Exploring the social dimensions of energy use: a review of recent research initiatives

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Abstract

Within the last decade, a number of initiatives (e.g. conferences, workshops, and research programmes) have been launched by governments, international organizations, universities, research groups, and non-profits to consider the social dimensions of energy production and consumption. This paper reviews and characterizes thirteen of these initiatives, with a particular (but not exclusive) focus on research programmes that address social aspects of consumption and efficiency in the UK. Examples from the US and elsewhere are also noted. The review shows that different institutions are approaching the question of energy use as a social problem in very different ways, and suggests that further coordination and ongoing comparative study of these initiatives could increase their impact.

Introduction

Reducing energy use in buildings is a critical component of meeting carbon reduction commitments. Much of the work in this area follows a physical, technical, and economic model of the built environment (1993). Energy use in buildings has also been considered as a social problem rather than a technological one (Stern and Aronson 1984; NRC 1980). How societies are motivated to use or conserve energy has been a topic addressed sporadically by social scientists for more than a century (Rosa, Machlis, and Keating 1988). From this perspective, reducing

energy use in buildings requires changes in the entire fabric of society.

In response to the latest Intergovernmental Panel on Climate Change reports, many countries are ratcheting up their carbon emissions reduction targets. In the UK, for example, the target in 2006 was a 60% reduction by 2050, but in 2008 the target increased to 80% (Adam 2008). One effect of such enormous carbon reduction targets is that it seems increasingly unlikely that technologies alone will save the day. The deployment of efficient, renewable, and zero-carbon technologies at scale sufficient to achieve this reduction would be unprecedented, and will probably not go unnoticed by the general public. In fact, how to garner public support for a transition to a more sustainable future has become a hot topic, which is discussed and debated in the media, in town halls, on street corners, and in the academic literature.

Not since the 1970s has energy been so prevalent a political topic. US President Barack Obama mentioned renewable technologies in his inaugural address, the G8 Energy Ministers have issued plans for energy security and energy saving (ENS 2006; Energy Tech 2008), and work around meeting the Kyoto Protocol continues. As these national and international policy discussions proceed, what—if anything—is happening to the fabric of society? And what—if anything—is happening in the field of energy and social science that can capture, explain, or affect this transition?

To contribute to a broader understanding of how we comprehend and the new (?) relationship between energy and society, this paper will focus on a limited selection of recent initiatives that purport to engage in this very task. Within the last decade, a number of conferences, workshops, and research

programmes have been launched by governments, international organizations, universities, think tanks, and non-profits to consider the social dimensions of energy production and consumption. This paper reviews and characterizes these initiatives, with a particular (but not exclusive) focus on research programmes that address social aspects of consumption and efficiency in the UK.

We have elected to study the aims of research centres rather than the research they provide for several reasons. First, many of these centres are new, and comparable bodies of published research from each one is not yet available. Second, by following the aims of the centres, we gain a better sense of what some of the larger social priorities are to which these centres are responding. Academic agenda-setting is driven in various parts by intellectual interests, disciplinary considerations, peer judgment, and the practical need for funding. To obtain a research grant, it is not uncommon for researchers to say they will do one thing but actually pursue something slightly different. We do not mean to suggest that researchers intend to deceive their funders or the public, just that the general aims of the research may be higher or farther than the limits of time and funding permit. Additionally, it is difficult to accurately predict exactly where the research will lead, particularly in large, multi-year, multi-institutional projects. Our interest here is in what the initiatives claim to be doing, as it provides a reasoned representation of the public face of research as well as a useful point of departure for analysis. Third, in an interdisciplinary field such as energy, it may be useful to call attention to new nodes of potential knowledge creation. Longstanding departments in established disciplines are ranked and listed by external bodies, such as the UK Research Assessment Exercise. In 2008, the RAE assessed 67 academic subjects, but "energy" was not one of them. For better or worse, these 67 subjects are socially legitimated in ways that many energy research centres are not. From the viewpoint of existing scholars, this process of professional scrutiny may be either rewarding or problematic. From the viewpoint of future scholars who seek information on how to choose where they might develop and hone their skills, naming and characterising energy research centres may provide a useful function.

The paper begins with a brief background on status of social science in energy research, selecting a few specific papers as a frame for the analysis. Next, it describes the methods by which thirteen energy and social science initiatives were selected for study, what materials were studied, and how they were analysed. The results characterise the initiatives studied and develop a typology of four different initiative categories. These categories are arranged by the extent to which energy and/or social research play a central role in each endeavour. In the discussion, we return to the framing papers to consider how different types of initiatives—either separately or together—might be more or less likely to provide the new research directions and developments for which these authors call. The paper concludes with some suggestions for how research on energy and social science initiatives could be further developed. Finally, it proposes using the linguistic tools implemented in this study as a lens to examine additional kinds of texts and gain further insights about the development of ideas in this field.

Background: Energy & Social Research

Since the 1970s, social science has played a role in energy research. Although technical, physical, and economic aspects of the built environment have dominated work in this area, other social science fields have played consistent (if relatively minor) supporting roles. In the literature, this work is often defined as "behavioural" research, where the word "behaviour" is often accompanied by other words such as "individual" and/or "residential" (see for example, Wilson and Dowlatabadi 2007). Using examples from the US and UK, Lutzenhiser and Shove (1999) argue that the role of social science in energy research has been limited not by the ability of social science to contribute, but more by the ways that government organizations shape, fund, and contract energy research.

Energy research, however, has not always had much of a role in the broader social sciences. Although Biggart and Lutzenhiser (2007) argue that energy inefficiency is a legitimate social problem that could be usefully explored using the tools of economic sociology, energy has long remained a fringe element in most non-economic social science fields. A qualitative and quantitative review of social science energy research in the UK by Berkhout et al. (2003) showed that the subject is only represented at about 28% of UK universities. The authors also found that most (72%) of the social science energy research groups in the UK conduct some form of economic research, while far fewer adopt a political science perspective (22%) or a sociology/social psychology perspective (26%). Some groups pursue research in more than one discipline, which accounts for the overlap. Interestingly, this study also suggests that the size and number of the centres studied had declined over the period between the early 1990s and the early 2000s.

