system’ not in the sense of a real-world entity, but as a construct to aid understanding [16, 17].

‘Culture’ is another core concept, and here we are not using the term to refer to any particular pre-defined ethnic or social group, but in recognition of the diversity of values, beliefs, knowledge, practices, technologies, and other cultural determinants that exist within any given society. Our hypothesis is that distinctive clusters of cultural norms, energy practices and material culture will be able to be identified within a given society, and that identifying and studying the characteristics of these ‘energy cultures’ will give insights into the heterogeneity of energy behaviours. The term ‘energy cultures’ brings the norm-practice-material culture dynamic to the fore, rather than the more decentred influences that are the focus of much STS literature (although still recognizing the influence of external agents).

Within the energy literature, the concept of culture has generally been more implied than overt. The key exception is in the work of Loren Lutzenhiser [12] who suggests that 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” (12, p. 54). Our ‘energy cultures’ framework builds on Lutzenhiser’s insights.

### **3. The Energy Cultures Framework**

The Energy Cultures framework (Fig 1) proposes that consumer energy behaviour can be understood at its most fundamental level by examining the interactions between cognitive norms (e.g. beliefs, understandings, motivations etc), material culture (e.g. heating technologies, building form, etc) and energy practices (e.g. activities, processes). These are all aspects of ‘behaviour’, and using a household as an example, cognitive norms might include social aspirations, expected comfort levels, environmental values and respect for tradition; material culture might include heating devices, house structure, and insulation; and energy practices might include temperature settings, hours of heating, and maintenance of technologies. Each of these three components (cognitive norms, material culture and energy practices) individually affects energy use, yet they are also strongly interactive. For example, the existence of a heat pump (material culture) will result in very different practices from a household with an open fire; or a frugal upbringing (cultural norms) will impact on energy practices and possibly on the choice of technologies (material culture).

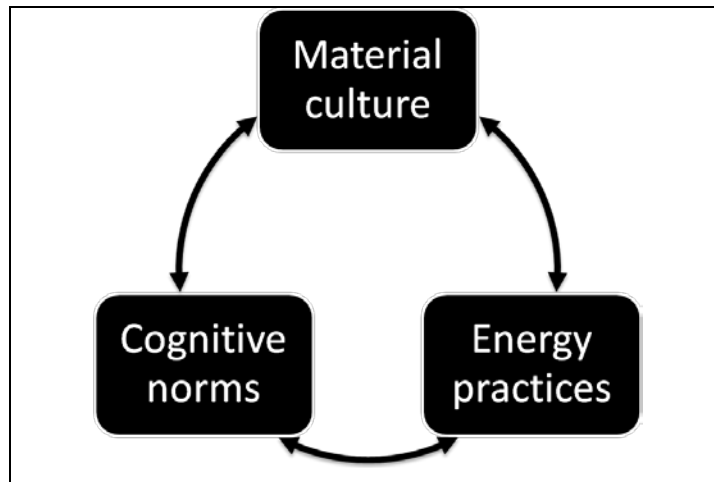


Fig. 1. The core concept of the Energy Cultures framework: cognitive norms, material culture and energy practices and the interactivity between them.

The three components and their interactions form the core of the Energy Cultures framework, but there are also wider systemic influences on behavior (Figure 2). 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, age 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 influenced by such things as the energy price structure and social marketing campaigns.

