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The Practice of Interdisciplinarity

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Barry Barton, Paul Thorsnes and Miranda Miroso

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The Practice of Interdisciplinarity

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Abstract: There is a rocky chasm between the promise of interdisciplinary research and successful interdisciplinary research practice. As a group of researchers from New Zealand, based in five different disciplines (consumer psychology, economics, sociology, law, engineering), we share an interest in the behaviour of energy consumers, but understand behaviour through very different lenses. Initially we were mutually baffled by our discipline-specific languages and diverse theoretical stances. Over a period of time, however, we developed ways of working together to realise the benefits of collaboration. In this paper we reflect on the differences between disciplinarity and interdisciplinarity, and discuss the practices we have adopted that support interdisciplinarity. These include the importance of trust, focusing on a problem, being aware of limits, sharing a common intellectual framework, testing ideas across the disciplines, and practicing interdisciplinarity at every level of the research project. We suggest that not all people are comfortable with interdisciplinary work, and draw parallels with Kohlberg's 'stages of moral development', in that interdisciplinarians need to be 'post-conventional' in the sense that they do not feel bound by the conventions of their own discipline and recognise the legitimacy and value of other perspectives and methods of inquiry.

Keywords: Interdisciplinary Research, Research Practice, Post-conventional, Peer Review, Energy Cultures

Introduction

INTERDISCIPLINARY RESEARCH HAS been described as essential for addressing complex problems, particularly for sustainability issues involving human behaviours in a constrained material world (Stern, 2007). By bringing different forms of expertise together, an interdisciplinary research team will ideally provide a multi-faceted appreciation of the problem, apply multiple research techniques, and offer an integrated understanding. This can be contrasted with single-discipline approaches, which provide a relatively narrow perspective on a given problem, and collectively offer detailed but fragmented and unconnected pools of knowledge (Massey et al., 2006; Midgley, 1996)

However there is a rocky chasm between the promise of interdisciplinary research and successful interdisciplinary research practice. As a group of researchers from New Zealand, based in five different disciplines (consumer psychology, economics, sociology, law, engineering), we share an interest in the behaviour of energy consumers. We have worked together in various ways over a period of years, and recently (October 2009) commenced a 3-year

interdisciplinary research project called ‘Energy Cultures’. In brief, the project focuses on an applied problem – *why is it so hard to get householders to adopt more energy-efficient and energy-conserving behaviour?* This involves a multi-method research programme in which the first two years are spent gathering both qualitative and quantitative data from households, and the third year is spent testing the success of at least one behaviour change intervention.

This paper was written in response to a request that we reflect on our experiences of interdisciplinarity as a team of researchers from diverse backgrounds. In writing it, we have chosen to not focus on the Energy Cultures research itself, but instead to discuss the *practice* of interdisciplinarity – that is, how does it differ from doing research with others from within the same discipline; and what are some of the characteristics of our interdisciplinary processes that we feel has contributed to the success of the Energy Cultures project so far?

The paper was written jointly by the five key researchers in Energy Cultures and the project coordinator. In writing this article, as with our other joint writing, we have intentionally used common language, and avoided academic or discipline-specific jargon, so as to be comprehensible to as wide an audience as possible.

What are Disciplines?

Our starting point was to consider what it means to be part of a discipline. Most of the Energy Cultures team are social scientists and one comes from a ‘hard science’ background. In our view, the concept of a discipline is not confined to western knowledge, so that non-western knowledge systems can also be considered ‘disciplines’. Our discussion below is therefore worded so as to be inclusive of both.

We believe that disciplines are particular sets of ways of constructing, checking, holding and passing on knowledge. Disciplines are in part distinguished by the contexts in which they are applied, and the classes of problems to which the discipline directs its inquiries. They involve a range of techniques that are considered appropriate to defining and investigating those problems. They also have a particular set of perspectives on the nature of the world in which they work – for example, some disciplines place particular value on empirically measurable data, while others do not. A discipline’s methods of inquiry, and the resulting knowledge, are co-determined with that discipline’s underlying assumptions about that part of the world it is interested in.