Owens and Driffill (2008), on the other hand, see a different picture. They report that "insights across the social sciences have increasingly been applied to a range of energy and environmental issues" (p. 4412) and that the "evolution of social scientific understanding…has been rapid over the past few years, and this is reflected in substantial investment in research" (p. 4414). These authors conclude their paper with an appendix of research centres, programmes and projects with relevance to energy policy.

Owens and Driffill's paper is written ten years after Lutzenhiser and Shove's article and five years after Berkhout et al's paper. Do these five years (2003-2008) mark a critical "tipping point" for energy and social research? Recent media studies show that there has been significant growth in media coverage of climate change, particularly between 2004-2007 (Boykoff and Mansfield 2008). Is the increase in funding to which Owens and Driffill refer simply a response to this increase in public interest, or does it represent a genuine growth in understanding? That is, in throwing money at the problem, are wheels being reinvented or are the wheels taking us to new locations? This paper takes the approach that a review of the recent research initiatives may lead toward a broader understanding of what is happening in the field. We are particularly interested in investigating different conceptions of the locations, underpinnings, and meanings of human activity.

Methods

SELECTION

Selecting appropriate initiatives for study is a key difficulty in an endeavour such as this. What counts as "an initiative" could range from an informal meeting between researchers to a multi-year, multi-institutional, multi thousand Euro project. We have elected to focus more on the later than on the former. Thirteen initiatives were selected for initial review. Ten of the initiatives described in this review were taken from Appendix A in Owens and Driffill (2008). These are all research programmes. Three more were added by the author due to her direct experience of them: a US research programme, an international workshop, and a US conference series on behavior, energy, and climate change. This conference was included because it is oriented directly toward the topic of this paper. Other conferences, such as the longer-running American European Council for an Energy-Efficient Economy summer studies, may have a panel or two that deal with this subject. But in general, these conferences only tangentially address the need for social science in energy research.

For the most part, we elected to look at ongoing, multi-year, group projects rather than funding given to individuals for their own research, or group endeavours of shorter duration. Individual work is critically important to the development of any field, but it is not the orientation of this review. We seek to understand the role that research groups, in particular, play in the field. Similarly, there are a host of one-off workshops that can be catalysts for further work in the field, both at the individual and group level. For example, The Meeting Place, which is part of the UKERC project, has held an average of 17 events per year since 2004. Many of these are 2 day residential workshops which have been held specifically to develop new synergies between different strands of energy research and build up the strengths of the research community. Although these events are valuable, perhaps even critical, we have not included them in our analysis because the longer-term contribution of each meeting to the shape of the field is at this time uncertain. We characterize them as an event, rather than an initiative. Similarly, we have not included ongoing online media discussions on relevant topics. For example, the oil company Shell has formed a media partnership with European Voice and EuroNews through which it "encourages dialogue" on the "energy challenge". One such forum in the series, entitled "Global Warming and Lifestyle Changes" is clearly relevant to our topic of interest (Comment Visions 2008). However, we argue that there is no "there" there: it may be an ongoing initiative, but it is a online discussion that is not framed as a contribution to research.

CONSTRUCT VALIDITY

In focusing on the aims of research initiatives, we have elected to study text available on programme websites, rather than creating a corpus from the available publications of each programme's research staff. In making this choice, there are some reasonable questions about the validity of this construct. How well do programme websites actually reflect the research work performed under their auspices? Websites are often written at or near the launch of a project, using text from the success-ful funding proposal. As the research progresses, the findings may change how the research group views and/or approaches its tasks. Some themes may become more prominent or less prominent. Meanwhile, the website language remains the same, proclaiming all themes are equal. We expect that there may be some divergence between programme reality and programme aims. Nevertheless we submit that treating the programme website as the public face of a research initiative is a reasonable subject for analysis.

ANALYSIS

Analysis of the selected initiatives consisted mainly of a review of their websites, with a particular focus on their mission statements and research theme descriptions. These texts were used to characterize which academic disciplines the initiatives identify with most closely, as well as which keywords were used in defining the work.

The selection of the keywords themselves was an iterative process. The meaning of language is a combination of denotative and connotative associations, which is partially objective (is the keyword present or absent?) and partially subjective (what does the keyword mean in this context? Is its presence or absence notable in some way?). Software called AntConc 3.2 was used to display the keywords, sorted and arranged in a vertical plane, surrounded by the context in which they appear. Linguists call this process "concordancing" and assert that it allows a researcher to focus on the metalingual aspects of language—its patterns and paradigms (Wynne 2008). Although the texts used for this paper were not extraordinarily long, this method facilitated the process of content analysis, ensured that our analysis did not overlook words hidden within other words, and provided an objective lens through which to see language as data. The further research section at the end of the paper notes that this approach may be promising for future applications with much larger texts, such as proceedings from the summer studies of the American and European Councils for an Energy-Efficient Economy.

Inevitably, characterizing any multi-year, multi-disciplinary effort according to only a handful of words (in our case, 19) and disciplines (we have selected five, plus "interdisciplinary") will be an approximation of their original meaning. For example, we have elected to separate "politics" and "policy," but "social psychology" is represented more crudely as encompassing both "sociology" and "psychology." To counteract somewhat the unavoidable flattening of nuances caused by comparative analysis across a range of cases, we have tried to describe ranges of meaning where possible.

The keywords and frequencies discussed in Tables 1 and 2 are only limited by space. Other words we searched for include: practice(s); institution(s); organization(s); innovation; and transformation.