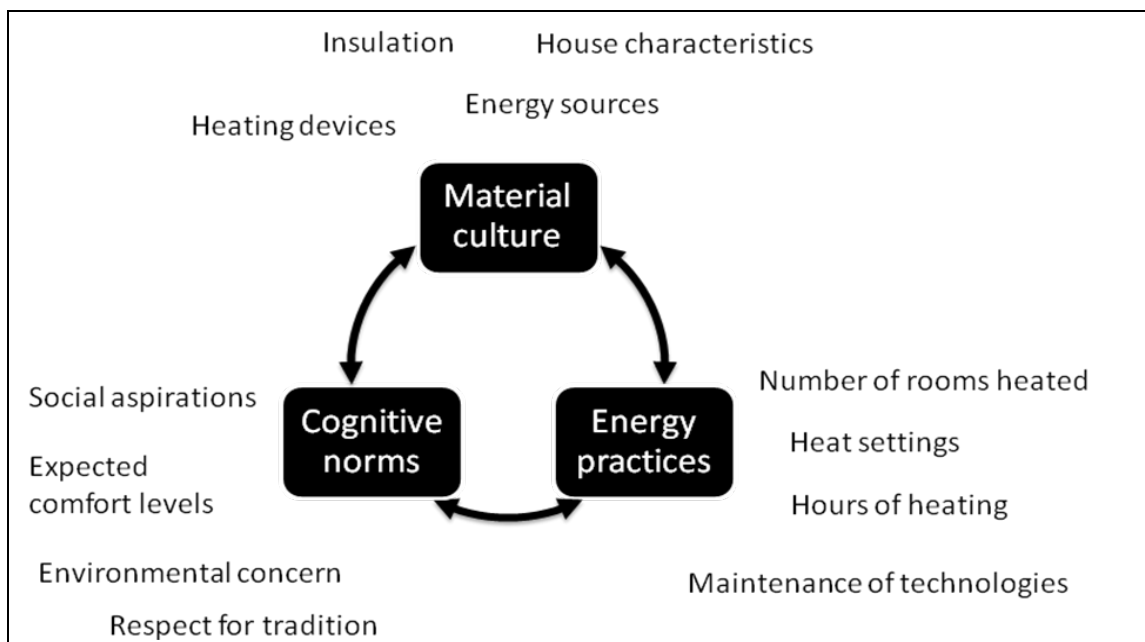


Fig. 2. Using the Energy Cultures framework to depict some of the wider systemic influences on behaviour.

#### 4. Application of the Energy Cultures Framework

Having initially developed the Energy Cultures framework as a commonly agreed depiction of the problem we were seeking to address, we found it had other uses. Firstly, it aided in constructing hypotheses for our research into household energy behavior. For example, we hypothesise that clusters of similar 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’.

Secondly, the framework has provided a conceptual structure for the design of the research programme. Each of the disciplines has particular methodologies which can help inform different components of the energy cultures framework, and the interactions between them. To date (at the end of our first year), we have studied cultural norms (and in particular the influence of values on practices and material culture) using ‘values laddering’, a method from consumer psychology involving in-depth interviews. Households have been surveyed to identify their material culture, practices and cognitive norms, as well as some of the external influences recognized by householders such as information sources and social networks. Choice modelling, an economics method, has been used to identify the tradeoffs that people make in their preferences for household heating and hot water systems, which in terms of the models informs the interactivity of cognitive norms with both material culture and energy practices. The data is being collected at three scales – some households are being subject to all three data collection methods; the latter two methods being applied both within our three case study areas and nationally.

A third use of the framework is as an integrating tool. We 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) was used to design the choice 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. Integrated analysis of this data will start to identify clusters of ‘energy cultures’, which will then be studied in greater depth in segmented focus groups of householders using soft systems methodology. The wider legal and policy context affecting behavior will be examined through legal desktop investigations. Opportunities for effective interventions will be sought both from the reported experiences of energy culture group members, and from the policy review. In year 3 some interventions will be trialled within culture groups.

A fourth application of the framework has been to understand behavior change in retrospect. 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’ [18]. We have examined the behavioural shifts occurring in a New Zealand transition town, Waitati, using the Energy Cultures framework.

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. 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.

To date, the most significant change in material culture is in home insulation. 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 secured government subsidies for a mass home insulation project in 2009 and facilitated the project. As a result, 53 of the 200 houses in Waitati received subsidised 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' (for example a far lower level of uptake was achieved in other areas). 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, WEP proposes to build a community owned wind turbine to provide power for the district while feeding 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 that requires changes also 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 anticipate 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, as well as gaining Government funding to develop a financial model and business plan take the 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 the individuals directly involved and of the community as a whole.