A defining feature of most disciplines is their distinctive sets of practices, by which they generate the knowledge products of the discipline. By practices, we refer in part to the means of inquiry (usually called research methodologies) particular to that discipline. However there are other discipline-specific behaviours relating to the construction of knowledge, such as ways of assessing its accuracy, validity, applicability, methods of knowledge communication, and measures of esteem. Practices in western disciplines may also include such things as accepted laboratory behaviours, citation styles, peer review, and specific terminologies. Acting in a disciplinary manner means not only being familiar with its knowledge, but mastering the techniques, language and rituals associated with it (Rønningen et al., 2008). In many ways, the academic disciplines are like nation states of the intellectual world, with their own territories, languages, cultures and governance arrangements. These features can limit the ability of disciplinarians to communicate easily with other disciplines.

Disciplines are further distinguished by what constitutes proof, or credible support of a proposition. This test of believability can differ considerably. In science, for example, findings must usually be able to be independently replicated by others; lawyers have a consensus on what constitutes proof of a proposition of law. The use of some form of peer review – using others within the discipline to assess acceptability – is common to all disciplines.

There is, however, no ‘natural’ or self-evident dividing line between disciplines. Between some disciplines, distinctions are clear (between mathematics and Greek, for example) but in some cases the differences are more about historical roots and self-definition than anything particularly unique about their practices. Many disciplines share theories and research methodologies, or adopt these from other disciplines, their difference being in their fields of inquiry. Despite their apparent cast-iron perimeters, disciplines are in reality far more organic and interactive than might often be assumed. And disciplines are not static, but evolve over time. Sometimes this evolution leads to huge divergences within a single discipline, such as physics, which ranges from ‘hard science’ to philosophical realms of multiple co-existing universes.

Recent decades have seen many new disciplines emerge as new approaches or fields of inquiry emerge (e.g. consumer psychology, computer science). Yet the direction is generally towards divergence – splits into new disciplines – rather than convergence. Even the well established systems approaches have not so far achieved their integration potential (Midgley, 1996), possibly because they involve complex integrative theoretical frameworks that are difficult to master and operationalise. It is often easier to split and divide than to aggregate. Interdisciplinarity flies in the face of this trend.

Finally, we observe that different disciplines have different strengths. Some disciplines are better than others for situations explainable by empirical data. Others may work better at providing understandings of what it is to be human. For any given problem, there is likely to be a range of approaches that may provide insights. As one of our team has previously written:

[I]t would be absurd to assert that all knowledge systems are equally powerful for all uses and questions, but we hasten to add that asserting one system to always be more powerful or legitimate than the other for all types of problems would be equally absurd (Stephenson & Moller, 2009).

It is hardly surprising, then, that interdisciplinary research – bringing together a team of people from different disciplines to work together on a problem – can be hugely challenging. As well as different realms of knowledge, the individuals are likely to bring different perspectives on the nature of the world, and different practices – such as methods of inquiry, different terminologies, and tests of believability. To create an interdisciplinary team involves not only working against the tendency for disciplinary fragmentation, but doing so in a way that bridges across all of these differences. Having said this, we also recognise that not every problem requires interdisciplinary interrogation. It will generally be the knotty, complex, hard-to-solve issues (often those involving humans!) that will benefit from multiple perspectives.

Interdisciplinary Practice

To write this section, we reflected as a group on what we have done that has helped us work in an interdisciplinary fashion. In hindsight, we realise that while we did not set out to consciously develop a set of interdisciplinary practices, this is in fact what we have done. These practices do not attempt to generate a common worldview, knowledge or practice, but rather to create ways in which these can be incorporated into a shared inquiry into a problem. They work to moderate the difficulties that could potentially be caused by the differences in knowledge and practice between our disciplines.