Results

The results of the review are presented in two stages. The first stage characterizes all the programs along the comparative elements discussed above. These results are shown in Table 1. The second stage groups individual programs into categories. A brief synopsis of each initiative has been provided in Appendix A.

Table 1. Energy and Social Science Initiatives

Initiative Name	Type	Year	Location	Economics	Politics	Policy	Sociology	Psychology	Interdisciplinary	Markets	Supply	Demand	Efficiency	Conservation	Consumption	Sustainability	Survivability	Adaptation	Climate Change	Energy	Carbon	The Public	Technology	Systems	Lifestyles	Behaviour	Transition	Governance
				Disciplines Cited						**Keywords Used**																		
Surrey Energy Economics Centre (SEEC) http://www.seec.surrey.ac.uk/	RP	1980	UK	×						×	×	×	×							×								
Oxford Institute of Energy Studies http://www.oxfordenergy.org/research.html	RP	1982	UK	×	×					×	×	×							×	×								
Tyndall Centre for Climate Change Research "Constructing Energy Futures" theme (1 of 7) http://www.tyndall.ac.uk	RP	2000	UK				×		×											×	×		×				×	
Centre for Business Relationships, Accountability, Sustainability, and Society (BRASS) (9 areas) http://www.brass.cf.ac.uk/	RP	2001	UK	×	×	×				×	×	×				×				×	×	×	×	×				×
UK Energy Research Centre "Demand Reduction" theme (1 of 7) http://www.ukerc.ac.uk/	RP	2004	UK	×		×	×	×		×		×	×		×	×			×	×		×	×			×		
Carbon Vision Initiative, "Buildings" theme (1 of 4) http://www.carbontrust.co.uk/technology/carbonvision/	RP	2004	UK						×			×	×			×				×			×	×				
Sussex Energy Group http://www.sussex.ac.uk/sussexenergygroup/	RP	2005	UK			×			×		×													×				
Precourt Institute for Energy Efficiency (PIEE) "Behavior" theme (1 of 6) http://piee.stanford.edu	RP	2006	US	×			×	×		×		×	×		×				×	×		×			×	×		
RESOLVE (5 of 5) http://www.surrey.ac.uk/resolve/	RP	2006	UK	×			×	×		×	×	×	×		×	×				×	×				×	×	×	
Behavior, Energy, & Climate Change Conference (BECC) http://piee.stanford.edu/cgibin/htm/Behavior/becc_conference.php	CF	2007	US																×			×				×		
Living With Environmental Change (LWEC) http://www.rcuk.ac.uk/research/ccprog/lwec.htm	RP	2007	UK	×		×				×		×	×			×			×	×	×		×	×		×		×
IHDP Science and Policy Dialogue "Energy, Sustainability and Societal Change" http://www.ihdp.unu.edu/article/431	WS	2008	INT				×		×		×		×			×			×						×	×		
Centre for Climate Change Economics and Policy (CCEP) http://www.cccep.ac.uk/	RP	2009	UK	×	×	×	×									×	×	×	×	×	×		×	×	×	×		×
Totals:	n=1	3		8	3	5	6	3	4	7	6	8	7	0	3	7	1	1	7	10	5	5	6	5	4	7	2	3

Key: RP = Research Programme (n=11); CF = Conference (n=1); WS = Workshop (n=1)

Table 2. Keywords in Initiative Texts

Frequency Grouping	Keywords/Concepts	# of Initiatives
High	Energy	10
	Demand	8
Medium	Sustainability	7
	Behaviour	7
	Markets	7
	Efficiency	7
	Climate Change	7
	Supply	6
	Technology	6
	Carbon	5
	The Public	5
	Systems	5
Low	Lifestyles	4
	Consumption	3
	Governance	3
	Transition	2
	Survivability	1
	Adaptation	1
	Conservation	0

STAGE 1: OVERALL CHARACTERIZATION

This section discusses the thirteen initiatives as comparable cases. In doing so, it treats each initiative as roughly equivalent to every other initiative. This stage of the results starts descriptively, identifying the initiatives themselves as well as the disciplines and keywords they mention. Some exploratory questions are raised within the keywords section, but most of the analytical reasoning appears in the second stage of the results.

Initiatives

Eleven of the initiatives represented here are characterized as research programmes, which we define as being multi-year programmes that encompass the work of several individual researchers acting in a group context. There is also one conference and one workshop represented. The conference is a new annual conference on behavior that has been held twice (in 2007 and 2008); the workshop was billed as the kick-off event for a longer term project.

The start year for each initiative has been listed in Table 1. The initiatives studied are a range of ages, from almost 30 years old (SEEC, the Surrey Energy Economics Centre) to newly minted (CCEP, the Centre for Climate Change Economics and Policy). A place in the analysis had been held for a new centre on sustainable behaviours, funded jointly by the UK Economic and Social Research Council (ESRC) and the Department of Environment, Food, and Rural Affairs (Defra). This centre is currently under development, but it has yet to be formally announced.

Eleven of the initiatives are located in the United Kingdom and funded by UK sources, predominantly the Research Councils. Two are located in the US, and these two are inter-related. Both the Precourt Institute for Energy Efficiency and the man-

agement of the Behavior, Energy, and Climate Change (BECC) conference are located at Stanford University. As BECC is convened jointly by PIEE and two other organizations (the California Institute for Energy Efficiency and the American Council for an Energy Efficient Economy), we have treated BECC as a separate initiative from PIEE. The last initiative is an international workshop supported by the International Human Dimensions Programme on Global Environmental Change (IHDP).

Disciplines

The disciplinary perspectives most frequently mentioned in the initiatives were "economics" (8 initiatives) and "social factors" or "sociology" (6 initiatives). Five initiatives take a policy approach to their work. Four initiatives (Carbon Vision, RESOLVE, LWEC and CCEP) cite a combination of factors, including social and economic, as important to their work. Interdisciplinary, multi-disciplinary, or "many disciplines" approaches were referred to explicitly in only four instances. The disciplines and factors next least mentioned were "politics/political" and "psychology/psychological". Only three initiatives associated themselves with each of these branches of social science, and these initiatives do not overlap with each other. Although "cultural" factors appeared in both the Tyndall and RESOLVE descriptions, neither of these programs tie themselves explicitly to anthropology. PIEE is the only group that lists anthropology as a field of interest.