These are all 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 and supply can offer clues as to how change might be initiated in other contexts.

Finally, a further intention with the Energy Cultures research programme is to identify suitable interventions for behavior change. It was clear from the literature [6] 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. The research programme aims to describe and characterise this heterogeneity, so as to be in a better position to match interventions to specific energy cultures. This will be undertaken and tested in Year 3 of the programme.

## 5. Conclusions

The Energy Cultures model 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. Nevertheless we have found it to have a number of other 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 crossdisciplinary 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 are using it as a common point of reference and a tool for integration of research findings from our multi-stream research project.

The adaptability of the Energy Cultures framework is such that it displays Wilson and Dowlatabadi's three requirements for a successful integrating model [6]. It accounts for different *contexts*—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, a group of households, a community (such as Waitati), 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.

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 may 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 ('energy cultures') 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.

## References

- [1] World Energy Outlook, International Energy Agency, Paris, 2009, p. 211.
- [2] DEFRA, A Framework for Pro-environmental Behaviours. Department for Environment, Food and Rural Affairs, British Government, London, 2008, p. 76.
- [3] J. Stephenson, B. Barton, G. Carrington, D. Gnoth, R. Lawson, P. Thorsnes , Energy Cultures: A framework for understanding energy behaviours, Energy Policy 38, 2010, pp. 6120–6129
- [4] N.W. Biggart, L. Lutzenhiser, Economic sociology and the social problem of energy inefficiency. American Behavioral Scientist 50, 2007, pp.1070–1087.

- [5] J. Keirstead, Evaluating the applicability of integrated domestic energy consumption frameworks in the UK, *Energy Policy* 34, 2006, pp. 3065–3077.
- [6] C. Wilson, H. Dowlatabadi, Models of decision making and residential energy use, *Annual Review of Environment and Resources* 32, 2007, pp.169–203.
- [7] R.R. Dholakia, N. Dholakia, A.F. Firat, From social psychology to political economy: a model of energy use behavior. *Journal of Economic Psychology* 3, 1983, pp. 231–247.
- [8] W.F. Van Raaij, T.M.M. Verhallen, A behavioral model of residential energy use, *Journal of Economic Psychology* 3, 1983, pp. 39–63.
- [9] R. Wilk, Consumption, human needs, and global environmental change. *Global Environmental Change* 12, 2002, pp. 5–13.
- [10] S. Barr, A.W. Gilg, A conceptual framework for understanding and analyzing attitudes towards environmental behavior, *Geografiska Annaler* 89B(4), 2007, pp. 361–379.
- [11] G. Hitchcock, An integrated framework for energy use and behaviour in the domestic sector. *Energy and Buildings* 20, 1993, pp. 151–157.
- [12] L. Lutzenhiser, A cultural model of household energy consumption. *Energy* 17, 1992, pp. 47–60.
- [13] E. Shove, *Comfort, Cleanliness and Convenience*. Oxford International Publishers, Oxford, 2003.
- [14] A. Smith, A. Stirling, Moving outside or inside? Objectification and reflexivity in the governance of socio-technical systems. *Journal of Environmental Policy & Planning* 9, 2007, pp. 351–373.
- [15] P. Bourdieu, *The Logic of Practice* (transl. R. Nice). Polity Press, Cambridge, 1992.
- [16] P. Checkland, Soft systems methodology: a thirty year retrospective. *Systems Research and Behavioural Science* 17, 2000, pp. S11–S58.
- [17] G. Midgely, *Systems Thinking*. Sage publications, London, 2003.
- [18] Transition Towns New Zealand Aotearoa, n.d. What are transition towns? /<http://www.transitiontowns.org.nz/node/1667S>. (accessed 15.12.2010).