Develop Relationships

Our collaborations started well prior to the Energy Cultures project. The five key investigators worked together in various combinations on a number of research-related projects over several years. This began with organised attempts to have cross-disciplinary discussions on sustainable energy problems, together with a number of other researchers, at a time when we did not know one another well. We recall sessions where people did not understand what others were saying; disagreements as to the meaning of key words; jargon (use of incomprehensible discipline-specific terms); lack of agreement even on the nature of a problem; and general discomfort with talking to people of other disciplines.

Gradually, however, some of those involved in the discussions started to get past this mutual incomprehension. We worked together on some joint research bids (initially unsuccessful), as well as working together on other projects. Some of the team were also centrally involved in setting up the Otago Energy Research Centre (www.otago.ac.nz/oerc) which promotes interdisciplinary approaches to energy sustainability research. We learnt something of each other's ways of working and thinking, and built up mutual trust, with small steps of increasing engagement over time. We worked past communication barriers by trying to be very clear about what we each meant, and articulating underlying principles in preference to detailed knowledge.

In starting to work in this way, we self-selected as people who enjoyed interdisciplinary conversations. We found we worked together well, and we began to appreciate the insights that arise from working with others who think differently and know different things. But it took time: recognising the limitations of one's discipline as the sole arbiter of a problem flies against the tendency of disciplines to do just this. And at a personal level, getting beyond the view that other disciplines are full of strange people who think differently, to not only appreciating what others have to offer, but happily playing with ideas that might previously have seemed utterly foreign, is a mental shift that can take time and effort.

Sharing an academic background, though, does make it easier to develop comfortable and respectful collaborative relationships. Despite disciplinary differences, academics share Western understandings of the nature of knowledge and its construction. How much more complex it is to develop collaborative research relationships with knowledge systems outside the academic arena, and particularly where there are different philosophies of knowledge and world view. One of our team members co-leads another research programme in which both Māori and academic researchers are engaging with Māori communities on their actions and initiatives for environmental management. There, the team is attempting to weave together two different traditions of enquiry, so that Māori world views, knowledge systems and practices are not seen as 'other', but are given equivalent honour and respect to western

approaches. Bringing together different knowledge philosophies is potentially far more challenging in every respect than working across western academic disciplines, but the process is not significantly different from what we have experienced with Energy Cultures, except perhaps with a far greater emphasis on building relationships and trust.

Focus on a Problem

From this background of mutual learning, our foray into the Energy Cultures interdisciplinary research project was triggered by a problem that we all agreed on, and the evidence that decades of single-discipline studies had done relatively little to resolve it. This became apparent when we engaged a research assistant who reviewed over 800 articles on the topic of household energy behaviour from a cornucopia of disciplines. Reading and discussing some of the key articles, together with sharing our own knowledge and experiences, helped generate a common understanding of the characteristics, scope and nature of the problem of household energy behaviour, and its contextual influences. The exercise also helped identify what each discipline could potentially offer – knowledge, methodologies and/or theories.

Despite having this history of mutual interaction and problem exploration, we would have gone no further except that an opportunity arose to bid for research funds.¹ In particular, and unusually in our experience, the funding criteria did not exclude an interdisciplinary approach, which could have been seen as a radical departure from ‘safe’ research. In bidding, we benefited from the strong support from a key government agency, a large energy company, and a local authority² – all of which saw value in bringing multiple research perspectives to bear on something that they all saw as a significant problem. Happily for the project, the combination of circumstances resulted in success with our funding bid. We are aware that in other circumstances, interdisciplinary research might be seen as too untried and too risky to fund compared to the ‘known quantity’ of a discipline-based approach.