Several initiatives tied themselves to a number of disciplines, but not all use disciplinary language. The Sussex Energy Group mentioned no specific disciplinary approach. Four initiatives (UKERC, Carbon Vision, IHDP, and Oxford Institute for Energy Studies) mention an expertise in "the social sciences", but
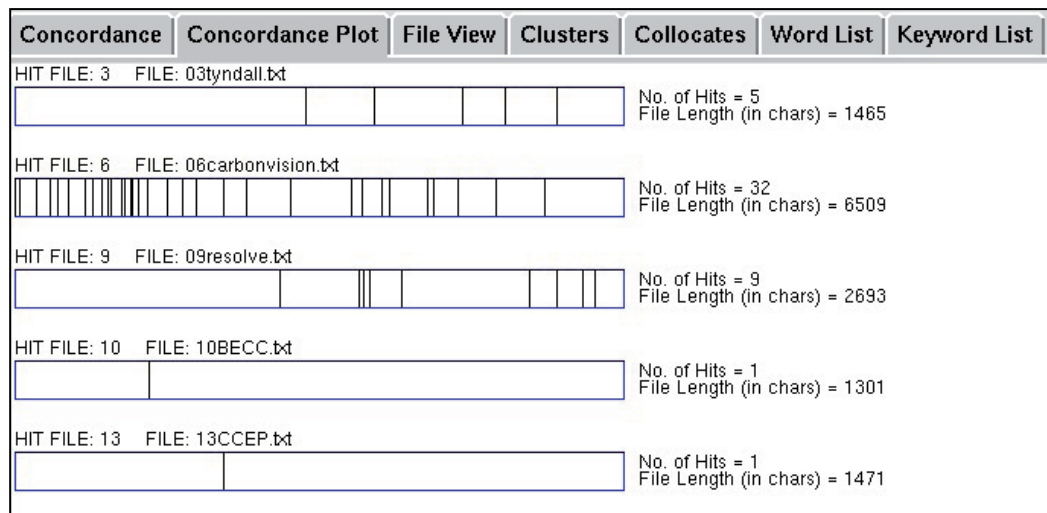
Figure 1. Concordance plot of the word "carbon" in five initiatives: Tyndall, Carbon Vision, RESOLVE, BECC and CCEP. Generated in AntConc 3.2.

UKERC, IHDP and Carbon Vision do not further define their connection to any specific fields within the social sciences. PIEE's behavior program uses the term "behavioral science" to describe its activities and lists 15 different fields as some of the areas it covers. PIEE's model of behavior will be explored in more detail in the discussion section near the end of the paper.

Keywords

Table 2 shows the keywords used in the initiatives in descending order of frequency. It is not surprising that the highest number of references is to the word "energy," but it is surprising that it appeared in only ten of the 13 initiatives. The next most popular term was "demand". Tied for third were "sustainability", "behaviour", "markets", "efficiency", and "climate change". Energy supply issues and technology were the next most frequent terms. "Carbon" appeared in only five of the initiatives, along with "public" and "systems". The lowest category of mentions includes "lifestyles", "consumption", "governance", and "transition". Almost but not quite absent, there was one mention each of "adaptation" and "survivability," both of which appeared in the CCEP text. "Conservation" was not mentioned by any of the initiatives, although RESOLVE's work on consumption does incorporate the study of consuming less.

Supply or Demand?

In the initiatives studied, energy demand was a more popular subject of study (8 initiatives) than supply (6 initiatives). In some instances, it was difficult to wrest even these distinctions from the initiative descriptions. We have characterized six initiatives as discussing energy "supply", but the word itself does not appear very frequently in the texts. "Supply" was used to generally characterize initiatives that mentioned various kinds of energy resources, like OIES's "economics of petroleum, oil, gas, nuclear power, solar and renewable energy" and SEEC's "oil and gas markets, privatisation and regulation of energy markets". OIES was virtually the only initiative that focused exclusively on supply. It conceptualizes "demand" only in the sense

that it recognizes producing and consuming nations, but does not study the dynamics of demand as a phenomenon driven by factors other than resource availability. "Demand" was used to characterize initiatives that focused on end-use sectors more than energy resources.

Energy or Carbon?

One revelation in the course of the research was that energy-relevant research may not contain the word "energy" at all. Three initiatives avoided this term entirely. LWEC refers to "fossil fuel consumption"; CCEP refers only to "climate change"; and BRASS discusses "sustainability". Tyndall mentions energy in the title of its "Constructing Energy Futures" theme, but its stated focus in the text is on "decarbonization". Carbon Vision mentions "carbon" more than any other initiative (32 times), followed by RESOLVE (9 times), Tyndall (5 times), BECC (once), and CCEP (once). Normalizing for text length, Carbon Vision still uses "carbon" about 40% more than the next highest user. Figure 1 shows a "concordance plot" generated by AntConc 3.2, that allows for a visual description of the appearance of "carbon" (including "decarbonization") in each of these five text files. Each vertical line shows an occurrence of the target word and its location in relation to the rest of the text file.

STAGE 2: CATEGORIZATION

For most of the initiatives discussed, social science around energy issues is only a part of the research endeavour. Tyndall, UKERC, Carbon Vision, BRASS, LWEC, CCEP, IHDP, and PIEE all have other themes and agendas. Based on the concordance analysis and document review, we have grouped the initiatives into four categories: 1) Macro Environment and Society; 2) Traditional Energy; 3) Energy, Technology and Society (ETS); 4) Society, Energy, and Technology (SET). In developing this typology, we recognize that although the first two categories relatively easy to distinguish, the last two are less distinct. They are close variants of each other and differ only in the level of emphasis placed on social science relative to energy technologies.

Macro Environment and Society (5 initiatives)

This category is the most general. It contains the five initiatives for which energy is but a small part of the overall research endeavour. The Tyndall Centre, for example, has one theme that addresses energy, but it also pursues research in seven other areas, such as climate science and policy, international development, and sustainable coastlines. BRASS focuses on corporate social responsibility, and in doing so looks at sustainability from the perspective of the production and consumption of goods and services. Some of the environmental areas it focuses on are food systems, forestry, mobility, and mining. Sustainable energy comes into the BRASS agenda mostly through alternative fuels for transport. Living with Environmental Change is a vast undertaking that concentrates mainly on ecosystem services, including clean air, fresh water, healthy soils, and flood and disease protection. It sees energy consumption, economic growth, and population growth as a threat to the natural world and looks for ways to cope with these pressures. Similarly, the International Human Dimensions Programme (IHDP) is incredibly broad in scope. Its five core science projects are: Global Environmental Change and Human Security; the Global Land Project; Industrial Transformation; Land-Ocean Interactions in the Coastal Zone; and Urbanization and Global Environmental Change. If the IHDP energy workshop develops into a science project on a comparable scale, it will likely conceptualize energy from a similarly global perspective. The Centre for Climate Change Economics and Policy looks at the political economy of a low-carbon future, and like BRASS, has an orientation towards how businesses will act and react. Because its focus is generally on broader forms of economic activity, we have classified it as a macro-oriented initiative, even though its environmental aspects are somewhat weaker than the other initiatives in this category.

Traditional Energy (2 initiatives)

We put the two oldest initiatives—the Oxford Institute for Energy Studies and the Surrey Energy Economics Centre (SEEC)—in the "traditional energy" category. Both are the only initiatives that explicitly address such important systems as oil and gas markets. Both use energy economics extensively in their work, lay claim a longstanding body of research, and continue to produce scholarship in these areas. For these groups, energy resources are empirical commodities that have political, social, and economic significance at the market level. Neither the commodities themselves nor their significance is debated.

Energy, Technology, and Society (ETS) (4 initiatives)

This category contains initiatives for which energy is central, but few if any of these initiatives study the traditional energy resources. Instead, they vigorously investigate the newer, less-traditional resources and related technological systems such as renewables, distributed generation, demand-side management, and efficiency. In these initiatives, the role of social science is present and pursued, but it is generally secondary to and in support of the study of the energy technologies themselves. Initiatives in this category include The UK Energy Research Centre, the Carbon Vision Initiative, the Sussex Energy Group, and the Behavior, Energy and Climate Change (BECC) Conference.

Society, Energy and Technology (SET) (2 initiatives)

This category looks at the same forms of energy as above, but it places social research first and energy second. Initiatives in this area are generally led by bona fide social scientists, rather than engineers with social scientific tendencies. Initiatives in this area include RESOLVE and the Precourt Institute for Energy Efficiency's behavior program (it should be noted, however, that PIEE's other programs fit squarely in the Energy, Technology, and Society area).

Discussion

Although the above typology above is somewhat subjective, we hope the directions it suggests may be useful in considering where the future of the field of energy and social research could lie. We discuss the potential drawbacks and benefits of each category below, then address opportunities for collaboration across categories.

POTENTIAL DEVELOPMENTS AND DIRECTIONS

Both Owens & Driffill (2008) and Berkhout et al (2003) outline promising directions for future developments in energy research. Owens and Driffill suggest eight different possible developments: knowing about attitudes and behaviours; new disciplinary insights and more sophisticated concepts of interdisciplinarity; dealing with complexity; reconceiving the role of the public and consumers; challenging the deliberative turn in policy-making; avoiding mixed messages; the need for a systemic approach; and confusion of objectives. Many of these suggestions are good ideas and sound advice for any empirically-oriented field. For energy research, we agree that particularly important categories for future work include socio-technical systems (included under interdisciplinarity), better ways of dealing with complex situations, and reconceiving the role of the public. Berkhout et al. suggest seven themes which are more broadly drawn: processes of long-run change in socio-technical systems; vulnerability, resilience, and adaptiveness; services, systems of provision and consumption practices; policies in natural monopolies and liberalised markets; public attitudes and processes of governance; energy in the global context; and integrated appraisal of energy systems and policies. Of these, we think three themes—processes of long-run change in socio-technical systems; vulnerability, resilience, and adaptiveness; and services, systems of provision and consumption practices—hold the most promise for advancing the field in practical and practicable ways. Drawing upon the typology above and the directions suggested by these authors, we suggest that such developments are more likely to occur in the context of some kinds of initiatives than in others.

Rolling Along

If more research is funded in the "traditional energy" vein, we would expect incremental improvements in knowledge rather than step changes. It is critically important to understand the existing system, and this information can help provide a baseline for a transition to a future system. However, further research with this approach does not help us prepare for a world where traditional resources may no longer exist or be used as they are today. We characterize the potential knowledge devel-
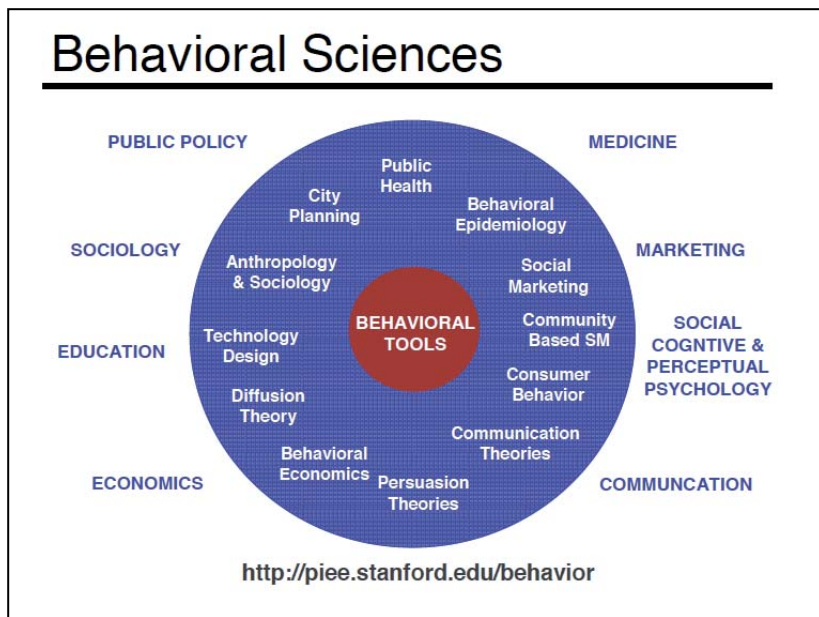
Figure 2. PIEE concept map of behavioural sciences related to "energy positive" actions.