Share a Common Intellectual Framework

Possibly the most important component of our interdisciplinary practice – the ‘glue’ that holds the project together - is the Energy Cultures Framework. This theoretical construct models the characteristics of the energy behaviour problem, in a way that makes sense to all the team members regardless of their discipline. The framework began as a simple diagram in our research bid, but had evolved markedly by the start of the research project. We soon realised that while we had only intended it to represent the ‘field’ we were working within, it was potentially far more powerful, in that it provided a framework around which we could each see where our particular expertise (knowledge and practices) could contribute to understanding the whole. As a pan-disciplinary concept, the Energy Cultures Framework thus became an integrating tool for practice and knowledge across the disciplines involved in our project. The Energy Cultures Framework and its applications are described in detail in *‘Energy Cultures – a framework for understanding energy behaviours’* (Stephenson et al., 2010).

¹ From the Foundation for Research, Science and Technology, New Zealand

² NZ Energy Efficiency and Conservation Authority, Mercury Energy Ltd, and Dunedin City Council

Know your Limits

Working in an interdisciplinary way does not require that a geographer becomes a physicist, or that an economist becomes a legal expert. Although we share key articles from various disciplinary perspectives, we do not try to become experts in each other's fields. Trying to do so would be mind-boggling, and would also dilute the valuable differences we bring in perspectives and competencies.

Because we respect each other's disciplinary and methodological expertise, we are happy to entrust each researcher to bring their relevant disciplinary perspectives to the table, and to design and manage the stages of the research that involve discipline-specific methods and analyses. However, we also collaborate where we feel it may provide a richer research design. For example, one stage of the research involves 'choice modelling', an economics-based research technique that generates empirical data from people's preferences of the attributes of products or services. To develop the 'choices' we came together as a team and brainstormed ideas on attributes and choices, using our inherent and 'common-sense' knowledge, as well as drawing from the outputs of an earlier (qualitative) stage of the research project that identified the values that underlay householders' behaviour. However our economist is the custodian of the choice modelling research design, and is ultimately responsible for its quality, so the responsibility for the final design of this stage lies with him. After all, the choice modelling needs to be recognisable as good work in the terms of the economics discipline, and needs to be publishable in relevant peer-reviewed journals.

Interdisciplinarity also involves accepting the limitations of one's own discipline, and seeing different methodologies as means to a common end. An example is a discussion between our marketer and economist, contrasting methods used in consumer psychology and those used in economics. In psychology the standard mode of enquiry is to put together an experimental framework which controls as much of the environment as possible. Treatments are manipulated, covariates measured and effects on a dependent variable are estimated. In contrast, economists do very little experimental work but seek to isolate their variables of interest statistically by, for example, incorporating dummy variables into models to strip out the effects of uncontrolled influences. In our team, we developed a shared view that both approaches are essentially working to the same end, and that neither is universally better or worse than the other.

In relation to the problem we are researching, we all recognise that without each other's expertise the research project would not be sufficiently comprehensive. We recognise that insights from other disciplines have the potential to change our personal understanding of the problem, and possibly change how our own discipline approaches it. There *is* a potential for conflict, particularly in the areas where our disciplines overlap – but at the same time, this is where the most fruitful discussions take place. So ... it's risky, but it's rewarding!

Play with Ideas, yet Rigorously Test them

The powerhouse of our interdisciplinary practice is when we get together to share ideas. This is the way we developed the research bid, designed the Energy Cultures Model, developed the research programme, designed the individual research stages to date, and co-wrote the *Energy Cultures Framework* article and this one. On reflection, the key elements of these interactions are firstly that we meet face-to-face around a table (although sometimes

one of our team links in via teleconference); our meetings are relatively small (usually 4-8 people); they are informally facilitated by one or two team members; and the purpose is to be creative and productive. Generally we use a whiteboard to record ideas, and to draw spatial links or diagrams where words are insufficient. There is an acceptance that anyone's ideas are potentially as cogent as anyone else's, and we have found through experience that sometimes the most insightful comments may be from the person who nominally knows least about the topic. Having developed and practised this approach successfully for some time, as something that worked for us as a group, we have become aware of the idea of synectics, developed by Prince (1970), as a structured way of enhancing creativity. It seems that, in essence, we were naturally applying many of suggestions contained in the literature on synectics, which now appears to be most widely applied in education to develop creative thinking in the classroom.