opment in this area as "rolling along" to indicate that new ideas are unlikely to spring forth from this endeavour.

Reinventing the Wheel

In the "macro environment and society" approach, the importance of energy related research seems almost inconsequential. At the very least, it is not critical to the mission of any of these initiatives. New findings in energy and social research *could* come from these areas, but since the focus in these initiatives is not on energy to begin with, we fear that such findings would be a happy coincidence rather than the results of a concerted effort. These efforts may find, for instance, that public education about climate change has the effect of reducing carbon emissions. However, since 30 years of public education about energy efficiency has not had the effect of reducing absolute levels of energy use, it seems unlikely that public education about climate change will be wildly more successful in this task. The danger here is that much time and effort will be spent reinventing parts of the energy and social research wheel instead of moving forward in new directions. There certainly are new directions in these initiatives—such as CCEP's focus on "survivability"—but to inform the energy research agenda they would need to be better integrated with energy issues.

New Directions

From our perspective, the most promising avenue for new developments will be from work at the interface of the more closely inter-related groups of Energy, Technology & Society (ETS) and Society, Energy, and Technology (SET). The ETS configuration should be fairly familiar to readers, as it is the usual configuration of energy and social scientific research. The SET configuration is slightly newer. One of the benefits of the SET configuration is the tendency for relative newcomers to energy research to rethink the field through the lens of their own background and training. For PIEE, for example, neuroscientist Carrie Armel has made foundational readings available online and constructed a concept map that describes how a number of different disciplines and fields affect our understanding of what she calls "energy positive" behaviours (see Figure 2). Of the initiatives studied, this is the most explicitly broad representation of the relevant fields. Whether or not one agrees with this particular conceptualization of the field, we argue that a greater degree of reflexivity in energy and social research is a positive development.

Both of ETS and SET groups, in principle, should be capable of doing work on socio-technical energy systems. However, in practice, it seems difficult to equally privilege the social and the technical. Hence, we suggest that work in both these categories should continue, in order to provide the tension necessary at the interface between them. This idea leads to a discussion of how to think about how to foster opportunities for collaboration in the current research landscape.

COMBINING FORCES: OPPORTUNITIES FOR COLLABORATION

The field of social science energy research is experiencing growth for the first time since the 1970s. Along with this growth, however, comes the real dilemma of integrating existing knowledge and new challenges in a timely fashion with current personnel. As Berkhout et al (2003) acknowledge, social science energy research is not a prevalent field in many institutions. Because energy expertise is hard to gain, it may be difficult to find. It may also be difficult to recognize or correct its absence.

A workshop on energy innovation policy raised an interesting question about the relationship between "incumbents" and "outsiders" in low-carbon energy businesses (Sussex Energy Group 2008). The question basically concerns how best to draw upon existing resources and experience, while allowing for and supporting the development of new participants. It made us wonder whether a similar problem is present in low-carbon research.

Framing the problem as one of incumbents and outsiders provides a slightly different picture of how research initiatives might work together. If the outsiders in this picture are new-

comers to the energy field, they could benefit from the knowledge of incumbents. Incumbents, on the other hand, could benefit from some new ideas brought in from "the outside."

In our typology, outsiders would include initiatives in the Macro Environmental and the Society, Energy, and Technology (SET) categories. Incumbents would be initiatives in the "traditional energy" and Energy, Technology, and Society (ETS) categories. We would expect to see unions between insiders and outsiders, but not between two groups of like kind. We can think of two cases at two different universities that support this premise. In the first case, the Surrey Energy Economics Centre (traditional energy, incumbent) and RESOLVE (SET, outsider) formally acknowledge each others expertise and claim to work together. In the second case, at Oxford University, two incumbent groups (Oxford Institute of Energy Studies and another group that is part of the Carbon Vision project) have virtually no association with each other.

Other promising collaborative opportunities exist between the Macro Environmental and other incumbent groups, as well as incumbent groups in different countries. For example, the call for more energy work on services, systems of provision and consumption practices might gainfully be approached by researchers from BRASS and Carbon Vision. A partnership between the Centre for Climate Change Economics and Policy and the UK Energy Research Centre could be useful in the area of vulnerability, resilience, and adaptiveness. Work on socio-technical energy systems is often advanced by comparative international study, because technologies on virtually any scale—from household appliances to large complex technical systems—have socially-constructed aspects that differ from country to country. These are just hypothetical examples, of course. Whether such partnerships would work in reality is another question. But considering the urgency of the task ahead, thought experiments of this kind about how to combine intellectual resources currently available in the field seems like a low-cost, low-risk first step.