To come up with both of our academic papers, for example, we initially sat down together around a table, and started to talk, recording our first brainstorm. Then we went away and thought about it individually, read some articles, and started to note down our own ideas, exchange them, and add to others' ideas. Sometimes two of us would have an informal chat which sparked more ideas. Then we came back together around a whiteboard to shape and consolidate what we wanted to say. Finally, one of us wrote up a draft and the others then helped polish the final result. In the latter stages of the process, there was no shortage of critical review from team members, as we each considered the emerging product from each or our perspectives. In some instances, where it was felt that a part of a paper lay very much in others' expertise, team members might not question the disciplinary underpinnings but would certainly challenge it if it did not 'make sense' from their perspective. Both significant and subtle alterations were made until the team was happy with the final product. Overall this exemplifies the interactive/reflective/iterative process that we use whenever we need to come up with a shared position.

From research design to academic writing, we find that the 'peer review' by team members from other disciplines provides a different rigour to review by others in the same discipline. Other disciplines will ask different questions, and judge by a different set of understandings and expectations. While the usual peer review process gives internal validity within the bounds of a discipline, we feel that surviving interdisciplinary review provides an external validity, which affords an extra degree of robustness. The ability to be able to apply and respond to this additional form of external peer review is one of the key day to day differences that defines our experiences working as an interdisciplinary group.

Practice Interdisciplinarity at Every Level

An interdisciplinary team does not exist in a vacuum. If the conditions around the team were not conducive to interdisciplinary practice, we suspect it would be far harder to work in the way we do.

We have already mentioned the multi-disciplinary network of energy researchers – the Otago Energy Research Centre – which in many ways provided the nurturing conditions for the Energy Cultures project. In addition, the research project is physically located and supported in a dynamic interdisciplinary research centre which provides a positive environment for this and many other interdisciplinary projects. The Centre for the Study of Agriculture, Food and Environment at Otago University (CSAFE) has some 25 concurrent research pro-

jects, most of which incorporate different disciplines (often natural scientists and social scientists working together). Of note are the long-running ARGOS research programme, which investigates ecological, economic and social measures of farm sustainability, and the Tiaki Mahinga Kai programme, that incorporates a number of cross-cultural research projects bringing together indigenous and western knowledge streams.

The collegial and supportive atmosphere at CSAFE, where interdisciplinary research is a way of life, is hugely beneficial to our own interactions. To quote one of our team:

I'm not sure but I imagine that people sometimes cling to disciplines because these labels help define a sense of identity. It is easier to say "I am a market economist" than to say "I am an interdisciplinarian"! CSAFE provides a 'home' where you are among like-minded researchers. Not only does this provide researchers with an identity, but it also benefits the project by providing the opportunity to share ideas between research projects, share networks etc. And having a supportive environment like CSAFE means that we can take intellectual risks. It sets up a trusting environment and normalises non-risky ideas exchange (i.e. the risk of being made to feel silly or ignorant). (Energy Cultures team member)

We also attempt to support interdisciplinarity in our research management. We have two co-leaders plus a dedicated project coordinator, so leadership roles are shared. We are using novel software developed within the university for supporting collaborative research, which provides a range of tools for data storage, analysis and web-based team interaction.³ We have an Advisory Group with members from industry, community and government who meet with us on a regular basis. Our postgraduate students (three PhD and two Masters students at this stage) have backgrounds in sociology, marketing, geography, engineering, psychology, anthropology and law. We provide interdisciplinary supervision, and encourage them to draw from more than one disciplinary knowledge base while keeping their feet in their originating disciplines. In this way we aim to help develop a new generation of interdisciplinarians.

Be a Certain Type of Person?

Reflecting together on our interdisciplinary practices, we realised that as individuals we may be different from some of our colleagues who regard interdisciplinarity with suspicion or uncertainty. We became particularly interested in whether there might be a psychological element in the willingness or ability to be interdisciplinary. Reviewing literature, we found that this is a common observation, but typically made as an 'aside' to the main thrust of an article.