Conclusions and Further Research

In this paper, we identified and characterized thirteen initiatives that engage social science to varying degrees in the pursuit of energy research. After using linguistic tools to study the aims of each initiative, we developed a typology of four categories into which we grouped these efforts. Next, we considered the likelihood that the kinds of initiatives in each group would produce, either separately or together, the kind of future research that some authors have called for in the field. We argue that neither the macro environmental approach, nor the traditional energy approach will produce the necessary research. Instead, we turn toward initiatives that combine society, energy, and technology in various permutations and suggest that further research in these areas may lead out of the thicket of what Owens and Driffill call the "persistent emphasis in policy discourse on awareness-raising and education" (p.4413).

As indicated earlier, this work could be further developed by adding other initiatives to the pool studied thus far. Studying other groups in the UK with different funding sources (e.g. private foundation, non-profit, for-profit), or groups in other countries could contribute a comparative angle to the research. We could also deepen the research by analyzing papers done by researchers in the initiatives studied. This development could, however, represent a significant additional investment of time, depending on how up to date and available the references and texts are at each website. Moreover, this effort could (for better or worse) blur the current focus on the aims of research groups with a more traditional literature review.

During the course of our research on research, we became interested in the opportunities of doing further content analysis of texts in the field of energy efficiency. In particular, we would like to take up the idea of incumbents and outsiders in social science and energy research. To do so, we might examine ACEEE and ECEEE proceedings as longitudinal representations of an incumbent community pursuing energy efficiency research. How have ACEEE and ECEEE researchers been engaging in the "new" field of energy and social research? How have the conceptions of the role of behaviour and human agency changed in the efficiency literature compared to the broader academic literature? There are many questions that could be usefully explored through these methods, which we hope may yield additional insights into what we know, how we know it, and how well we share our knowledge with others.

Appendix A

These brief descriptions are provided to help the reader understand how each initiative describes itself. These synopses are taken directly from each initiative's website without alteration, including the use of personal pronouns. The concordance analysis includes but is not limited to these descriptions.

1. **Surrey Energy Economics Centre (SEEC)** is a research centre based at the University of Surrey, that examines all aspects of the economics of energy, including oil and gas markets, privatisation and regulation of energy markets, demand modelling and forecasting and energy efficiency.

2. The **Oxford Institute of Energy Studies (OIES)** is a centre for advanced research into the social science areas of energy issues. Our aim is to promote dialogue between consumers and producers, government and industry, and academics and decisions makers in order to gain a more informed understanding of the factors that influence international energy markets. Research carried out encompasses the economics of petroleum, oil, gas, nuclear power, solar and renewable energy; the politics and sociology of energy; international relations of producing and consuming nations; and the economics and politics of the environment in its relationship with energy.

3. **The Tyndall Centre** brings together scientists, economists, engineers and social scientists, who together are working to develop sustainable responses to climate change through trans-disciplinary research and dialogue on both a national and international level - not just within the research community, but also with business leaders, policy advisors, the media and the public in general. Seven themes: 1) Informing international climate policy; 2) Constructing energy futures; 3) Building resilience to climate change; 4) International development; 5) Sustainable coasts; 6) Engineering cities; 7) Integrating frameworks.

4. The **Centre for Business Relationships, Accountability, Sustainability, and Society (BRASS)** focuses on the most important dimensions of the developing Corporate Social Responsibility and business sustainability agenda. The research reflects nine research areas: 1. Business Impacts, Regulation & Management; 2. Resource & Technology Management For Sustainability; 3. Making Progress Towards Sustainability : Measuring, Reporting and Learning; 4. Responsible Management, Governance and Leadership; 5. Sustainable Consumption and Marketing; 6. Sustainable Lifestyles and Communities; 7. Towards Sustainable Food; 8. Towards Sustainable Mobility; 9. Rethinking the Future for Sustainability

5. The **UK Energy Research Centre (UKERC)** is the focal point for UK research on sustainable energy. It takes an independent, whole-systems approach, drawing on engineering, economics and the physical, environmental and social sciences. The Centre's role is to promote cohesion within the overall UK energy research effort. It acts as a bridge between the UK energy research community and the wider world, including business, policymakers and the international energy research community. Research themes are: 1) Demand Reduction; 2) Future Sources of Energy; 3) Energy Infrastructure and Supply; 4) Energy Systems and Modelling; 5) Environmental Sustainability; 6) Materials for Advanced Energy Systems; 7) Cross-cutting Research Activity

6. **Carbon Vision** comprises a coordinated package of university-based research studies to explore how we are going to make the transition to a low carbon economy. Achieving this vision will require radical, innovative thinking. Carbon Vision is fostering this by building broad partnerships that will help to lay the foundations of a low carbon economy. It seeks to stimulate a step change in thinking that will radically improve the way the world thinks about this new era. The activities we support through the Carbon Vision partnership are: 1) The Carbon Vision Leadership Programme: to support outstanding scientists and engineers as they become world leaders in low carbon research and development; 2) Carbon Vision Buildings: showing how to achieve 50% carbon reduction in the carbon 'footprint' of new and existing buildings by 2030; 3) Carbon Vision Industry: to provide the tools required to develop step change reduction in the lifetime carbon emissions associated with basic products and their manufacture; 4) SUPERGEN: to extend and expand the EPSRC SUPERGEN programme on meeting the challenges of providing sustainable power generation and supply.

7. **Sussex Energy Group (SEG).** There is growing awareness that the transition to a sustainable energy economy is one of the main challenges facing us in the 21st century. Although climate change is a significant factor, there are many other reasons why we need to address the energy transition, including security of supply, fuel poverty and the opportunities offered by innovations such as renewable energy resources, distributed generation and combined heat and power. Critically, the transition needs to be designed in such a way that maximises economic efficiency. An effective response requires technical ingenuity, behavioural change

and virtually unprecedented political commitment. Three themes link together in addressing the challenge of such a transition: • How to appraise the options for technology and policy around transitions. • How transitions occur, how technology can be 'shaped', and how technological regimes can be managed. • How to govern the complex and uncertain transition processes.