Some people are clearly uncomfortable in working in interdisciplinary settings. Moller et al. (2008) describe an interdisciplinary research programme where some of the researchers left at the beginning and others after a few years. They suggest that this was because the process was so challenging for some personalities that not all would stay the distance.

³ This prototype Virtual Research Environment was developed at Otago University and built on a commercial social networking platform (BaySpire Inc). See the following for more information: <http://eresearch.wiki.otago.ac.nz/Er09-Presentations>; http://eresearch.wiki.otago.ac.nz/images/0/0f/Virtual_Research_Environment.pdf

Fry (2001: 165) describes a successful team as having “personal chemistry” between team members, incorporating high levels of trust and respect. Jakobsen et al. (2004) contend that successful leaders of interdisciplinary research projects need to be able to integrate disciplines in their own mind, and that the interpersonal skills of team players are important. Team members need to be able to “identify the strengths and weaknesses of different methods, and view them as complementary” (Midgley, 1996:25). They must be willing to accept others’ positions (Massey et al., 2006), and be “prepared to view their disciplinary ability as a contribution to a joint goal and respect the contributions from other disciplines” (Janssen & Goldsworthy, 1996: 270). Such personal qualities are important for understanding others’ positions and reaching agreement on how methodologies might fit together in the interests of the project as a whole (Rønningen et al., 2008).

While the observations recorded above are all insightful regarding the personal characteristics of interdisciplinary researchers, they do not really offer any understanding regarding how and why people might interact differently in a research context. Exploring this idea we came across Kohlberg’s (1975) ‘stages of moral development’. Kohlberg postulates three main stages of moral development – pre-conventional, conventional and post-conventional. Morals in the pre-conventional stage are concerned with obedience, punishment and self-interest. At the conventional level, morals are integrated with social norms and are expressed as adherence to laws and other social codes. At the post-conventional level, which Kohlberg argues many people never reach, morals involve a higher level of reasoning and abstraction that allows the individual to recognize situations where self and society may be in conflict and in which, for example, it may be preferable to break societal laws.

At post-conventional level, a person can hold their own view of the world but simultaneously accept that someone else can have a legitimate view of the world that is completely different. Right and wrong are thus more context-driven, and rules are considered to only be useful guidelines that should be adapted if need be according to situation. Different opinions and values are respected as unique to other individuals or societies rather than shunned. Decisions are taken using ‘Kantian’ perspectives where people make judgments as if they were in another’s position.

Applying this thinking to disciplinarity, while disciplines are clearly not homogeneous structures they do reflect common sets of beliefs and accepted practices. These can be seen as rules and norms that (from a conventional perspective) should not be transgressed. To work in an interdisciplinary way means accepting other disciplinary perspectives and methods as equally valuable. Analogously to Kohlberg’s ‘advanced moral development’, interdisciplinarity involves integration and acceptance of others’ ideas, and the adaptation of conventions and rules to fit a context.

By referring to Kohlberg, we are not claiming that team members have reached some ultimate stage of moral development, but what we do draw from these ideas is that to work in an interdisciplinary way requires some degree of ‘post-conventionality’. That is, we each are aware of both the strengths and limits of our own discipline, and do not feel bound by its rules and expectations. At the same time, we still work (particularly in other parts of our lives) within our discipline, and publish in discipline-specific journals. We appreciate and respect the knowledge and methodologies of other disciplines and realise that all have a contribution to make depending on the context. And finally we are happy to push the boundaries, to work in ways that are not necessarily directly legitimised by our discipline, and to take risks with ideas.

Conclusion

Our interdisciplinary journey is still in its early stages. We do not consider that we have ‘cracked the code’ of interdisciplinarity, and that the journey will be smooth all the way. There will undoubtedly be challenges ahead, not least of which will be the challenge of integration of our research findings. But we do consider that the practices that we are using, and our reflections on our processes, will assist us in achieving our goals as an interdisciplinary team.