8. The mission of the **Precourt Institute for Energy Efficiency (PIEE)** is to promote energy efficient technologies, systems, and practices, emphasizing economically attractive deployment. PIEE works to understand and overcome market, policy, technology, and human behavioral barriers to economically efficient reductions of energy use and to inform public and private policymaking. Energy Efficiency is vital for the U.S. and world economy, for environmental protection, and for energy security. PIEE has six focus areas of energy efficiency research that we believe will help create workable options to promote energy efficiency. These clusters are: 1) Buildings: commercial and residential building design, construction, operations, and embedded technologies, including building energy models and other design tools; 2) Transportation: technology and regulation of passenger cars and light duty trucks; transportation systems analysis; vehicle electrification; 3) Systems: systems analysis; electric generation/distribution systems, storage/distribution options, vehicle/building interaction; 4) Behavior: behavioral and decision making research, analysis, and intervention; 5) Energy Modeling: economic modeling of the energy system, institutions, and economic impacts, including process modeling of energy use; 6) Energy Policy: policy design, policy analysis, individual faculty advocacy; pricing policies, policy interventions, R&D policy.

9. The overall aim of **RESOLVE** is to develop a robust understanding of the links between lifestyle, societal values and environment. In particular, RESOLVE will work to provide robust, evidence-based advice to policy-makers in the UK and elsewhere who are seeking to understand and to influence the behaviours and practices of 'energy consumers'. Specific objectives of RESOLVE are: * to explore material, economic, psychological, sociological and cultural accounts of the relationship between modern lifestyles and the environment; * to develop theoretical and empirical understandings of the potential for long-term lifestyle change in moving towards a sustainable energy economy;* to understand the economic, social and psychological implications of a technological transition to a sustainable energy economy; * to develop an empirical 'evidence base' for effective policy intervention in energy-related behaviours and practices;* to engage effectively with policy-makers, opinion-formers and the media in developing and communicating this new body of research. The work programme is structured around three inter-woven intellectual strands: energy and carbon 'mapping' (V1), social psychological influences (V2), and socio-cultural understandings (V3) of lifestyles. These three 'vertical' strands are informed and supported by two (horizontal) cross-cutting themes – on energy lifestyle scenarios (H1) and on policy and governance (H2). Keywords: life-

styles, values, environment, energy consumption, carbon reduction, low-carbon economy.

10. The 2008 **Behavior, Energy and Climate Change Conference (BECC)** is the second annual conference focused on understanding the nature of individual and organizational behavior and decision making and using that knowledge to accelerate our transition to an energy-efficient and low carbon economy. The 2008 BECC Conference builds on the overwhelming success of the first BECC Conference in 2007, during which over 500 participants discussed successful policy and program strategies, shared important research findings, and built dynamic new networks and collaborations. The 2008 BECC Conference will bring together a diverse group of policymakers, social scientists, program implementers, media, and energy experts to explore the practical application of social and behavioral insights to address our climate challenges. We will review recent behavioral research, discuss current and emerging policy issues, share effective program/communication strategies, and encourage collaboration across government, utility, business, and research sectors. Our goal is to achieve viable solutions for meeting long-term energy and greenhouse gas emissions reduction targets by improving the design, adoption, and continued effectiveness of policies, programs, technologies, and individual/organizational actions.

11. **Living with Environmental Change (LWEC).** Human activities, most notably worldwide fossil-fuel demand and rapid population and economic growth in the developing world, are accelerating environmental change and increasing pressure on ecosystems and services, challenging our social and economic well-being. HM Treasury has identified this issue as a key challenge that the UK must address in the next decade, a concern supported by the Intergovernmental Panel on Climate Change Forth Assessment, the Millennium Ecosystem Assessment, and the Stern Review. LWEC is a major interdisciplinary research and policy partnership to tackle environmental change and the societal challenges it poses, and so to provide a firmer basis for people to deal with the unprecedented changes that the world will face over the next century. All seven Research Councils, working with partners in at least nine Government departments, will design the LWEC programme across the relevant research areas and policy and industrial sectors. Through a 10-year programme, LWEC aims to provide: the knowledge, tools, predictions, solutions and business opportunities needed to increase resilience to, and reduce economic costs of, environmental changes such as more severe weather and reduced biodiversity; and the best information to enable sustainable management and protection of vital ecosystem services - such as clean air, fresh water, healthy soils, and flood and disease protection - on the time and space scales on which the economy is managed.

12. What are the barriers to cleaner and more efficient energy production? Which institutional frameworks, behavioural patterns and lifestyles lead to more efficient energy uses? These questions and others were successfully addressed by the International Human Dimensions Programme on Global Environmental Change **(IHDP)** at its 2nd annual **Science Policy Dialogue** Workshop, "Energy, Sustainability and Societal Change".

13. **Centre for Climate Change Economics & Policy (CCEP)**. Human-induced climate change could have enormous impacts on economies and societies if we persist with 'business as usual'. This is the consensus view of climate scientists and one with which economists are increasingly finding agreement (e.g. The Stern Review). It is much less certain, however, that our economic, social and political systems can respond to the challenge. Will public, private and civic actors take action to create low-carbon economies? What emission reduction strategies will be efficient, equitable and acceptable? How much should we invest, and when, on measures to reduce vulnerability to climate change? Who will bear the costs and enjoy the benefits? These types of questions inform the work of the ESRC Centre for Climate Change Economics and Policy. Its mission is to advance public and private action on climate change through rigorous, innovative research. To fulfil the Centre's mission, an innovative combination of qualitative and quantitative studies will be conducted by a highly multi-disciplinary team. The Centre has five inter-linked research programmes: 1. Developing climate science and economics; 2. Climate-change governance for a new global deal; 3. Adaptation to climate change and human development; 4. Governments, markets and climate-change mitigation; 5. The Munich Re Programme: evaluating the economics of climate risks and opportunities in the insurance sector.

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