Contrasting interdisciplinarity with our earlier discussion of what it is to be a discipline, we suggest interdisciplinarity is defined by an acceptance of multiple ways of constructing knowledge, and the intent to integrate these to address complex problems. Its points of evolution from disciplinarity are in the development of new shared practices, new shared theoretical constructs, and a new, additional burden of proof – being the scrutiny of those in disciplines other than one’s own.

Interdisciplinarity is more than ‘just working together’. It involves paying attention to how we think, how we relate, how we behave, what language we use, how we communicate, and how we co-create knowledge. It may also require certain types of people – those who are comfortable working outside the knowledge base and practices of their own discipline, and who are happy to be challenged and occasionally discomfited. The reward is new illuminations on old problems.

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About the Authors

Dr. Janet Stephenson

Dr. Stephenson has a background in sociology, planning and geography. Her research interests are in socio-cultural interactions with the environment, particularly in response to changes and challenges. She co-leads two 3-year interdisciplinary research projects. 'Energy Cultures' examines drivers of household energy behaviours and barriers to behavioural change, and Tirohia he Huarahi (Plans Power Partnerships) is a cross-cultural research project on Māori resource management. She also has a particular research interest in perceptions of landscapes, and in how to reconcile the multiple interpretations of landscape qualities as expressed by different disciplines and by communities.

Prof. Rob Lawson

Prof. Lawson's special area of expertise is in the study of consumer behaviour, though he also has interests in the development of marketing theory. Within consumer behaviour his research has been concentrated into two broad areas: tourist behaviour, and the values and lifestyles of NZ consumers. In the latter area he is co-leader with Sarah Todd of the New Zealand consumer lifestyles project and Rob has been involved with four out of the five major surveys since the project was first run in 1979. The latest data was collected at the end of 2005. Other recent and current projects have involved work on fruit and vegetable consumption, levels of physical activity and the growth and development of farmers' markets. He is co-leader of the Energy Cultures project.

Prof. Gerry Carrington

Prof. Carrington's research interests in energy and energy efficiency have resulted in over 94 research publications, two patents, 30 industry reports and one text book. His contributions to engineering were recently recognised by his election as fellow of the Institution of Professional Engineers, NZ. Since 1998 he has had a key role in the development of an Applied Science degree programme at the University of Otago. He was also Head of the Department of Physics from January 2003 to December 2007.

Prof. Barry Barton

Professor Barry Barton's field of research is energy, natural resources and environmental law. Climate change, energy policy and energy security hold a growing importance, and present special legal challenges. Barry analyzes the theory of regulation, industry self-regulation, and the relationship between regulation and effective markets. Professor Barry Barton is Chairperson of the Academic Advisory Group of the Section on Energy, Environment, Natural Resources and Infrastructure Law of the International Bar Association, a Director of the Environmental Defence Society, and Editor of the Australian Resources and Energy Law Journal.

Dr. Paul Thorsnes

Dr. Thorsnes' research interests are primarily in the areas of urban/regional and environmental economics and policy. Recent research includes estimates of the effect on housing prices of environmental amenities, such as proximity to natural areas and the clean-up of industrial sites, and analyses of mechanisms with which to allocate resources to the production of urban amenities. Paul's teaching interests are in microeconomics, urban/regional economics, and environmental economics. He has taught previously at the University of Oregon and Grand Valley State University in Michigan.

Dr. Miranda Miroso

Miranda Miroso is currently the Project Co-ordinator for the Energy Cultures project. She also lectures in the Food Science Department at the University of Otago. Miranda is a consumer behaviour researcher and her research includes anti-consumption, sustainable consumption (especially in the context of food and energy), consumer movements and activism. She finished her PhD at the end of 2009 which was entitled: Dynamic ideologies: Insights from the Slow Food Movement. Using a qualitative research methodology, the thesis explored the interaction between consumer movements and ideological change.

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